# INFORMATION HANDOUT

**For Contract No. 02-4F7404**
**At 02-Tri-299-19.2/19.5**

**Identified by**
**Project ID 0213000021**

## MATERIALS INFORMATION

Foundation Report for Contract No. 02-2E2004

Soil Nail Wall @ PM 19.4

Wall #05E007

Geotechnical Design Report for Contract No. 02-2E2004

# MATERIALS INFORMATION

Foundation Report for Contract No. 02-2E2004

Soil Nail Wall @ PM 19.4

Wall #05E007

State of California

Business, Transportation and Housing Agency

# Memorandum

*Flex your power!*
*Be energy efficient!*

To: MR. JOSEPH DOWNING, CHIEF
Office of Bridge Design North
Structure Design
Division of Engineering Services MS9-4/8I

Date: March 15, 2011
File: 02-TRI-299-PM 19.4
02-2E2001
0200000204
Swede Cr. Superelevation
Retaining Wall @ PM 19.4
Wall # 05E0007

Attention: Mr. Joey Aquino

From: **DEPARTMENT OF TRANSPORTATION**
**DIVISION OF ENGINEERING SERVICES**
**Geotechnical Services – MS 5**
**Office of Geotechnical Design – North**

Subject: Revised Foundation Report for Retaining Wall #05E0007

## Introduction/Scope of Work

Per your request, we are providing Revised Foundation Recommendations report for State Highway 299 in southwestern Trinity County, California. This report supersedes the recommendations provided in the original Foundation Report prepared by our Office for this project dated October 5, 2010 for Soil Nail Retaining Wall (Wall# 05E0007). The proposed wall is to be constructed as a portion of the Swede Creek roadway widening project. This update is needed due to changes in the wall length and location to accommodate changes in design of the project. Changes in wall location and length were provided to us by the Office of Bridge Design North (OBDR). The Office of Geotechnical Design North, Branch C completed a subsurface investigation for this project during March and April 2010.

The following foundation recommendations are based on the subsurface information gathered during the subsurface investigation, and a review of the available Revised General Plan dated March 10, 2011 and subsequent e-mail correspondence. A copy of the Revised General Plan is attached.

## Project Description

The proposed new soil nail wall will be incorporated as part of the Swede Creek Roadway Widening Project located between Post Miles 19.2 to 19.6 along State Highway 299 in south western Trinity County, California. At the time of our investigation, Highway 299 consists of a two-lane roadway paved with asphalt concrete (AC). Highway 299 has two 11 foot wide travel ways with approximately 0 to 1 feet of paved shoulders in this region. Within the project area the highway is roughly aligned

east/west. The Trinity River parallels the south side of the highway. Overhead utility lines were not observed in the project limits and it is unknown if underground utilities are located within the project limits.

At the onset of this project District 3 Design originally planned to complete the proposed widening by completing cuts on the north side of the existing highway and placement of a Standard Plan Type 1 retaining wall between approximate project stationing 61+50 to 62+20. Due to the exposure of bedrock in the highway cut just west of the wall location, the District assumed that shallow bedrock would be encountered in the vicinity of the proposed wall location, therefore limiting the proposed height of the wall needed to complete the widening. During our Office's subsurface investigation for the proposed Standard Plan wall it was determined that the subsurface rock was significantly deeper than District Designs original assumptions which would significantly increase the height and cost of the proposed wall. At this time our Office recommended that since the District was already considering doing a minor cut for the proposed widening directly across from the proposed Standard Plan wall location that they may want to re-evaluate the alignment and complete all the necessary widening by cutting on the north side of the highway. At this time our Office also indicated that the existing cut slope on the north side of the highway between approximate project stationing 61+50 to 63+50 would likely not support a slope ratio steeper than 1:1 and should the District wish to utilize a steeper slope ratio that they consider use of a soil nail wall within these limits. Based on our recommendations, the District re-evaluation of the proposed alignment and the General Plan submitted to our Office by the Office of Structure Design, it is our understanding that District Design proposes to utilize the recommended soil nail wall that will be located on the north shoulder of the existing highway. In this report, the Stations are referenced from the "A1" Line shown on the General and Foundation Plans dated August 16, 2010. Table 1 summarizes the beginning and ending stations of the proposed soil nail wall with corresponding heights.

**Table 1. Proposed Soil Nail Retaining Wall**

| Retaining Wall Number | Station "LOL1" Line ("A1" Line) | | Offset to wall face from "A1" Line | | Length (ft) | Height (ft) |
|---|---|---|---|---|---|---|
| | Begin (ft) | End (ft) | Begin (ft) | End (ft) | | |
| N/A | 10+00 (60+60) | 12+69 (63+30) | 22.9 | 22.9 | 269 | 0.0-16.0 |

## Physical Setting

The physical setting of the project site and the surrounding area was reviewed to provide climate, topography and drainage, man-made and natural features, geology and seismicity, and soil survey characteristics to aid in project design and construction. The site itself is

located approximately 6.0 miles. northwest of the town of Big Bar, California along State Highway 299. The following is a discussion of the above review:

**Climate**

According to the National Weather Service, California Climate Normals for 1943-2009, the average annual precipitation in Big Bar area, which is located approximately 6 miles. southeast of the site, is about 37 inches. The average annual air temperature is approximately 56°F with average monthly extremes of 33°F in January and 97°F in July. Occasional snowfall has been known to occur within this area but usually does not stick to the ground.

**Topography and Drainage**

According to United States Geological Survey (USGS) 7.5 minute Topographic Map "Del Loma, Quadrangle" dated 1982 and observations in the field, the site is located in the gently to moderately rolling west trending Trinity River drainage valley with steep hill slopes bounding the north and south sides of the valley. The existing highway elevation in the project area is approximately 450 feet above mean sea level. The existing highway generally slopes down to the west. The east-west trending Trinity River is located on the south side of the existing highway and an unnamed drainage channel (Big Swede Creek) and Swede Creek are depicted on the map on the northern side of the highway in the approximate middle of the project limits.

**Man-made and Natural Features of Engineering and Construction Significance**

The current highway was constructed with both cuts and fills, and it is anticipated that the new alignment and widening will be constructed by cutting into the existing hillside on the northern side of the highway and the addition of minor fills on the south side to widen the highway. Cuts in the general vicinity of the project vary from approximately 1:1 to vertical. Fills in the general vicinity and on the south side of the project are variable from 1:1 to 2:1 (H:V).

Natural features at the site include the Trinity River, which is approximately east/west aligned. The area surrounding the highway consists of steeply sloping hillside topography. Vegetation in the general area consists of native grasses, weeds and poison oak, with moderate brush and conifer trees. The existing cuts are not vegetated and the vegetation on the fill slopes consists of grasses and small to large deciduous and conifer trees.

**Regional Geology and Seismicity**

According to the USGS geologic map "Geologic Map of the Klamath Mountains, California and Oregon", 1:500,000, W.P. Irwin, 1982, the site is approximately located on the boundary between Jurassic age, meta-andesite of the Hayfork Bally and Jurassic age mélange. The mélange contains volcaiclastic rocks, chert, tuff altered sandstone and limestone. Rock outcrops observed in the field compare favorably with those described on the map. More detailed mapping will be completed for the Geotechnical Design Report for this project.

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.

We utilized Caltrans ARS Online v 1.0.2 to determine the closest active fault to the project site. The program indicated the Mad River Fault Zone is located approximately 25 miles. west of the site. 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 7.2. The ARS results indicated that the maximum credible earthquake from this fault zone would result in a peak horizontal bedrock acceleration of approximately 0.3g at the site. Bedrock at the site is at or near the surface based on the field review.

**Field Exploration**

The Office of Geotechnical Design-North conducted a subsurface investigation between March and April 2010. The subsurface investigation consisted of advancing three mud rotary borings (Nos. R-10-101, R-10-102, and R-10-103) through the existing roadway section adjacent to the proposed wall location. The mud rotary borings were advanced using a self-casing wireline-diamond coring method extending to a maximum depth of 50 feet below ground surface. Sampling was achieved by retrieval of continuous core samples and Standard Penetration Tests.

The subsurface investigation revealed the site materials at the location of the proposed soil nail wall (Wall No. 05E0007) generally consist of approximately 20 to 40 feet of medium dense to dense, silty-sand/sandy-silts with gravel, cobbles and boulders underlain by moderately hard to hard, very intensely to closely fractured metamorphic rock (Granulite).

For subsurface data and boring locations, please refer to the Log of Test Borings. Log of Test Borings for site-specific information and conditions will be forwarded once completed.

**Laboratory Testing**

No laboratory tests were completed for this report.

**Seismic Data and Evaluation**

The project site is not located within any Alquist-Priolo Earthquake Fault Zones (EFZs) as established by the California Geological Survey. Based on the Department of Transportation (Caltrans) ARS Online v 1.0.2, the controlling fault for the site is the Mad River fault zone, located approximately 25 miles west of the site. This fault zone could produce a maximum credible earthquake of magnitude 7.2 and is made up of northeast dipping reverse faults. ARS analysis indicated that the maximum credible earthquake from this fault would result in a peak horizontal bedrock acceleration of approximately 0.3g at the site. Depth to bedrock should be considered near surface in the area of the proposed retaining wall for this project.

The potential for ground rupture hazard due to fault movement is considered low since no known active fault crosses the project site. The potential for liquefaction to occur is considered to be minimal at the project site.

**Groundwater**

At the time of our site investigation no seeps or wet locations were observed in the existing cut where the proposed wall will be located. A groundwater monitoring well was installed in Boring R-10-001 during our subsurface investigation. Groundwater was not encountered when measured on 10/5/10. Results of future groundwater measurements taken between now and the project RTL will be reported to the RE Pending File. Groundwater traveling through cracks and voids in the rock or at the soil/bedrock interface maybe encountered during the drilling process of the soil nails. It should be anticipated that chances of encountering groundwater during construction will increase if wall construction occurs during the wetter time of year, typically October through May in the area.

**Corrosion**

The Department considers the site to be corrosive to foundation elements if one or more of the following conditions exist for the representative soil and/or water samples taken at the site: Chloride concentration is greater than or equal to 500 ppm, sulfate concentration

is greater than or equal to 2000 ppm, or pH is 5.5 or less.

Our Office has reviewed corrosion test results completed by the District for this project. Soil samples were obtained for corrosion analyses at Post Mile 19.27 and tested in June 2009 for pH and Resistivity. Based on the result of the corrosion analyses, pH = 6.96, the site is considered non-corrosive.

**Soil Nail Wall Recommendations**

The following soil nail wall recommendations are based on the subsurface conditions encountered during our site exploration, existing site surface conditions, proposed District improvements, the project plans and cross-sections provided to our Office by District 2 Design, as indicated on the Revised General Plan dated March 14, 2011, provided by Mr. Joey Aquino with the Office of Bridge Design North (OBDN) and per e-mail correspondence dated March 14, 2011. A copy of the Revised General Plan provided to our Office is attached. Based on the Revised General Plan provided, the proposed soil nail wall will have a maximum vertical height of 16.0 feet.

The following design parameters were used for the wall analyses, using the SNAILWin 5.01 program. The minimum factor of safety is 1.5 with pullout controlling. Due to the lack of recovered subsurface material during the drilling operations, Slope W was utilized to obtain an equivalent phi and cohesion for the subsurface materials to be utilized in the SNAIL program. Phi and cohesion were obtained by modeling the existing slope and back calculating the subsurface soil properties for slope stability with a Factor of Safety of 1.1.

**Design Parameters:**

Phi = $40^{o}$
C = 50 psf
Gamma = 120 pcf

**Soil Nail Design Recommendations:**

Due to the length and varied height of the proposed wall, our Office recommends that the wall be divided into 3 zones rather than 2 zones as identified in the original Foundation Report for this project. Zone 1 should begin at LOL1 line Sta: 10+00 (A1 Line Sta: 60+60) and extend to LOL1 line Sta: 10+50 (A1 line Sta: 61+10). Zone 2 should begin at LOL1 line 10+50 (A1 line Sta: 61+10) and extend to LOL1 line 11+50 (A1 Sta: 62+10). Zone 3 should begin at LOL1 line Sta: 11+50 (A1 line Sta: 62+10) and extend to LOL1 line Sta: 12+69 (A1 line Sta: 63+30).

Between LOL1 line Sta: 10+00 to 10+07 and Sta: 12+52 to 12+69 our Office recommends one level of nails
Length of Nail = 18 feet
Inclination = $15^0$
Vertical Distance from top of cut to first level = 3 feet

Between LOL1 Line Sta: 10+07 to 10+17 and Sta: 11+92 to 12+52 our Office recommends two levels of nails
Length of Nail = 18 feet
Inclination = $15^0$
Vertical Distance from top of cut to first level = 2 feet
Vertical Distance from first level to second level = 3 feet

Between LOL1 Line Sta: 10+17 to 10+27 and Sta: 11+02 to 11+92 our Office recommends three levels of nails
Length of Nail = 18 feet
Inclination = $15^0$
Vertical Distance from top of cut to first level = 2 feet
Vertical Distance from first level to second level and vertical distance between each successive level = 3 feet

Between LOL1 Line Sta: 10+27 to 10+52 and Sta: 10+82 to 11+02 our Office recommends four levels of nails
Length of Nail = 18 feet
Inclination = $15^0$
Vertical Distance from top of cut to first level = 2 feet
Vertical Distance from first level to second level and vertical distance between each successive level = 3 feet

Between LOL1 Line Sta: 10+52 to Sta: 10+82 our Office recommends five levels of nails
Length of Nail = 18 feet
Inclination = $15^0$
Vertical Distance from top of cut to first level = 2 feet
Vertical Distance from first level to second level and vertical distance between each successive level = 3 feet

Horizontal Spacing = 5 feet maximum between all nails in each row

$Q_d$ = design pullout resistance = 1660 lbs/linear ft.

Reinforcing: #8 bars, 60 ksi
Punching Shear = 36 kips

**Test Nail Assemblies:**

Our Office recommends that the majority of the test nail locations be selected by the engineer in the field, as best suited locations are better identified during the excavation for the wall. Maximum Total Allowable movement for test nails shall conform to the recommended tolerances identified in the Standard Special Provision.

**General Notes to Designer and Resident Engineer**

1. The analysis for this wall assumed that the material behind the wall is free draining. Strip drains behind the wall are required to alleviate pore water pressure from surface/groundwater water that will likely migrate through fractures and voids within the rock/soil material behind the wall.

2. Our Office recommends that one verification nail for Zone 1 be placed between LOL1 line Stations 10+00 and 10+25 and the second verification nail be placed between Stations 10+25 to 10+50. For Zone 2 we recommend a verification nail be placed between LOL1 line Stations 10+50 to 10+80 and the second verification nail be placed between Stations 10+80 to 11+50. The verification nails for Zone 3 maybe placed anywhere with the Zone.

**Construction Considerations**

1. Depth to groundwater was not determined during the subsurface investigation. It should be anticipated that ground water will migrate in the fractures and voids within the native material during the wet season.

2. Difficult drilling conditions should be anticipated due to the presence of cobbles and boulders encountered within the subsurface materials at the site.

3. Caving hole conditions were encountered during our subsurface investigation, and should be anticipated during drilling of the soil nails due to predominately cohesionless soils encountered at the site.

**Project Information**

Standard special Provisions S5-280, "Project Information," discloses 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. *Log of Test Borings for Soil Nail Wall @ PM 19.4, Wall No. 05E0007.*

*Data and Information included in the Information Handout provided to the bidders and Contractors are:*

A. *"Foundation Report Update #1 for Retaining Wall #05E0007" 02-TRI-299 PM 19.4, dated March 15, 2011*

*Data and information available for inspection at the District Office:*

A. *None*

*Data and information available for inspection at the Transportation Laboratory:*

A. *12 boxes of Soil/Rock Cores*

The recommendations contained in this report are based on specific project information regarding structure location and dimensions that has been provided by the OBDN, Branch 3. If any conceptual changes are made during final project design, the Office of Geotechnical Design - North, Branch C should review those changes to determine if the foundation recommendations provided in this report are still applicable. Any questions regarding the above recommendations should be directed to Bill Webster at (916) 227-1041, or Douglas Brittsan (916) 227-1079.

PROFESSIONAL GEOLOGIST
W.P. WEBSTER
No. 2485
CERTIFIED
ENGINEERING
GEOLOGIST
Exp. 2-28-13
STATE OF CALIFORNIA

William Webster, CEG
Engineering Geologist
Office of Geotechnical Design-North

Douglas E. Brittsan, GE
Senior Transportation Engineer
Office of Geotechnical Design-North

Attachments

cc: OGDN
Mark_Willian@dot.ca.gov
Douglas Brittsan
RE Pending File/HQ/Caltrans/CAGov
Structure OE/HQ/Caltrans/CAGov
Chris Harvey/D02/Caltrans/CAGov - PM
Byron Berger/D02/Caltrans/CAGov - D2 DME

REGISTERED PROFESSIONAL E
DOUGLAS E. BRITTSAN
No. GE2459
Exp. 9/30/12
GEOTECHNICAL
STATE OF CALIFO

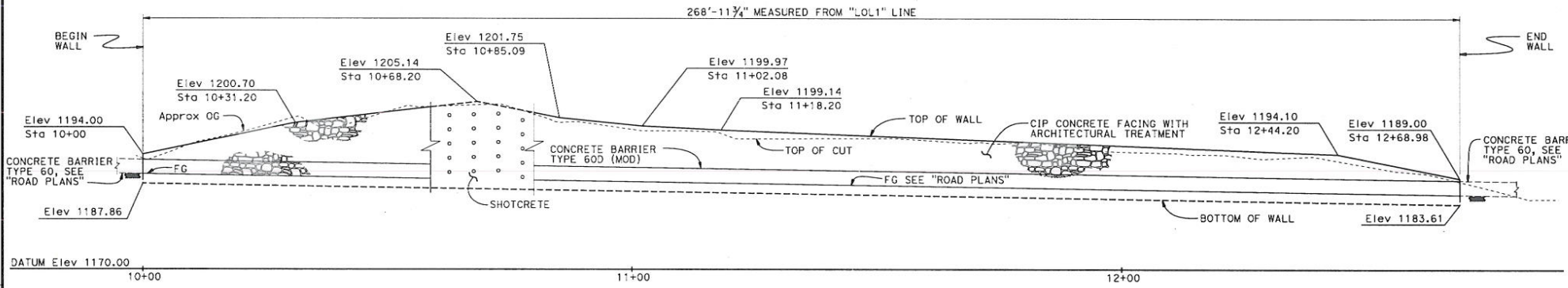
| DIST | COUNTY | ROUTE | POST MILES TOTAL PROJECT | SHEET No | TOTAL SHEETS |
|---|---|---|---|---|---|
| 02 | Tri | 299 | | | |

REGISTERED CIVIL ENGINEER X DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Jose W Aquino III — No. 58386 — Exp. 12-31-12 — CIVIL — STATE OF CALIFORNIA

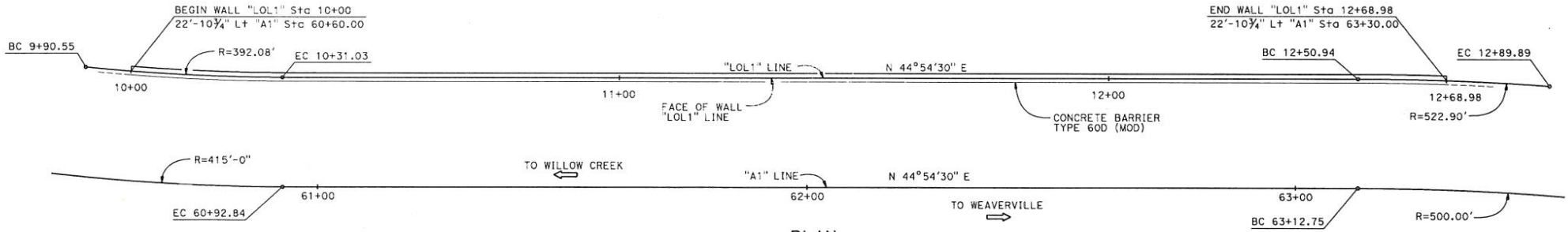
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.




## ELEVATION
1" = 10'

NOTES:
- ∘ Indicates Soil Nail

| "LOL1" Line | "A1" Line |
|---|---|
| R = 392.08' | R = 415.00' |
| Δ = 2°27'47" | Δ = 70°15'15" |
| T = 8.45' | T = 291.96' |
| L = 16.90' | L = 508.86'' |




## PLAN
1" = 10'

| "LOL1" Line | "A1" Line |
|---|---|
| R = 522.90' | R = 500.00' |
| Δ = 10°57'26" | Δ = 50°44'86" |
| T = 19.48' | T = 237.09' |
| L = 38.95' | L = 442.78'' |

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

Joseph E Downing
DESIGN ENGINEER

| | BY | CHECKED | LOAD FACTOR DESIGN | LIVE LOADING | | |
|---|---|---|---|---|---|---|
| DESIGN | Art V Herrera | Joey Aquino | | | | |
| DETAILS | Jay Reid | Joey Aquino | LAYOUT | Art V Herrera | | Joey Aquino |
| QUANTITIES | Joey Aquino | Art V Herrera | SPECIFICATIONS | Xiahong Li | PLANS AND SPECS COMPARED | Xiahong Li |

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES
STRUCTURE DESIGN
DESIGN BRANCH 3

CU 03-242
EA 2E2001
FILE => 02-2e2001-a-gp01.dgn

BRIDGE NO. 05E0007
POST MILE 19.2/19.6

DISREGARD PRINTS BEARING EARLIER REVISION DATES

| REVISION DATES | | | | | | | | | SHEET | OF |
|---|---|---|---|---|---|---|---|---|---|---|
| 5-25-10 | 7-22-10 | 8-16-10 | 9-29-10 | 9-30-10 | 10-4-10 | 10-1-10 | 3-2-11 | 3-10-11 | 1 | 18 |

# RETAINING WALL @ PM 19.4
# GENERAL PLAN NO. 1

STRUCTURES DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.07-24-06)

# MATERIALS INFORMATION

Geotechnical Design Report for Contract No. 02-2E2004

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:** MR. AL TRUJILLO
Safety Design Leader
District 2

**Date:** November 10, 2010

**File:** 02-TRI-299 PM 19.2/19.6
02-2E2001
0200000204
Swede Cr Superelevation

Attn: Mike Feakes

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

**Subject:** Geotechnical Design Report for Swede Creek Superelevation Project

## Introduction

Per your request, we are providing a Geotechnical Design Report (GDR) for State Highway 299 between PM 19.2 and PM 19.6, in Trinity County, California. Figure 1 depicts the approximate site location. At this location, re-alignment and widening of the existing highway is proposed.

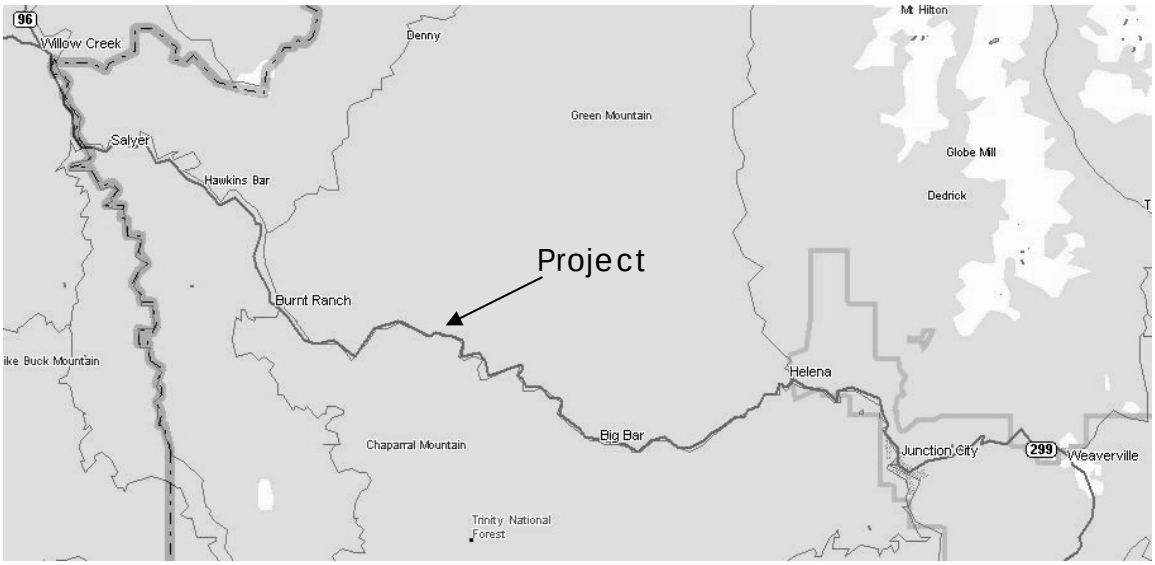



Figure 1. Map showing the project location.

This report includes a review of published data such as California Geologic Surveys (CGS) publications and United States Department of Agriculture (USDA) soil survey, a review of previous site explorations, and a site reconnaissance. A subsurface investigation was completed for portions of this project.

This report is intended solely for the purpose of roadway design elements and construction. Geotechnical recommendations for the soil nail wall has been provided to the Office of Structure Design under a separate cover "Foundation Report" by our Office.

This report is intended for use by the project roadway design engineers, construction personnel, and may be used by bidders and contractors.

**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 10 foot wide travel lanes with approximately 1 foot paved shoulders in this region. Several 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 and Big Swede Creek crosses beneath the highway in a box culvert at approximately PM 19.5. In addition, an existing pre-cast concrete crib wall is located at approximately PM 19.45 and an abandoned bridge structure at approximately PM 19.5. Overhead utilities were not observed in the area of the proposed re-alignment. Underground utilities were not located in the area cleared for our subsurface investigation by Underground Service Alert.

As stated above, this project involves re-alignment and widening of the existing highway. Proposed improvements include cuts, a soil nail wall and installation of rockfall protection measures on the north side of the highway.

**Pertinent Reports and Investigations**

The following documents were used in preparing this report.

a) Western Regional Climate Data Center http://www.wrcc.dri.edu/, October 2010.
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 "Del Loma, Quadrangle" dated 1982.
d) USGS, "Geologic Map of the Klamath Mountains, California and Oregon", 1:500,000, W.P. Irwin, 1982.
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, December 2009.

**Caltrans Reports**

The following Caltrans memorandums were reviewed for this report.

a) Memorandum, "Preliminary Geotechnical Report", 02-TRI-299 PM 19.2/19.6 dated December 17, 2009.
b) Memorandum, "Foundation Report for Retaining Wall #05E0007" 02-TRI-299 PM 19.4 dated October 5, 2010

**Physical Setting**

The physical setting of the project site and the surrounding area was reviewed to provide climate, topography and drainage, man-made and natural features, geology and seismicity, and soil survey characteristics to aid in project design and construction. The site itself is located approximately 6.0 miles northwest of the town of Big Bar, California along State Highway 299. The following is a discussion of the above review:

Climate

According to the National Weather Service, California Climate Normals for 1943-2009, the average annual precipitation in Big Bar area, which is located approximately 6 miles southeast of the site, is about 37 inches. The average annual air temperature is approximately 56°F with average monthly extremes of 33°F in January and 97°F in July. Occasional snowfall has been known to occur within this area but usually does not stick to the ground.

Topography and Drainage

Based on a review of the Del Loma Quadrangle, and observations in the field, the site is located in the gently to moderately rolling west trending Trinity River drainage valley with steep hill slopes bounding the north and south sides of the valley. The existing highway elevation in the project area is approximately 450 feet above mean sea level. The existing highway generally slopes down to the west. The east-west trending Trinity River is located on the south side of the existing highway and an unnamed drainage channel (Big Swede Creek) and Swede Creek are depicted on the map trending north/south and pass beneath the highway in the approximate middle of the project limits.

Man-made and Natural Features of Engineering and Construction Significance

The current highway was constructed with both cuts and fills, and it is anticipated that the new alignment and widening will be constructed by cutting into the existing hillside on the northern side of the highway and the addition of minor fills on the south side. Cuts in

the general vicinity of the project vary from approximately 1:1 to vertical. Fills in the general vicinity and on the south side of the project are variable from 1:1 to 2:1 (H:V).

Natural features at the site include the Trinity River, which is approximately east/west aligned. The area surrounding the highway consists of steeply sloping hillside topography. Vegetation in the general area consists of native grasses, weeds and poison oak, with moderate brush and trees. The existing cuts are not vegetated and the vegetation on the fill slopes consists of grasses and small to large deciduous and conifer trees.

## GEOLOGY

The project site is located in the south-central portion Klamath Mountains geologic province (Irwin, 1966). The Klamath Mountains province is an arc-shaped region, approximately 80 miles wide and 400 miles long, that straddles northwestern California and southwestern Oregon. The province is composed of several mountain ranges that include Siskiyou, Trinity, Trinity Alps, Scott, Scott Bar, Marble, South Fork, and Salmon Mountains. This area is a broad plateau, ranging in elevation from 5,000 to 7,000 feet, which has been deeply incised by the Smith, Klamath, Scott, Salmon, and Trinity Rivers. The Klamath Mountains are composed primarily Paleozoic and Mesozoic marine volcanic and sedimentary rocks. Ultramafic and granitic rocks compose a significant minority in the province. Structurally the province is composed of a series of eastward dipping thrust plates. From west to east the thrust plates are called: Western Jurassic plate, Western Paleozoic and Triassic plate, Central metamorphic plate, and Eastern Klamath plate. Figure 2 shows some of those features.

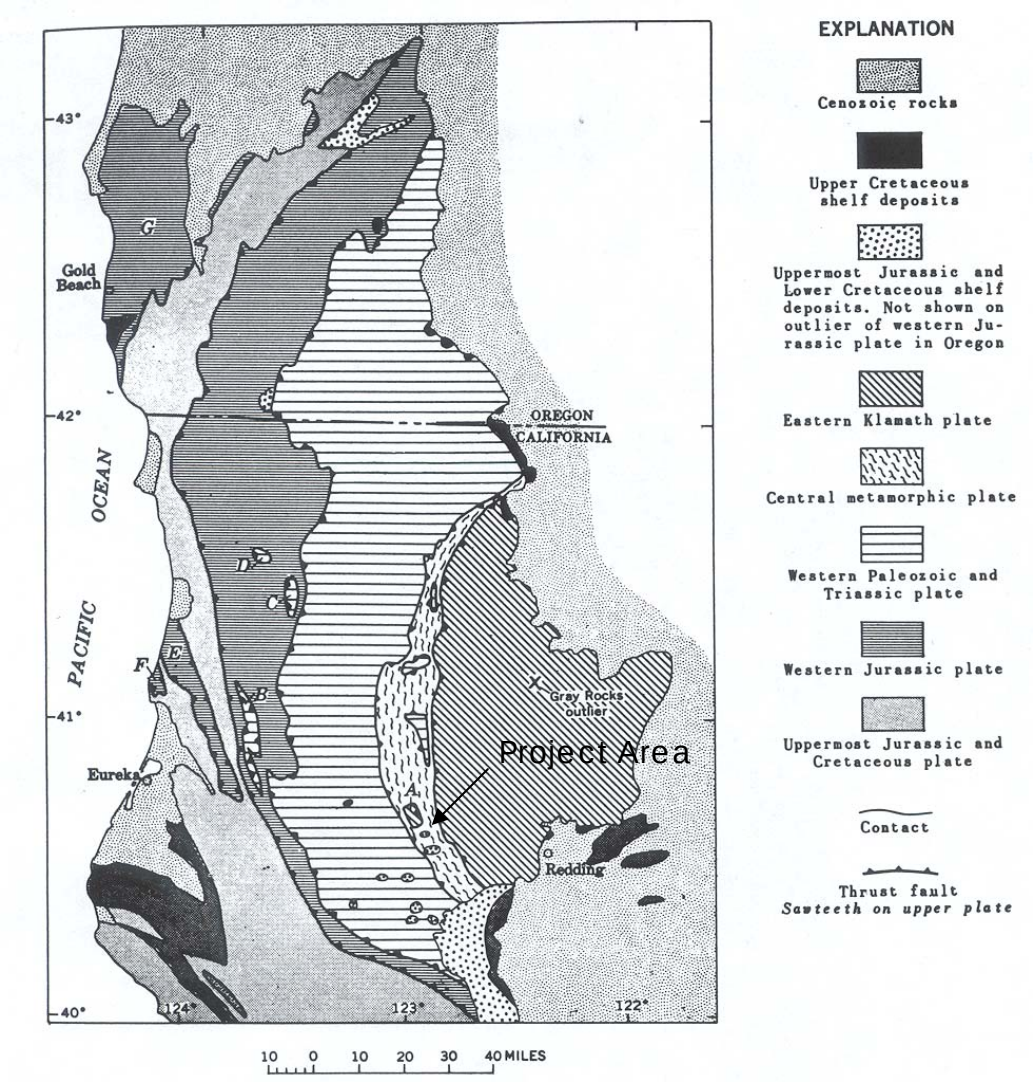
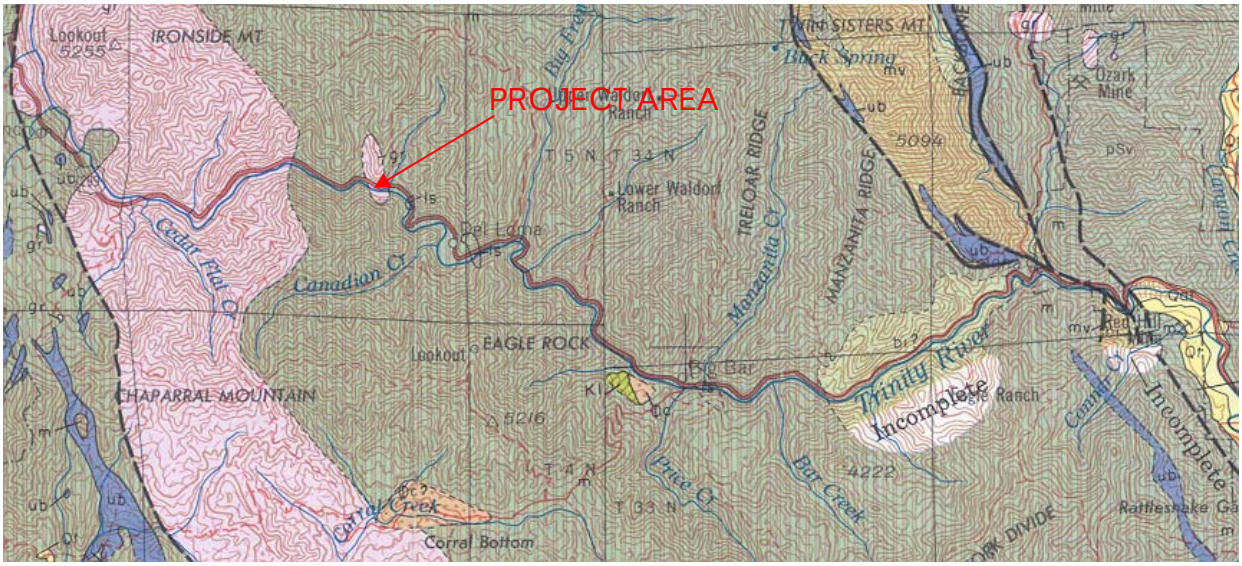



Figure 2. Map of Klamath Mountains geologic province ( after Irwin, 1966).

## REGIONAL GEOLOGY

The project area lies within Central Metamorphic plate of the Klamath Mountains geologic province (see Figures 2 and 3). The Salmon Hornblende Schist (map unit pSv) and the Abrams Mica Schist (map unit pSs) are the two main geologic units in this region (Irwin 1981). The Salmon Schist is the structurally lower unit and was formed from mafic volcanic rocks. The Abrams Schist was derived from sedimentary rocks (shale, sandstone and limestone). Lower Cretaceous marine sedimentary rocks (map unit Kl) of the Great Valley sequence were deposited on those schists (pSv and pSs). During Oligocene time nonmarine sedimentary rocks of the Weaverville Formation (map unit Oc) were deposited on the older rocks. During Quaternary time sand and gravel were deposited along present streams channels and the remnants of older stream terraces (map units Qal and Qt). During late Jurassic time granitic rocks of the Shasta Bally batholith

(map unit gr) intruded those rocks. Two major folds have been identified within the Central Metamorphic plate, a broad shallow syncline and anticline. As was mentioned previously the Western Paleozoic and Triassic plate, the Central Metamorphic plate and the Eastern Klamath plate are separated by eastward dipping inactive thrust faults.




EXPLANATION

| | |
|---|---|
| Qal – Recent Alluvium | Qt – Quaternary nonmarine terrace deposits |
| Oc – Weaverville Formation | ub – Mesozoic ultrabasic rocks |
| bi? – Mesozoic basic rocks | gr – Jurassic granitic rocks |

Kl – Lower Cretaceous marine rocks (Great Valley Sequence)
m – Undivided metamorphic rocks
pSv – Pre-Silurian metavolcanic rocks (Salmon Hornblende Schist)

Figure 3. Regional Geologic Map that includes Project Area (after Strand, 1962).

## SITE GEOLOGY

The rock at this site is red-brown to dark gray-green, moderately weathered to decomposed, intensely to moderately fractured, hard to very hard igneous (granite-gr), metavolcanic (Salmon Schist-pSv) and sedimentary rock (Abrams Schist-pSs). See the Regional Geologic Map shown in Figure 3. In the eastern 2/3rds of the project limits, bedrock is covered by variably thick layer of soil/colluvium and/or debris slide. Published geologic mapping (Irwin, 1963) of the area reviewed and it has no mapped outcrops of serpentinite at the site.

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.

Seismicity

We utilized Caltrans ARS Online v 1.0.2 to determine the closest active fault to the project site. The program indicated the Mad River Fault Zone is located approximately 20 miles west of the site. 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 7.2. The ARS results indicated that the maximum credible earthquake from this fault zone would result in a peak horizontal bedrock acceleration of approximately 0.3g at the site. Bedrock at the site is at or near the surface based on the field review.

National Resource Conservation Soil Survey

According to the United States Department of Agriculture *"Shasta-Trinity National Forest Area, Parts of Humbolt, Siskiyou, Tehama and Trinity Counties, California"*, 2007/2008, the site soils are mapped as Etsel Family and Rock outcrop Goulding Family.

*Etsel family*, 40-80 percent slopes. This soil consists of very gravelly loam derived from weathered metasedimentry rock. The soil is well drained. Surface runoff is slow and the erosion potential is slight (K factor 0.37). This soil has been assigned to Hydrologic Group D. Permeability is reported as 4-14 micro m/sec., pH is reported as 5.6-6.5 and corrosion information for this unit is not provided.

*Rock outcrop Goulding Family*, 60-80 percent slopes. This soil consists of a very thin veneer of very gravelly loam overlying weathered metasedimentary and volcanic rock outcrops. The soil is excessively drained. Surface runoff is slow and the erosion potential is slight (K factor 0.37). Corrosion potential is low with a pH of 6.1 to 6.5. This soil has been assigned to Hydrologic Group D. Permeability is reported as 4-14 micro m/sec., pH is reported as 6.6-7.3 and corrosion information for this unit is not provided.

**Field Investigation**

Site Visit

Mr. Bill Webster of this Office performed the field investigation for this project between March and April 2009, with subsequent work in October 2010.

The current alignment of the highway is roughly trends east/west. The current highway appears to be in good shape, extensive cracking or deformation of the highway pavement section was not observed within the project limits. The existing cuts and fills within the project limits appear to be performing adequately from a global stability perspective. However, rockfall appears to be generated from cuts within the western 2/3rds of the project limits. Existing cuts within the project limits range up to 80 feet in vertical height with slope ratios of 1:1 to near vertical. Existing fills within the project limits range up to

40 feet in vertical height. Fill slope ratios were observed to be 1:1 (H:V) or flatter. Soil observed in the fills appears to be comprised of silty-sand and/or sandy-silt with gravels, cobbles and boulders. Bedrock outcrops exposed within the project limits are comprised of igneous and metavolcanic rock. The existing fills are slightly too moderately vegetated with grasses, brush and small trees, the existing cuts within the project limits are not vegetated.

Based on a conversation with the Maintenance Supervisor of the Willow Creek Highway Maintenance Station, rockfall from the existing cuts is the only historic maintenance concern from a geotechnical standpoint within the proposed project limits.

Subsurface Exploration

Subsurface exploration was performed March 16-18, 2010 at the site to assess foundation conditions for the projects proposed standard plan wall. The Office of Geotechnical Design – North (OGDN) drilled two mud-rotary borings to define subsurface conditions. The two borings were drilled within the existing roadway adjacent to the anticipated "Wall" layout line. During the subsurface investigation it was determine that the proposed standard plan wall might not be feasible and an alternate alignment might be utilized by the District. Based on the potential changes or Office completed an additional investigation on April 12-14, 2010. The additional investigation consisted of drilling one mud-rotary boring on the north side of the existing alignment to determine subsurface conditions for a potential soil-nail or soldier-pile wall. The locations of these borings are shown on the Boring Location Map attached as Plate 3, as R-10-001 to R-10-003.

"Relatively undisturbed" samples were collected at various depths by advancing a "Standard Penetration Test" (SPT) sampler (1.4 inch O.D.) under a standard striking force weight (140 lb) dropped 30 inches. Materials obtained within the sampler and core barrel from the hole were utilized to visually classify the subsurface material encountered.

Subsurface Soil and Rock Conditions

Classification of the soil/rock at the site was based on visual observations of the existing cut slopes, material recovered in the SPT sampler and material recovered within the core barrel during the drilling process.

In the area of original proposed wall, the soils are generally classified as loose to medium dense, silty-sand with gravel, cobbles and boulders. Underlying the soil at depth (40 feet east end of original proposed wall and 60 feet west end) is intensely to moderately weathered and intensely to moderately fractured metavolcanic bedrock.

In the area of boring R-10-003, soils and bedrock encountered are the same as encountered in borings R-10-001 & 002; however the bedrock was encountered at a depth of approximately 20 feet.

Due to the drilling methods utilized for the borings determination of groundwater elevations at the time of drilling was not possible. However a standpipe pizometer was installed in boring R-10-001 for future measurement of groundwater elevations. Further detail regarding groundwater elevations is provided in the groundwater section of this report below.

Corrosion

Our Office has reviewed corrosion test results completed by the District for this and previous projects in the area. Soil samples were obtained for corrosion analyses from five locations between Post Miles 18.75 to 19.27 and tested in July 2007 and June 2009 for pH and Resistivity. Results of the test are provided in the table below.

| Post Mile | Date tested | pH | Minimum Resistivity (ohm-cm) |
|---|---|---|---|
| 18.75 | July 2007 | 5.9 | 5200 |
| 18.81 | July 2007 | 5.7 | 4700 |
| 18.83 | July 2007 | 6.9 | 7700 |
| 18.87 | July 2007 | 6.2 | 8000 |
| 19.27 | June 2009 | 7.0 | 7053 |

A site is considered to be corrosive if one or more of the following conditions exist for the representative soil: chloride concentration is 500 ppm or greater, sulfate concentration is 2000 ppm or greater, or pH is 5.5 or less. The minimum resistivity serves only as an indicator parameter for possible presence of soluble salts and is not included to define a corrosive site. It is the practice of the Corrosion Technology Branch that if the minimum resistivity of the sample is greater than 1000 ohm-cm, the sample is considered to be non-corrosive and testing to determine the sulfate and chloride content is not performed. Based on the results of the tests completed the site should be considered non-corrosive.

**Geotechnical Recommendations**

General

The District proposes to complete the shoulder widening and realignment with cuts, fills and the addition of a soil nail wall between project stationing 60+80 to 63+00. It should be noted that recommendations for the proposed soil nail wall has been provided to the Office of Structure Design under a separate cover “Foundation Report”.

Fills

Based on the project plans (dated 7/29/09) and cross-sections (dated 10/19/10) provided to our Office by District 2 Design, it is our understanding that minor fills typically 2 feet or less in thickness are proposed for this project. The proposed fills are to raise shoulder grades to match proposed final roadway elevations. Based on the cross-sections provided to our Office a slope ratio of 2:1 (H:V) or flatter is proposed by the District at each location. Based on the proposed slope ratio and limited thickness of the fills our Office does not anticipate geotechnical concerns with the proposed fills.

It is anticipated that native materials, not import, will likely be used to construct the proposed fill slopes. District Landscape Architecture should be consulted to provide erosion control recommendations.

Cuts

It is our understanding that several cuts into the base of the existing cut slopes will be required to complete the proposed project. The proposed cut locations and slope ratios are provided in the table below.

| Cut Location<br>Project Stationing | Maximum Height<br>Depicted on Cross-Sections (feet) | Maximum Width<br>Depicted on the Cross-Sections (feet) | District Proposed Slope Ratio<br>(H:V) |
|---|---|---|---|
| 56+00 – 56+25 | 6 | 1.5 feet | 0.25:1 |
| 56+75 – 57+00 | 9.5 | 0.5 | 0.25:1 |
| 57+75 – 58+75 | 35 | 4 | 0.25:1 |
| 59+50 – 60+00 | 18 | 2 | 0.25:1 |
| 60+50 | 23 | 1 | 0.25:1 |
| 64+75 – 65+00 | 21 | 6 | 1:1 |
| 69+00 – 70+00 | 18 | 6 | 0.5:1 to 0.25:1 |

The existing cuts in the areas of the proposed cuts are comprised of hard, closely to moderately fractured igneous and metavolcanic rock with slope ratios that vary from 0.5:1 to vertical and in some small areas are over hung. Based on the existing slope ratios being similar or steeper than the proposed slope ratios our Office does not anticipate the Districts proposed slope ratios will promote additional slope instabilities.

Based on the Districts proposed cut widths, all of the proposed cuts are considered sliver cuts, the District should be aware that sliver cuts are typically more difficult to construct that standard width cuts (>8 foot width). We recommend that the District Construction be consulted to provide input on construction methods for propose cuts.

Due to the presence of bedrock being exposed in many of the existing cuts, hard rock excavation techniques will be required to complete the proposed cuts. Due to the limited proposed cut widths and closely spaced fracturing within the existing rock, it is our opinion that there will be insufficient overburden to consider blasting as an alternative for hard rock excavation techniques. It is likely that use of a hoe-ram or other hard rock excavation technique would be the most productive method for constructing the proposed cuts in rock. The District should be aware that this method of constructing cuts in rock typically does not produce a uniform cut face and typically requires slightly additional material be removed to meet the proposed finish grades. Our Office recommends the District utilize an earth work volume of 1.05% for estimating purposes.

Standard Plan Retaining Wall

No Standard Plan Retaining Walls are proposed as a portion of this project. However, a Soil Nail Wall will be constructed on the north side of the highway between project stationing 60+80.68 to 63+00. Our Office has already provided a "Foundation Report" to the Office of Structure Design for the proposed wall.

Slide Potential

The presence of shallow-seated and/or deep-seated slides was observed in the project. During our field investigation we identified an area that appears to be a dormant debris slide. Limited field mapping of the presumed slide was completed and is depicted on the aerial photo in Figure 4 below. Our Office considers the area identified as "Dormant Debris Slide" as being globally stable in its current configuration. Based on our recommendation, the District is utilizing a soil nail wall to mitigate removal of material from the base of the slope mapped as debris slide to perform the roadway widening required. It is our opinion that the slope will be globally stable after widening and installation of the soil nail wall is completed. However, small failures in the form of sheet rills, slope wash, erosion gullies and differential erosion are anticipated in the remaining 1:1 cut above the soil nail wall. It is anticipated that this slope erosion will generate rockfall from the slope above the wall in the slide area that will need to be mitigated. Mitigation recommendations for rockfall in this area are provided in the "Rockfall" recommendations section below.

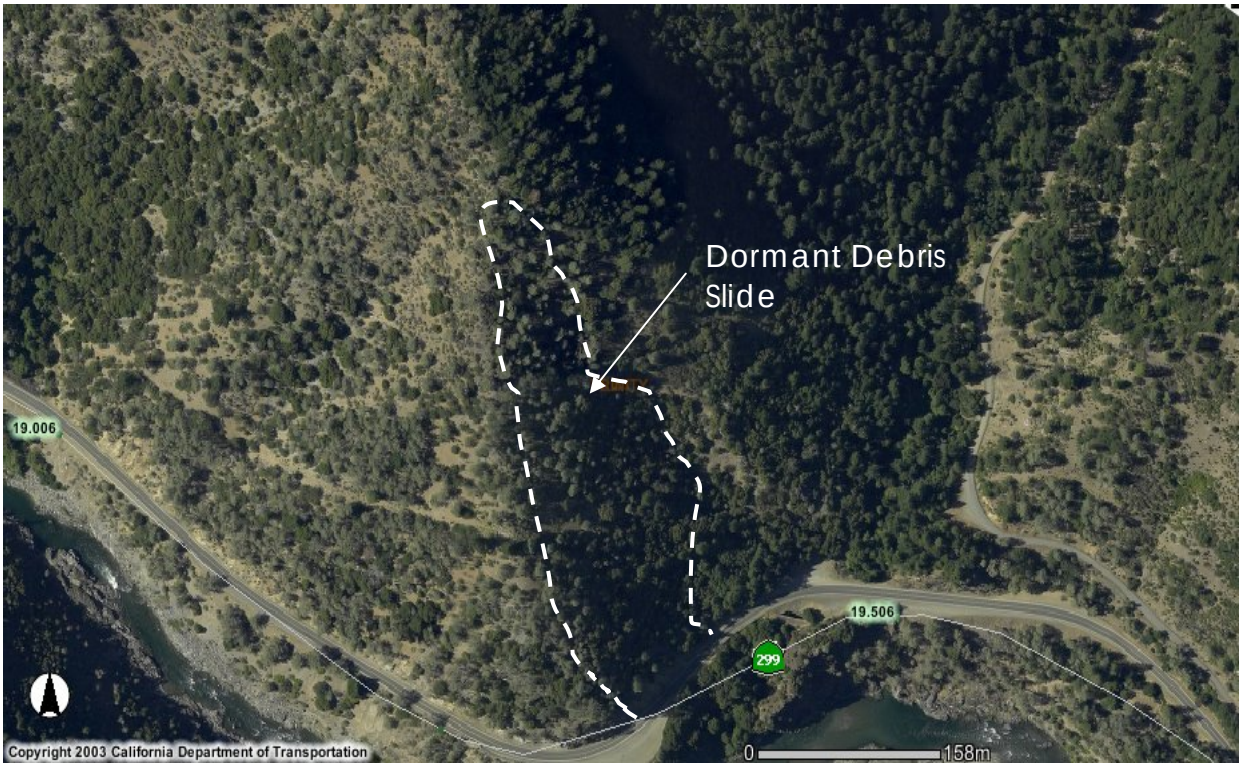



Figure 4. Aerial Photo that includes Project Area. Dashed line denotes approximate Dormant Debris Slide Limits

Rippability

Based on our subsurface investigation and observations in the field the existing native surface materials are comprised of soil and/or bedrock. Bedrock exposed within the project limits consists of variably weathered, moderately hard to hard igneous and metavolcanic rock that is closely to moderately fractured. It is anticipated that this rock material will be encountered in excavations for proposed cuts between project stationing 56+00 to 63+70 and 68+80 to70+00. Based on fracture spacing within the exposed rock cut faces it is our opinion that this rock material is rippable but will pose difficulty for smaller conventional equipment and will likely require hard rock excavation techniques.

Soils exposed within the project limits consist of silty-sands/sandy-silts with gravel, cobbles and boulders. Based on field observations we estimate that the existing soil slopes consist of 35-45% boulder size material. It is anticipated that this soil material will be present in excavations for proposed cuts between project stationing 63+70 to 65+00. It is our opinion that this soil material will be rippable utilizing conventional excavation equipment.

Rockfall

During our field investigation and per conversation with the area Maintenance Supervisor, rockfall reaches the existing travel lane from the cut slopes on the north side

of the highway between the approximate project stationing 57+50 to 63+20. Rockfall between Sta: 57+50 to 60+50 has an average block size of 6-8 inches in diameter, and is due to the moderate spaced fracturing in the rock exposed in the cut face. Rockfall between Sta: 60+50 to 63+20 has an average block size of 1 foot with occasional blocks up to 3 feet in diameter and is due to differential erosion, where sub-rounded to rounded boulders are exposed and roll down the slope as the silty-sand matrix is weathered from the slope face.

Our Office recommends that Double Twisted Wire Mesh (DTWM) drapery be placed on the slope to assist with managing rockfall in both zones identified above. Between project stationing 57+50 to 60+80 we recommend that the DTWM extend from a minimum of 15 feet beyond the top of the existing cut down to an elevation of 5 feet above the proposed finish grade of the highway. Between project stationing 60+80 to 63+00 we recommend that the DTWM extend from a minimum of 15 feet beyond the top of existing cut down to the top of wall elevation for the proposed soil nail wall.

If District opts to include these rockfall mitigation recommendations as a portion of this project our Office should be contacted to provide the Non-Standard Special Provision (nSSP) for the project specifications. In addition, our Office is available to assist with the development of the project plans for the DTWM.

Settlement/Expansive Soils

Based on the granular nature of the soils and rock to be excavated settlement and/or soil expansion will likely not be a concern for utilization of this material for the proposed project fills.

Groundwater

The table below represents groundwater level measurements completed on the open standpipe piezometer installed Boring R-10-001 which extends to a depth of 60 feet below existing roadway surface (elevation 1126).

| Date Measured | Depth to Water |
|---|---|
| 10/5/10 | Not Encountered |

No seeps were observed in the existing cuts or fills and water was not observed flowing in the roadway drainage areas during any of our field visits. Our Office does not anticipate groundwater will be encountered in any cut slope excavations or in temporary excavations for the proposed soil nail wall, provided construction is completed during the dryer time of year, typically May-October. Water was observed flowing in Swede Creek and Trinity River during all field work. Groundwater elevations will vary depending on the time of year, annual rainfall levels, and water elevations within surrounding

drainages, rivers, creeks and streams.

As previously noted, an open stand-pipe ground water monitoring well was constructed at the location of boring R-10-001. We recommend that the ground water monitoring well be abandoned at the end of the project. Abandonment can either be completed by the contractor as a portion of the contract or our Office maybe contacted to complete the abandonment. Should the our Office be utilized to complete the abandonment, an additional 100 hours should be resourced to the for unit 59-322 and an additional 40 hour resourced to unit 59-323 for activity 270.

Temporary Excavations

Temporary excavations will be required for the proposed Soil Nail Wall. It is our opinion that the temporary cuts for the proposed wall can be excavated utilizing conventional excavation methods.

**Proposed Future Investigations**

No other fieldwork is proposed at this time. If the project scope changes, such as adding additional retaining walls, changing the highway alignment, etc., other areas of the project may need to be revisited.

**Project Information**

Standard special Provisions S5-280, "Project Information," discloses 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. Log of Test Borings for Soil Nail Wall @ PM 19.4,
   Wall No. 05E0007.

*Data and Information included in the Information Handout provided to the bidders and Contractors are:*

A. "Foundation Report" for Retaining Wall @ PM 19.4, Wall No. 05E0007, dated September 16, 2010
B. "Geotechnical Design Report" for Swede Creek Superelevation Project, dated November 10, 2010

*Data and information available for inspection at the District Office:*

B. "Geotechnical Design Report" for Swede Creek Superelevation Project, dated November 10, 2010

*Data and information available for inspection at the District Office:*

*A. None*

*Data and information available for inspection at the Transportation Laboratory:*

*A. 12 boxes of Soil/Rock Cores*

The recommendations contained in this report are based on specific project information regarding project plans and cross-sections that has been provided by the District 2 Design. If any conceptual changes are made during final project design or during construction, the Office of Geotechnical Design - North, Branch C should review those changes to determine if the recommendations provided in this report are still applicable. Any questions regarding the above recommendations should be directed to Bill Webster at (916) 227-1041, or Douglas Brittsan (916) 227-1079.

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