

**STONYBROOK CREEK SALMONID
MIGRATION BARRIER
REMOVAL PROJECT**

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1.0 PROJECT OVERVIEW

1.1 Project Overview

The Stonybrook Creek watershed lies within Alameda County, east of Hayward. The watershed runs north to south and has a drainage area of 6.9 square miles. The creek joins Alameda Creek in Niles Canyon, approximately 13 river miles upstream from San Francisco Bay. The Alameda Creek watershed once supported a run of native steelhead trout. However, the placement of numerous dams, culverts, and other structures on Alameda Creek and its tributaries has resulted in the complete blockage of anadromous fish runs. In 2000 an assessment of the potential for restoring a viable steelhead trout population to the Alameda Creek watershed was completed (Gunther et. al, 2000). The report identified Stonybrook Creek as being the lowest tributary in the watershed containing suitable rearing and spawning habitat for steelhead.

In 2004 the Center for Ecosystem Management and Restoration (CEMAR) obtained funding to complete an alternatives analysis and develop conceptual designs for replacing two of the County maintained crossings on Palomares Road, at mile posts 8.60 and 8.75. These crossings were both identified as complete upstream migration barriers for steelhead and rainbow trout. The replacement of these crossings with structures that provide fish passage is part of the recommendations outlined in the Stonybrook Creek Fish Passage Assessment that was prepared for the Alameda County Public Works Agency (Love, 2001).

With support from CEMAR, Winzler & Kelly Consulting Engineers and Michael Love and Associates has developed conceptual designs for two new road crossings that improve fish passage conditions. In support of this design effort, Blackburn Consulting, Inc. conducted a preliminary foundation investigation and Marvin Smitherman conducted the topographic survey. Additionally, Michael Love and Associates assessed fish passage conditions at three downstream privately maintained stream crossings to determine if they are barriers to fish passage.

This report summarizes the conceptual designs developed for removal and replacement of two road-stream crossings on Palomares Road at post mile 8.60 and 8.75. The assessment of the downstream crossings is described in a separate report.

1.2 Design Overview

The Stonybrook Creek Salmonid Migration Barrier Removal Project included the completion of a conceptual design for the removal and replacement of two existing culvert barriers with two new road crossings that will improve access to upstream habitat for migrating steelhead/rainbow trout. Hydraulically, the new crossings must provide passage for various life stages of fish over a wide range of flows, allow for the natural movement of channel bed load, and provide enough capacity to accommodate a 100-year flood. An additional requirement of the project design is that it allow a minimum of one lane of traffic through the project site during construction. The conceptual design incorporates methods of construction and sequencing that are necessary to meet these project requirements.

The conceptual design includes a pre-cast bottomless arch culvert at post mile 8.60 on Palomares Road (hereafter, “upstream crossing”) and a pre-manufactured steel bridge at post mile 8.75 (hereafter, “downstream crossing”). The design also provides for one lane of traffic to pass

through the project site during construction activities. The channel bed at both locations will be graded upstream and downstream of the new crossings to achieve the design slope, which closely approximates the natural slope of Stonybrook Creek within the project reaches. The conceptual designs were developed based on the assumption that both crossings could be constructed at the same time. This assumption does not preclude the crossings being constructed at different times, but this issue needs to be determined prior to the final design phase. We anticipate that constructing the two crossings at different times will increase the overall cost for construction.

1.2.1 Upstream Crossing, Post mile 8.60

The conceptual design at the upstream crossing includes: the placement of a temporary bridge during construction, removal of the existing concrete and masonry culvert, re-grading of the channel in the vicinity of the crossing, the placement of a new pre-cast concrete arch culvert and wing walls on cast-in-place strip footings, and the paving of the final roadway over the new culvert. The conceptual plans are included in Appendix A of this report.

A temporary bridge is required to maintain one lane of traffic through the project site during construction. The temporary bridge is a pre-manufactured steel bridge which would later be used as part of the permanent downstream crossing (discussed in the following section). The temporary bridge is approximately 14 feet wide and 80 feet long. The temporary bridge will be set in place by cranes immediately to the north of the proposed culvert (as shown on sheet C-3.0) to allow for one lane of traffic during the construction of the channel and new culvert stream crossing. One side of the bridge will have a permanent guard rail attached, while a temporary concrete barrier rail will be placed along the other side for traffic safety during construction. There will be some minor grading and temporary fill required to allow the placement of the temporary bridge. The temporary bridge is designed to be removed and relocated to the downstream crossing after a minimum of five of the six pre-cast concrete culvert sections are installed and backfilled with aggregate base to accept one lane of traffic.

The existing culvert at the upstream crossing will be removed after placement of the temporary bridge. The concrete rubble from the demolished culvert will be removed from the site for proper disposal. Suitable boulders from the existing masonry work may be incorporated into the channel grading.

The channel grading at the upstream crossing will consist of re-grading the channel to a new grade of approximately 8.9 percent. The design active channel is 24 foot wide with 8:1 side slopes. From the active channel, the banks will be cut to 2:1 slopes, or steeper as needed, to match the existing ground slope above the top of the banks. The regraded channel will have a natural bottom consisting of native channel materials and is intended to resemble the natural channel. Rather than being a straight grade, the channel section will be comprised of a series of step-pools which will have a minimum depth of approximately one foot (as shown on Sheets C-4.0 and C-5.0 of the conceptual plans). Pool spacing is based on the observed spacing in the channel adjacent to the site and results from research into channel slope verses pool spacing. These step pools are not intended to be permanent structures. Instead, the design channel is expected to be further shaped by higher flows and adjust into a stable step-pool configuration similar to the adjacent channels. Constructing the step-pools into the finished channel grade is

expected to provide suitable fish passage conditions immediately following construction while minimizing the amount of channel adjustment that may occur after construction.

The upstream culvert crossing will consist of a pre-cast concrete arch comprised of six pre-cast concrete units each with a 32 foot width and a 9 foot rise. The pre-cast sections would be hauled by truck to the site and set in place by crane or excavator. The pre-cast units would be set on cast-in-place reinforced concrete footings that run the length of the culvert. The footings would extend approximately two feet below the design channel, which is the presumed location of bedrock based on the limited geotechnical investigation performed as part of this conceptual design effort. The footings for the culvert will be keyed into the existing bedrock. The bedrock surface will have an irregular shaped surface either naturally or after excavation to the designed footing elevations. For added stability, rebar will also be drilled and epoxied into the bedrock prior to the footings being cast in place. The geotechnical report used for the design is included in Appendix B of this report.

One issue that was not specifically addressed in the geotechnical report was the potential for slaking of the exposed bedrock. Slaking is mostly a problem in clay shales, but much less of a problem in sandstone. The borings encountered predominately sandstone. The friable siltstone/shale beds noted on page two of the geotechnical report refer to very thin layers within hard, thick sandstone beds, exposed in existing canyon walls and road cut outcrops. The road cuts have stood for long periods of time without visual deterioration from slaking. There is no evidence that slaking is a significant problem at this site. It is possible that localized shale beds could be present along a downstream footing where exposure to air and water could cause deterioration of the rock. This potential issue should be addressed by Blackburn Consulting Inc. during final design and construction.

Pre-cast concrete wing walls will abut the new pre-cast concrete culvert. The wing walls will have concrete anchors as well as pre-cast concrete footings to expedite placement. As with the cast-in place footings design, the design utilizing bedrock at each of the wing wall locations was based on the limited geotechnical investigation and may need to be revised during the final design. If bedrock is found in the vicinity of the planned wing walls as a part of a focused geotechnical investigation suggested to be conducted as part of the final design, then the design may be changed to cast-in place concrete wing walls that could be easily modified to match the bedrock surface. Sheet piling might also be considered as a construction method for the wing walls during final design.

The final roadway will be brought up to grade using structural backfill consistent with Caltrans Standards. The final surface will be asphalt concrete and match the existing roadway's alignment and grade. New guard rails with appropriate terminal sections will replace the existing metal beam guard rails.

1.2.2 Downstream Crossing, Post Mile 8.75

The conceptual design at the downstream crossing includes: the placement of sheet pile with a cast-in-place concrete pile cap for the bridge footing, removal of the existing reinforced concrete box culvert and wing walls, installation of a pre-manufactured steel bridge, re-grading of the

channel in the vicinity of the crossing, and paving of the final roadway over the new bridge. The conceptual plans are included in Appendix A of this report.

The sheet pile with the cast-in-place pile cap will provide a foundation for the pre-manufactured bridge proposed for this site and is a key design feature that contributes to the constructability of the site. Sheet piling can be driven with minimal disturbance to the surrounding soils. Therefore, the sheet pile footing will be placed while the existing culvert is functioning to provide one lane of traffic during construction. The footing on the west side of the proposed bridge may not require sheet piling due to the expected presence of bedrock close to the ground surface. If this is the case, a cast in place footing on bedrock would be used on the west side similar to the strip footing described for the culvert at the upstream crossing.

The bridge will have an 80 foot span and a 28 foot width and will likely be comprised of four individual sections (each section seven feet wide) that will be pre-manufactured off site. The sections will be hauled to the site, set in place with one or more cranes and bolted together in place. These prefabricated steel bridges are normally installed quite rapidly, minimizing construction time and a greatly reducing road closure time. Two sections (14 feet width) of the new bridge will be set on the footings to provide one lane of traffic through the site to allow the demolition and removal of the existing culvert and excavation of the channel underneath the bridge (as shown on sheet C-6.0 of the conceptual plans). One side of the bridge will have the permanent guard rail attached and a temporary concrete barrier rail will be placed along the other side for traffic safety during construction. As previously discussed, the temporary bridge for the upstream crossing will utilize the other two pre-manufactured bridge sections (14 feet width). The remaining two bridge sections will be placed at this crossing once the upstream crossing progresses to the point where the temporary bridge crossing is no longer needed.

The roadway through the downstream crossing will match the alignment and grade of the existing roadway. The final roadway at the downstream crossing will be brought up to grade using structural backfill consistent with Caltrans Standards. The final surface for the new bridge will be asphalt concrete. The new roadway will have two 12 foot lanes and two foot shoulders for a total paved road width of 28 feet. New guard rails are planned only for the bridge but may be extended beyond the bridge as a part of the final design, if required.

1.3 Opinion of Probable Construction Costs and General Considerations

A planning level opinion of probable construction costs was completed based on the conceptual design. Since the designs are not fully developed the cost estimate relied on numerous assumptions. It is possible that during final design, site conditions may become apparent that could cause actual construction costs to vary. Our current overall opinion of probable construction costs for completing both crossings is \$1,100,000.

The use of a pre-manufactured bridge at this site will have the benefit of being able to be used as a temporary bridge during construction of the upstream culvert. This offers significant savings since the cost of renting a temporary bridge is typically close to the cost of purchasing a pre-manufactured bridge. If the two crossings were to be completed independently, the cost of the upstream crossing alone would be substantially higher.

It was assumed that traffic control at the site could be one lane of controlled traffic consistent with a Caltrans low-volume road closure. This type of closure assumes good site distance and would consist of yield signs rather than a full signal system. A full signal system would be used if the road were considered to have a high traffic volume and would have significantly higher costs associated with it.

It was also assumed that the two project sites will be accessible by cranes. The cranes will be required to set the pre-cast culvert and pre-manufactured steel bridge, as well as for construction of the sheet pile foundation for the pre-manufactured steel bridge. If the road to the site is not accessible by cranes it is possible the design would need to be modified to reduce the size of the pre-manufactured culvert or bridge which could result in higher overall project costs. See Table 1.1 on the following page for an itemized list of probable costs.

**Stonybrook Creek Salmonid Barrier Removal Projects
Engineers Opinion of Probable Construction Costs
October 25, 2005**

Item No	Item Description	Unit	Quantity	Unit Cost	Extended Cost
1	Mobilization and Demobilization	LS	1	\$42,000	\$42,000
2	Traffic Control ¹	LS	1	\$40,000	\$40,000
3	Creek Bypass and Erosion Control	LS	1	\$15,000	\$15,000
4	Clearing and Grubbing	LS	1	\$10,000	\$10,000
5	Temporary Creek Crossings ²	LS	1	\$28,000	\$28,000
6	Demolition (Asphalt Concrete, Existing Culvert, Guard Rail, Rubble)	LS	1	\$15,000	\$15,000
7	Structure Excavation for Upstream Crossing (PM 8.60)	CY	1295	\$45	\$58,275
8	Furnish Pre-Cast Concrete Culvert, Headwalls and Wingwalls	LS	1	\$120,000	\$120,000
9	Install Pre-Cast Concrete Culvert, Headwalls and Wingwalls	LS	1	\$25,000	\$25,000
10	Structural Concrete for Culvert (Strip Footings)	CY	27	\$600	\$16,200
11	Regrade Channel at Upstream Crossing	LS	1	\$12,000	\$12,000
12	Structure Backfill for Culvert	CY	664	\$40	\$26,560
13	Structure Excavation for Downstream Crossing (PM 8.75)	CY	4388	\$45	\$197,460
14	Steel Sheet Piling	SF	1	\$36,000	\$36,000
15	Structural Concrete Downstream Crossing (Pile Cap Abutment)	CY	10	\$600	\$6,000
16	Furnish Pre-Manufactured Steel Bridge	LS	1	\$162,500	\$162,500
17	Install Pre-Manufactured Steel Bridge	LS	1	\$18,000	\$18,000
18	Regrade Channel at Downstream Crossing	LS	1	\$14,000	\$14,000
19	Class II Aggregate Base (for Roadway Subgrade)	CY	180	\$45	\$8,100
20	Asphalt Concrete Pavement	Ton	111	\$110	\$12,210
21	Metal Beam Guard Rail	LF	85	\$55	\$4,675
22	Guard Rail Terminal System	EA	2	\$3,500	\$7,000
23	Roadway Striping	LS	1	\$4,000	\$4,000
24	Revegetation and Landscaping	LS	1	\$5,000	\$5,000

Subtotal: \$841,995

Estimating Contingency@30%: \$252,599

Engineers Opinion of Probable Construction Costs: \$1,100,000

¹ Traffic Control System Assumes Low Volume Road with No Temporary Traffic Signals

² Temporary Creek Crossings will be accomplished with pre-manufactured bridge for permanent installation at downstream crossing

2.0 DEVELOPMENT OF CONCEPTUAL DESIGNS

The following summarizes the numerous considerations, calculations, observations, and assumptions that lead to the development of the final conceptual designs.

2.1 Design Flows

The design process required estimating the peak design flows for the two crossings. The following watershed statistics were used as part of estimating flows (Table 1):

Table 2.1 - Watershed Statistics

	Downstream Crossing (MP 8.75)	Upstream Crossing (MP 8.60)
Drainage Area (DA):	5.72 mi ²	5.68 mi ²
Mean Annual Precipitation (MAP) ¹ :	22.0 in/yr	22.0 in/yr
Mean Basin Elevation (E):	< 1000 ft	< 1000 ft

¹ Estimated from isohyetal map of mean annual precipitation in California, developed by Daly and Taylor (1998).

The peak design flow was set at the peak flow having a 100-year recurrence interval, as specified by NMFS (2001) and California Department of Fish and Game (CDFG, 2002) stream crossing design guidelines.

Magnitudes of peak flows associated with varying recurrence intervals were estimated using three different methods: (1) rational method, (2) regional flood estimation regression equations by the USGS for the Central Coast region (Waananen and Crippen, 1977), and (3) probabilistic analysis of local streamflow records using standard procedures outlined in Bulletin 17B (USGS, 1982). The following table summarized the results (Table 2).

Table 2.2 - Estimated peak flows and recurrence intervals for the downstream crossing (MP 8.75). Peak flows at the upstream crossing are slightly lower.

Estimated Peak Flow	2 year (cfs)	10 year (cfs)	25 year (cfs)	50 year (cfs)	100 year (cfs)
(1) Rational Method ¹	403	681	1,018	1,370	1,771
(2) Waananen and Crippen, 1977	77	404	671	929	1,219
(4) Average of Local Streamflow Records adjusted by drainage area ²	167	710	1,096	1,427	1,784

¹ Used Intensity-Duration-Frequency curves from four rain gaging stations located between 3.8 miles and 11 miles from the project location. Estimated time of concentration was 55 min.

² Used records from seven nearby stream gages and adjusted peak flow estimates by drainage area. Stream gage drainage areas ranged between 0.28 mi² and 37.5 mi².

Estimates for the 100 year peak flow were very similar using the rational method and the average of stream flow records. For the design flow we conservatively selected a peak flow of **1,790 cfs** for both stream crossings.

2.2 Channel Design

2.2.1 Existing Channel Grade

Surveying a longitudinal profile through the project site is essential for developing successful channel designs. Since the two crossings are less than 800 feet apart, we chose to survey one long continuous profile. It extended over 1,700 feet, beginning 455 feet below the downstream crossing to 400 feet above the upstream crossing. The average slope of the surveyed channel was 8.7 percent. However, the slope varied substantially above and below each of the crossings, ranging between 6.2 percent below the downstream crossing to 9.0 percent between the two crossings (Figure 1).

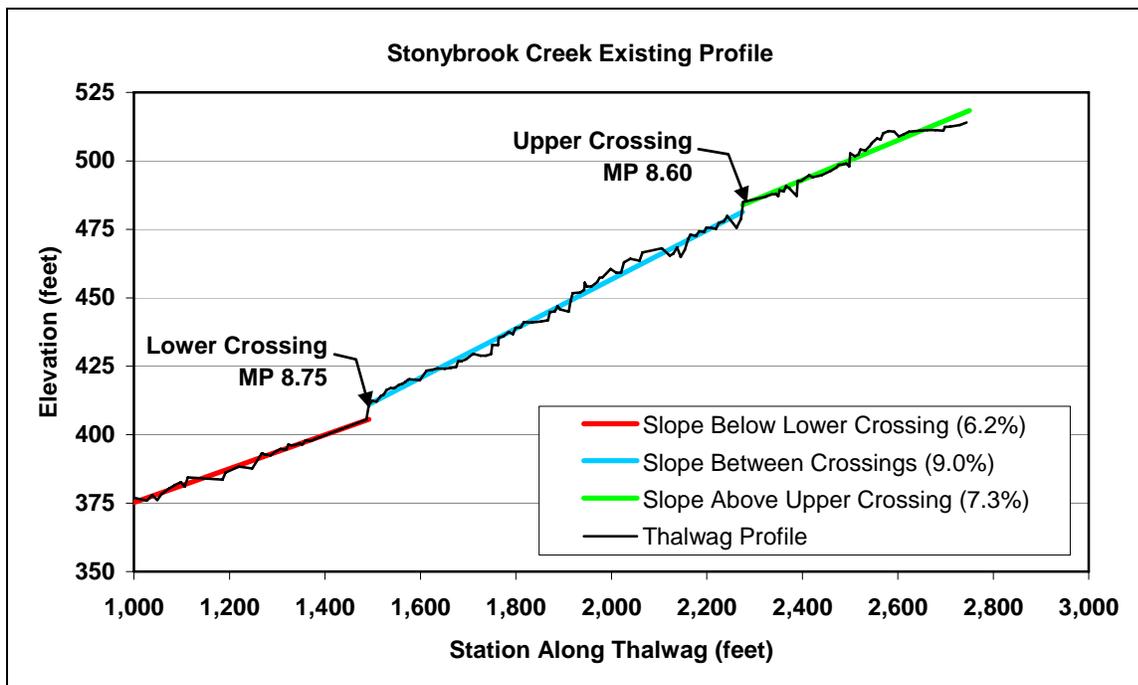


Figure 2.1 - Figure 1 – Longitudinal profile of Stonybrook Creek through the project area. Slopes were estimated using linear regression of surveyed thalweg points, excluding the culverts.

Upstream of the downstream crossing the channel appears severely aggraded with large boulders. The boulders have deposited at the culvert inlet due to the channel constriction caused by the undersized culvert. This creates a 5.5 foot drop in the channel bed immediately upstream from the culvert inlet which completely blocks fish passage and reduces the culvert's capacity (Figure 2). The deposition above the culvert also appears to have starved the downstream channel of the larger bedload sizes.

2.2.2 Reference Reach

The project area is located within Stonybrook Canyon, a highly confined section of channel. The channel reach between the two stream crossings is approximately 800 feet in length. Throughout this reach the road bed encroaches on the stream's right bank (looking downstream) and bedrock controls the form of the left bank. The bed shape and slope is predominately controlled by numerous large boulders.



Figure 2.2 - Inlet of the downstream crossing (MP 8.75), as flow cascades down a 5.5 foot drop over boulders deposited due to the channel constriction caused by the culvert.

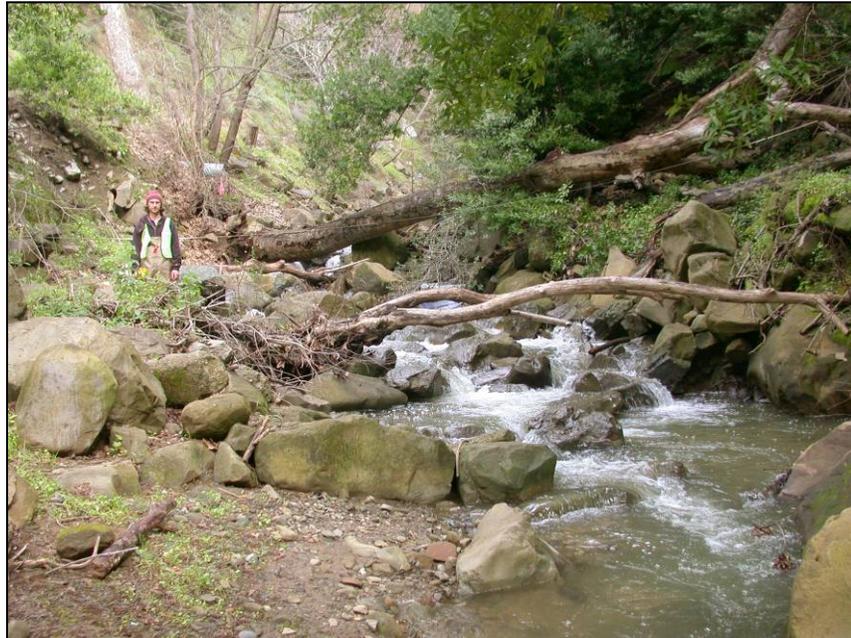


Figure 2.3 - Location of the reference reach, 200 feet upstream of the downstream crossing (MP 8.75)

As part of the design process a reference channel reach was located roughly 200 feet upstream of the downstream crossing which appeared representative of the entire channel between the two crossings (Figure 3). Within the reference reach a Wolman pebble count was conducted to characterize the streambed material, a channel cross section was surveyed, and the water surface slope through the cross section was measured.

To characterize the streambed material and aid in estimating appropriate hydraulic roughness, a particle size distribution was created from the pebble count. It found the d84 (84 percent of particles less than the d84) to be approximately 2 feet and the d50 to be nearly 7 inches (Figure 4). These values correspond with large bedload characteristic of a steep stream such as Stonybrook Creek. The material size and distribution is considered suitable for reconstructing step-pools into the regraded channel without needing to import large rock.

Width at the 2-year flow and conveyance area at the 100-year flow were used in designing the shape of the regraded channel and selecting the appropriate culvert size for the upstream crossing. To estimate these values we conducted a hydraulic analysis of the reference cross section using the computer software, WinXSPro (USFS 2005). The analysis estimated the wetted channel width at the 2-year peak flow to be approximately 26 feet, with a mean water depth of 1.7 feet. The wetted area of the channel at the 100-year peak flow was 180 square feet and water velocities within the channel at the 2-year and 100-year peak flows were estimated to be 3.9 feet per second and 9.6 feet per second, respectively. Additional detail is provided in the attached representative cross section summary.

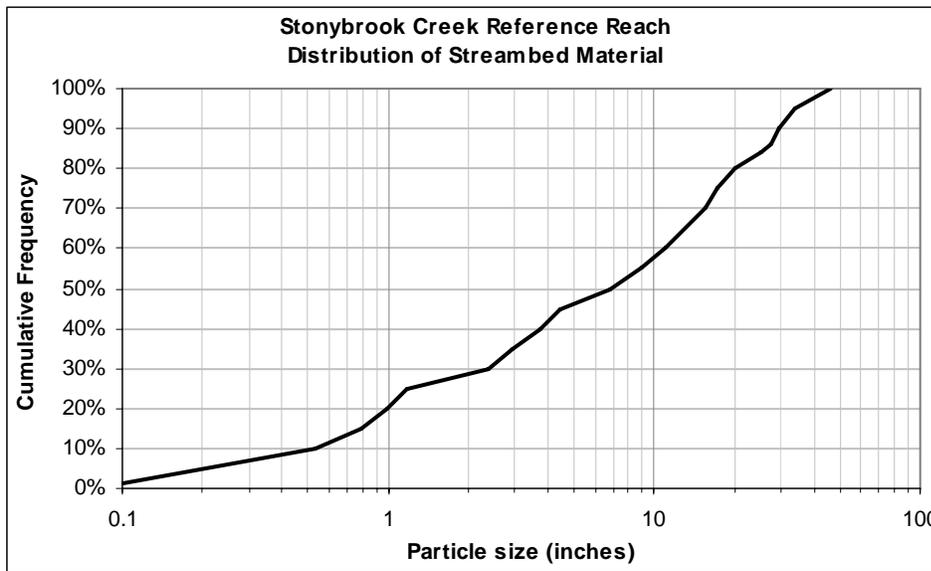


Figure 2.4 - Particle size distribution of streambed material located within the reference reach approximately 200 feet upstream of the downstream crossing.

2.3 Stream Channel Design

2.3.1 Design Channel for the Upstream Crossing (MP 8.60)

Determining stable design slopes at the two crossings required examining the channel grade upstream and downstream, and identifying hard features in the channel that control the stream's grade. For the upstream crossing the stable channel slope is estimated to be 8.9 percent. The channel will be regraded from Station 22+35 to Station 23+72, a total of 137 feet to match the existing adjacent stream grades approximately 100 feet downstream and 200 feet upstream of the crossing (Figure 5). The survey also noted bedrock spanning the channel bottom at a location about two hundred feet downstream of the upstream crossing. Bedrock typically functions as a hard point in the channel, and is expected to prevent the streambed from incising below the upstream crossing following the replacement of the downstream crossing.

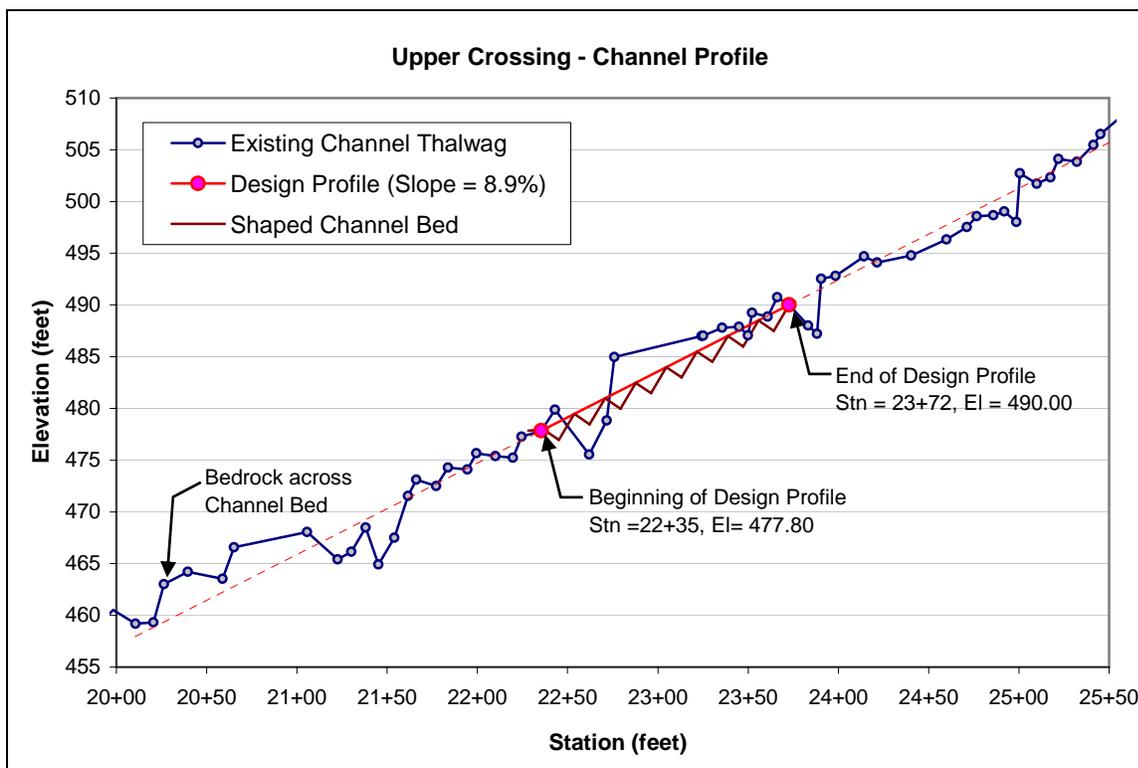


Figure 2.5 - Design channel profile for the upstream crossing at Mile Post 8.60.

2.3.2 Design Stream Grade for Downstream Crossing (MP 8.75)

Determining a stable channel grade at the downstream crossing was more challenging than at the upstream crossing. The deposited boulders at the culvert inlet appear to have influenced the channel grade for more than 100 feet upstream. Additionally, the channel immediately downstream of the culvert has a much lower gradient than the rest of the channel. The discrepancy in slopes is likely due in part to encroachment of the road fill into the channel between the two crossings, which straightened the stream channel and caused it to become steeper.

The design of the downstream crossing incorporates two channel grades (Figure 6). The regrading begins just below the culvert outlet at Station 13+50 and continues upstream 140 feet

at an average slope of 8.9 percent. At Station 14+90 there is a slope break and the design channel grade steepens to 11.8 percent. The regraded channel ends at Station 15+85, approximately 15 feet below a 4 foot high falls over an extremely large stable boulder that spans the channel. A slope break was needed to balance the amount of native streambed material available for grading.

We anticipate the stream shape and grade at the downstream crossing will adjust over time. Since both banks under the proposed bridge are bedrock, the channel adjustments will be confined and will not disturb the bridge abutments. Additionally, the bridge will be more than 20 feet above the channel bed, providing ample room for the bed to aggrade while maintaining adequate conveyance for the 100 year flow.

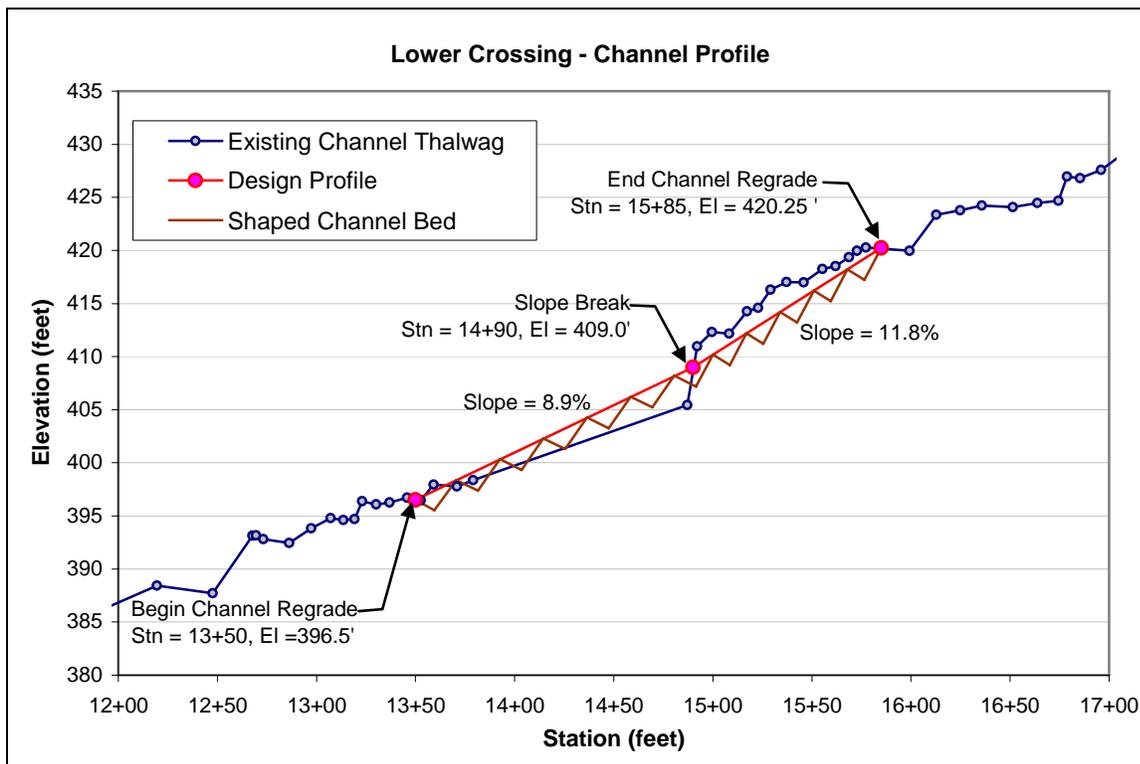


Figure 2.6 - Design channel profile for the downstream crossing at Mile Post 8.75.

2.3.3 Shaping of Streambed for Both Crossings

Since streams with slopes greater than 3 to 4 percent naturally either have a step-pool or cascade channel morphology, we propose to construct a rough step-pool shape into the finished channel bed. This will provide suitable fish passage conditions immediately after construction and assist the channel in setting up a stable step-pool configuration. However, we anticipate that substantial adjustment to the bed shape will still occur following construction.

The step-pool design is intended to be relatively easy to construct, provide suitable resting areas for fish, and be shaped in roughly the same configuration that is found in steeply sloping natural streams (i.e., 9 to 12 percent). Specified pool spacing for this project was determined through field observations of the adjacent channel and use of pool spacing relationships developed for other steep streams (Chin, 1999; Zimmermann and Church, 2001) (Figure 7 and Table 3). Additionally, each step pool must have a residual pool depth of one foot to provide adequate

resting area for fish. The steps will be constructed using native streambed material from the project site, which is comprised of large boulders as well as sands, gravels, and cobbles.

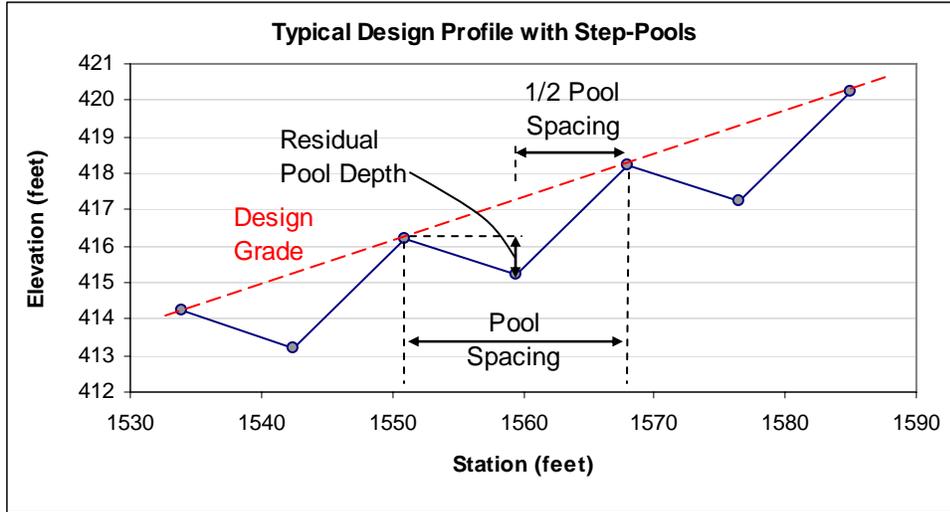


Figure 2.7 - Typical of step-pool configuration for regraded channel sections.

Table 2.3 - Step pool spacing for regrade channel reaches

Channel Reach	Average Design Grade	Reach Length	Average Pool Spacing
Upstream Crossing (MP 8.60)	8.9%	137 feet	22 feet
Downstream Crossing (MP 8.75):			
Lower Section	8.9%	140 feet	22 feet
Upper Section	11.8%	95 feet	17 feet

2.3.4 Channel Cross Sectional Shape

For both crossings the bottom channel width was set at 24 feet, based on results from the hydraulic analysis of the reference cross section at the 2-year peak flow. The bottom has a side slope of 8(Horizontal):1(Vertical) and the banks have side slopes of 2(Horizontal):1(Vertical). Given the large size of material that will be graded, the channel will likely end up with many irregularities with numerous large rocks protruding from the bed and banks. This will be similar in nature to the natural channel and provide many quiet-water areas and dissipate energy at higher flows.

2.4 Fish Passage Improvements

When implemented, this project will result in the removal of two complete fish barriers that were identified in the Stonybrook Fish Passage Assessment (Love, 2001). These existing barriers will be replaced with new crossings that provide for a roadway over a natural stream channel. At the crossings, the proposed designs utilize a step-pool channel at slopes found in the adjacent natural channel. The channel will be shaped using only native streambed material found on site. The design is intended to allow the channel to adjust naturally in both shape and profile. The end result will be a channel that provides fish passage and fish habitat similar to the adjacent natural channels. Due to the type of work involved, it would be preferable to select a contractor with

experience completing successful in-stream channel work. When completed, the project will open up access to over 3,000 feet of previously blocked habitat for steelhead and rainbow trout.

2.5 References

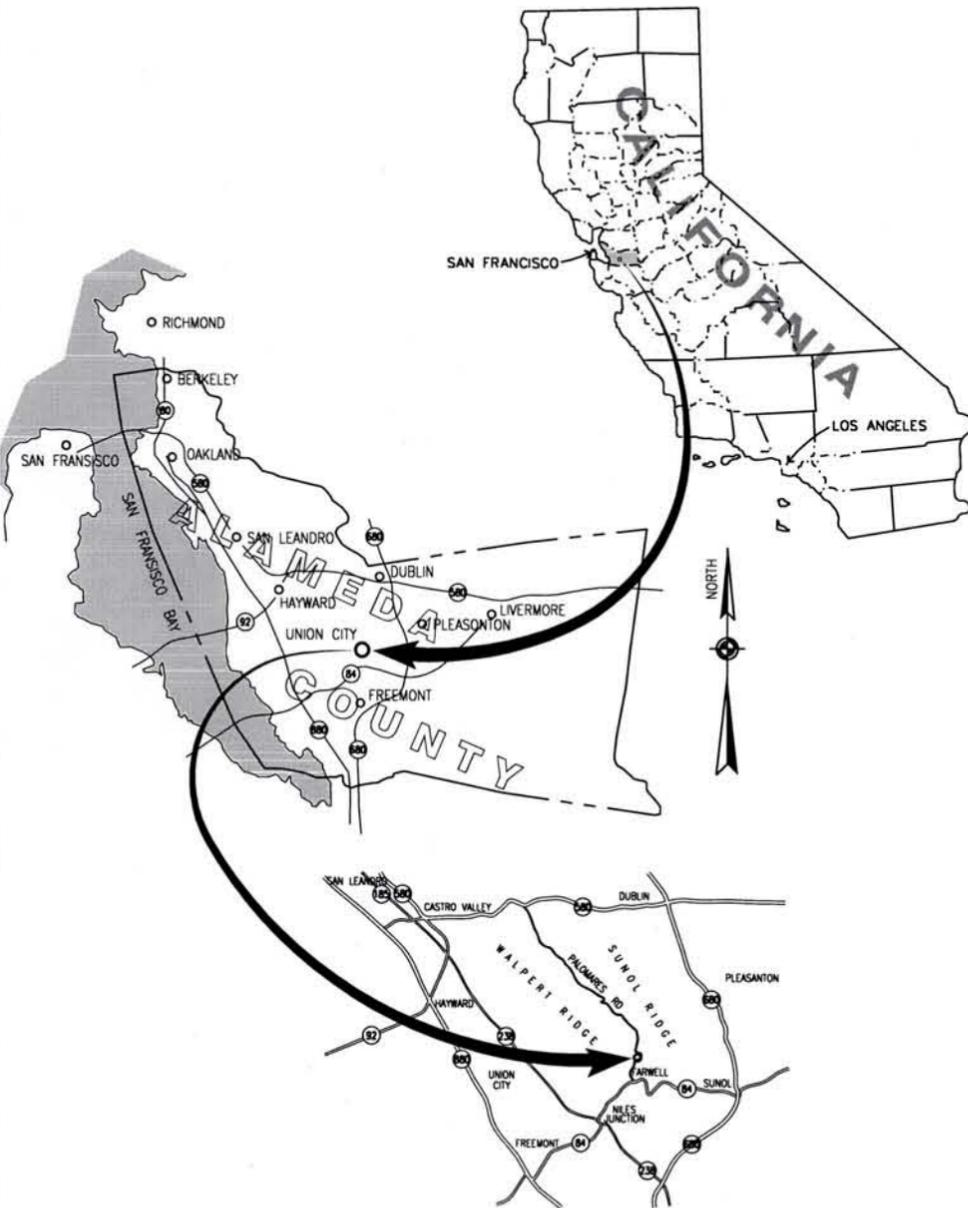
- Bathurst, J.C. 1978. *Flow Resistance of Large-Scale Roughness*. Journal of the Hydraulics Division, AM. Soc. Civil Engr., Vol. 104, No. HY12, pp. 1587-1603.
- California Department of Fish and Game. 2002. *Culvert criteria for fish passage*. 17 pages.
- Chin, Anne. 1999. The morphologic structure of step-pools in mountain streams. *Geomorphology*, 27:191-204.
- Daly, Chris and George Taylor. 1998. *California Average Annual Precipitation: 1961-90*. ArcView Shapefile produced by Natural Resources Conservation Service, Water and Climate Center, Portland OR.
- Gunther, A.J., J. Hagar, and P. Salop. 200. An assessment of the potential for restoring a viable steelhead trout population in the Alameda Creek Watershed. Applied Marine Sciences, Inc., Livermore, CA, 90 pages.
- Love, Michael. 2001. Stonybrook fish passage assessment. Prepared for Alameda County Public Works Agency. April 6, 2001. 27 pages.
- National Marine Fisheries Service. 2001. *Guidelines for salmonid passage at stream crossings*. NMFS SW Region. 14 pages
- Rantz, S.E. 1968. *Average Annual Precipitation and Runoff in North Coastal California*. Hydrologic investigations atlas HA-298, USDI Geol. Survey, Wash. D.C. 4 pages.
- USFS. 2005. WinXSPRO, A Channel Cross Section Analyzer, User's Manual, Version 3.0 Gen. Tech. Rep. RMRS-GTR-147. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 95 p..
- USGS. 1982. *Guidelines for determining flood flow frequency*. Bulletin #17B of the Hydrology Subcommittee. Interagency Advisory Committee on Water Data, US Dept. of Interior, Geological Survey, Virginia.
- Waananen, A. O. and J.R. Crippen. 1977. Magnitude and frequency of floods in California. USGS, Water Resources Investigation 77-21, Menlo Park, CA 96 pages.
- Zimmermann, A., and M. Church (2001). *Channel morphology, gradient profiles and bed stresses during flood in a step-pool channel*. *Geomorphology* 40: 311-327.

Appendix A
Conceptual Design Plans

CONCEPTUAL DESIGNS FOR TWO STONYBROOK CREEK SALMONID MIGRATION BARRIER REMOVAL PROJECTS

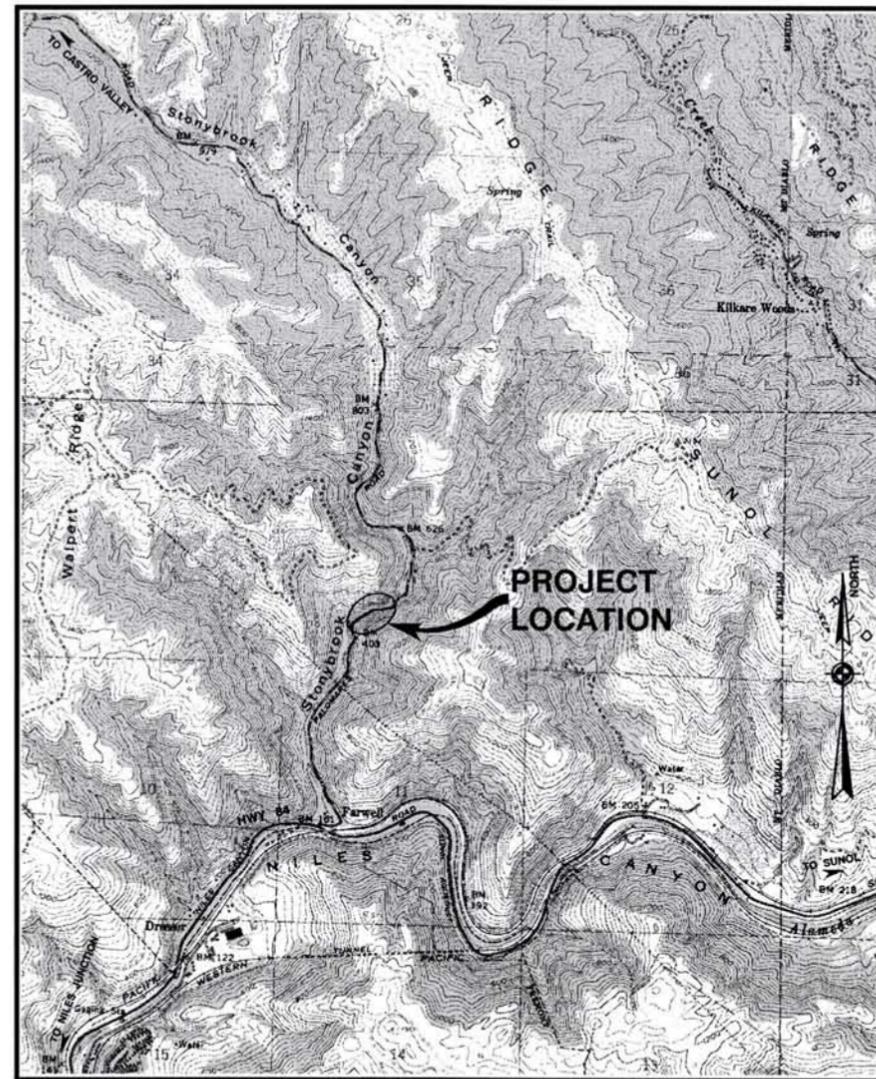
(PALOMARES ROAD AT POSTMILES 8.60 AND 8.75)

OCTOBER 2005

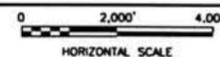


LOCATION MAP

N.T.S.



VICINITY MAP



HORIZONTAL SCALE

SHEET INDEX

- G-1.0 COVER SHEET
- C-1.0 GENERAL NOTES, SYMBOLS, ABBREVIATIONS, & INDEX SHEET
- C-2.0 OVERALL CREEK PROFILE
- C-3.0 POST MILE 8.60 PLAN VIEW
- C-4.0 POST MILE 8.60 PROFILE
- C-5.0 POST MILE 8.60 SECTIONS
- C-6.0 POST MILE 8.75 PLAN VIEW
- C-7.0 POST MILE 8.75 PROFILE
- C-8.0 POST MILE 8.75 SECTIONS

WINZLER & KELLY CONSULTING ENGINEERS 633 THIRD STREET EUREKA, CA 95501-0417 PH (707) 443-8326 FAX (707) 444-8330		DATE	APPROVED
Michael Love & Associates Hydrologic Solutions PO Box 4477 Arcata, CA 95518 (707) 476-8938		DESCRIPTION	REVISIONS
DES. SA/ML	CHK SA	DRAWING SCALE	DRAWING SCALE AS SHOWN ON PLAN
DES. SJD	CHK AC	DRAWING SCALE	DRAWING SCALE AS SHOWN ON PLAN
Center for Ecosystem Mgmt & Restoration Conceptual Designs For TWO STONYBROOK CREEK SALMONID MIGRATION BARRIER REMOVAL PROJECTS CIVIL COVER SHEET			
JOB NUMBER 04101601		SHEET 1 of 9	
SCHEMATIC SUBMITTAL NOT FOR CONSTRUCTION OCTOBER 2005			
G-1.0			

SURVEY:

1. SITE TOPOGRAPHY SURVEY CONDUCTED BY MARVIN SMITHERMAN ON NOVEMBER 3, 2004. HORIZONTAL AND VERTICAL DATUM FROM ALAMEDA COUNTY BENCHMARK "PAL-23".

BENCHMARK:

ALAMEDA COUNTY BENCHMARK "PAL-23" ELEVATION 562.066

STD ALA CO DISC IN TOP E'LY COR 3'X3' +/- CONC FOOTING FOR 8" CMP POLE W/ NO PARKING SIGN, 10' +/- W'LY OF WEST E.P. @ S'LY END TURNOUT @ MILE 8.55 +/- ALONG PALOMARES ROAD.

GENERAL NOTES:

1. CONTRACTOR RESPONSIBLE FOR COMPLIANCE WITH ALL PROJECT PERMITS.
2. SEE PLAN SHEETS C-3 AND C-6 FOR CONSTRUCTION WORK PHASING FOR THE POST MILE 8.60 AND POST MILE 8.75 SITES RESPECTIVELY.

DEMOLITION NOTES:

1. PRIOR TO COMMENCING ANY EXCAVATION OR DEMOLITION WORK, THE FISH SCREENS AND COFFER DAMS MUST BE INSTALLED AND FISH REMOVED FROM THE PROJECT AREA BY A QUALIFIED BIOLOGIST.
2. NATIVE STREAMBED MATERIAL THAT IS EXCAVATED TO BE SEGREGATED AND STOCKPILED ON SITE FOR RE-USE IN CHANNEL REGRADING.
3. ANY PUMPS USED ON-SITE (DEWATERING ETC) SHALL BE PLACED ON ABSORBANT PADS. THE CONTRACTOR SHALL HAVE SPILL CONTAINMENT MATERIALS LOCATED AT THE SITE, WITH OPERATORS TRAINED IN SPILL CONTROL PROCEDURES.

TRAFFIC CONTROL NOTES:

1. TEMPORARY LANE CLOSURE TRAFFIC CONTROL TO BE CONSISTENT W/ LANE CLOSURE FOR LOW VOLUME, TWO-LANE ROADS PER CALTRANS MANUAL OF TRAFFIC CONTROLS - CURRENT EDITION

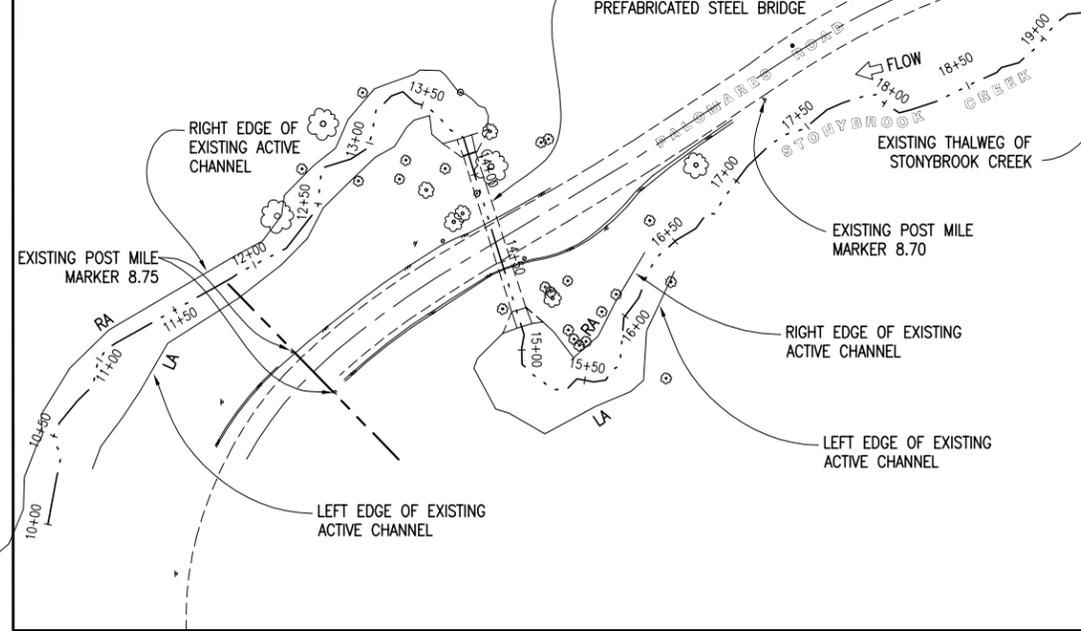
SYMBOLS:

DESCRIPTION:	EXISTING:
MONUMENT LINE	-----
CENTER LINE	-----
INDEX CONTOUR LINE	-----10
CONTOUR LINE	-----
THALWEG	-----Th
RIGHT ACTIVE CHANNEL	-----RA
LEFT ACTIVE CHANNEL	-----LA
FENCE LINE	-----x
GUARD RAIL	-----□
EDGE STRIPE	-----~
PAVEMENT GRADE BREAK	-----~
GRADE	+ 100.00
SIGN	⊙
SURVEY MONUMENT	⊙
TREE WITH SIZE	⊙
UTILITY POLE	⊙
UTILITY VAULT	□

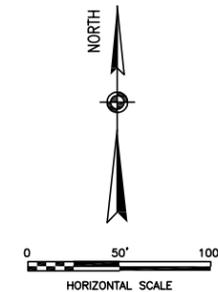
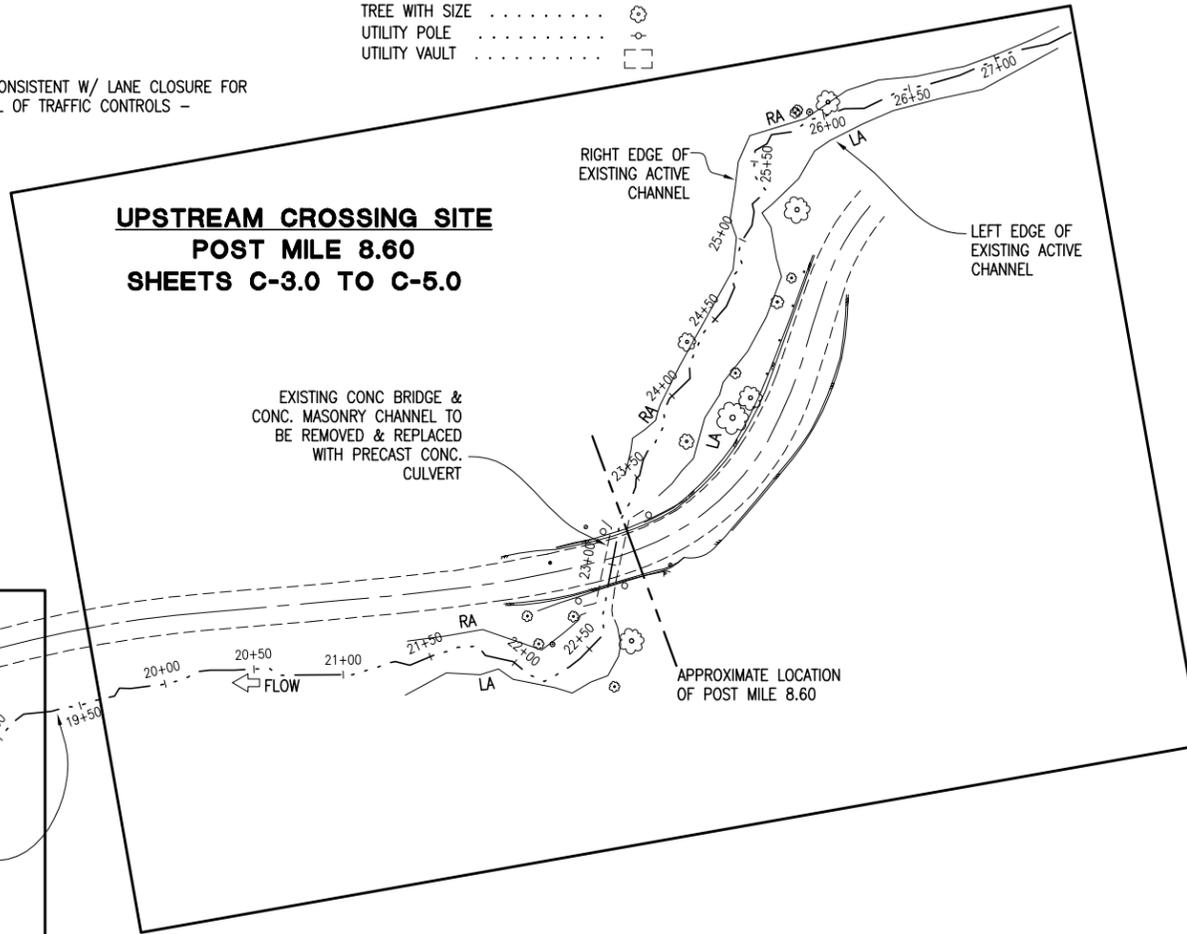
ABBREVIATIONS:

AC	ASPHALT CONCRETE
ALA	ALAMEDA
APPROX	APPROXIMATE
AVE	AVERAGE
C	CENTERLINE
CH	CHANNEL
CONC	CONCRETE
(E)	EXISTING
ELEV	ELEVATION
E'LY	EASTERLY
INV	INVERT
(N)	NEW
(P)	PROPOSED
PM	POST MILE
W'LY	WESTERLY

**DOWNSTREAM CROSSING SITE
POST MILE 8.75
SHEETS C-6.0 TO C-8.0**



**UPSTREAM CROSSING SITE
POST MILE 8.60
SHEETS C-3.0 TO C-5.0**



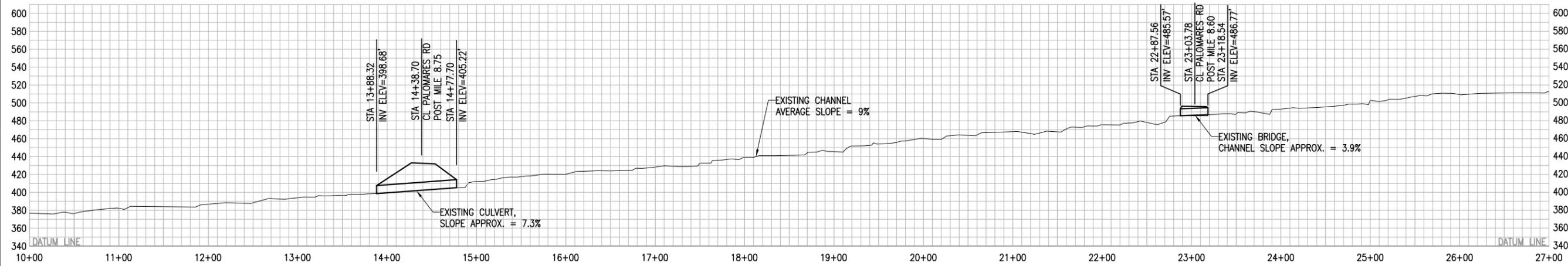
PALOMARES ROAD & STONYBROOK CREEK

**SCHEMATIC SUBMITTAL
NOT FOR CONSTRUCTION
OCTOBER 2005**

<p>WINZLER & KELLY CONSULTING ENGINEERS 633 THIRD STREET EUREKA, CA 95501-0417 PH (707) 443-8326 FAX (707) 444-8330</p>		<p>Michael Love & Associates Hydrologic Solutions PO Box 4477 Arcata, CA 95518 (707) #6-8938</p>	
DES	SA	DRN	SJD
SUPV	SA	CHK	ML
DRAWING SCALE:		DRAWING SCALE AS SHOWN ON PLAN	
<p>Center for Ecosystem Mgmt & Restoration Conceptual Designs For TWO STONYBROOK CREEK SALMONID MIGRATION BARRIER REMOVAL PROJECTS</p>			
<p>CIVIL GENERAL NOTES, SYMBOLS, ABBREVIATIONS, & INDEX SHEET</p>			
JOB NUMBER		04101601	
SHEET		2 OF 9	
<p>C-1.0</p>			

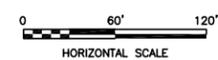
DOWNSTREAM CROSSING SITE
POST MILE 8.75
SHEETS C-6.0 TO C-8.0

UPSTREAM CROSSING SITE
POST MILE 8.60
SHEETS C-3.0 TO C-5.0



STONYBROOK CREEK THALWEG PROFILE

SCALE: SEE SCALE BAR



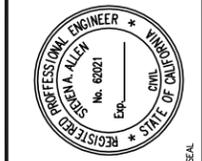
NO.	DATE	DESCRIPTION	BY

WINZLER & KELLY
CONSULTING ENGINEERS
 633 THIRD STREET
 EUREKA, CA 95501-0417
 PH (707) 443-8326
 FAX (707) 444-8330

Michael Love & Associates
Hydrologic Solutions
 PO Box 4477 Arcata, CA 95518 (707) #6-8938

DES.	SA/ML	DRN	S/D
SUPV.	SA	CHK	ML

DRAWING SCALE:
 DRAWING SCALE AS SHOWN ON PLAN



Center for Ecosystem Mgmt & Restoration
 Conceptual Designs For TWO STONYBROOK CREEK
 SALMONID MIGRATION BARRIER REMOVAL PROJECTS
 CIVIL
OVERALL CREEK PROFILE

SCHEMATIC SUBMITTAL
NOT FOR CONSTRUCTION
OCTOBER 2005

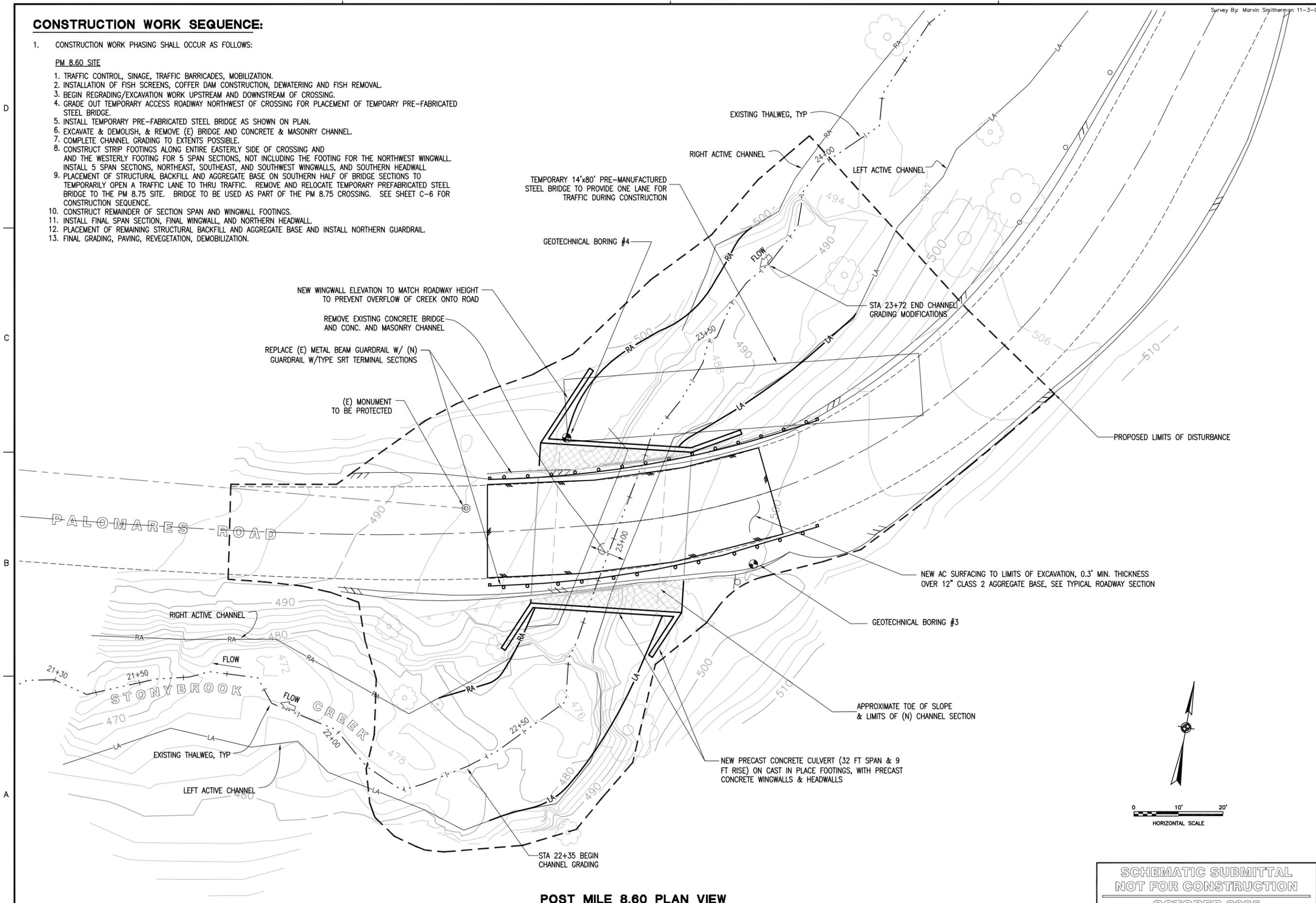
JOB NUMBER: 04101601
 SHEET 3 OF 9
C-2.0

CONSTRUCTION WORK SEQUENCE:

1. CONSTRUCTION WORK PHASING SHALL OCCUR AS FOLLOWS:

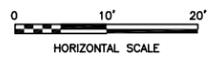
PM 8.60 SITE

1. TRAFFIC CONTROL, SINAGE, TRAFFIC BARRICADES, MOBILIZATION.
2. INSTALLATION OF FISH SCREENS, COFFER DAM CONSTRUCTION, DEWATERING AND FISH REMOVAL.
3. BEGIN REGRADING/EXCAVATION WORK UPSTREAM AND DOWNSTREAM OF CROSSING.
4. GRADE OUT TEMPORARY ACCESS ROADWAY NORTHWEST OF CROSSING FOR PLACEMENT OF TEMPORARY PRE-FABRICATED STEEL BRIDGE.
5. INSTALL TEMPORARY PRE-FABRICATED STEEL BRIDGE AS SHOWN ON PLAN.
6. EXCAVATE & DEMOLISH, & REMOVE (E) BRIDGE AND CONCRETE & MASONRY CHANNEL.
7. COMPLETE CHANNEL GRADING TO EXTENTS POSSIBLE.
8. CONSTRUCT STRIP FOOTINGS ALONG ENTIRE EASTERLY SIDE OF CROSSING AND AND THE WESTERLY FOOTING FOR 5 SPAN SECTIONS, NOT INCLUDING THE FOOTING FOR THE NORTHWEST WINGWALL. INSTALL 5 SPAN SECTIONS, NORTHEAST, SOUTHEAST, AND SOUTHWEST WINGWALLS, AND SOUTHERN HEADWALL.
9. PLACEMENT OF STRUCTURAL BACKFILL AND AGGREGATE BASE ON SOUTHERN HALF OF BRIDGE SECTIONS TO TEMPORARILY OPEN A TRAFFIC LANE TO THRU TRAFFIC. REMOVE AND RELOCATE TEMPORARY PREFABRICATED STEEL BRIDGE TO THE PM 8.75 SITE. BRIDGE TO BE USED AS PART OF THE PM 8.75 CROSSING. SEE SHEET C-6 FOR CONSTRUCTION SEQUENCE.
10. CONSTRUCT REMAINDER OF SECTION SPAN AND WINGWALL FOOTINGS.
11. INSTALL FINAL SPAN SECTION, FINAL WINGWALL, AND NORTHERN HEADWALL.
12. PLACEMENT OF REMAINING STRUCTURAL BACKFILL AND AGGREGATE BASE AND INSTALL NORTHERN GUARDRAIL.
13. FINAL GRADING, PAVING, REVEGETATION, DEMOBILIZATION.

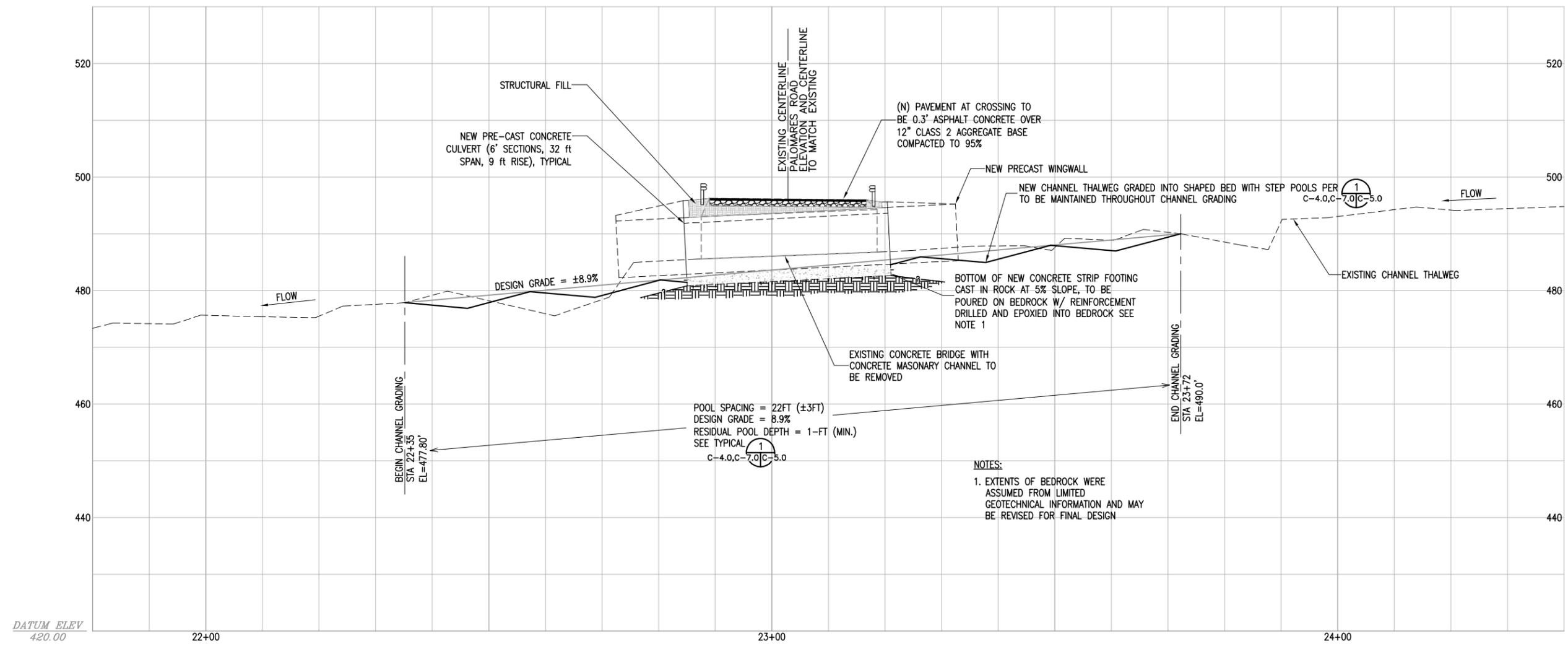


POST MILE 8.60 PLAN VIEW

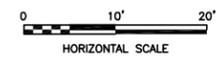
**SCHEMATIC SUBMITTAL
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DES. SA/ML	DRN. S/D	CHK. AC	APPROVED
SUPV. SA	DRK. AC	DRAWING SCALE AS SHOWN ON PLAN	DATE
<p>REGISTERED PROFESSIONAL ENGINEER STEPHAN ALLEN No. 62021 Exp. _____ STATE OF CALIFORNIA</p>		<p>REVISIONS</p>	
<p>Center for Ecosystem Mgmt & Restoration Conceptual Designs For TWO STONYBROOK CREEK SALMONID MIGRATION BARRIER REMOVAL PROJECTS</p>			
<p>CIVIL POST MILE 8.60 PLAN VIEW</p>			
<p>J:\CAD\JOBS\2004\04101601\dwg\C-3.0.dwg</p>		<p>JOB NUMBER 04101601</p>	
<p>10/25/2005</p>		<p>SHEET 4 OF 9</p>	
<p>C-3.0</p>			



STONYBROOK CREEK THALWEG PROFILE AT POST MILE 8.60
SCALE: SEE SCALE BAR



DATUM ELEV
420.00

NOTES:
1. EXTENTS OF BEDROCK WERE ASSUMED FROM LIMITED GEOTECHNICAL INFORMATION AND MAY BE REVISED FOR FINAL DESIGN

POOL SPACING = 22FT (±3FT)
DESIGN GRADE = 8.9%
RESIDUAL POOL DEPTH = 1-FT (MIN.)
SEE TYPICAL
C-4.0, C-7.0 | C-5.0

BEGIN CHANNEL GRADING
STA 22+35
EL=477.80

END CHANNEL GRADING
STA 23+72
EL=490.0'

NO.	DATE	DESCRIPTION	BY	APPROVED

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CONSULTING ENGINEERS
633 THIRD STREET
EUREKA, CA 95501-0417
PH (707) 443-8326
FAX (707) 444-8330

Michael Love & Associates
Hydrologic Solutions
PO Box 4477 Arcata, CA 95518 (707) #6-8938

DES. SA/ML	DRN S/D
SUPV SA	CHK AC

DRAWING SCALE:
DRAWING SCALE AS SHOWN ON PLAN



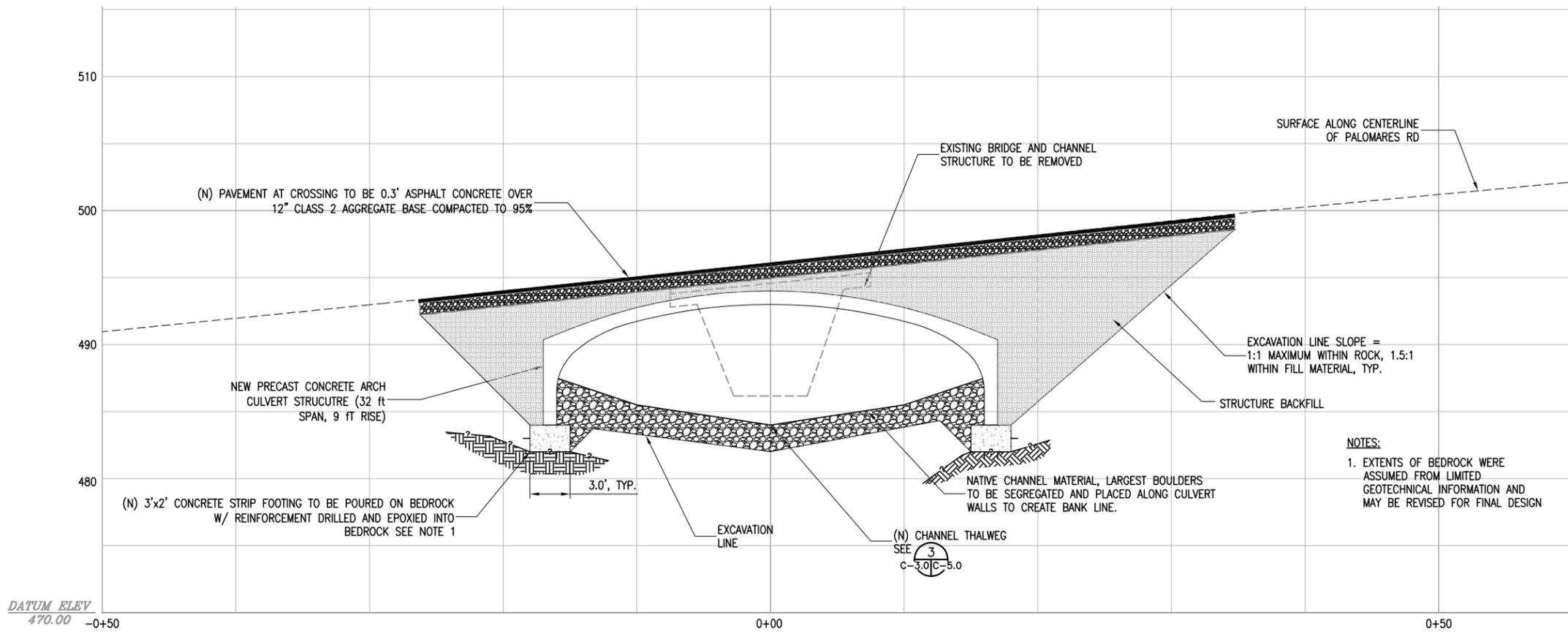
Center for Ecosystem Mgmt & Restoration
Conceptual Designs For TWO STONYBROOK CREEK
SALMONID MIGRATION BARRIER REMOVAL PROJECTS

CIVIL

POST MILE 8.60 PROFILE

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OCTOBER 2005

JOB NUMBER 04101601
SHEET 5 OF 9
C-4.0

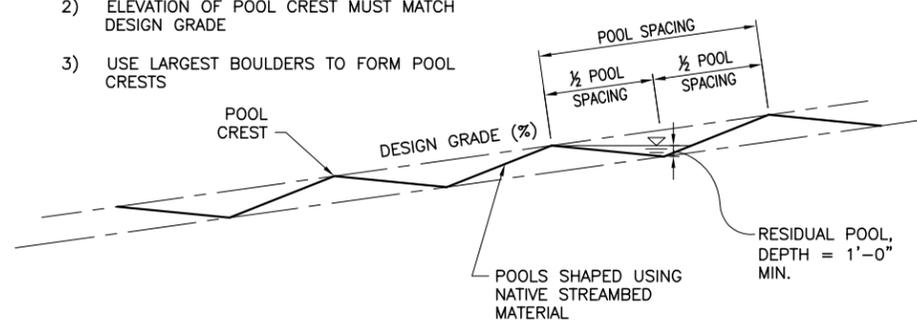


2 TYPICAL SECTION AT CULVERT
C-3.0|C-5.0 SCALE: SEE SCALE BAR

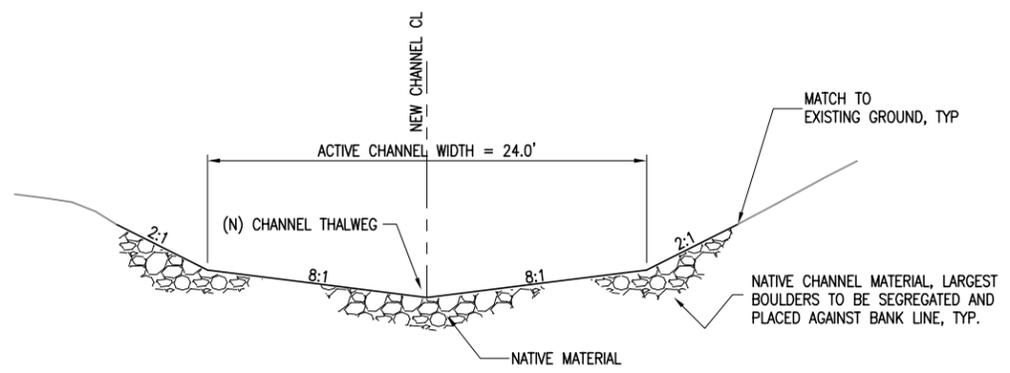


CONSTRUCTION NOTES FOR (N) CHANNEL BEDS

- 1) BEDS FORMED BY MOVING NATIVE MATERIAL TO MATCH DIMENSIONS ON PLANS
- 2) ELEVATION OF POOL CREST MUST MATCH DESIGN GRADE
- 3) USE LARGEST BOULDERS TO FORM POOL CRESTS



1 TYPICAL BED SHAPE
C-4.0, C-7.0|C-5.0 SCALE: NTS



3 TYPICAL CHANNEL SECTION
C-3.0|C-5.0 SCALE: SEE SCALE BAR

NO.	DATE	DESCRIPTION	BY	APPROVED

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Hydrologic Solutions
PO Box 4477 Arcata, CA 95518 (707) #6-8938

DES	SA/ML	DRN	SJD
SUPV	SA	CHK	AC

DRAWING SCALE: AS SHOWN ON PLAN



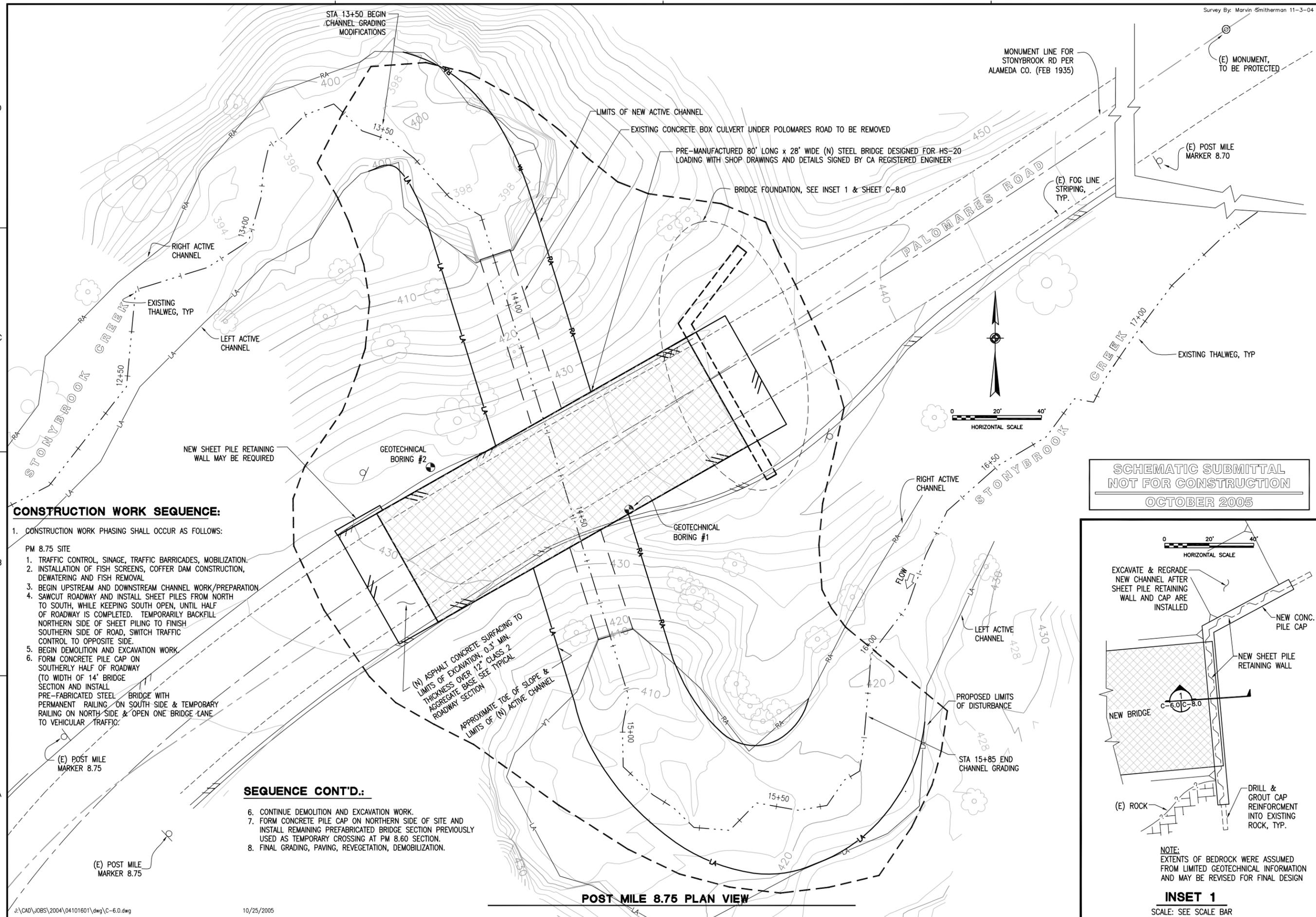
Center for Ecosystem Mgmt & Restoration
Conceptual Designs For TWO STONYBROOK CREEK
SALMONID MIGRATION BARRIER REMOVAL PROJECTS

CIVIL

POST MILE 8.60 SECTION

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OCTOBER 2005

JOB NUMBER	04101601
SHEET	6 OF 9
C-5.0	



CONSTRUCTION WORK SEQUENCE:

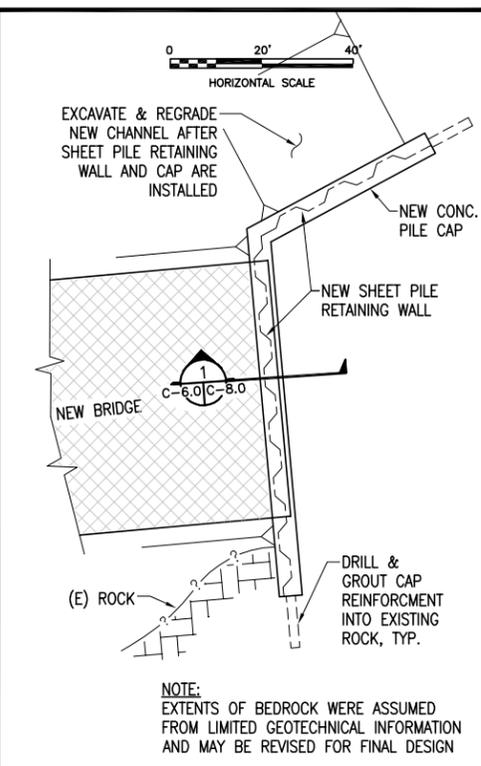
1. CONSTRUCTION WORK PHASING SHALL OCCUR AS FOLLOWS:
- PM 8.75 SITE
 - TRAFFIC CONTROL, SINAGE, TRAFFIC BARRICADES, MOBILIZATION.
 - INSTALLATION OF FISH SCREENS, COFFER DAM CONSTRUCTION, DEWATERING AND FISH REMOVAL
 - BEGIN UPSTREAM AND DOWNSTREAM CHANNEL WORK/PREPARATION
 - SAWCUT ROADWAY AND INSTALL SHEET PILES FROM NORTH TO SOUTH, WHILE KEEPING SOUTH OPEN, UNTIL HALF OF ROADWAY IS COMPLETED. TEMPORARILY BACKFILL NORTHERN SIDE OF SHEET PILING TO FINISH SOUTHERN SIDE OF ROAD, SWITCH TRAFFIC CONTROL TO OPPOSITE SIDE.
 - BEGIN DEMOLITION AND EXCAVATION WORK
 - FORM CONCRETE PILE CAP ON SOUTHERLY HALF OF ROADWAY (TO WIDTH OF 14' BRIDGE SECTION AND INSTALL PRE-FABRICATED STEEL BRIDGE WITH PERMANENT RAILING ON SOUTH SIDE & TEMPORARY RAILING ON NORTH SIDE & OPEN ONE BRIDGE LANE TO VEHICULAR TRAFFIC.

SEQUENCE CONT'D.:

- CONTINUE DEMOLITION AND EXCAVATION WORK.
- FORM CONCRETE PILE CAP ON NORTHERN SIDE OF SITE AND INSTALL REMAINING PREFABRICATED BRIDGE SECTION PREVIOUSLY USED AS TEMPORARY CROSSING AT PM 8.60 SECTION.
- FINAL GRADING, PAVING, REVEGETATION, DEMOBILIZATION.

POST MILE 8.75 PLAN VIEW

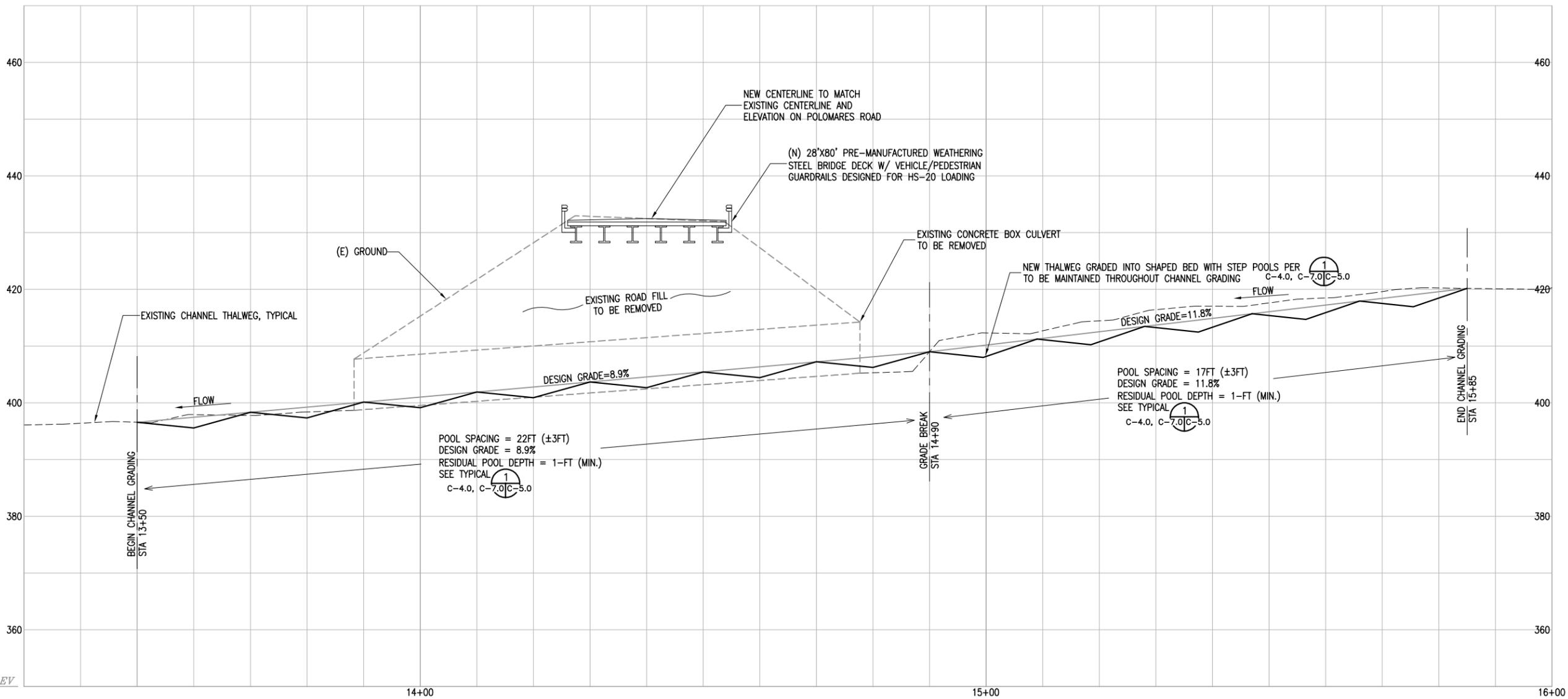
SCHEMATIC SUBMITTAL
NOT FOR CONSTRUCTION
OCTOBER 2005



NOTE:
EXTENTS OF BEDROCK WERE ASSUMED FROM LIMITED GEOTECHNICAL INFORMATION AND MAY BE REVISED FOR FINAL DESIGN

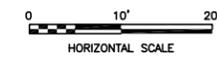
INSET 1
SCALE: SEE SCALE BAR

WINZLER & KELLY CONSULTING ENGINEERS 633 THIRD STREET EUREKA, CA 95501-0417 PH (707) 443-8326 FAX (707) 444-8330		Michael Love & Associates Hydrologic Solutions PO Box 4477 Arcata, CA 95518 (707) #6-8938
DES. SA/ML SUPV. SA	DRN. S/D CHK. AC	DRAWING SCALE AS SHOWN ON PLAN SEAL
Center for Ecosystem Mgmt & Restoration Conceptual Designs For TWO STONYBROOK CREEK SALMONID MIGRATION BARRIER REMOVAL PROJECTS CIVIL		
POST MILE 8.75 PLAN VIEW		
JOB NUMBER 04101601 SHEET 7 OF 9		
C-6.0		
REVISIONS DATE APPROVED		SYM. DESCRIPTION



STONYBROOK CREEK THALWEG PROFILE AT POST MILE 8.75

SCALE: SEE SCALE BAR



NO.	DATE	DESCRIPTION	BY	APPROVED

WINZLER & KELLY CONSULTING ENGINEERS
 633 THIRD STREET EUREKA, CA 95501-0417
 PH (707) 443-8326 FAX (707) 444-8330

Michael Love & Associates
 Hydrologic Solutions
 PO Box 4477 Arcata, CA 95518 (707) #6-8938

DES. SA/ML	DRN. S/D	CHK. AC
SUPV. SA		

DRAWING SCALE: AS SHOWN ON PLAN



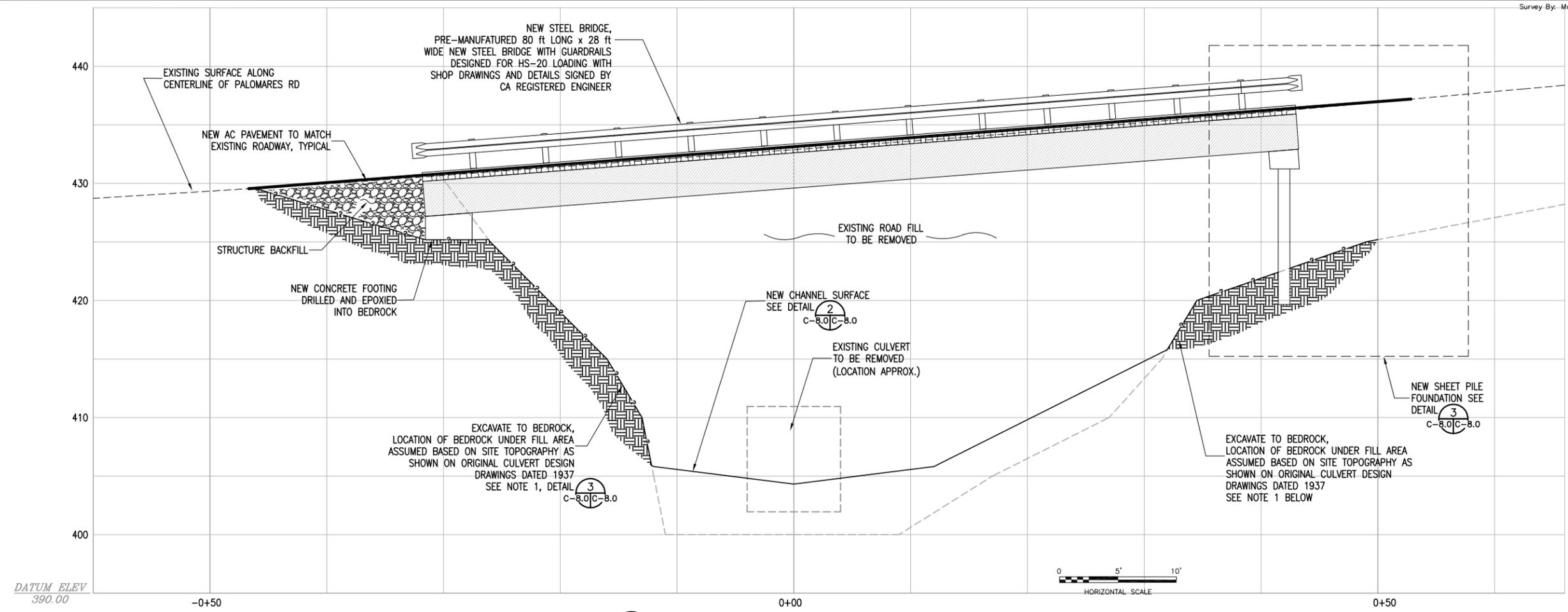
Center for Ecosystem Mgmt & Restoration
 Conceptual Designs For TWO STONYBROOK CREEK SALMONID MIGRATION BARRIER REMOVAL PROJECTS

CIVIL

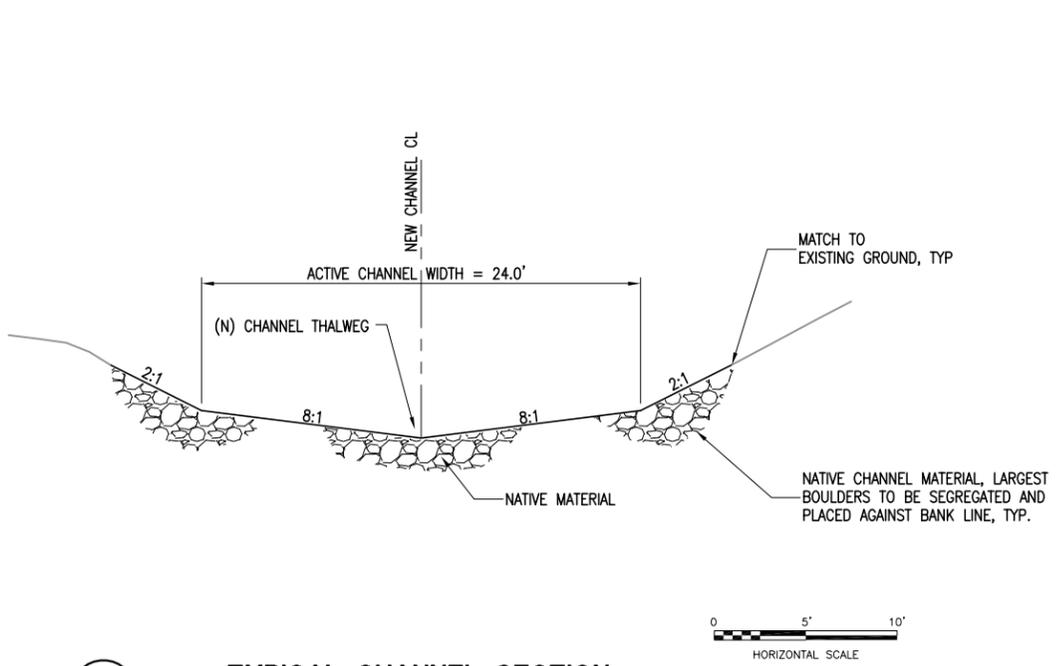
POST MILE 8.75 PROFILE

JOB NUMBER	04101601
SHEET	8 OF 9
C-7.0	

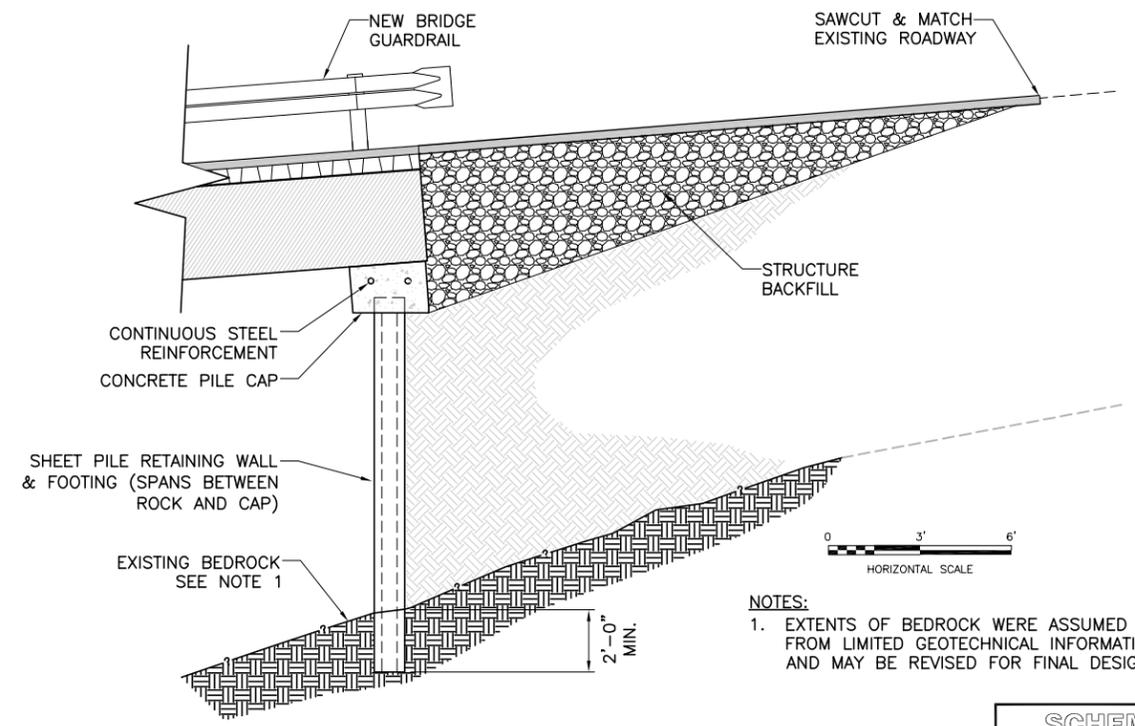
SCHEMATIC SUBMITTAL
NOT FOR CONSTRUCTION
OCTOBER 2005



1 TYPICAL SECTION AT CULVERT
C-06|C-08 SCALE: SEE SCALE BAR



2 TYPICAL CHANNEL SECTION
C-8.0|C-8.0 SCALE: SEE SCALE BAR



3 SHEET PILE FOUNDATION
C-8.0|C-8.0 SCALE: SEE SCALE BAR

SCHEMATIC SUBMITTAL
NOT FOR CONSTRUCTION
OCTOBER 2005

DES.	SA/ML	DRN	S/D	DATE
SUPV	SA	CHK	AC	APPROVED
DRAWING SCALE: AS SHOWN ON PLAN				REVISIONS
Center for Ecosystem Mgmt & Restoration Conceptual Designs For TWO STONYBROOK CREEK SALMONID MIGRATION BARRIER REMOVAL PROJECTS CIVIL POST MILE 8.75 SECTION				
JOB NUMBER 04101601 SHEET 9 OF 9 C-8.0				
WINZLER & KELLY CONSULTING ENGINEERS 633 THIRD STREET EUREKA, CA 95501-0417 PH (707) 443-8326 FAX (707) 444-8330 SUBCONSULTANT Michael Love & Associates Hydrologic Solutions PO Box 4477 Arcata, CA 95518 (707) #6-8938				

Appendix B
Preliminary Foundation Investigation

PRELIMINARY FOUNDATION INVESTIGATION
Stonybrook Creek Migration Barrier Removal Projects
Palomares Road M.P. 8.75 and M.P. 8.60

Alameda County, California



3265 Fortune Court ■ Auburn, CA 95602-7847
(530) 887-1494 ■ Fax: (530) 887-1495



2437 Front St. ■ West Sacramento, CA 95691
(916) 375-8706 ■ Fax: (916) 375-8709

Geotechnical/Geo-Environmental/Materials Engineering and Forensics ■ Construction Management and Inspections
BCI File #562.1
March 28, 2005

Mr. Steve Allen
Winzler & Kelly, Consulting Engineers
633 3rd Street
Eureka, CA 95501-0417

Subject: **Preliminary Foundation Investigation**
Stonybrook Creek Fish Passage Projects
Palomares Road M.P. 8.75 and M.P. 8.60
Alameda County, California

Dear Mr. Allen:

Blackburn Consulting, Inc. (BCI) prepared this Preliminary Foundation Investigation report for the subject Migration Barrier Removal Projects along Stonybrook Creek in accordance with our agreement dated May 28, 2004.

Please call if you have questions on this report or require additional information. We appreciate this opportunity to be of service.

Sincerely,

BLACKBURN CONSULTING, INC.

Rick Sowers, P.E., C.E.G.
Senior Project Manager

Reviewed by:

Patrick Fischer, C.E.G.
Principal

Distribution: Client (4)



**PRELIMINARY FOUNDATION INVESTIGATION
STONYBROOK CREEK MIGRATION BARRIER REMOVAL PROJECTS
PALOMARES ROAD @ PM 8.75, 8.60**

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SEISMIC SETTING	2
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APPENDIX

- Boring Logs
- Laboratory Test Results
- Weathering Descriptors

INTRODUCTION

BCI prepared this preliminary foundation investigation for two migration barrier removal projects along Stonybrook Creek. This report provides preliminary geotechnical recommendations for design and construction of new structure foundations at each channel crossing. Our services are based on design for conceptual replacement structures as developed by Winzler & Kelly. Elevations used in this report are based on site topography developed by Marvin Smitherman.

We prepared this report for Winzler & Kelly, project engineer. Do not use or rely upon this report for different locations or improvements without the written consent of BCI. Additional investigation may be required for final design, depending on final structure type, layout and channel profile.

SCOPE OF SERVICES

To prepare this report, BCI:

- Conducted a site review, marked boring locations, notified USA and obtained an Alameda County encroachment permit.
- Reviewed published geologic and topographic mapping of the sites.
- Performed surface geologic reconnaissance of the site vicinities.
- Drilled and sampled two test borings at each project location.
- Performed laboratory testing and geotechnical engineering analysis in support of the recommendations contained herein.

PROJECT LOCATION AND DESCRIPTION

Project Locations

The sites are located on Palomares Road about one mile north of SR 84 (Niles Canyon Road) in Alameda County, California. Palomares Road generally parallels Stonybrook Creek along the base of Stonybrook Canyon and crosses the creek at several locations. The crossing at PM 8.75 is approximately 800 ft south of the PM 8.60 crossing. We show the project locations and site topography on Figure 1.

Site and Project Descriptions

M.P. 8.75

This crossing contains an existing 8 ft wide x 9 ft high, 89 ft long, concrete box culvert. The culvert invert is about 25-30 ft below road grade, with about 15-20 ft of earth embankment above the culvert and exterior fill slopes at a gradient of about 2H:1V. The creek alignment bends sharply (>90°) near both the inlet and outlet, and a large aggradation of boulders has accumulated near the inlet (resulting in a 10+ ft drop in channel profile at that location).

Upstream and downstream of the crossing, the Palomares Road alignment is generally parallel to the creek along a steep (6-8%) southwest gradient.

We understand this culvert will be replaced with either a pre-fabricated concrete arch or clear-span bridge. We expect a minimum 20 ft channel span to provide adequate width for bedload transport. The channel profile may be re-graded to eliminate the steep inlet drop and provide a uniform gradient for fish passage.

M.P. 8.60

The existing crossing is a 20-25 ft long concrete slab bridge over a trapezoidal-shaped channel with stone masonry side-slopes and a rough concrete floor. Base of channel is about 9 ft wide; top of channel is about 15 ft wide; and length of the trapezoidal channel about 77 ft. Channel erosion at the outlet has created a 5 ft drop in profile grade.

As at the M.P. 8.75 crossing, we understand this crossing will be replaced with either a pre-fabricated concrete arch or clear-span bridge. We expect a minimum 20 ft channel span to provide adequate width for bedload transport. The channel profile may be re-graded to eliminate the perched outlet and provide a uniform gradient for fish passage.

GEOLOGIC SETTING

Our site work and published geologic literature indicate both sites to be underlain by Cretaceous sedimentary rocks of the Panoche Formation. The Geologic Map of the San Francisco-San Jose Quadrangle (Wagner, et al., 1990) describes these rocks as marine sandstone, shale, siltstone and conglomerate. Mapping by Graymer, et al., (USGS Open File Map 94-132, 1994), shows the sites to be underlain by distinctly bedded and well lithified Cretaceous sandstone and shale. Rock bedding is shown to strike uniformly northwesterly and dip southwest at 70°. We attach a site geologic map as Figure 2.

We observed rock consistent with the above description at both sites, as well as throughout the canyon in this vicinity. The canyon slopes are very steep (gradients up to 1:1 and steeper) and expose mostly bedded sandstone. The sandstone is moderately to slightly weathered and hard, with generally thick beds (greater than one foot). The sandstone is interlayered with thin (less than one inch) laminated and intensely fractured (“friable”) siltstone/shale beds. Rock bedding at both sites strikes uniformly northwest and dips generally 60-80° to the southwest.

SEISMIC SETTING

Our review of published geologic mapping and preliminary site review did not reveal the presence of Late Quaternary (displacement within the last 700,000 years) or younger faults within or adjacent to the project site, and the sites are not within or adjacent to an Alquist-Priolo Earthquake Fault Zone for fault rupture hazard.

Based on published geologic maps and the State of California, Department of Transportation, California Seismic Hazard Map (1996), the closest recognized Late Quaternary or younger faults are the following:

1. Calaveras-Paicines-San Benito Fault, located approximately 2.8 miles (4.5 km) northeast of the site.
2. Verona-Williams Fault, located approximately 3.0 miles (4.8 km) northeast of the site.
3. Hayward Fault, located approximately 3.4 miles (5.5 km) southeast of the site.

The controlling fault for design is the Calaveras-Paicines-San Benito Fault, a strike-slip style fault with an estimated maximum magnitude of 7.5. The horizontal Peak Bedrock Acceleration (PBA) at the site is 0.55g based on the California Seismic Hazard Map. Caltrans' Division of Geotechnical Services indicates the PBA must be rounded up to the nearest tenth (0.6g) for spectra construction. Based on our boring data, we classify the site soil profile as Type C (based on foundations established in weathered rock).

For seismic design, use the 0.6g peak horizontal rock acceleration curve from Figure B.5 (Soil Profile Type C for a Magnitude of 7.5 ± 0.25) of the Caltrans Seismic Design Criteria (2004, Version 1.3).

SUBSURFACE CONDITIONS

To characterize the subsurface soil and rock conditions, BCI observed and logged two test borings at each site, drilled to a maximum depth of 29 ft. The borings were advanced using hollow stem auger and, in rock, by means of wireline coring. We obtained drive-samples from soil and highly weathered rock with 2.0 inch OD "standard penetration" and 3.0 inch OD "California Modified" samplers driven with standard 350 ft-lb striking force (per ASTM D1586). Samples of less weathered underlying rock were recovered by NQ core and retained in core boxes for reference.

The boring locations are shown on Figures 3 and 4. Detailed logs are included in the Appendix. The degree of weathering and hardness noted on the logs are keyed to the descriptors included in the Appendix.

M.P. 8.75 Site

The test borings at the M.P. 8.75 site encountered loose to medium dense, silty sand and sandy silt, with scattered sandstone fragments, to depth 27 ft in B-1 (southeast abutment, to elev. 405 ft) and depth 20 ft in B-2 (northwest abutment, to elev. 412 ft). We interpret these materials as culvert backfill and young colluvium/alluvium. These soils are unconsolidated, variable in strength, and subject to erosion where exposed.

We encountered bedrock below the surface soils, described as slightly to moderately weathered, moderately hard, thickly to thinly bedded sandstone, with interbedded, moderately weathered, soft, laminated siltstone. Bedding planes observed in the cores typically dip about 60-70° from

horizontal. Core recovery ranged from 30-100%, with RQD¹ in the range of 20-40% (reflecting the variably weathered and bedded nature of the rock).

M.P. 8.60 Site

The test borings at the M.P. 8.60 site encountered medium dense, sandy silt and stiff, sandy clay with scattered sandstone fragments to depth 14 ft in B-3 (southeast abutment, to elev. 486 ft) and depth 4 ft in B-4 (northwest abutment, to elev. 490 ft). We interpret these materials as fill and young colluvium/alluvium, with variable strength and subject to erosion where exposed.

We encountered sandstone bedrock underlying the surficial soils. The rock is described as intensely to slightly weathered, moderately hard, sandstone. The rock at this site was drillable with power auger equipment and no rock cores were recovered.

GROUNDWATER

The augered portions of the test borings were dry during drilling (June, 2004). We expect that shallow groundwater at both sites may be seasonally “perched” over the rock unit at elevations slightly above channel bottom. Groundwater within the underlying rock is likely restricted to zones of intense weathering and within layers of laminated bedding.

LABORATORY TESTS

We performed the following laboratory tests on representative soil samples from the test borings:

- Soil Gradation (per ASTM D 422)
- Moisture/Density (per ASTM D-2216, D-2937)
- Soil Corrosivity (pH, Resistivity, Sulfates/Chlorides)

The gradation tests indicate the surface soil to be silty sand with gravel with 29% passing 200-mesh sieve (“SM” per Unified Soil Classification). In-place moisture contents range from 6-16%, and dry densities from 103-122 pcf.

Results of our corrosivity testing on a representative sample from B-3 (P.M. 8.60 Site) are as follows:

pH:	7.4
Min. Resistivity:	2250 ohm-cm
Chloride:	13.3 ppm
Sulfate:	61.9 ppm

¹ RQD = Rock Quality Designation, defined as the sum of length of solid core pieces greater than 4 inches long divided by the total length of core run.

CONCLUSIONS AND RECOMMENDATIONS

We recommend new structure support at both sites to be achieved within intact rock underlying the surficial soil unit. Based on the boring data, we expect the top of rock in the near vicinity of both existing culverts to be at or slightly above channel bottom, and to slope up in directions away from the channel. In general, the upper portion of the rock is intensely weathered and relatively soft, especially at levels above channel bottom, and becomes less weathered and harder with depth.

Construction backslopes will need to be reviewed, based on the selected structure type, length, depth to rock and construction sequencing. For preliminary design, use 1.5:1 (H:V) gradient within fill material and 1:1 gradient within rock.

Structure Foundations – Bridge

For new bridge foundations established within existing fill, we recommend steel H-section piling penetrating the underlying sandstone. For new foundations established within rock (i.e., longer bridges with abutment lines located away from the channel), spread footings or cast-in-drilled-hole (CIDH) piling may be suitable, depending on the depth of fill and shape of the rock surface at those locations. Further exploration may be required for these alternatives.

Spread footing foundations established within fill or alluvial soils above the rock are not recommended due to variable bearing conditions, settlement potential, and security with respect to long-term bank erosion (and possible lower stream profile). Driven concrete piles are also not recommended due to the potential for shallow rock and limited penetration. The suitability of CIDH piling will depend on the depth of fill at the abutment locations, as these excavations may experience significant caving if drilled through the existing fill and/or alluvial soils.

For steel H-piles, we recommend a minimum of HP 10"x57 lb sections to enable pile advancement through the coarse alluvium and achieving a minimum 5 ft penetration into the underlying rock unit. For preliminary design, assign allowable design (service) loading to 45 tons per pile for these piles; pile loading to 70 tons per pile can be achieved with greater penetration into the rock unit.

Design tip elevations for the piles will depend on structure type and length. We can provide tip elevations based on further bridge details, when available. For preliminary design of short span bridges near the existing culverts, assume pile tips to extend 5 ft below channel bottom at each site (to approximately elevation 400 at M.P. 8.75, and elevation 480 at M.P. 8.60).

Structure Foundations – Arch Culverts

Footing support is available at both sites for open-bottom arch culverts with bases established near existing channel bottoms. For preliminary design, we consider 20 ft wide open-bottom culverts (e.g., pre-cast segmental units placed on cast-in-place concrete strip footings), centered at or near the existing culverts. Support for these structures is available on reinforced concrete strip footings of minimum width 3 ft, established about 2 ft below existing invert elevation and within intact rock, as identified by a BCI representative upon construction exposure.

Use an allowable bearing capacity of 5 tsf, net at groundline, for footings with minimum 3 ft width. Higher bearing pressures are available with increased rock penetration and/or positive field review by this office.

For preliminary design, and assuming footing lines near existing culvert inverts, use bottom of footing grades as shown in Tables 1 and 2. In general, we expect the rock surface to be higher as the footing lines move away from the channel, and the elevations provided in Tables 1 and 2 must be reviewed, and modified as necessary, once the structure types and locations are established.

TABLE 1

P.M. 8.75	
	Plan Footing Grade (Elev.- Ft.)
Inlet	403
Outlet	396

TABLE 2

P.M. 8.60	
	Plan Footing Grade (Elev.- Ft.)
Inlet	485
Outlet	483

We expect rock excavation to be locally difficult but achievable by use of air tools without blasting. Rock blasting would likely disrupt/degrade integrity of the surrounding rock and should be avoided. If the rock surface is variable along the footing lines, we consider the use of plain concrete appropriate to provide positive contact between the footing elements and suitable rock, as needed.

Use a coefficient of friction to resist sliding of 0.40 between the footing and weathered rock. Passive pressures in the rock unit can be based on an equivalent fluid weight of 500 pcf. Use passive pressures of 300 pcf (EFP) for soil above the rock. For additional security against sliding (if necessary), or if hard rock precludes reasonable rock excavation, doweling can be utilized to establish a positive connection between the footing and rock (e.g., #8 bars grouted in drilled holes extending 5±ft into rock).

Place footing concrete neat, without forming, against trimmed, intact bearing material in clean and dry excavations. Assuming dry season (low flow) construction, we expect de-watering to be achievable by means of diking/diversion of surface water and sump pumping.

The alluvial soils overlying the rock are subject to scour and bank erosion. If rock slope protection is placed at the inlet/outlet, or along the banks, construct in accordance with Caltrans Standard Plans. Depending on structure location, construction backslopes within the overlying fill may require slopes at gradients flatter than 1:1 for stability.

Culvert Corrosion

Based on our pH, sulfate and chloride testing, and Table 854.1A of the Caltrans Highway Design Manual, there are no restrictions on cementitious materials with respect to soil corrosivity. Table 3 presents metal corrugated pipe culvert material and minimum unprotected thicknesses for a 50-year maintenance free service life with respect to soil corrosivity. The recommendations are based on our pH and resistivity testing, and Table 854.3B of the CHDM.

Table 3

Recommended Metal Corrugated Pipe Culvert Material	Minimum 50-year Design Thickness
Galvanized Steel-Metal	2.0 mm
Aluminum	1.5 mm
Aluminized Steel	1.6 mm

The above minimum thicknesses do not take pipe abrasion resistance and overfill height into consideration.

RISK MANAGEMENT

Our experience and that of our profession clearly indicates that the risks of costly design, construction, and maintenance problems can be significantly lowered by retaining the geotechnical engineer of record to provide additional services during design and construction. For this project, BCI should be retained to:

- Update the preliminary foundation recommendations upon selection of a preferred design.
- Review and provide comments on the civil plans, foundation plans, and specifications prior to construction, especially with respect to foundation support away from the channels. Additional data may be required for some structure locations.
- Monitor construction to check and document our report assumptions. At a minimum, BCI should monitor site grading, footing excavations, pile driving and RSP key (if used).
- Update this report if design changes occur, 2 years or more lapses between this report and construction, and/or site conditions have changed.

If we are not retained to perform the above applicable services, we are not responsible for any other party's interpretation of our report, and subsequent addendums, letters, and discussions.

LIMITATIONS

BCI performed services in accordance with generally accepted geotechnical engineering principles and practices currently used in this area. We do not warranty our services.

BCI based this report on the current site conditions. We assumed the soil, rock and groundwater conditions observed in our borings are representative of the subsurface conditions on the site. Actual conditions between borings could be different. For culvert design, footing levels will vary depending on final structure locations, and the recommendations contained in this report are preliminary and conditioned on BCI's review of structure plans and the opportunity to modify the recommendations, as necessary. For bridge design, BCI will provide supplemental pile recommendations based on further design details.

Our scope was limited to support for new structure foundations and did not include evaluation of on-site hazardous materials, scour potential, abutment design or flooding. This study also did not include evaluation of approach roadway sections or future channel modifications.

Modern design and construction are complex, with many regulatory sources/restrictions, involved parties, construction alternatives, etc. It is common to experience changes and delays. The owner should set aside a reasonable contingency fund based on complexities and cost estimates to cover changes and delays.

Logs of our test borings are presented in the Appendix. The lines designating the interface between soil and rock types are approximate. The transition between soil/rock types may be abrupt or gradual. Our recommendations are based on the final logs, which represent our interpretation of the field logs and general knowledge of the site and geological conditions.

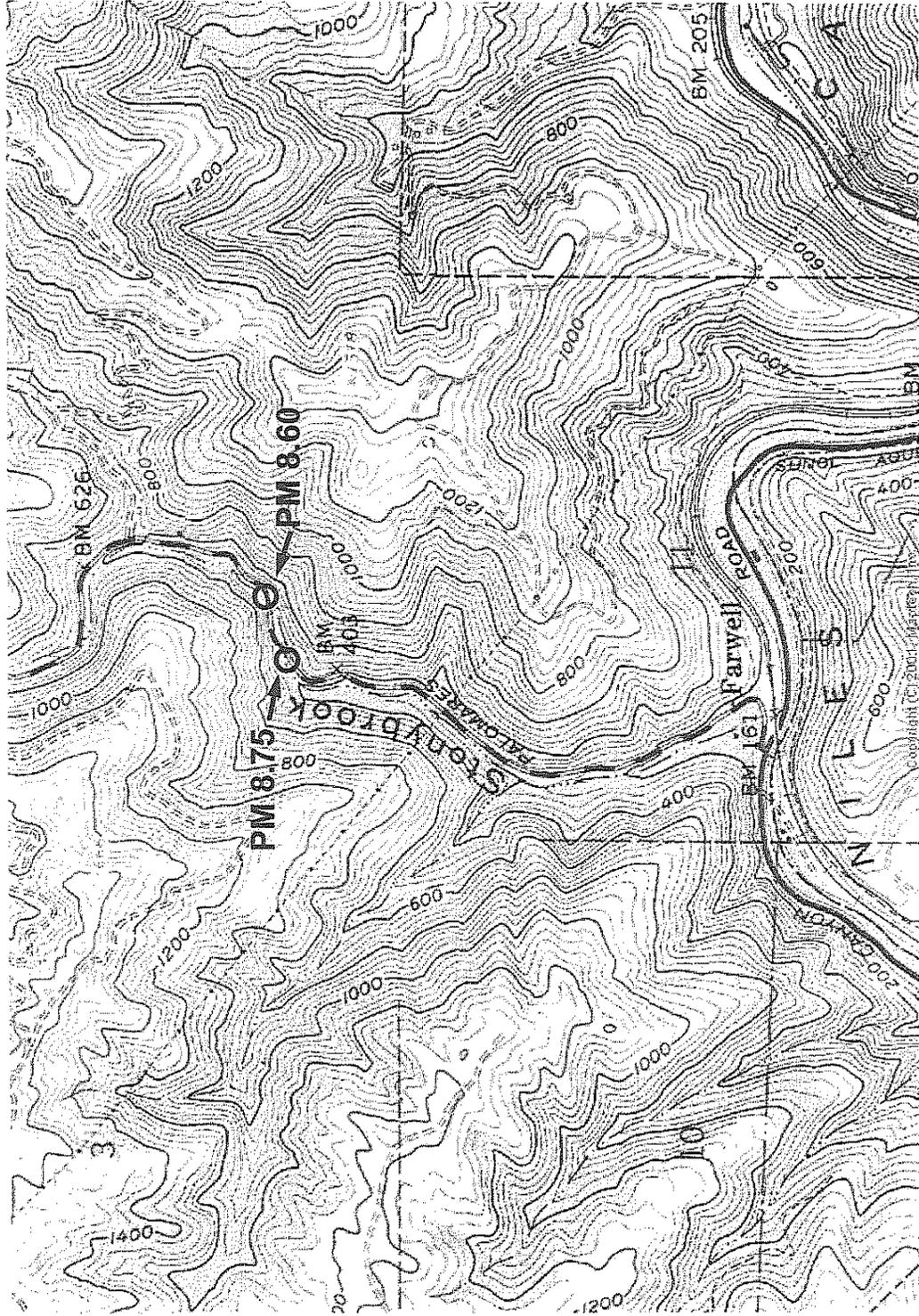
FIGURES

Figure 1 – Site Location and Topography

Figure 2 – Geologic Map

Figure 3 – Site Plan, PM 8.75

Figure 4 – Site Plan, PM 8.60



NTS

Adapted from Terrain Navigator, USGS Niles Quadrangle

Job No: 562.1

Date: March 2005

Figure 1

Site Location and Topography

Stonybrook Creek Fish Passage Projects, Palomares Road
Alameda County, California

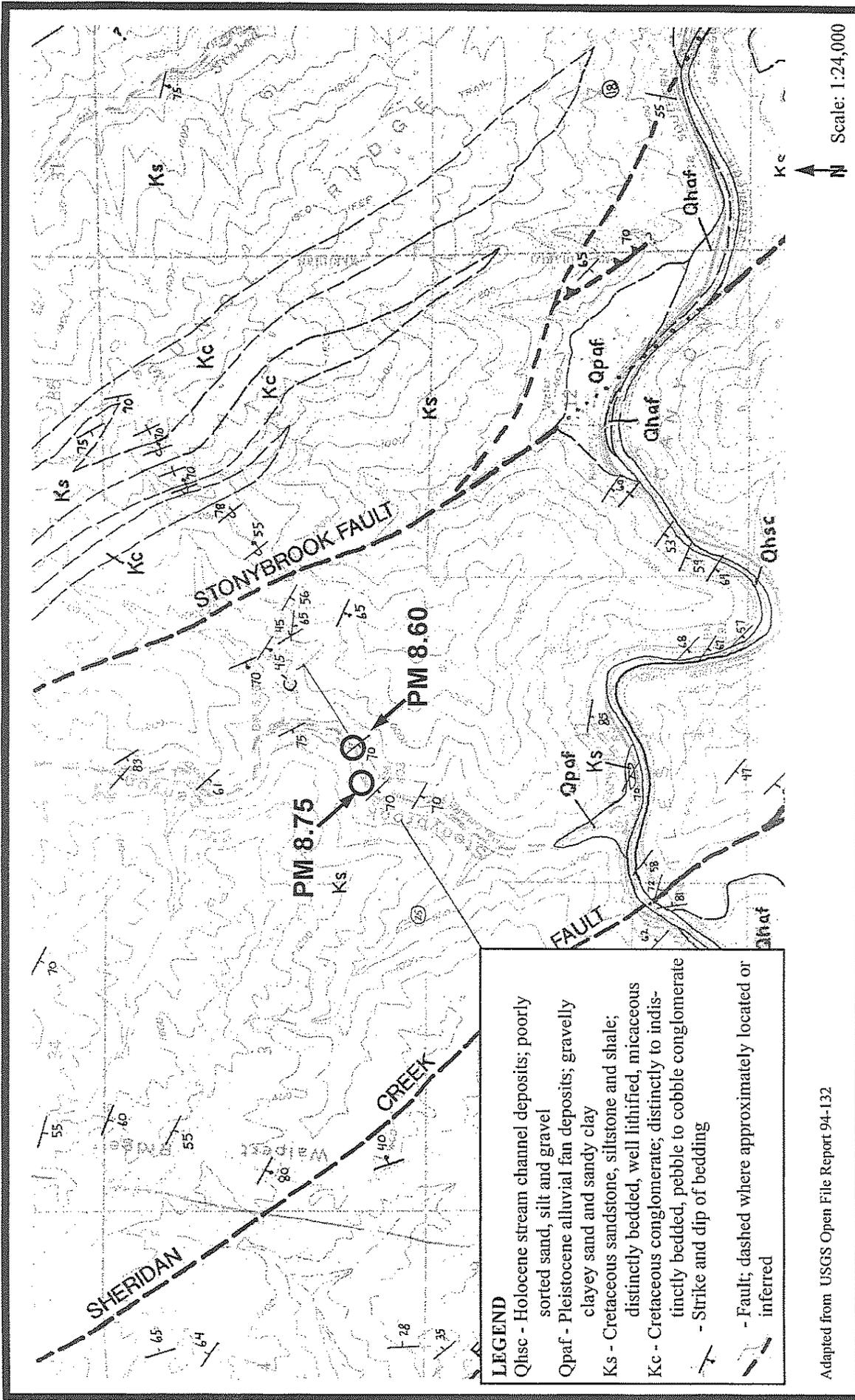
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(530) 887-1494
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blackburn
consulting

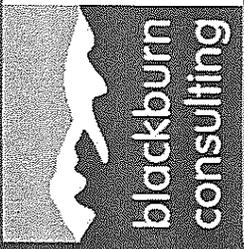


Job No: 562.1
 Date: March 2005
 Figure 2

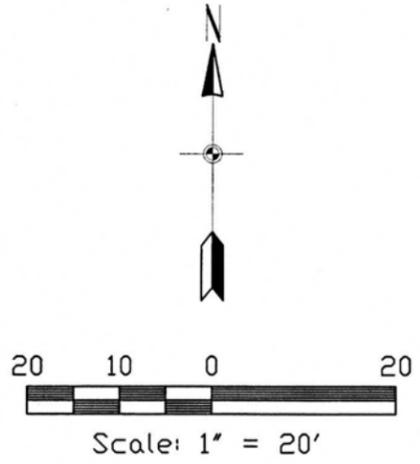
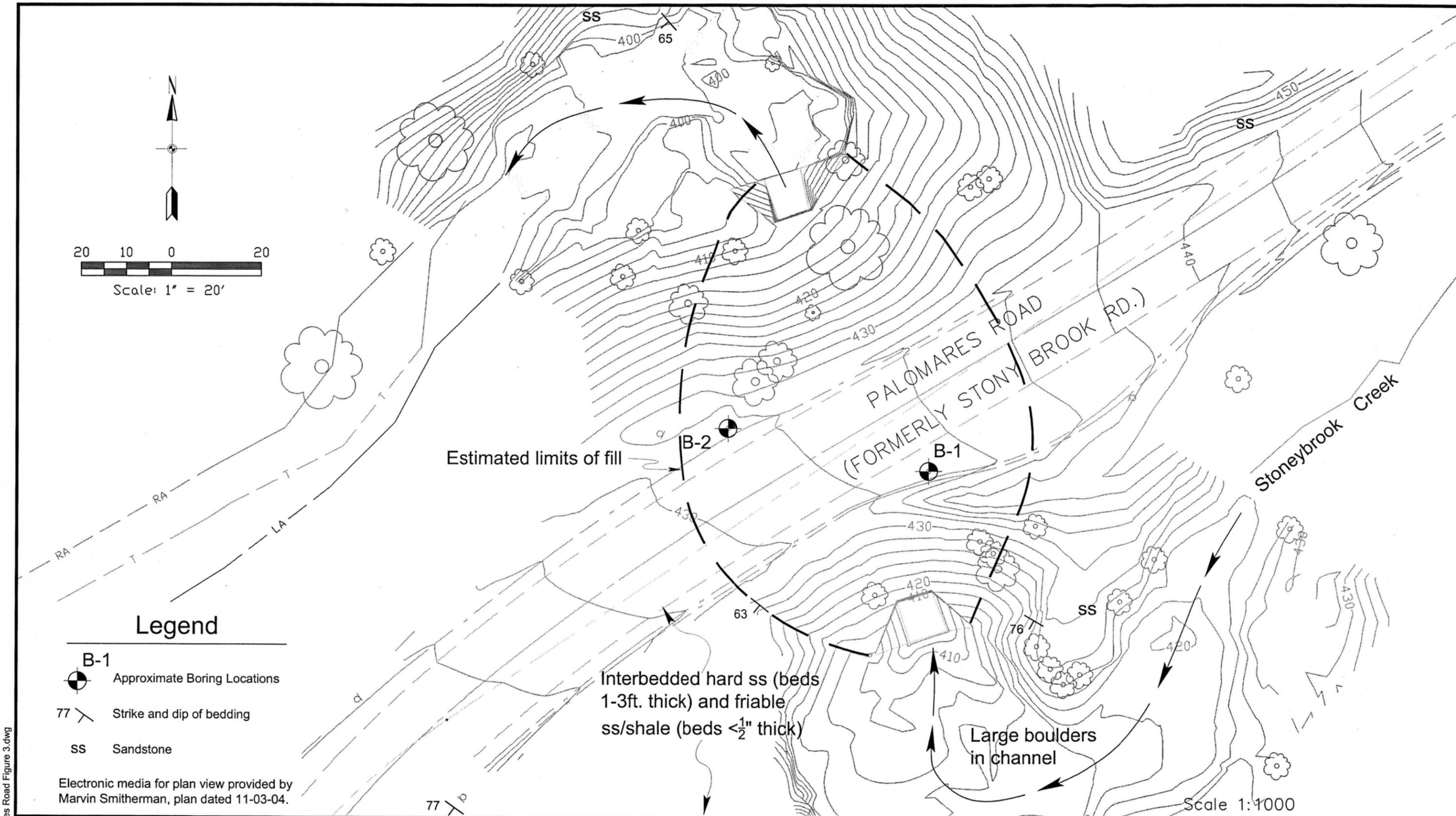
Geologic Map

Stonybrook Creek Fish Passage Projects, Palomares Road
 Alameda County, California

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 Auburn, CA 95602
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 (530) 887-1495 Fax
 E-mail: bcstaff@blackburnconsulting.com



Adapted from USGS Open File Report 94-132



Legend

-  B-1 Approximate Boring Locations
-  77 Strike and dip of bedding
-  SS Sandstone

Electronic media for plan view provided by Marvin Smitherman, plan dated 11-03-04.

Interbedded hard ss (beds 1-3ft. thick) and friable ss/shale (beds $< \frac{1}{2}$ " thick)

Large boulders in channel

Scale 1:1000

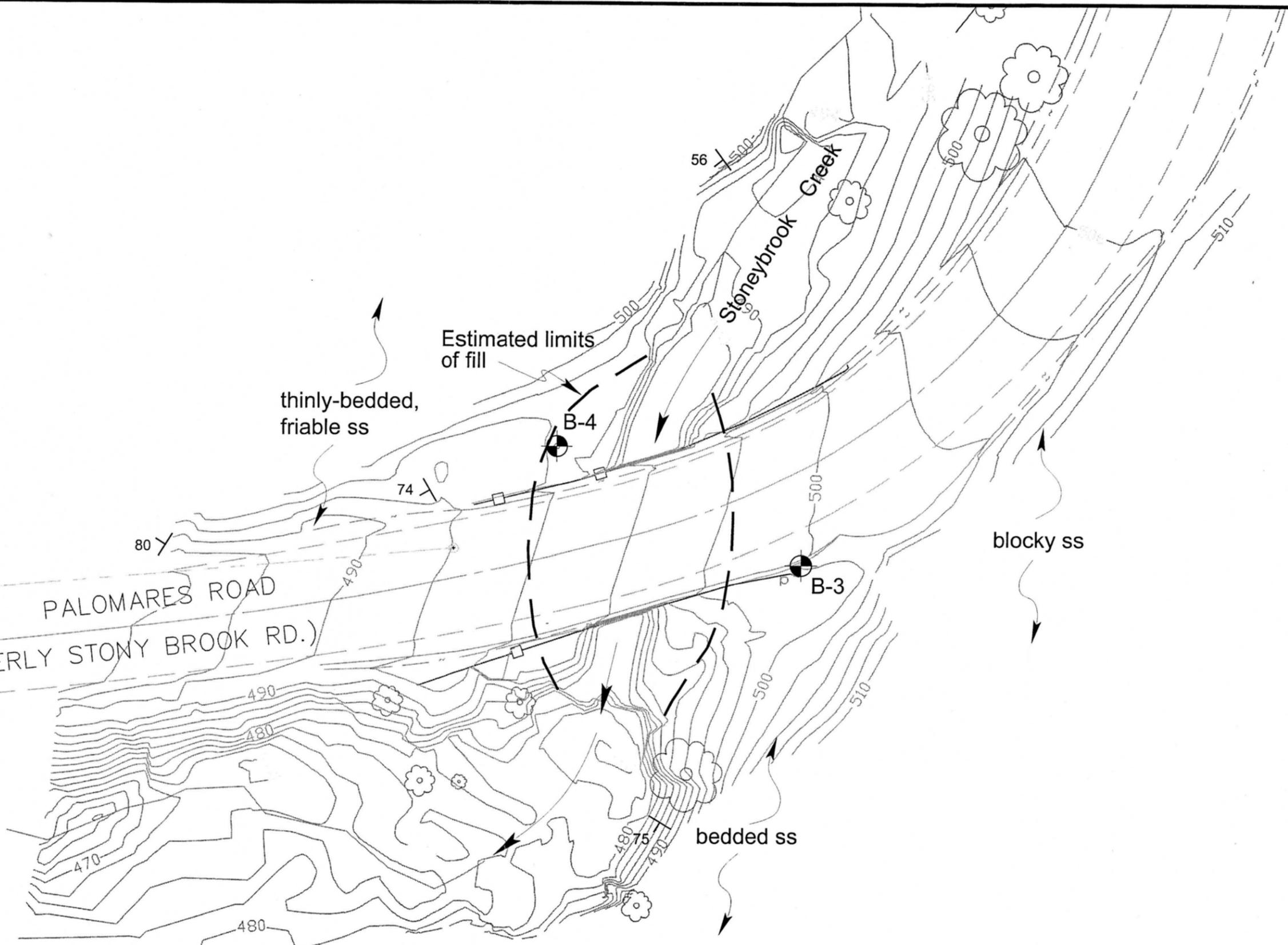
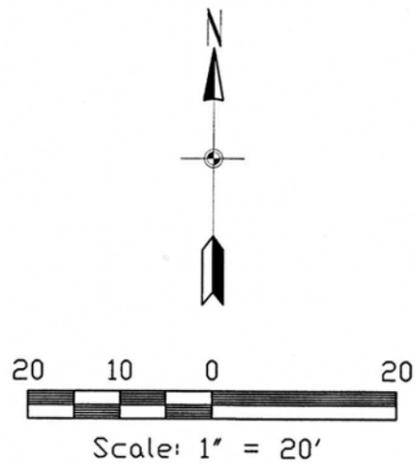
03-23-05 562.1 Palomares Road Figure 3.dwg



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SITE PLAN
Palomares Road at PM 8.75

File No. 562.1
Mar. 2005
Figure 3



Legend

- B-1 Approximate Boring Locations
- 77 Strike and dip of bedding
- SS Sandstone

Electronic media for plan view provided by Marvin Smitherman, plan dated 11-03-04.

03-23-05 562.1 Palomares Road Figure 4.dwg



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SITE PLAN
Palomares Road at PM 8.60

File No. 562.1
Mar. 2005
Figure 4

APPENDIX

Boring Logs

Laboratory Test Results

Weathering Descriptors

LOG OF TEST BORINGS 1



FILE NO.: 562.1
 PROJECT: Stonybrook Creek
 LOCATION: Alameda County, California
 CLIENT: Winzler & Kelly

DRILLING DATE: 6/1/04
 DRILLING METHOD: 6" HSA/NQ Core
 LOGGED BY: RDS
 CHECKED BY: PFF

ELEVATION: 433.0 ft
 DATUM: Wiltzer & Kelly
 WATER DEPTH: dry
 READING TAKEN:

FIELD					GRAPHIC LOG	DESCRIPTION	LABORATORY					
DEPTH (FEET)	SAMPLE	SAMPLE NO.	N-VALUE	POCKET PEN. (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	DIRECT SHEAR C (PSF)	DIRECT SHEAR ϕ ANGLE
5	X	1	19			Silty sand (SM), medium dense, light brown, with subangular rock fragments, non-plastic, dry. (Fill and Slope Colluvium)						
10	X	2	46				122.4	6.3				
15	X	3	10									
20	X	4	23				114.6	7.0				
25	X	5	16									
30	Run A Run B					Sandstone, light gray, moderately to slightly weathered, moderately hard, thinly bedded with interbeds of soft/laminated siltstone. Run A: 100% rec; 33% RQD Run B: 30% rec; 20% RQD						

LOG OF BOREHOLE STONYBROOK.GPJ BLACKBRN.GDT 3/23/05

No free groundwater encountered.
 Boring backfilled with native cuttings 6-1-04.

LOG OF TEST BORINGS 2



FILE NO.: 562.1
 PROJECT: Stonybrook Creek
 LOCATION: Alameda County, California
 CLIENT: Winzler & Kelly

DRILLING DATE: 6/1/04
 DRILLING METHOD: 6" HSA/NQ Core
 LOGGED BY: RDS
 CHECKED BY: PFF

ELEVATION: 431.5 ft
 DATUM: Witzler & Kelly
 WATER DEPTH: dry
 READING TAKEN:

FIELD						DESCRIPTION	LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	N-VALUE	POCKET PEN. (TSF)	GRAPHIC LOG		DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	DIRECT SHEAR C (PSF)	DIRECT SHEAR ϕ ANGLE	ADDITIONAL TESTS
5	X	1	24		[Dotted pattern]	Silty sand (SM), loose to medium dense, light brown, with subangular rock fragments, non-plastic, dry. (Fill and Slope Colluvium)							
10	X	2	6		[Dotted pattern]								
15	X	3	30		[Dotted pattern]								
20	X	4	50/0.2		[Diagonal hatching]	Sandstone, light gray, intensely to moderately weathered, soft.							
25	X	5 Run A	50/0.1		[Diagonal hatching]	Sandstone, light gray, slightly weathered, moderately hard, thickly bedded. Run A: 95% rec; 41% RQD							
No free groundwater encountered. Boring backfilled with native cuttings 6-1-04.													

LOG OF BOREHOLE STONYBROOK.GPJ BLACKBURN.CDT 3/23/05

LOG OF TEST BORINGS 3

FILE NO.: 562.1
 PROJECT: Stonybrook Creek
 LOCATION: Alameda County, California
 CLIENT: Winzler & Kelly

DRILLING DATE: 6/2/04
 DRILLING METHOD: 6" HSA
 LOGGED BY: RDS
 CHECKED BY: PFF

ELEVATION: 499.7 ft
 DATUM: Wiltzler & Kelly
 WATER DEPTH: dry
 READING TAKEN:



FIELD					GRAPHIC LOG	DESCRIPTION	LABORATORY					
DEPTH (FEET)	SAMPLE	SAMPLE NO.	N-VALUE	POCKET PEN. (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	DIRECT SHEAR C (PSF)	DIRECT SHEAR φ ANGLE
Bag A												
5	✕	1	11		[Symbol]	Silty sand (SM), medium dense, light brown, with subangular rock fragments, low plasticity, dry.						Grad; Corros.
10	✕	2	15		[Symbol]	Sandy clay (CL), stiff, mottled dark brown and black, with angular sandstone fragments, dry, medium plasticity.	102.7	16.6				
15	✕	3	50		[Symbol]	Sandstone/siltstone, dark brown-gray, decomposed, soft, moist.						
20	✕	4	73		[Symbol]	Sandstone, light gray, intensely weathered, moderately hard, becoming moderately to slightly weathered with depth, dry. Essential auger refusal at depth 29 ft.						
25	✕	5	50/0.4		[Symbol]							
						No free groundwater encountered. Boring backfilled with native cuttings 6-2-04.						

LOG OF BOREHOLE STONYBROOK.GPJ BLACKBURN.GDT 3/23/05

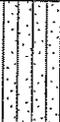
LOG OF TEST BORINGS 4

FILE NO.: 562.1
 PROJECT: Stonybrook Creek
 LOCATION: Alameda County, California
 CLIENT: Winzler & Kelly

DRILLING DATE: 6/2/04
 DRILLING METHOD: 6" HSA
 LOGGED BY: RDS
 CHECKED BY: PFF

ELEVATION: 494.1 ft
 DATUM: Wilzler & Kelly
 WATER DEPTH: dry
 READING TAKEN:



FIELD					GRAPHIC LOG	DESCRIPTION	LABORATORY					
DEPTH (FEET)	SAMPLE	SAMPLE NO.	N-VALUE	POCKET PEN. (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	DIRECT SHEAR C (PSF)	DIRECT SHEAR φ ANGLE
5						Sandy Silt (ML), medium dense, light brown, with sandstone fragments, low plasticity, dry. Fill (?)						
						Sandstone, tan to light gray, moderately weathered, moderately hard, dry. Essential auger refusal at depth 6 ft.						
						No free groundwater encountered. Boring backfilled with native cuttings 6-2-04.						

LOG OF BOREHOLE STONYBROOK.GPJ BLACKBRN.GDT 3/23/05

UNIFIED SOIL CLASSIFICATION (ASTM D 2487-98)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES	
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SCREEN	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS <5% FINES	Cu > 4 AND 1 < Cc < 3	GW	WELL-GRADED GRAVEL	
			Cu < 4 AND/OR 1 > Cc > 3	GP	POORLY-GRADED GRAVEL	
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR MH	GM	SILTY GRAVEL	
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL	
	SANDS <50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN SANDS <5% FINES	Cu > 6 AND 1 < Cc < 3	SW	WELL-GRADED SAND	
			Cu < 6 AND/OR 1 > Cc > 3	SP	POORLY-GRADED SAND	
		SANDS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR MH	SM	SILTY SAND	
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND	
FINE-GRAINED SOILS >50% PASSING NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT <50	INORGANIC	PI > 7 AND PLOTS > "A" LINE	CL	LOW-PLASTICITY CLAY	
			PI > 4 AND PLOTS < "A" LINE	ML	LOW-PLASTICITY SILT	
		ORGANIC	LL (oven dried)/LL (not dried) < 0.75	OL	ORGANIC CLAY OR SILT	
	SILTS AND CLAYS LIQUID LIMIT >50	INORGANIC	PI PLOTS > "A" LINE	CH	HIGH-PLASTICITY CLAY	
			PI PLOTS < "A" LINE	MH	HIGH-PLASTICITY SILT	
			ORGANIC	LL (oven dried)/LL (not dried) < 0.75	OH	ORGANIC CLAY OR SILT
	HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK COLOR, ORGANIC ODOR		PT	PEAT

NOTE: $Cu = D_{60}/D_{10}$
 $Cc = (D_{30})^2 / (D_{10} + D_{60})$

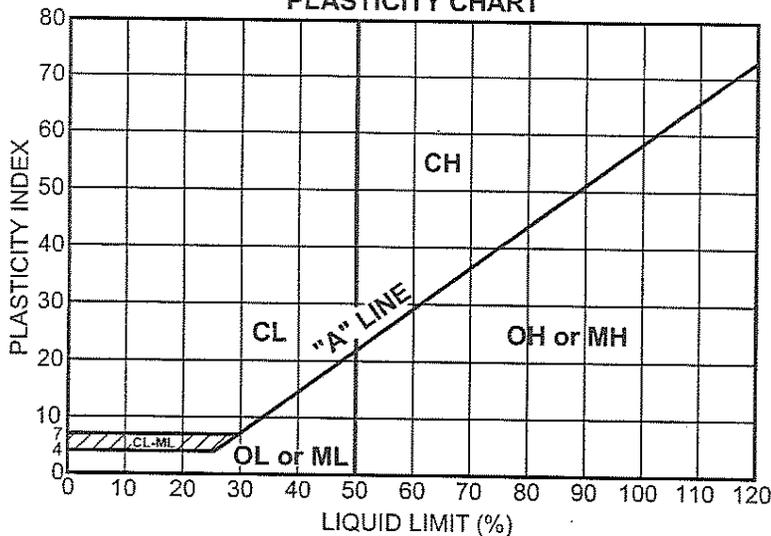
BLOW COUNT

THE NUMBER OF BLOWS OF A 140-POUND HAMMER FALLING 30" REQUIRED TO DRIVE THE SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE. THE NOTATION 50/4 INDICATES 4 INCHES OF PENETRATION ACHIEVED IN 50 BLOWS.

SAMPLE TYPES

- AUGER CUTTINGS
- SHELBY TUBE
- STANDARD PENETRATION (SPT)
- MODIFIED CALIFORNIA
- ROCK CORE

PLASTICITY CHART



ADDITIONAL TESTS

- CN - CONSOLIDATION
- CP - COMPACTION
- CT - CORROSIIVITY TESTING
- DS - DIRECT SHEAR
- PM - PERMEABILITY
- RV - R-VALUE
- SA - GRAIN SIZE ANALYSIS
- SW- SWELL TEST
- TV - TORVANE SHEAR
- UC - UNCONFINED COMPRESSION
- WA - WASH ANALYSIS

GROUND WATER LEVELS

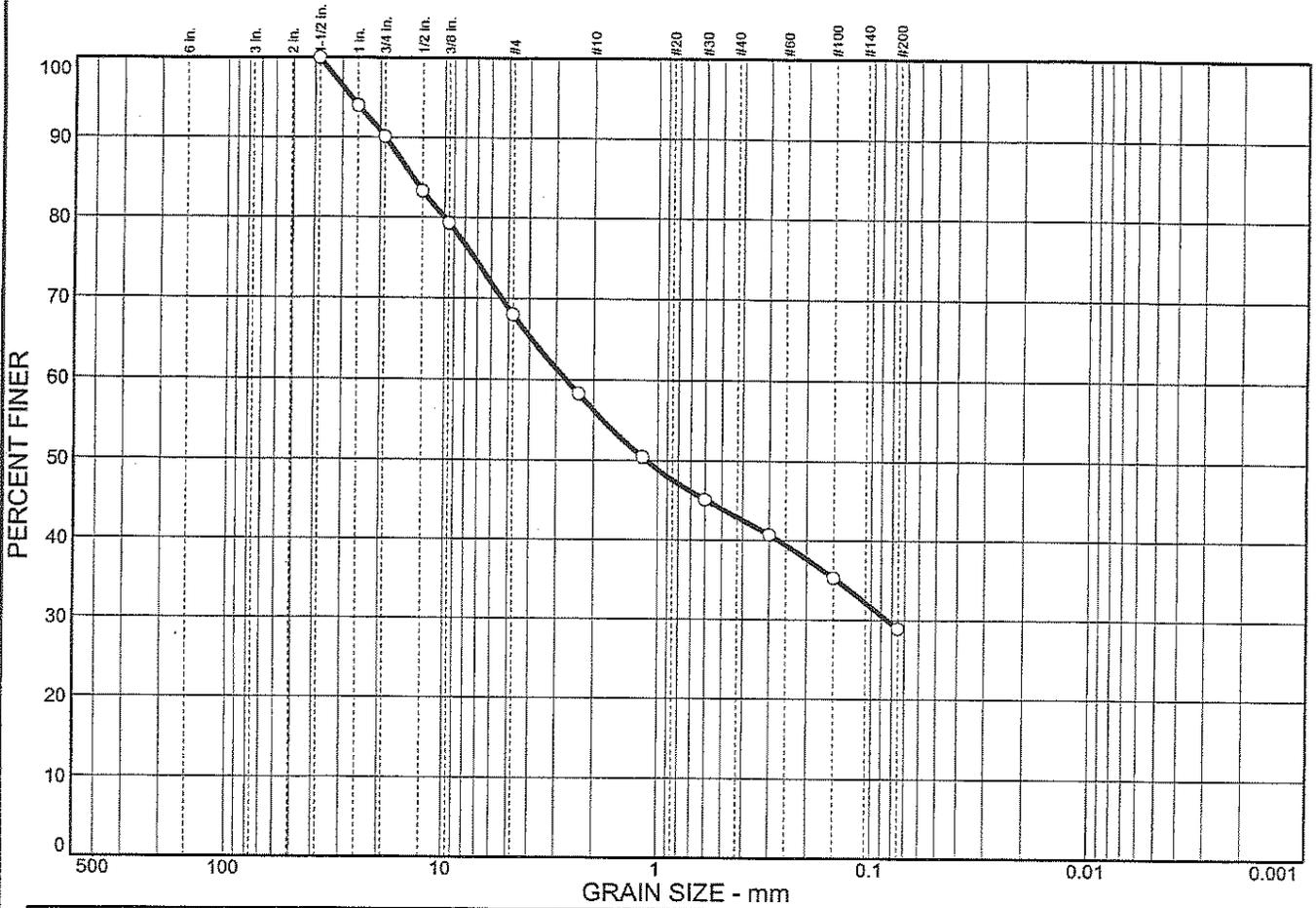
- WATER LEVEL AT TIME OF DRILLING
- LATER WATER LEVEL AFTER DRILLING



3265 Fortune Court
 Auburn, CA 95602
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 E-Mail: bcistaff@blackburnconsulting.com

LEGEND TO BORING LOGS AND SOIL DESCRIPTIONS

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	32.0	39.1	28.9	0.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5 in.	100.0		
1 in.	94.0		
.75 in.	90.1		
.50 in.	83.3		
.375 in.	79.3		
#4	68.0		
#8	58.3		
#16	50.4		
#30	45.1		
#50	40.7		
#100	35.3		
#200	28.9		

Soil Description

Dark grayish brown silty Sand with gravel (SM)

Atterberg Limits

PL= LL= PI=

Coefficients

D₈₅= 14.1 D₆₀= 2.70 D₅₀= 1.13
D₃₀= 0.0842 D₁₅= D₁₀=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

* (no specification provided)

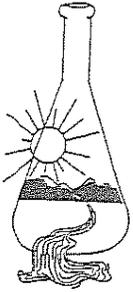
Sample No.: Bag A
 Location:

Source of Sample:

Date: 6-15-04
 Elev./Depth:

blackburn consulting

Client: Winzler & Kelly
 Project: Stonybrook Creek
 Project No: 562.1



Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 06/18/2004
Date Submitted 06/14/2004

RA

To: Craig Newport
Blackburn Consulting Inc.
3265 Fortune Ct.
Auburn, CA 95602

From: Gene Oliphant, Ph.D.
General Manager

The following is the report of analysis requested on SUN Order 42107.
Your purchase order number is .
Thank you for your business.

SUN #	Sample Describ	Sample #	Chloride as ppm Cl /Dry Wt.	Sulfate as ppm SO4 /Dry Wt.
82202	562.1\STONYBROOK CRK	BAG A	13.3	61.9

Methods: Sulfate-Cal Trans #417, Chloride-Cal Trans #422

WEATHERING DESCRIPTORS

Descriptors	Diagnostic features						General characteristics (strength, excavation, etc.) §
	Chemical weathering-Discoloration And/or oxidation		Fracture surfaces †	Mechanical weathering- Grain boundary conditions (disaggregation) primarily for granitics and some coarse- grained sediments	Texture and solutioning		
	Body of rock	No discoloration, not oxidized			Texture	Solutioning	
Fresh	No discoloration, not oxidized	No discoloration or oxidation	No separation, intact (light)	No change	No solutioning	Hammer rings when crystalline rocks are struck. Almost always rock excavation except for naturally weak or weakly cemented rocks such as siltstones or shales.	
Slightly weathered to fresh*	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull	Minor to complete discoloration or oxidation of most surfaces	No visible separation, intact (light)	Preserved	Minor leaching of some soluble minerals may be noted	Hammer rings when crystalline rocks are struck. Body of rock not weakened. With few exceptions, such as siltstones or shales, classified as rock excavation.	
Moderately to slightly weathered*	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty", feldspar crystals are "cloudy".	All fracture surfaces are discolored or oxidized	Partial separation of boundaries visible	Generally preserved	Soluble minerals may be mostly leached	Hammer does not ring when rock is struck. Body of rock is slightly weakened. Depending on fracturing, usually is rock excavation except in naturally weak rocks such as siltstones or shales.	
Moderately weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in situ disaggregation, see grain boundary conditions	All fracture surfaces are discolored or oxidized, surfaces friable	Partial separation, rock is friable; in semi-arid conditions granitics are disaggregated	Texture altered by chemical disintegration (hydration, argillation)	Leaching of soluble minerals may be complete	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to plans or weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened. Usually common excavation.	
Intensely to moderately weathered*	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay		Complete separation of grain boundaries (disaggregated)	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete		Can be granulated by hand. Always common excavation. Resistant minerals such as quartz may be present as "stringers" or "dikes."	

† Does not include directional weathering along shears or faults and their associated features. For example, a shear zone that carried weathering to great depths into a fresh rock mass would not require the rock mass to be classified as weathered.

§ These are generalizations and should not be used as diagnostic features for weathering or excavation classification. These characteristics vary to a large extent based on naturally weak materials or cementation and type of excavation.