FOR CONTRACT NO.: 02-3e8204

INFORMATION HANDOUT

MATERIALS INFORMATION

GEOTECHNICAL DESIGN REPORT

OPTIONAL DISPOSAL SITE

ROUTE: 02-TRI-299-36.6/36.8 pm

MATERIALS INFORMATION

GEOTECHNICAL DESIGN REPORT

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

M e m o r a n d u m

Flex your power!
Be energy efficient!

To: AL TRUJILLO
BRANCH CHIEF
DISTRICT 2 SAFETY DESIGN

Date: September 9, 2011

File: 02-TRI-299 PM36.6/36.8
02-3E8200
0200020166
North Fork Curve

Attn: Shaun Alexander
SAFETY DESIGN PROJECT ENGINEER

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Geotechnical Design Report for North Fork Curve Project

1. Introduction

Per your request we are providing this Geotechnical Design Report (GDR) for the proposed realignment of State Route 299 in central Trinity County, California. The realignment is proposed to be between the approximate post miles 36.6 to 36.8. The project site is located approximately 1 mile west of the town of Helena, California. It is our understanding that the proposed widening is to provide better site distance around the existing curve and widen existing paved shoulders within the project limits. The purpose of this report is to provide geotechnical recommendations for the project work proposed. Plate No. 1 presents a vicinity map showing the location of the project site. Plate No. 2 presents and aerial view of the proposed project limits.

This report includes a review of published data such as California Geologic Survey (CGS) publications and National Resource Conservation Service (NRCS) soil surveys, a review of previous site explorations, and a site reconnaissance.

Subsurface exploration in the form of seismic refraction surveys and slope stability was analyzed for this report. No laboratory testing was completed for this report. Project layout plan and typical cross-sections provided by the District were utilized to determine recommendations provided in this report.

This report is intended for use by the project roadway design engineer, construction personnel, bidders and contractors.

2. Existing Facilities and Proposed Improvements

At the time of our investigation, Highway 299 consisted of a two-lane roadway paved with asphalt concrete (AC). Highway 299 has two 11 foot wide traveled ways with variable 6 inch to 2 foot wide paved shoulders in this region. Unpaved shoulders including drainage ditches vary from approximately 2 feet to 15 feet throughout the project limits. No culverts were observed to cross beneath the highway within the project area. The Trinity River was observed to parallel the southern side of the highway varying from approximately 100 to 300 feet south and 30 to 80 feet below the existing highway. A +/- 300 foot long gabion or welded wire mesh wall and a +/- 500 foot long, "Can Wall" wall constructed of 36 inch diameter corrugated metal pipe are located on the south side of the existing highway within the project limits. Overhead and underground utilities were not observed in the area of the proposed widening. In addition, Pigeon Point Campground is located south of the existing highway in the western limits of the project.

As stated above, this project involves widening of the existing highway. Proposed improvements include cuts on the north side of the highway to allow widening of the paved shoulder widths throughout the project limits.

3. Pertinent Reports and Investigations

The following documents were used in preparing this report.

a) Western Regional Climate Data Center http://www.wrcc.dri.edu/, March 2011.
b) United State Department of Agriculture, National Conservation Service Web Soil Survey http://websoilsurvey.nrcs.usda.gov, "Shasta-Trinity National Forest Area, Parts of Humbolt, Siskiyou, Tehama and Trinity Counties, California", 2007/2008.
c) United States Geological Survey (USGS) 7.5 minute Topographic Map "Helena" dated 1982.
d) USGS, "Geologic Map of the Redding 1x2 Degree Quadrangle, Shasta, Tehama, Humboldt, and Trinity Counties, California", Fraticelli, Albers Irwin and Blake Jr., 1987.
e) DMG, Open File Report 2000-19 "A General Guide for Ultramafic Rocks in California - Areas More Likely to Contain Naturally Occurring Asbestos", 2000.
f) Caltrans DOT, "Asbestos Locations Map District 2", 2001.
g) Caltrans ARS Online v 1.0.2 http://10.160.173.178/shake2/shake_index2.php, March 2011.
h) "Geology of California" Second Edition, Robert M. Norris and Robert W. Webb, 1990, P. 128-132

4. Caltrans Document and Reports Reviewed

a) "District Preliminary Geotechnical Report for North Fork Curve Project", dated April 22, 2011.
b) "Seismic Refraction Survey, Route 299, North Fork Curve Correction", dated September 6, 2011
c) Cross-Sections "North Fork Curve Project", dated February 25, 2011
d) Layout Sheet "North Fork Curve Project", dated March 12, 2011

5. Physical Setting

5.1 Climate

Climate information was obtained from the Western Regional Climate Data Center at http://www.wrcc.dri.edu/. The nearest weather station is located in Big Bar, CA approximately ten miles west of the project. The Western Regional Climate Center includes monthly climate records for this location from 1943 through 2010. The average annual maximum temperature is 72°F, with the maximum for the warmest month, July, averaging 97°F. The average annual minimum temperature is 42°F, with the minimum for the coldest month, January, averaging 33°F. The average annual precipitation at Big Bar is 37 inches, with the majority falling between October and May. Minimal snowfall occurs between November and February, with an average annual snowfall of 6 inches with the month of January being the greatest contributor.

5.2 Topography and Drainage

According to the USGS quadrangle reviewed, the existing SR 299 roadway within the project area roughly trends east/west and parallels the Trinity River, located on the south side of the highway through a forested area. Widening for the new alignment is proposed to be completed on the north side of the existing highway, in rugged volcanic terrain. Elevation above mean sea level along the current alignment varies slightly but is approximately 430 feet in elevation throughout the project limits. Surface drainage is generally south towards the Trinity River with some local variations. The Trinity River drains westward. Native vegetation in the project area includes abundant grass/weeds, moderate brush and trees.

5.3 Regional Geology and Seismicity

The project is located in central Trinity County, within the Klamath Mountains geomorphic province. This geologic province has been further divided into two groups of rocks the Subjacent and Superjacent rocks. Trinity County is dominated by Subjacent rocks that have been divided into four different belts separated by thrust faults. From east the west the belts are comprised of the Eastern Klamath plate, the

Central Metamorphic plate, the Western Paleozoic and Triassic Plate and the Western Jurassic plate. (R. Norris and R. Webb)

5.4 Site Geology

According to the USGS geologic map review, the site is located within the Jurassic age, Hayfork Bally meta-andesite. The Hayfork Bally meta-andesite is considered to be a portion of the Hayfork terrane which is one of three terrane's that make up the Western Paleozoic and Triassic Plate. Rock outcrops observed in the field compare favorably with those described on the map. A portion of the Geologic map utilized for this report is attach as Plate No. 3

5.5 Seismicity

We utilized Caltrans ARS Online v 1.0.2 to determine the controlling active fault seismic concerns within the project limits. The program indicated the Mad River Fault Zone (McKinleyville Fault) is located approximately 31 miles west of the site is the controlling fault for peak bedrock acceleration within the project limits. The Mad River fault zone is considered to be made up of northeast dipping reverse faults and could produce a maximum credible earthquake of magnitude 7.0. The ARS results indicated that a maximum credible earthquake based on a probabilistic curve with a 5% chance of reoccurrence in 50 years would result in a peak horizontal bedrock acceleration of approximately 0.27g at the site. Bedrock at the site is at or near the surface based on the field review.

5.5 Naturally Occurring Asbestos (NOA)

We have reviewed the State of California, Air Resources Board (ARB) Map of California Showing Principal Asbestos Deposits, 2000 and the Caltrans DOT "Asbestos Location Map, District 2", 2001. According to both maps, the site is not in an area of naturally occurring asbestos. In addition, during our site reconnaissance the presence of serpentine was not observed in the bedrock exposed at the site.

5.6 National Resource Conservation Service Soil Survey

According to the soil survey reviewed, soils north of the existing highway are mapped as Pardoloe-Goulding complex and soils south of the highway are mapped as Xerofluvents-Riverwash complex. Below is a brief explanation of each soil's pertinent information with regards to project applications.

Pardoloe-Goulding complex, 50-75 percent slopes. This soil consists of well drained colluvium derived from weathered metavolcanics. Surface runoff is medium and the

erosion potential is slight (K factor 0.15). Corrosion potential is moderate for both concrete and steel (pH 6.1). This soil has been assigned to Hydrologic Group B. Permeability is reported as 0.6 to 2.0 in/hr.

Xerofluvents-Riverwash complex, 0-5 percent slopes. This soil consists of well drained alluvium derived from igneous, metamorphic and sedimentary rocks. Surface runoff is rapid and the erosion potential is slight (K factor 0.05). Corrosion potential is low for both concrete and steel (pH 6.7). This soil has been assigned to Hydrologic Group A. Permeability is reported as 2.0 to 24.0 in/hr.

6. Exploration

The Office of Geotechnical Support, Geophysics and Geology Branch completed a seismic refraction survey near the proposed project site during the month of July, 2011. Two seismic refraction lines were completed on the existing slope above the general area of the proposed cuts for this project. The seismic refraction survey was completed to estimate the depth to potentially non-rippable bedrock and provide estimated earthwork factors for material to be removed. A copy of the Seismic Refraction Survey Report is attached as Appendix 1.

7. Site and Geotechnical Conditions

Mr. Webster of this Office performed site visits for this report in February 2011 and August 2011. No subsurface exploration, sampling, or testing was performed during these site visits.

In general, the current alignment of the highway roughly trends east/west within the project limits. The highway is bounded on the north side by steep to shallow cuts and native hill slopes. Between approximate project stationing 18+00 to 19+50 the existing highway cut is varies from 1-4 feet in vertical height with a slope ratio of approximately 1.5:1 (H:V). Beyond our highway cut there is a relatively flat area that varies from 10-50+ a foot wide, then there is a series of cuts with a mid-slope bench. The two cuts in the series are approximately 20 feet in vertical height separated by a mid-slope bench that varies from 10-15 feet in width. The two cut faces have an approximate slope ratio of 0.5:1 but with the mid-slope bench the overall cut ratio is 0.75:1. These cuts on the surface are comprised of reddish-brown, sandy-clay, clayey-sand with trace cobbles and boulders. Boulders in these cuts were observed to range up to 4 feet in diameter. These cuts exhibit moderate to severe erosion and are poorly vegetated with small conifer trees and brush. The native slope beyond these cuts has a slope ratio of approximately 2:1 and is well vegetated with grass and moderate brush and trees. It appears that this flat area, cuts beyond the flat area and native slope above may have been worked as a mining or logging area in the past. Between project stationing 19+50-21+75, the existing cut ranges

up to 60 feet in vertical height and has variable slope ratios from near vertical to 1:1. The lower portion of this cut is comprised of moderately weathered, moderately hard to hard, moderately to slightly fractured meta-andesite. The upper portions of this cut are comprised of variably thick soil layers of reddish-brown, sandy-clay, clayey sand with boulders. The upper portions of the cut exhibit slope ratios that are closer to 1:1 and the lower portions in the more competent meta-andesite have the steep slope ratios. The native slope above the cuts has a slope ratio of approximately 2:1. The existing cut is un-vegetated in the rock sections, in the upper soil portions; it is moderately vegetated with grass and minor trees and brush. The native slope above the cut is moderately to well vegetated with grass, brush and trees. Several seeps were observed in this existing cut section, some of the seeps were emanating from fractures within the rock face and others were emanating from the contact zone between the soil/decomposed rock and competent rock contact and sheet flowing down the rock face of the lower portions of the cut. In addition, a number of drainage channels were observed within the native slope above the cut. The majority of these drainage channels observed were running parallel with the existing cut face. However, a larger size channel was noted running perpendicular to the cut face at approximate project stationing 19+80. This is also the location were the largest seep was observed emanating from the soil/bedrock contact.

The south side of the highway is bounded by earth retaining systems, a cut, fills and native slopes down to the Trinity River. Between approximate project stationing 10+00-17+00 there is an existing “Can Wall” 36 inch diameter corrugated metal pipes backfilled with mixed soil and gravel. The Can Wall has a maximum exposed height of 5 feet. Below the Can Wall is variable 30 to 40 foot long slope with a 40° slope angle down to an existing relatively flat river terrace. Between project stationing 17+00-19+00 is variable length fill/native slope with an approximate 1.5:1 slope ratio. A campground is located below this slope on the west end and the Trinity River is located below the slope on the east end. Between approximate project stationing 19+00-21+00 is a cut face. The cut has a slope ratio of 80° to vertical and is comprised of the same meta-andesite found on the north side of the highway. From approximate project station 19+00 to the end of the project is a welded wire mesh wall with a maximum height of 15 feet. Below the welded wire mesh wall is a fill/native slope with an approximate 1.5:1 slope ratio that extends down to the Trinity River.

Per conversation with Maintenance Supervisor from the Weaverville Maintenance Station, they have not had issues from a geotechnical standpoint within the project limits under its current configuration.

In general the existing highway and associated cuts, fills and walls are performing well. However, it was noted during the field reconnaissance that there was extensive cracking of the asphalt concrete (AC) in the east bound travel lane in the vicinity of the existing cut on the south side of the alignment. It is our opinion that this cracking is due to

ponding of drainage water within the pavement sub-grade. In addition, the soil/decomposed rock mantel observed at the tops of the existing cuts are undergoing moderate erosion. The erosion is expressed as minor slumps and riling within the existing slope faces. As stated above the highway cut slopes are performing well, however, it is our opinion that the cuts observed on the north side of the highway beyond the existing highway cut are not performing well but will not be impacted by the current proposed projects scope of work.

8. Geotechnical Recommendations

It is our understanding that this project proposes to increase clear recovery area, widen the existing highway to 12 foot traveled lanes with 4 and 8 foot paved shoulder areas and improve drainage facilities. Based on the cross-sections provided by the District, all work for these proposed improvements will take place on the north side of the existing highway alignment. In addition, the preliminary cross-sections indicate the District would like increase the existing shoulder areas from 0 to 25 feet to the north in some areas which will result in new cuts. Based on the preliminary typical cross-sections provided the District would like to utilize steeper than current slope ratios for the proposed cut between project stationing 19+50-22+50.

8.1 Fill Slopes

Based on the preliminary typical cross-sections provided, it is our understanding that no new fills will be constructed or existing fills widened as a portion of this project.

8.2 Cut Slopes

Based on the layout plan and cross-sections provided, the District proposes to complete the widening by cutting into the existing cuts on the north side of the existing highway. It is our understanding that the current centerline of the highway will not shift for the proposed project but the existing paved lanes, paved shoulders and unpaved shoulders will be widened to the north a maximum of 25 feet. Based on the cross-sections provided by District Design it is anticipated that the widening will produce new cuts with maximum slope lengths up to 70 feet. It is our understanding that the District would like to utilize a slope ratio of 1:1 for the cuts between project stationing 14+50-19+00 and a slope ratio of 0.1:1 (H:V) between the approximate project stationing of 19+25-22+50. Based on the results of the seismic refraction survey and our field mapping our Office does not recommend that the generalized slope ratios be utilized throughout the project limits. Our recommended slope ratios are provided in the table below:

Project Stationing	Districts Proposed Ratio	Recommend Cut Ratio 1	Recommended Cut Ratio 2
14+75 to 19+00	1:1	1:1	
19+25	0.1:1	1:1	
19+50	0.1:1	0.1:1 below elevation 1454 feet	1:1 above elevation 1454
19+75	0.1:1	0.1:1 below elevation 1466 feet	1:1 above elevation 1466
20+00 to 21+00	0.1:1	0.1:1 below elevation 1480	1:1 above elevation 1480
21+25	0.1:1	0.1:1 below elevation 1475	1:1 above elevation 1475
21+50	0.1:1	0.1:1 below elevation 1480	1:1 above elevation 1480
21+75 to 22+50	0.1:1	0.1:1 below elevation 1490	1:1 above elevation 1490

1. All slope ratios are provided in Horizontal to Vertical unless otherwise noted.
2. All elevations are in feet above mean sea-level unless otherwise noted.

The recommendations for slope ratios are provided with the sole consideration of slope stability. It should be noted that the existing cuts in the project limits with similar slope ratios exhibit moderate erosion features. Erosion features noted during our site reconnaissance were rills, slumps and over-steepened slopes at the crest of cuts. The District may consider reducing erosion potential on new cuts by completing slope rounding in the upper 5 feet at the crests of cuts and/or placing rock or concrete lined v-ditch's paralleling the cut crests to slow or prevent sheet flow down the slope face. District Landscape Architecture and/or District Hydraulics should be consulted to verify and/or provide other erosion control mitigation options that may be suitable at the cut locations

8.3 Rockfall

Based on conversations with the local Maintenance Supervisor for the area and our site reconnaissance, rockfalls have not been a concern within the project limits. During our site reconnaissance only minor rocks (less than 4 inch diameter) were observed at the roadway elevation. All of the rocks observed were contained within the existing paved and unpaved shoulder areas.

Since the project proposes to complete new cuts within the existing rock faces and overlying mixed soil/decomposed rock, rockfall potential will likely increase as the new cut faces relax to a state of equilibrium.

Based on the cross-sections provided by the District it is our understanding that the catchment area at the base of the proposed new cuts where rockfall potential may occur, will be increased from its current width of 1 foot paved and 1 foot unpaved (total 2 ft.) to a width of 8 feet paved and 1-25 feet unpaved (total 9-33 ft.). The increase in catchment width should reduce the potential for rock fall to reach the travel lanes.

At this time our Office does not recommend the District consider any additional rockfall mitigation measures for this project.

Should rockfall become an issue in the future at this location, it is our opinion that draping the slope with wire mesh drapery would likely be the most cost effective rockfall mitigation alternative.

8.4 Rippability

Our site reconnaissance and map review indicates that the North Fork Curve widening project area is underlain by Jurassic age volcanic rock (meta-andesite). During our site reconnaissance the presence of drilled hole was observed in the lower portions of the existing cut between project stationing 19+50-22+50. These drilled holes were likely utilized for blasting to create the current cut face.

Based on the seismic refraction survey report, non-rippable rock with seismic velocities up to 9000 ft/sec will be encountered within the excavation limits. The table below is our estimate of elevations at which depths greater than; non-rippable rock will likely be encountered in the proposed cut slope excavations based on project stationing:

Project Stationing	Presence of non-rippable rock within excavation limits	Estimated elevation at which non-rippable rock will be encountered below (ft)
14+75 to 18+50	Not anticipated	
18+75	Anticipated	1445
19+00	Anticipated	1450
19+25	Anticipated	1455
19+50	Anticipated	1460
19+75	Anticipated	1470
20+00 to 21+00	Anticipated	1480
21+25	Anticipated	1475
21+50	Anticipated	1480
21+75 to 22+50	Anticipated	1490

Based on our estimates of depth to non-rippable material and the Districts proposed cuts, our Office estimates that 70% +/-5% of the project total excavations will require hard rock excavation techniques.

For excavations at project stationing locations and depths below the elevations provided in the table above, it is anticipated that the use of explosives or other hard rock excavation methods such as hydraulic splitters, hoe-rams and chemical expanders will be required to complete the new cuts. Blasting is typically the most cost effective and efficient method to complete hard rock excavation.

If the District approves blasting as a hard rock excavation method, our Office recommends that Caltrans Standard Special Provisions 19-705 "Rock Excavation" be included in the project specifications. In addition, for portions of cut in rock ¾:1 or steeper our Office recommends the use of SSP 19-700 “Presplitting” be utilized to create a uniform slope face.

Our Office is aware of the two existing retaining walls within the project limits and the campground with associated buildings located just south and west of the project location that would fall within a 300 foot radius, and may be identified as structures of concern. However, it is our opinion that wall types within the project limits are flexible wall types and can tolerate some minor movement without distress. Also the buildings we are aware of associated with the campground are enclose pit toilets. If the District would like to reduce risk of damage to these structures or if the presence of other structures or underground/overhead utilities (gas, telecommunications, etc) are discovered then we would recommend SSP 19-705 be replaced with SSP 19-706. In either case SSP 19-700 should be utilized.

Based on the cross-sections provided by the District, the proposed cuts between project stationing 21+80 to 22+50 are sliver cuts. Our Office does not recommend that blasting be utilized to complete that sliver cuts as there is typically not enough overburden to contain fly rock.

8.5 Grading Factors

Based on the result of the Seismic Refraction Survey Report, earthwork factors vary from a low of 0.9 in colluvium to a maximum of 1.2 in the underlying un-weathered meta-andesite. The majority of the volume of the proposed cuts for this project will be within the weathered and un-weathered meta-andesite with earthwork factors >1; therefore we recommend that the District utilize a general earthwork factor of 1.15 for estimating purposes.

8.6 Groundwater & Drainage

Based on our site reconnaissance, topography, geology, groundwater elevations within the Trinity River should not affect the proposed cut excavations. However, during our site reconnaissance the presence of groundwater through the existing cut and out the cut face was observed. Several seeps were noted emanating from the existing cut face primarily at the approximate contact line of the overlying soil/decomposed rock and competent bedrock. Some seeps were observed emanating from fracture sets within the bedrock. In addition, during our reconnaissance several drainage channels were observed in the native slope above the existing highway cuts. One channel above the cut at approximate project station 19+80 drains towards the existing cut face. No water was observed flowing in any of the drainage channels observed but the drainage channels likely act as collector locations to infiltrate water into the subsurface. It was noted that the most active seeps in the cut face were below the observed channel at approximate station 19+80. Our Office recommends that all potential surface water and subsurface water be collected and directed away from the cut face to the extent possible. This could likely be done with concrete lined v-ditches and enclosed down pipes to the drainage improvements at the highway elevation. If v-ditches are utilized we recommend that one be placed at the brow of the cut and one at the hinge point in the cut if the compound cut option is select by the District. The ditch at the brow would be utilized to collect surface runoff from the native slope above and the one at the hinge point would be utilized to collect and re-direct and water that may be flowing along the soil/bedrock contact.

District Hydraulics should be consulted to verify and/or provide other drainage recommendations that may be suitable at the cut locations.

9. Construction Considerations

Contractors should be aware that we have made our best attempts, based on field mapping and seismic refractions surveys, to identify the elevation that non-rippable rock will be encountered. These elevations were identified at discrete points and are by no means an interpretation of the exact elevation of bedrock between the project stations. Due to the undulatory nature of the erosion and decomposition of rock, it should be anticipated that non-rippable bedrock could be encountered at elevations above or below the elevations provided in the table in the rippability section above.

Our Office has recommended that “Pre-splitting” be performed as a portion of blasting to help create uniform final cut faces. We recognize that the existing rock face is moderately to slightly fractured, and even though pre-splitting is being performed a completely smooth final cut face may not be obtained. There is the possibility that the blasting performed my cause some disturbance to wedges or blocks within the final cut face. Should loose/disturbed wedges or blocks of rock remain on the finished cut face after

blasting and excavation our Office recommends that they be removed. It is anticipated that these loose/disturbed rocks could be removed utilizing hand scaling methods. Scaling should be at the discretion of the Engineer during construction or a representative from our Office could assist the Engineer in determining if scaling is needed.

10. Proposed Future Investigations

No other fieldwork is proposed at this time. Representatives from our Office are available to assist District Construction Personnel during construction if needed.

11. Project Information

Standard Special Provision S5-280, "Project Information", disclosed to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

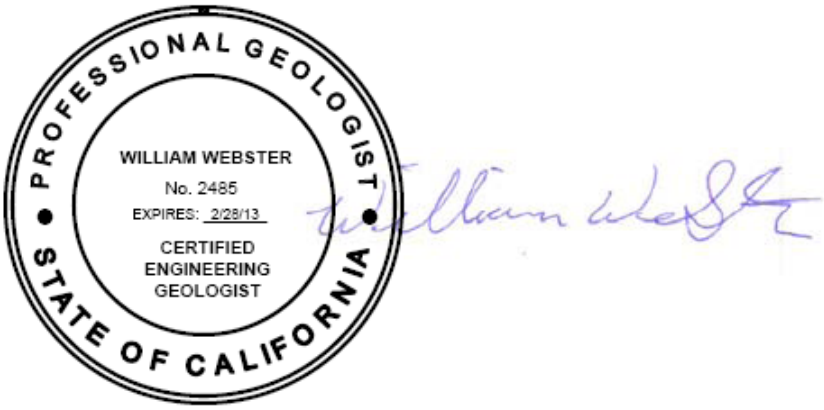
Data and information attached with the project plans are*:*
A. None

Data and Information included in the Information Handout provided to the bidders and Contractors are:
A. "Geotchnical Design Report North Fork Curve Project", 02-TRI-299 PM 36.6/36.8, dated September 9, 2011
B. "Seismic Refraction Survey, Route 299, North Fork Curve Project", 02-TRI-299 PM 36.6/36.8, dated September 6, 2011.

Data and Information available for inspection at the District Office:
A. None

Data and Information available for inspection at the Transportation Laboratory are:
A. None

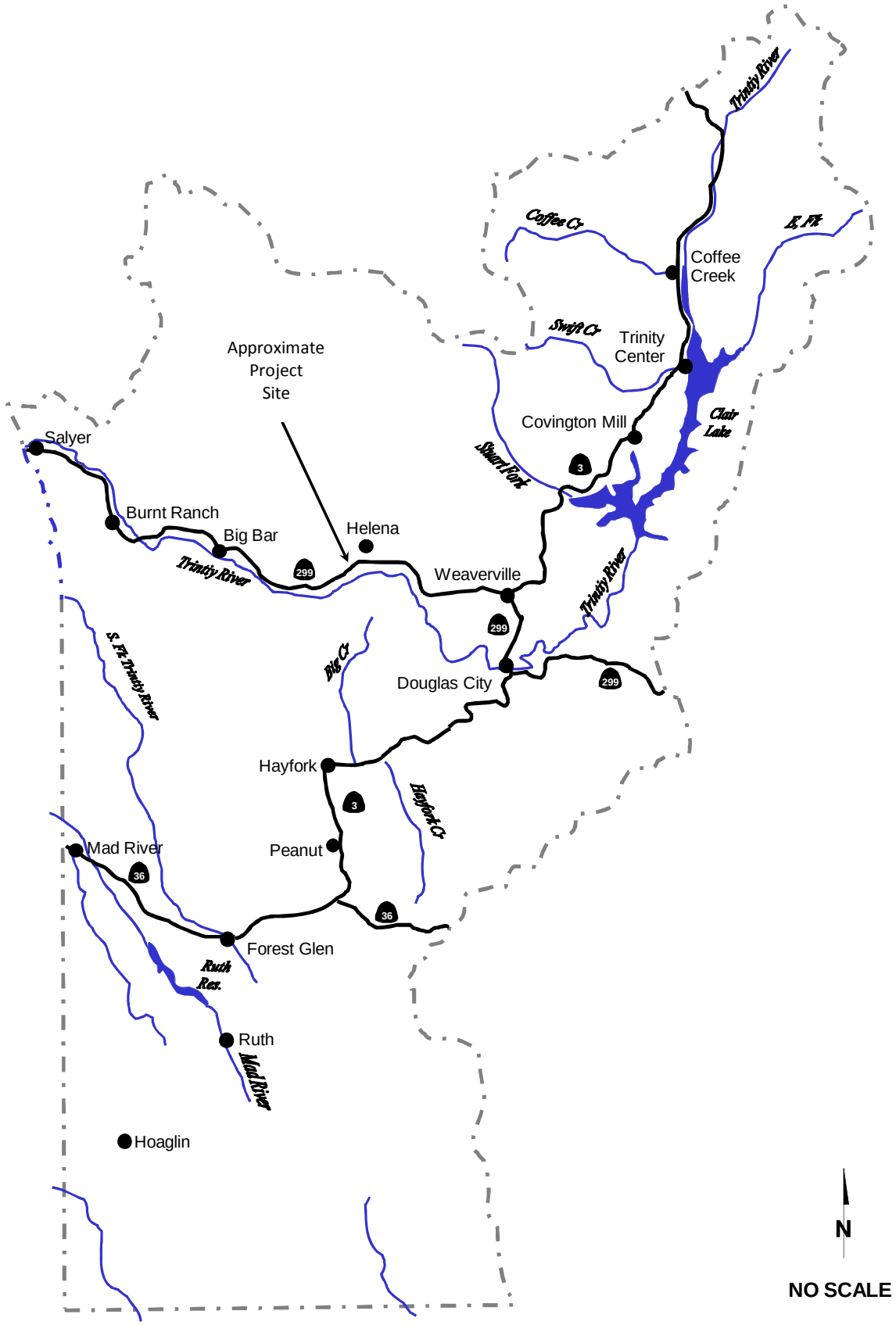
The recommendations contained in this report are based on the specific project information provided to this office through July 1, 2011. If any conceptual changes are made during final design or in the field that could relate to or are related to geotechnical issues, the Office of Geotechnical Design North should review those changes to determine if these recommendations still apply. If you have any questions, comments, or would like to request the additional support during construction for this project please call Doug Brittsan at (916) 227-1079.



William Webster, CEG
Engineering Geologist
Office of Geotechnical Design North
Branch C

Attachments
1. Plate 1. Vicinity Map
2. Plate 2. Aerial Photograph of Project Area
3. Plate 3. Geologic Map
4. Appendix 1. Seismic Refraction Survey Report

C: Doug Brittsan, (OGDN)
e-Copy: Chris Harvey, (D2-PM)
Eskinder Tadesse, (PCE)
Mark Willian, GS Corporate
D2 - RE Pending Files (c/o Shaun Alexender)
Byron Berger, (D2-DME)



CALTRANS
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Office of Geotechnical Services
Geotechnical Design Branch - North

EA: 02-3E820	VICINITY MAP	
Date: September 2011		
02-TRI-299 PM 36.6/36.8		PLATE NO.
Geotechnical Design Report		1

N

NO SCALE

CALTRANS
Engineering Services
Office of Geotechnical Services
Geotechnical Design Branch - North

EA: 02-3E820	**Aerial Photo**	
Date: September 2011		
02-TRI-299 PM 36.6/36.8		PLATE NO.
Geotechnical Design Report		**2**

Source: United States Geologic Survey, "Geologic Map of Redding 1x2 Degree Quadrangle, Shasta, Tehama, Humboldt and Trinity Counties, California", 1987.

EXPLANATION:

Qa: Alluvium and Colluvium (Holocene)--Unconsolidated silt, sand, and gravel in modern stream channels and on associated low terraces

hhb: Hayfork Bally Meta-andesite (Middle Jurassic)--Layered rnafic volcanogenic rocks ranging in texture from coarse agglomerate to crystal tuff, probably representing an island-arc deposit.

Approximate Project Limits

N

NO SCALE

Department of Transportation Division of Engineering Services Geotechnical Services Office of Geotechnical Design - North	EA: 02-3E820	GEOLOGIC MAP	
	Date: September 2011		
	02-TRI-299 PM 36.6/36.8) Geotechnical Design Report		PLATE 3

M e m o r a n d u m

Flex your power!
Be energy efficient!

To: **Douglas Brittsan**
Senior M&R Engineer
Geotechnical Design North
Division of Engineering Services

Date: September 6, 2011

File: 02-TRI-299-36.6/36.8
Project 0200020166

Attention: Bill Webster

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES-MS#5

Subject: Seismic Refraction Survey, Route 299, North Fork Curve Correction

Introduction

This memo documents the results of a refraction seismic survey to assist in the design of roadway improvements for Highway 299 at North Fork Curve. The seismic refraction survey was employed to assist in assessing the engineering characteristics of the material comprising the existing slopes. Refraction profiles were employed at two locations. The geometry of the study area created some challenges to successful application of seismic refraction imaging (discussed below).

Results and Discussion

Figure 1 is an aerial photo showing the locations of the two seismic lines. Seismic Line 1 was located at the northern-most edge of the geotechnical study area. The site is on the nose of a small ridge which falls off dramatically in both directions to near vertical. The eastern edge of Line 1 was controlled by that steep topography, creating a safety issue that needed to be addressed for successful completion. The western limit was a vertical scarp left by past hydraulic mining operations. This seismic line was 36 meters long (118 feet). Line 1 was located about 100 feet left of the stationing line and ran from about stations 17+90 to 20+70. Between the interval extending from 25.5 meters (83.6 feet) along the line to the end of the line, bedrock was exposed beneath the line in intermittent erosional rills. The processed model (Figure 2) indicates rock with a velocity of 2050 m/sec. (6725 ft/s) below an elevation of 454 meters (1490 ft). Cuts above these elevations will encounter slower material that may not support the proposed design slope.

Seismic refraction methods generally image to a depth of 20 to 30% of the maximum shot to geophone separation. For Line 1, maximum depth of investigation ranged between 9 and 13 meters below the seismic line and did not image to road grade (433 m, or 1422 ft). The line identified relatively fast rock (just over the limit of rippability) above road grade, beginning at elevation below 454 m (1490 ft). The outcrop at road grade exhibits evidence of prior drilling and blasting and supports the finding of the seismic survey.

Seismic Line 2 was 72 meters (236 feet) long and was placed at the best accessible location to image to road grade. That location placed Line 2 skewed to Line 1 through the less disturbed

portion of the existing slope. Two scarps were encountered along this traverse, both thought to be man-made erosional scarps from historic hydraulic mining operations. It began at 25.5 meters (83.7 feet) along Line 1, at roughly project station 20+40, and ended at about station 16+90 (see Figure 1). Although part of the seismic line is outside of the originally-defined study area, it confirms relatively fast rock exists to road grade as observed from outcrop in the field. Apparent bedrock velocity along Line 2 measures about 34% faster than the rock identified at the top of the ridge on Line 1, implying possible deep bedrock weathering, anisotropic rock strength related to jointing, or a combination of the two.

The results of our findings are summarized in the table below:

TABLE 1

Line	Layer	Average Thickness (m.) ft.	Average Velocity (m/sec)	Line Length(m), ft.	Inferred Material	Rippability	Earthwork Factor
1	1	(0-2.5), 0-8.2	360	(36), 118 ft	Colluvium	ER	.90
1	2	(3-10),9.8-32.0	1080		Weathered meta-sediments	MD	1.06
1	3	N/A	2050		Meta-sediments	NR	1.16
2	1	(0-4), 0-13.0	430	(72), 236 ft.	Colluvium	ER	.92
2	2	(0-11), 0-36.0	1280		Weathered meta-sediments	MD	1.09
2	3	N/A	2750		Meta-sediments	NR	1.20

[1] ER = Easily Ripped, MD = Moderately Difficult, DR = Difficult Ripping, NR = Not Rippable,

Ripping ability is based on unpublished Caltrans data for a Caterpillar D9G series bulldozer with a single-tooth ripper. These values are as follows:

Velocity (m/s)	**(ft/sec)**	**Rippability**
<1050	<3444	Easily Ripped
1050-1500	3444-4921	Moderately Difficult
1500-2000	4921-6562	Difficult Ripping
>2000	>6562	Not Rippable

Different excavation equipment may experience different results. Penetrating efficacy of the ripping tooth is often more important in predicting ripping success than seismic velocity alone. Undetected blocks or lenses of high-velocity material may also be present within rippable zones, requiring blasting or other means of mechanical breakage for excavation**.**

Earthwork Factor

The earthwork factor for a highway grading project is the ratio of embankment to excavation volume. A factor of 1.0 indicates no volumetric change from excavation to emplacement. Earthwork factors are based on empirical correlation with the seismic velocity of rock. The values shown are from published Caltrans studies (Stephens, 1978) and are extrapolated where necessary. They are listed in Table 1 above

Data Acquisition and Processing

Seismic refraction data were recorded using an EG&G Smartseis 24-channel seismograph with 14 MHz geophones. The profiles varied in length. The energy sources employed were a hammer and striker plate and a downhole seisgun percussion source. Refraction data from each shot were stored in the seismograph's memory. Both profile geometry and refraction data were backed-up to paper and floppy disk upon completion of the survey.

Profiles in this report are presented in terms of velocity units. A velocity unit is a three-dimensional unit, which due to its elastic properties and density, propagates seismic waves at a characteristic velocity or within a characteristic velocity range. Velocities denoted in this report and in the seismic refraction sections are expressed in meters per second. At least one velocity is present within a geological rock unit. In addition, each zone of weathering or fracturing within that geological unit can constitute its own velocity unit. Conversely, when two rock units such as water saturated gravel and moderately weathered rock propagate seismic waves at the same velocity and are adjacent to each other, both units would be part of the same velocity unit. Lastly, discontinuous velocities might result from variation in the degree of alteration in the form of physical and chemical weathering and should be considered in the interpretation of the data.

Thank you for the opportunity to work on this project. If you have any questions or need additional assistance, please contact me at (916) 227-1307 or Mr. Bill Owen at (916) 227-0227.

References

Stephens, E., 1978, Calculating earthwork factors using seismic velocities, California Department of Transportation, Report No. FHWA-CA-TL-78-23

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Geophysics and Geology Branch

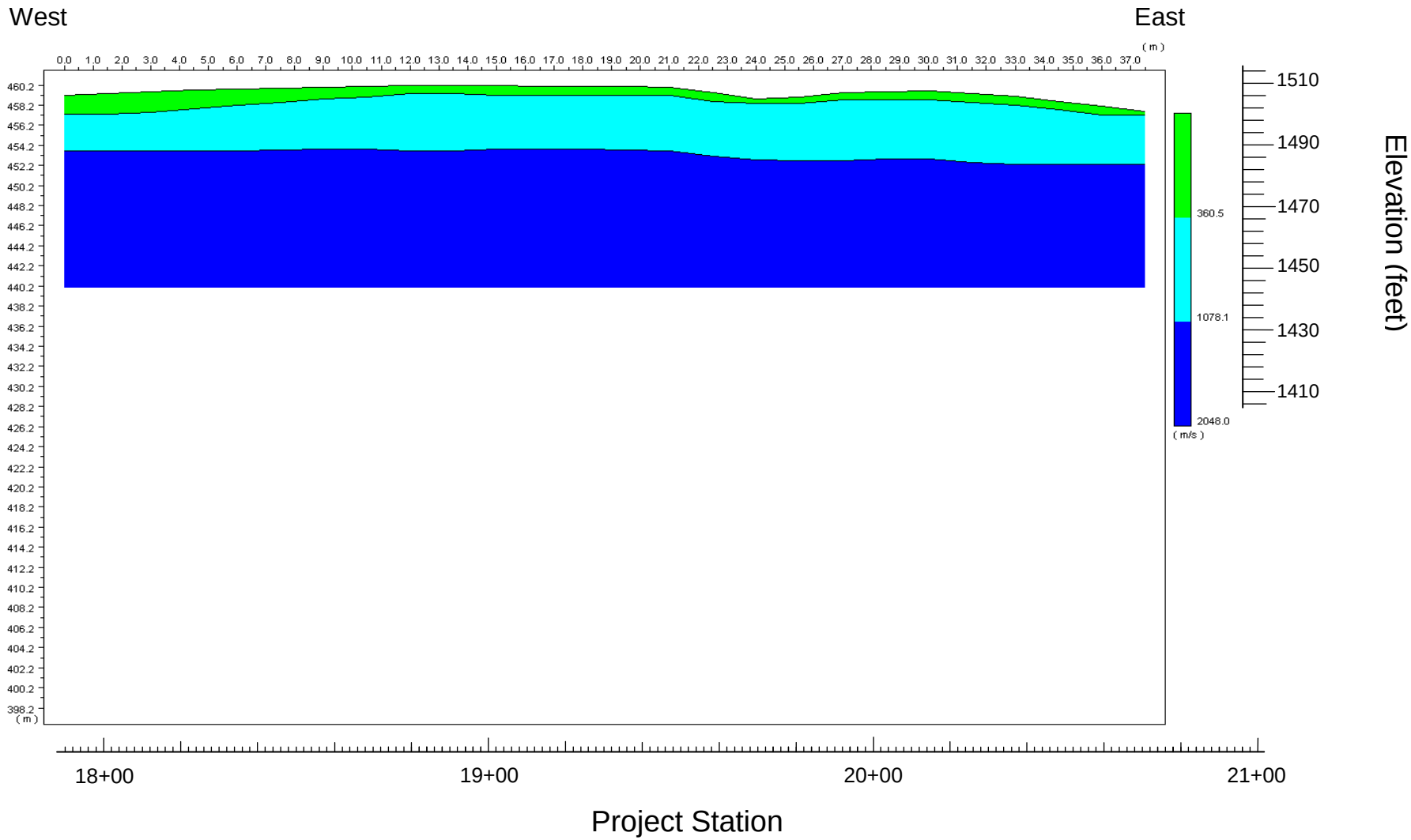
Reviewed By:

William Owen, PGP 1031
Chief, Geophysics and Geology Branch

PROFESSIONAL GEOPHYSICIST
W.P. OWEN
No. 1031
Exp. 3/31/2012
STATE OF CALIFORNIA

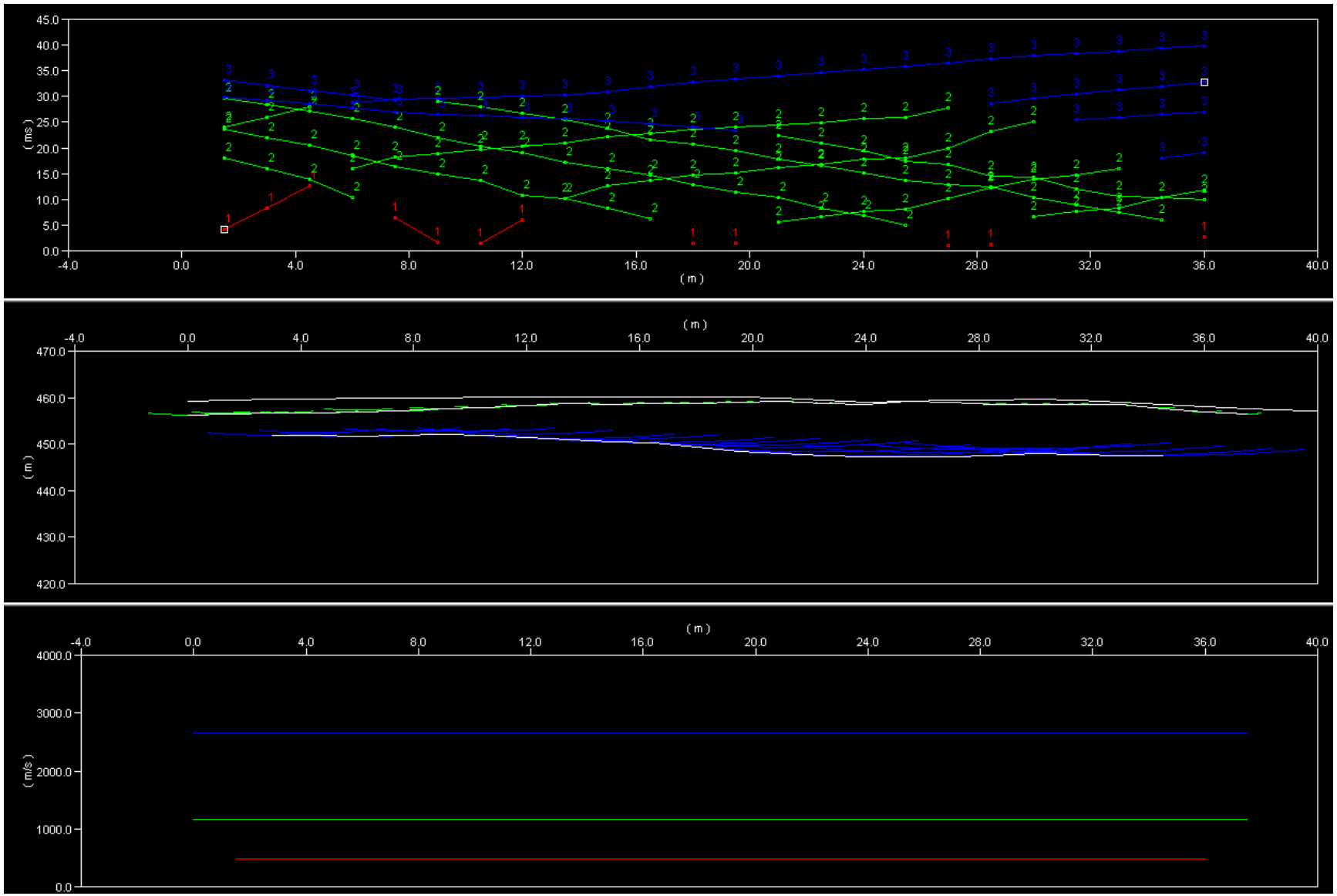
DL/WO
Project File: 02_TRI_299_36.7_2011_SEI.doc

Caltrans Division of Engineering Services Office of Geotechnical Support	Project: 0200020166 Date: September 2011	**Refraction Seismic Line Locations**	Figure 1:
	02_TRI_299_PM36.6_36.8 **North Fork Curve**		

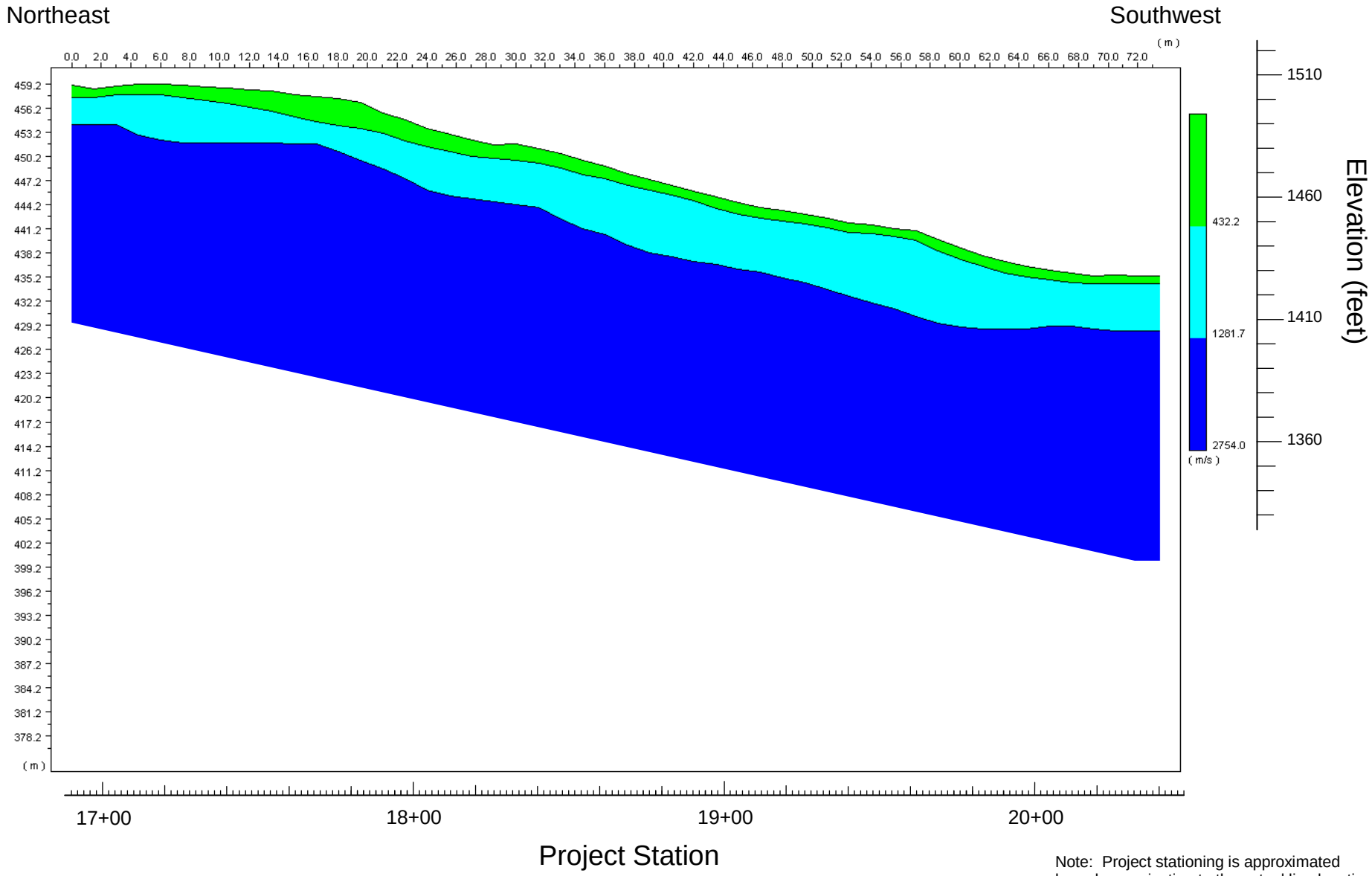


Note: Project stationing is approximated based on projection to the actual line location

Caltrans Division of Engineering Services Office of Geotechnical Support	Project: 0200020166 Date: September 2011	**Color Density Model** **Seismic Line 1**	Figure 2:
	02_TRI_299_PM36.6_36.8 **North Fork Curve**		



Caltrans Division of Engineering Services Office of Geotechnical Support	Project: 0200020166 Date: September 2011	**Time Distance Graph, Velocity Model and Depth Section** **Seismic Line 1**	Figure 3:
	02_TRI_299_PM36.6_36.8 **North Fork Curve**		



Note: Project stationing is approximated based on projection to the actual line location

Caltrans Division of Engineering Services Office of Geotechnical Support	Project: 0200020166 Date: September 2011	**Color Density Model** **Seismic Line 2**	Figure 4:
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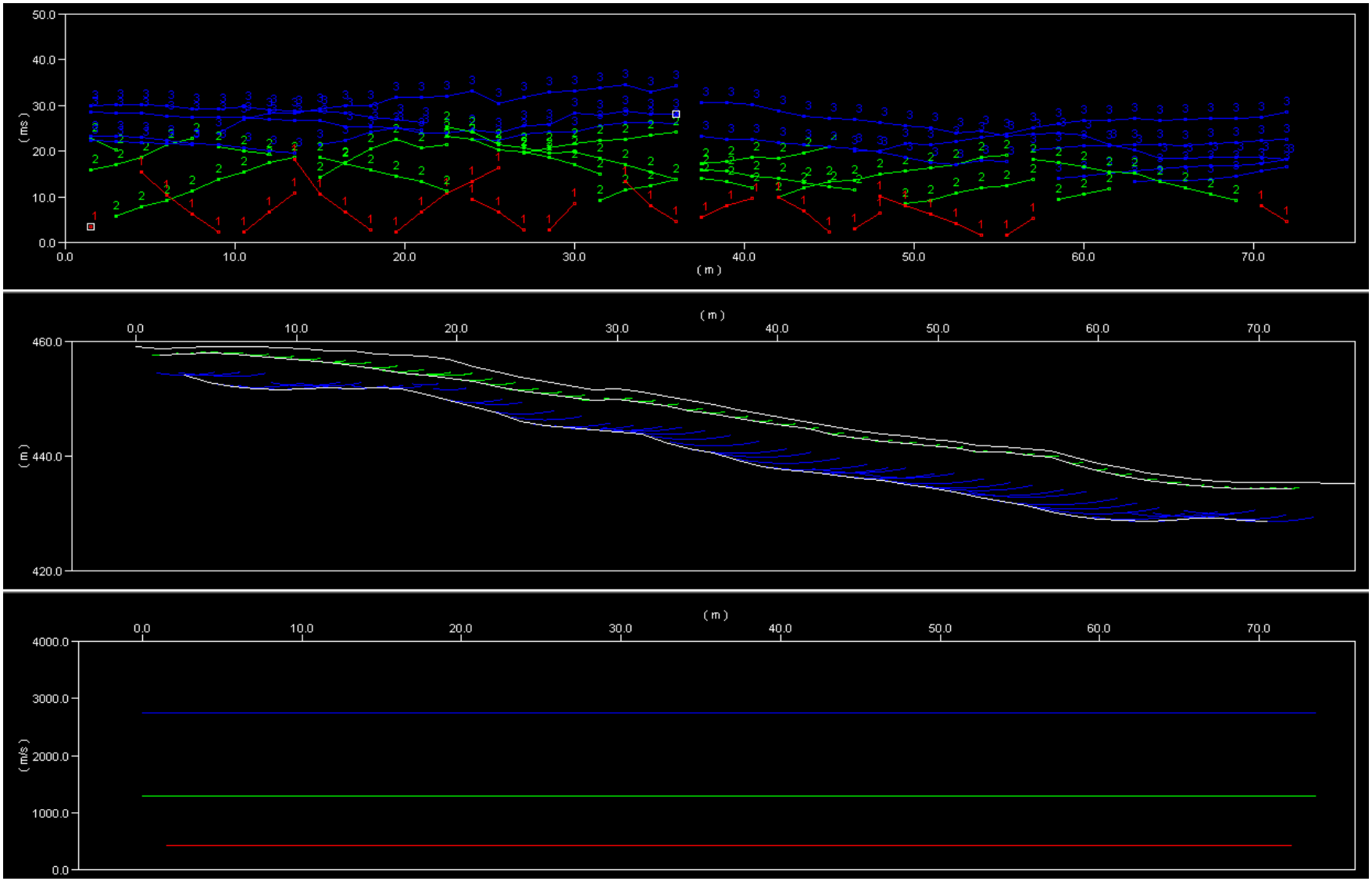

Caltrans Division of Engineering Services Office of Geotechnical Support	Project: 0200020166 Date: September 2011	**Time Distance Graph, Velocity Model and Depth Section** **Seismic Line 2**	Figure 5:
		02_TRI_299_PM36.6_36.8 **North Fork Curve**	

MATERIALS INFORMATION

OPTIONAL DISPOSAL SITE

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
02	Tri	299	36.6/36.8	1	3

STATE OF CALIFORNIA

DEPARTMENT OF TRANSPORTATION

PROJECT PLANS FOR CONSTRUCTION ON

STATE HIGHWAY

OPTIONAL DISPOSAL SITE

TO BE SUPPLEMENTED BY STANDARD PLANS DATED MAY 2006

INDEX OF PLANS

SHEET No.	DESCRIPTION
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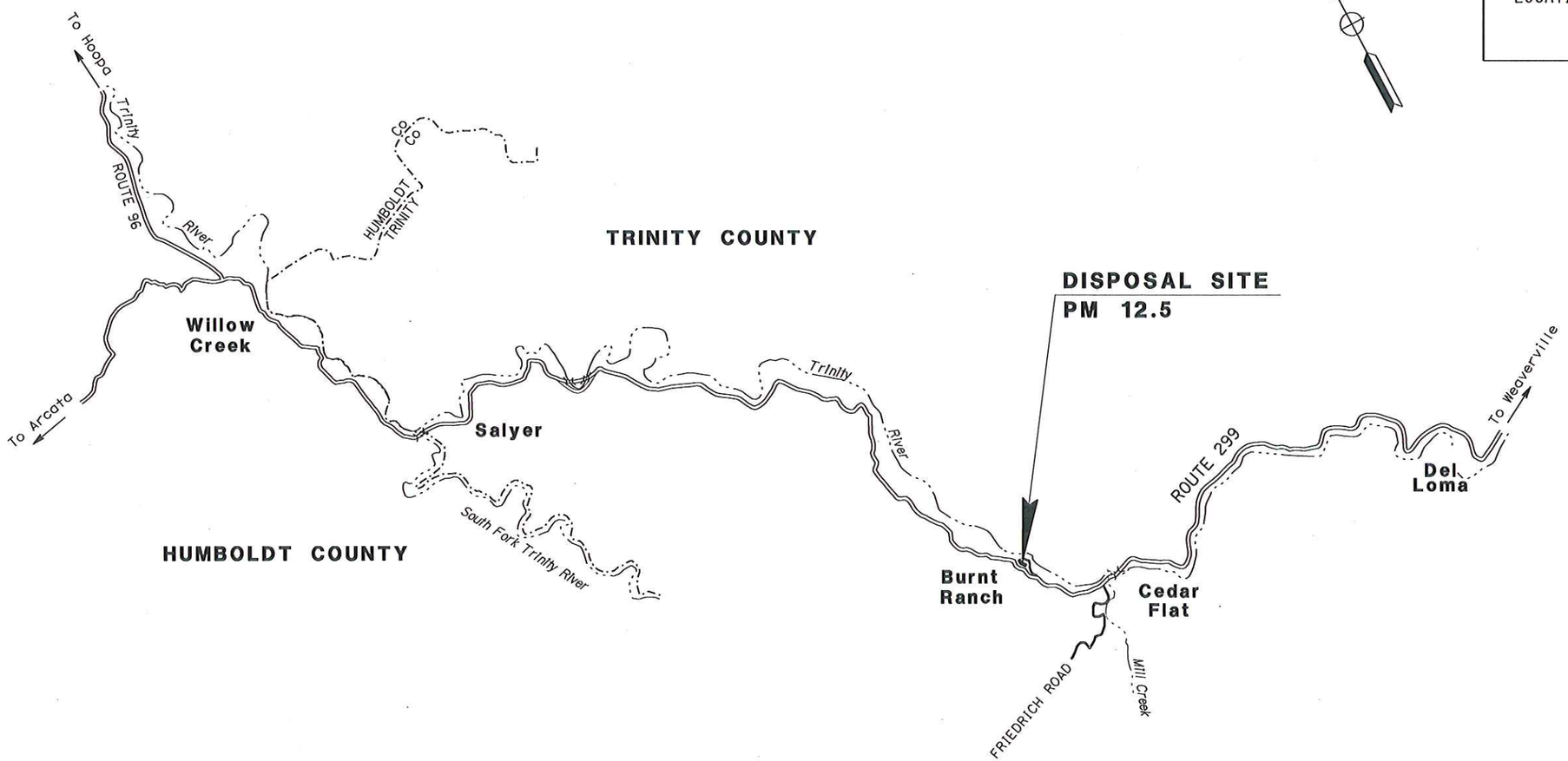
THE STANDARD PLANS LIST APPLICABLE TO THIS CONTRACT IS INCLUDED IN THE NOTICE TO CONTRACTORS AND SPECIAL PROVISIONS BOOK.



NO SCALE

THE CONTRACTOR SHALL POSSESS THE CLASS (OR CLASSES) OF LICENSE AS SPECIFIED IN THE "NOTICE TO CONTRACTORS."

PRELIMINARY

PROJECT ENGINEER DATE
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

REGISTERED PROFESSIONAL ENGINEER No. Exp. CIVIL STATE OF CALIFORNIA

DESIGN ENGINEER: SHAUN ALEXANDER
PROJECT MANAGER: ERIC AKANA

LAST REVISION 10-17-11
DATE PLOTTED => 30-NOV-2011
TIME PLOTTED => 11:35

CONTRACT No. 02-3E8204

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
02	Tri	299	36.6/36.8		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
SHAUN ALEXANDER
No. C70833
Exp. 06-30-13
CIVIL
STATE OF CALIFORNIA

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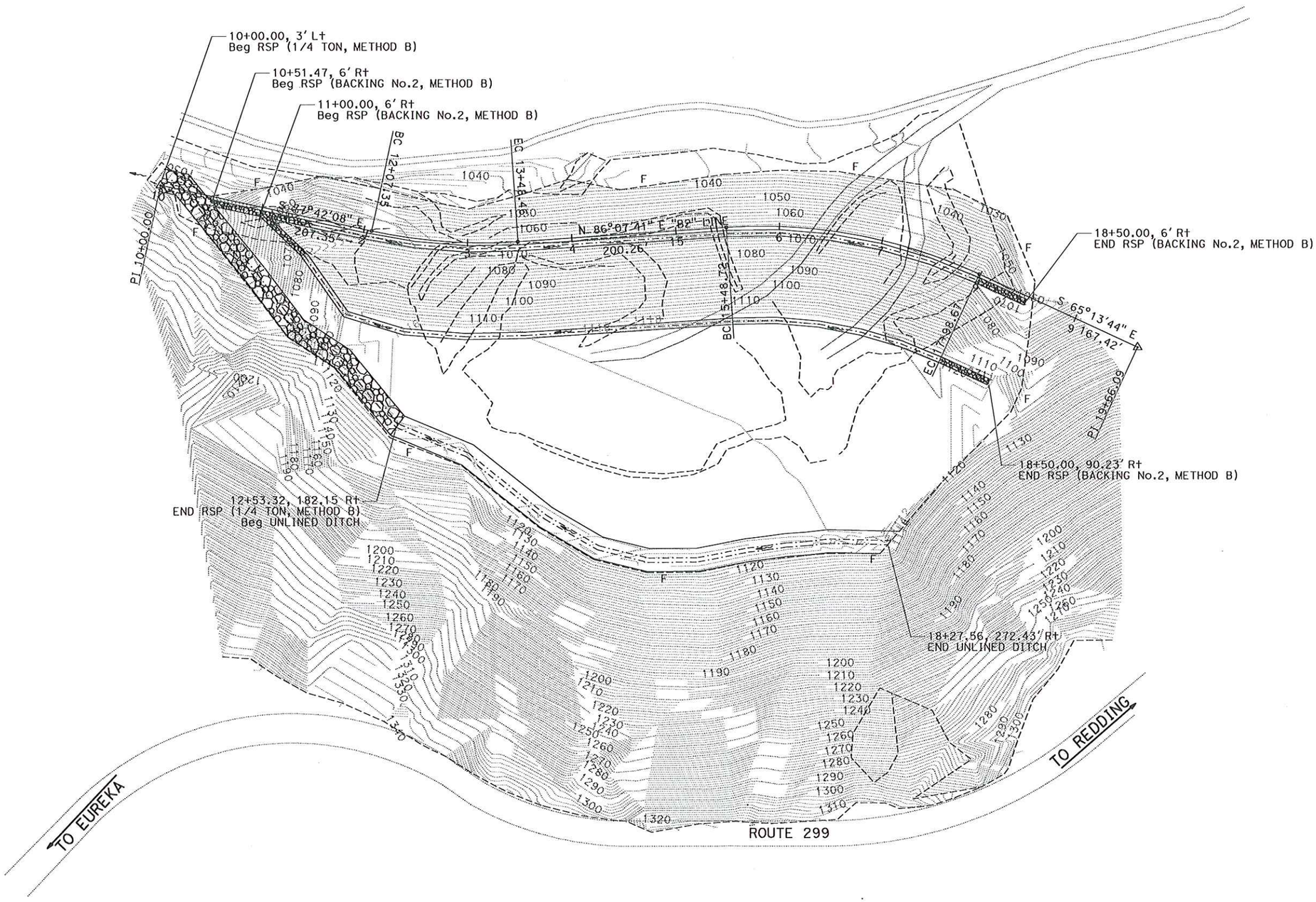

LAYOUT

SCALE: 1" = 50'

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REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY	SHAUN ALEXANDER
CHECKED BY	

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

DESIGN

FUNCTIONAL SUPERVISOR: AL TRUJILLO

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LAST REVISION 10-17-11

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TIME PLOTTED => 11:41

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DGN FILE => 3E820_Layout.dgn

CU 0316

EA 3E8201

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
02	Tri	299	36.6/36.8		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER SHAUN ALEXANDER No. C70833 Exp. 06-30-13 CIVIL STATE OF CALIFORNIA

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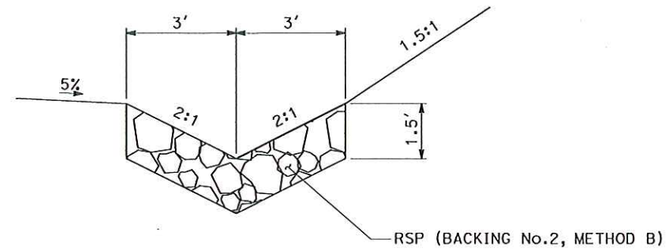

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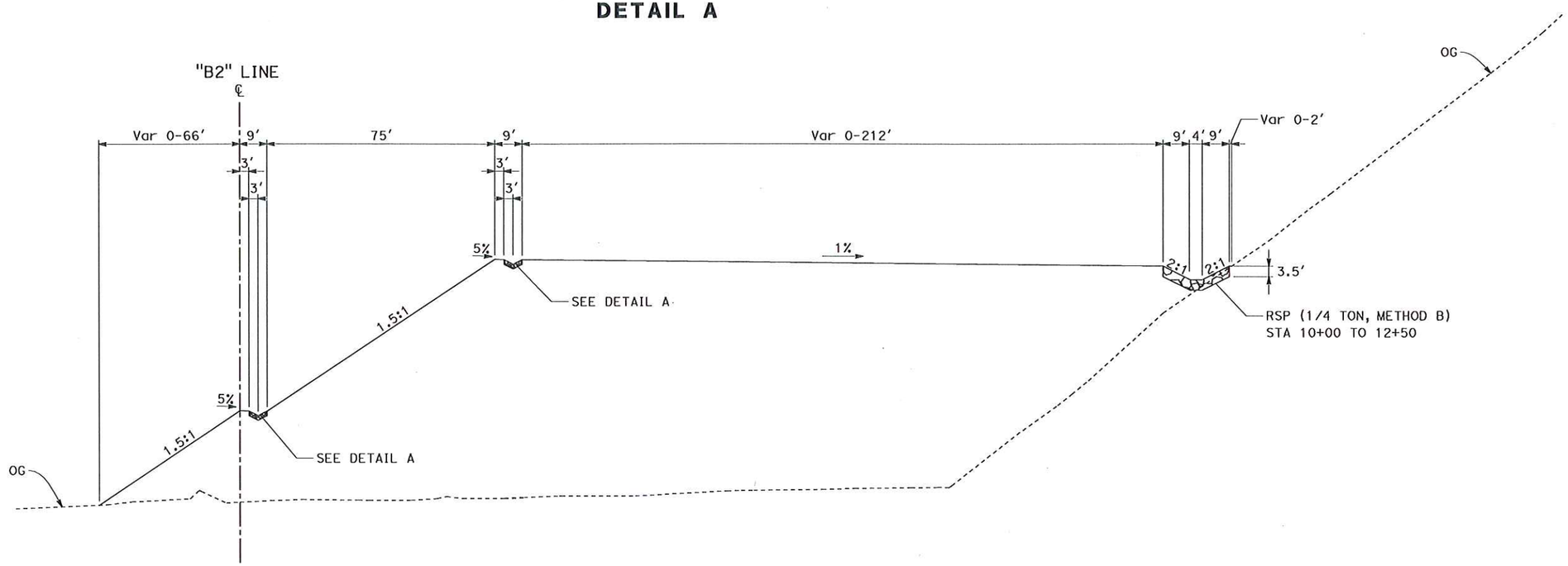

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TYPICAL CROSS SECTION

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans DESIGN

FUNCTIONAL SUPERVISOR: AL TRUJILLO

CALCULATED-DESIGNED BY: SOCORRO URENA

CHECKED BY: SHAUN ALEXANDER

REVISED BY

DATE REVISED

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LAST REVISION 10-17-11

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