

GEOTECHNICAL DESIGN REPORT

Lee Vining Rockfall Safety Project in Mono County near Lee Vining from 0.4 mile north of
National Forest Visitor Center Road to 0.7 mile north of Picnic Grounds Road

09-Mno-395 PM 52.3/53.7

EA: 09-33501

EFIS: 0900020002

June 25, 2012

Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design – North
Branch E

Memorandum

*Flex your power!
Be energy efficient!*

To: CEDRICK ZEMITIS
Project Manager
District 9 - Design

Attention: Cory Freeman

Date: June 25, 2012

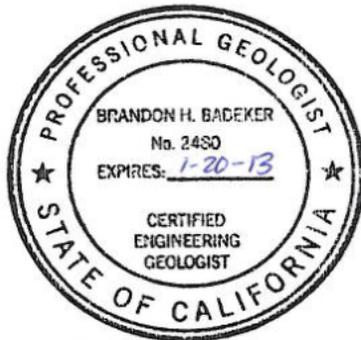
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PM 52.3/53.7
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Project ID. 09 0002 0002
Lee Vining Rockfall

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

Subject: Geotechnical Design Report

As requested, the Office of Geotechnical Design North (OGDN) is providing a District Geotechnical Design Report for the proposed Lee Vining Rockfall Safety Project on Highway 395 in Mono County, between postmiles 52.3 and 53.7, north the town of Lee Vining.

If you have any questions or comments, please call me, Brandon Badeker, at (916) 227-1046 or my supervisor, John Huang, at (916) 227-1037.



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1. Introduction

As requested, the Office of Geotechnical Design North (OGDN) is providing a District Preliminary Geotechnical Report for the proposed project on Highway 395 in Mono County, between postmiles 52.3 and 53.7, near the town of Lee Vining. The project is located adjacent to the westerly shore of Mono Lake. There is recurring rock fall at six locations along the alignment. It is proposed to grade slopes 1 through 3 at 2: 1 (h:v) or flatter. It is recommended that Slope 4 be draped with a double twisted wire mesh (DTWM) drapery. Attenuator systems consisting of DTWM over cable net drapery is anticipated for Slopes 5 and 6. No shoulder widening is anticipated.

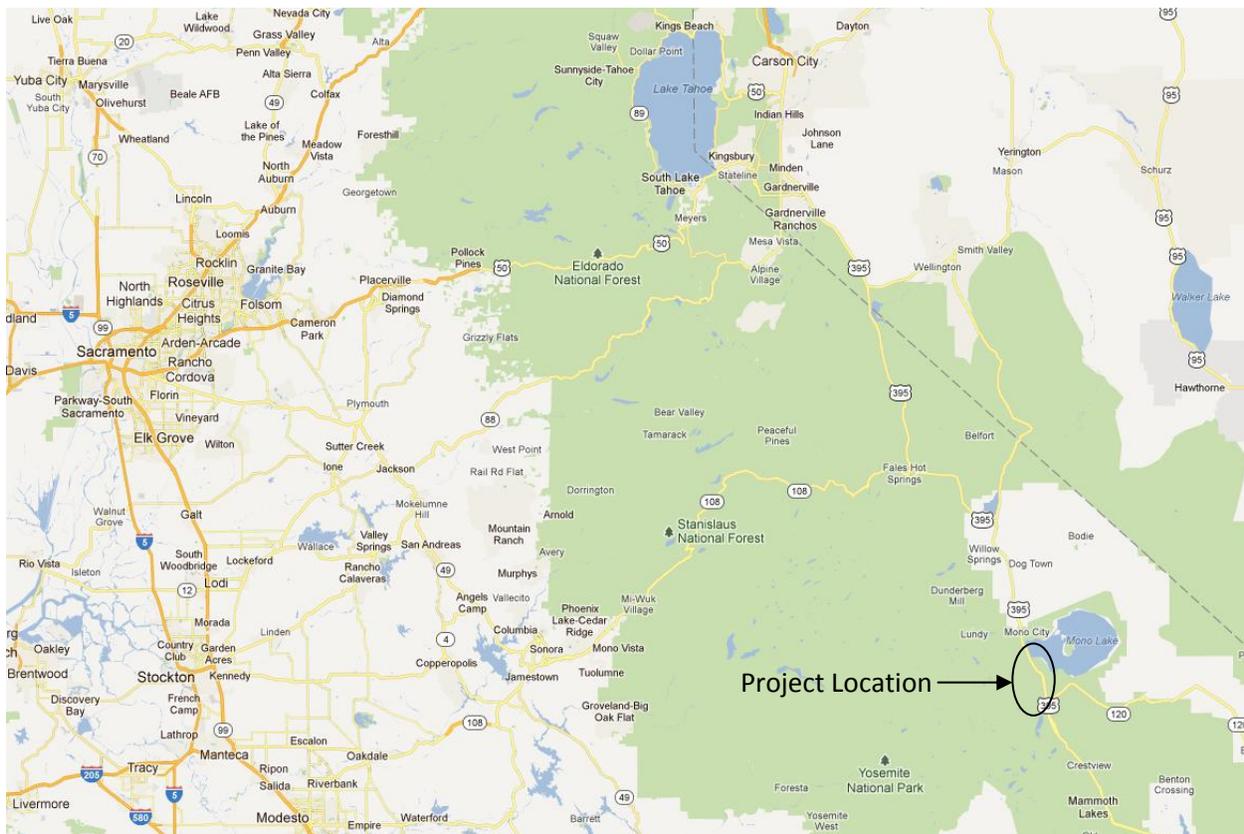


Figure 1: Vicinity Map showing the location of the Lee Vining Rockfall Safety Project, adapted from Google Maps, 2012.

2. Existing Facilities and Proposed Improvements

Highway 395 in this area trends north south, is constructed of two, twelve-foot lanes and one to four-foot paved shoulders and four to six-foot unpaved shoulders. The highway was constructed on a cut/fill in this section with the existing cut slopes graded at with a maximum vertical height of 70-feet. The fill slopes were graded at with a maximum vertical height of 20-feet. The cut slopes are covered with about 20 to 30% vegetative cover. Loose, fine material consistently erodes from the slope, undermining larger blocks of intact rock.

Slope 1 is located at PM 52.39, and begins at Station 114+90 and extends to Station 117+40. The slope lies at an angle of 1:1 (h:v) with a vertical height of about 25-feet to the hinge line. The slope then continues at 1.5: 1 to 2:1 (h:v). The length of the slope is about 250-feet parallel to the roadway. The rocks at this location are typically about 8-inches to 2-feet in diameter.



Figure 2: Photograph looking to the northwest showing Slope 1.

Slope 2 is located at PM 52.50. It begins at Station 120+60 and extends to Station 123+ 10 The slope lies at an angle of 1:1 with a maximum height of 25-feet and a length of about 215-feet along the roadway. The slope then continues at 1.5:1 to 2:1 (h:v) further west. The rocks at this location are typically 6-inches to 1.5-feet in diameter.



Figure 3: Photograph looking to the northwest showing Slope 2.

Slope 3 is located at postmile 52.93 and extends from Station 143+05 to 145+80. The slope lies at an angle of 0.75 :1 to 1:1 (h:v) with a maximum height of about 33-feet and a length of 260-feet. The slope then continues at 1.5:1 to 2:1. The rocks at this location are typically 8-inches to less than two-feet in diameter.



Figure 4: Photograph looking to the northwest showing Slope 3.

Slope 4 is located at postmile 53.05, north of the marina turn off. The slope extends from Station 149+90 to Station 159+95. The slope is currently at a ratio of 1:1 with a maximum height of 40-feet and a length of about 1000-feet. The slope then continues at 1.5:1 to 2:1 further west. The rocks at this location are typically 8-inches to 2-feet in diameter.



Figure 5: Photograph looking to the southwest showing Slope 4.

Slope 5 is located at postmile 53.30 and extends from Station 163+20 to 171+20. The slope lies at an angle of about 0.5: 1 to 0.75: 1 (h:v) with a maximum height of about 70-feet and a length of about 800-feet. The slope then continues at 1.5:1 to 2:1. The rock observed at the ground surface at this location is typically 8-inches to over 2-feet in diameter.



Figure 6: Photograph looking to the southwest showing Slope 5.

Slope 6 is located at postmile 53.59 and lies between Stations 175+60 and 179+00. The slope lies at an angle of 1:1 with a maximum height of 60-feet and a length of about 340-feet. The slope then continues at 2: 1(h:v). The rocks at this location are typically 18- inches to greater than four-feet in diameter.



Figure 7: Photograph looking to the north showing Slope 6.

3. Pertinent Reports and Investigations

In preparing of this report, following documents were reviewed:

- Bailey, R.A., 1989, Geologic map of Long Valley Caldera, Mono-Inyo Craters Volcanic Chain and Vicinity, Eastern California: U.S. Geological Survey, Miscellaneous Investigations Series Map I-1933, scale 1:62500.
- Western Regional Climate Center for 1988-2010
- USGS Topographic Map of the Mount Dana 7.5' quadrangle, 1 :24,000,1994
- USGS Topographic Map of the Lee Vining 7.5' quadrangle, 1 :24,000,1994
- Web Soil Survey, <http://websoilsurvey.nrcs.usda.gov> , United States Department of Agriculture
- Department of Water Resources, Water Data Library, <http://www.water.ca.gov/waterdatalibrary/>

4. Physical Setting

The physical setting of the project site and the surrounding area was reviewed to provide climate, topography and drainage, geology and seismicity characteristics to aid in preliminary project design and construction planning. The following is a discussion of our review:

4.1 Climate

According to the Western Regional Climate Center for the time period between 1988 and 2010, the average annual precipitation at the Lee Vining Station is about 14.50 inches. The majority of this precipitation (over 60 percent) falls between November and May. The average annual snowfall is 70.5 inches with the majority of the snowfall occurring between November and March. Average annual snow depth is one-inch. A maximum average for snow depth of 7-inches occurs during January. The annual maximum temperature is approximately 61.50 F and the average annual minimum temperature is 35.30 F. The station recorded the highest average daily maximum of 84.30 F in July and the lowest average daily minimum of 19.6° F in January.

4.2 Topography & Drainage

According to the USGS topographic map of the Mount Dana and Lee Vining 7.5 minute quadrangles (1994), the project site lies at an elevation of about 6500 feet above mean sea level as indicated by a bench mark to the east of the site. The overall topography is relatively flat-lying around Mono Lake but became moderately to very steep towards the west in the Sierra Nevada. The map indicates that Mono Lake lies to the east of the project site, and the town of Lee Vining is to the south of the project location. The National Forest Scenic Area Boundary lies to the south of the project. A copy of the topographic map is included as Figure 8. Regional drainage is to the east, towards Mono Lake.

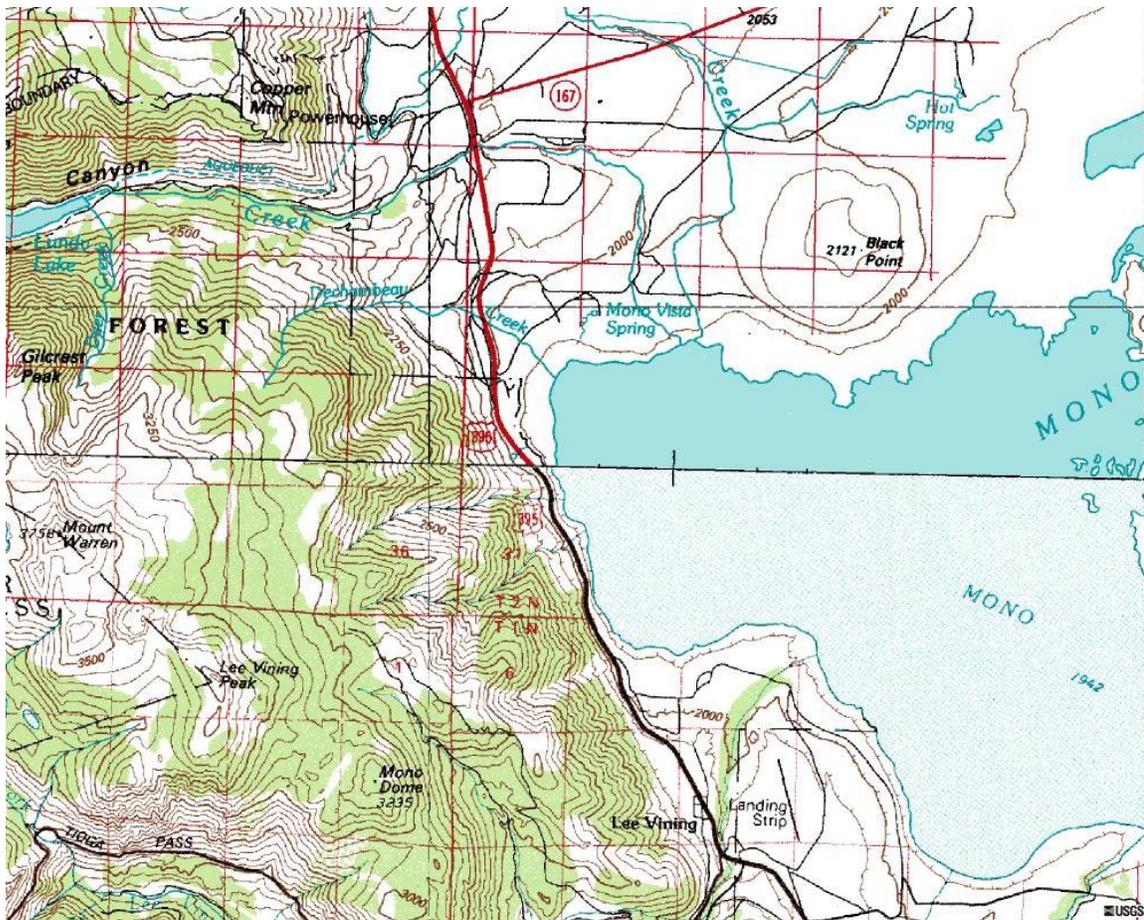


Figure 8: A portion of the Topographic Maps of the Mount Dana and Lee Vining Quadrangles, USGS, 1994.

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

Mono Lake and its associated tufa towers are considered a natural resource that cannot be disturbed.

4.4 Regional Geology and Seismicity

The project site lies at the interface between the Sierra Nevada Geomorphic province and the Basin and Range Geomorphic province. The Sierra Nevada Geomorphic Province is dominated by granitic rocks of Mesozoic age that intruded the overlying sedimentary deposits, and pushed up the existing Sierra Nevada Mountain Range through a series of orogenic mountain building events. The area is tectonically in a compressional regime.

The Basin and Range Geomorphic Province is typified by tectonic extension, creating a topography of linear, parallel, ridges and valleys, termed horsts and grabens.

According to the Geologic map of the Long Valley Caldera, Mono-Inyo Craters Volcanic Chain and Vicinity, Eastern California (USGS, 1989) the site is underlain by Quaternary

lake deposits (Qlt). A section from this map showing the project location is attached as Figure 9.

The map shows the Lee Vining Fault trends parallel to the Highway. According to Caltrans ARS online, the fault has been renamed to the Mono Lake Fault. The Mono Lake Fault is a normal fault with a maximum moment magnitude (MMax) of 6.6.

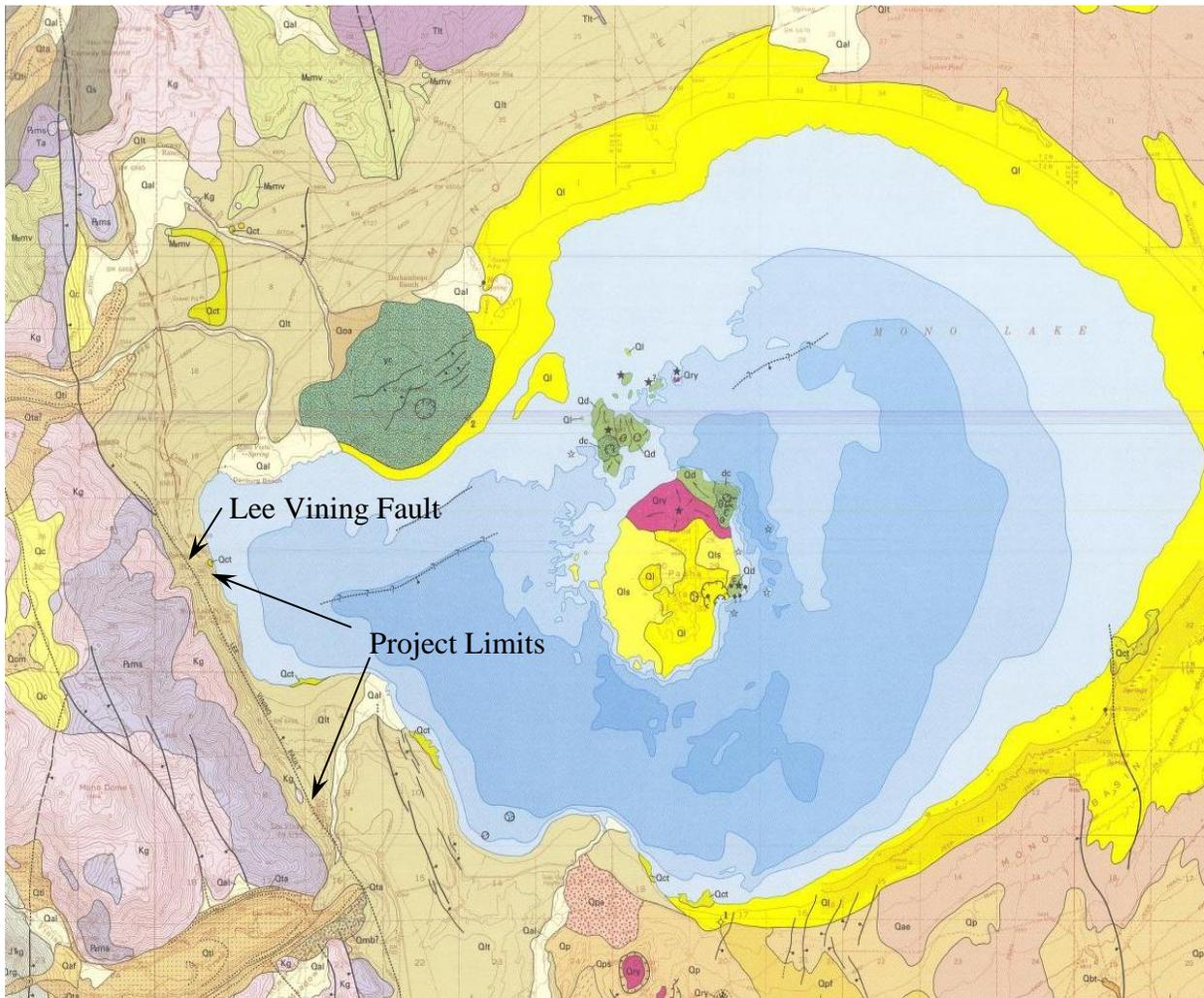


Figure 9: A portion of the “Geologic Map of Long Valley Caldera, Mono-Inyo Craters Volcanic Chain and Vicinity, Eastern California”.

SURFICIAL DEPOSITS

Alluvial, lacustrine, and hot-spring deposits

Qal	Younger alluvium (Holocene) —Unconsolidated silt, sand, and gravel deposited by actively aggrading streams; includes meadow and marsh deposits
Qt	Talus (Holocene) —Angular rock debris forming steep cones and ramparts mainly at base of cliffs
Qc	Colluvium (Holocene) —Loose heterogeneous detritus and soil accumulated by slopewash and other mass-wasting processes; locally includes reworked Holocene pumice and ash-fall deposits
Qls	Landslide deposits (Holocene) —Restricted to Paoha Island in Mono Lake; lacustrine sediments affected by landslide and earth flow, caused by uplift during emplacement of subjacent rhyolite cryptodome
Qaf	Alluvial fan deposits (Holocene and Pleistocene) —Coarse sand and gravel forming fans and moderately steep alluvial cones
Qae	Aeolian deposits (Holocene and Pleistocene) —Dune and windblown deposits composed predominantly of sand, ash, and fine pumice clasts; formed mainly by aeolian redeposition of ash and pumice lapilli from unconsolidated parts of the Bishop Tuff and pyroclastic deposits of Mono-Inyo Craters; occur mainly around southeastern and northeastern shores of Mono Lake and in northern parts of Cowtrack and Glass Mountain quadrangles
Ql	Lacustrine sediments (Holocene and Pleistocene) —Light-grayish-tan to buff, thin-bedded silts and clays containing numerous interbeds of white diatomite and basaltic, quartz-latic, and rhyolitic ash, mainly from local sources; occur in Long Valley as deposits of Pleistocene Long Valley Lake (Mayo, 1934) and on Paoha Island as deposits of Pleistocene Mono Lake (Lake Russell), where they underlie Wilson Creek Formation of Lajoie (1968, 1969); also includes lake-bottom oozes recently exposed along receding shoreline of Mono Lake. Also includes lake beds of uncertain age in Adobe Valley. Long Valley deposits attain as much as 300 m thickness in drill holes and are estimated to range in age from about 700 ka to 100–50 ka; Paoha Island deposits are about 100 m thick and are estimated to range in age from at least 170 ka to about 25 ka (Lajoie, 1968)
Qoa	Older alluvium (Pleistocene) —Stream deposits undergoing erosion and dissection; includes most late Pleistocene glacial outwash and related periglacial sediments
Qit	Lake terrace deposits (Pleistocene) —Lake terrace gravels, deltaic deposits, and interbedded fluvial and lacustrine sediments surrounding Mono Lake; as mapped, includes Wilson Creek Formation of Lajoie (1968, 1969); approximately coeval with Wisconsin age glaciations; maximum exposed thickness 70 m in Rush Creek
Qet	Travertine and calcareous tufa (Pleistocene) —Travertine hot-spring deposits, commonly located on faults, and calcareous tufa, deposited mainly along former shorelines of Pleistocene Long Valley Lake and around shores of Mono Lake
Intermediate to mafic rocks	
Qd	Dacite (Holocene) —Sparsely porphyritic dacite to rhyodacite lava flows and cinder cones (dc) on Paoha and Negit islands, typically containing small phenocrysts of plagioclase and hypersthene, and less commonly hornblende and biotite; paleoshoreline and tephra studies (Stine, 1984) suggest ages that range from about 2,000 yr B.P. to possibly less than 220 yr B.P.
Qyb	Younger basalt (Holocene and Pleistocene) —Dark scoriaceous trachybasalt flows and associated cinder cones (yc) containing conspicuous plagioclase and olivine phenocrysts; includes Red Cones, two cinder cones and associated lava flows that postdate Tioga glaciation, and nonglaciated flows near Pumice Butte in Devils Postpile quadrangle; also includes Black Point, a terraced cinder cone on northwest shore of Mono Lake in Bodie quadrangle, formed by subaqueous eruptions about 13,000 yr B.P. during a higher stand of lake (Lajoie, 1968)
Qry	Younger domes and flows (Holocene) —Aphyric rhyolite, predominantly glassy, varying widely in texture from dense obsidian to finely vesicular pumice; ages range from about 3,000 to 550 yr B.P. (Wood, 1977; Sieh and Bursik, 1986); includes chemically similar 1,350-yr-B.P. Wilson Butte in Inyo Craters chain and also sparsely porphyritic, low-silica, pyroxene rhyolite in Mono Lake; individual dome flows attain maximum thickness of 200 m and 4 km length

Tt	Latite welded tuff (Miocene) —Gray to black vitrophyric welded tuff with conspicuous eutaxitic texture; contains sanidine, plagioclase, biotite, augite, and occasionally hornblende phenocrysts; K-Ar ages range from 11.9 to 11.1 Ma (Gilbert and others, 1968); probable source is north of map area
Ta	Andesite (Miocene) —Trachyandesitic flows, tuffs, and breccias in northern parts of Cowtrack Mountain and Glass Mountain quadrangles; undated but considered Miocene in age based on stratigraphic relations (Gilbert and others, 1968; Krauskopf and Bateman, 1977)

METAMORPHIC ROCKS

Mmv	Metavolcanic rocks (Mesozoic) —Metamorphosed volcanic rocks of Ritter Range roof pendant, mainly in Mount Morrison, Devils Postpile, and Mono Craters quadrangles (Rinehart and Ross, 1964; Huber and Rinehart, 1965; Kistler, 1966a, 1966b; Fiske and Tobisch, 1978; Kistler and Swanson, 1981); Triassic, Jurassic, and Cretaceous in age
Pms	Metasedimentary rocks (Paleozoic) —Metamorphosed sedimentary rocks in the Benton Range, Casa Diablo Mountain quadrangle (Rinehart and Ross, 1957), in the Mount Morrison roof pendant, Mount Morrison quadrangle, (Rinehart and Ross, 1964), and in Gull Lake roof pendant, Mono Craters quadrangle (Kistler, 1966a, b; Kistler and Nokleberg, 1979); Ordovician, Silurian, Mississippian(?), Pennsylvanian(?), and Permian(?) in age

PLUTONIC ROCKS

Kg	Granodiorite (Cretaceous) —Mainly rocks mapped as "quartz monzonite similar to the Cathedral Peak Granite" in Mt. Morrison and Devils Postpile quadrangles (Rinehart and Ross, 1964; Huber and Rinehart, 1965), Round Valley Peak Granodiorite in Mount Morrison quadrangle (Rinehart and Ross, 1964) and equivalent rock formerly mapped as granodiorite or Rock Creek in Casa Diablo Mountain quadrangle (Rinehart and Ross, 1957), Mount Givens Granodiorite, and granodiorite of Fish and King creeks in Devils Postpile quadrangle (Huber and Rinehart, 1965); includes other small granitic masses of probable Cretaceous age: albite granite of McGee Mountain, quartz monzonite of Hilton Creek, granodiorite of Red Mountain, as well as other small unnamed felsic and dioritic bodies in the Mount Morrison and Casa Diablo Mountain quadrangles (Rinehart and Ross, 1957, 1964); also includes quartz monzonite of Aeolian Buttes (Kistler, 1966b) and granite of June Lake (R.W. Kistler, oral commun., 1987) in Mono Craters quadrangle
Jg	Granitic rocks (Jurassic) —Consists of rocks mapped as granite of Casa Diablo Mountain, Glass Mountain, and Cowtrack Mountain quadrangles (Rinehart and Ross, 1957; Krauskopf and Bateman, 1977)
Jtg	Granodioritic, dioritic, and gabbroic rocks, undivided (Jurassic and Triassic) —Mainly Triassic rocks mapped as quartz monzonite of Wheeler Crest and granodiorite of Benton Range in Casa Diablo Mountain and Glass Mountain quadrangles (Ross and Rinehart, 1957; Krauskopf and Bateman, 1977) and as Wheeler Crest Quartz Monzonite in Mount Morrison and Devils Postpile quadrangles (Rinehart and Ross, 1964; Huber and Rinehart, 1965); also includes quartz monzonite of Deer Spring in Casa Diablo Mountain quadrangle (Rinehart and Ross, 1957) and quartz monzonite of Lee Vining Canyon in Mono Craters quadrangle (Kistler, 1966b), also probably Triassic in age; also includes small masses of Triassic diorite and gabbro, as well as Jurassic aplite dikes and small intrusions in Glass Mountain and Cowtrack Mountain quadrangles (Krauskopf and Bateman, 1977)

Figure 10: A portion of the legend from the "Geologic Map of Long Valley Caldera, Mono-Inyo Craters Volcanic Chain and Vicinity, Eastern California".

4.5 Soil Survey

The online Web Soil Survey, <http://websoilsurvey.nrcs.usda.gov>, was utilized to provide a soil and erodability of the soils located at the Lee Vining rock fall project locations. The following Table and Figure describe the soil units observed at the site. There were two soil surveys utilized to provide soil classifications at the site, one, the “Soil Survey of Benton-Owens Valley Area, Parts of Inyo and Mono Counties” and two, the “Soil Survey of the Inyo National Forest, Western Part, California”.

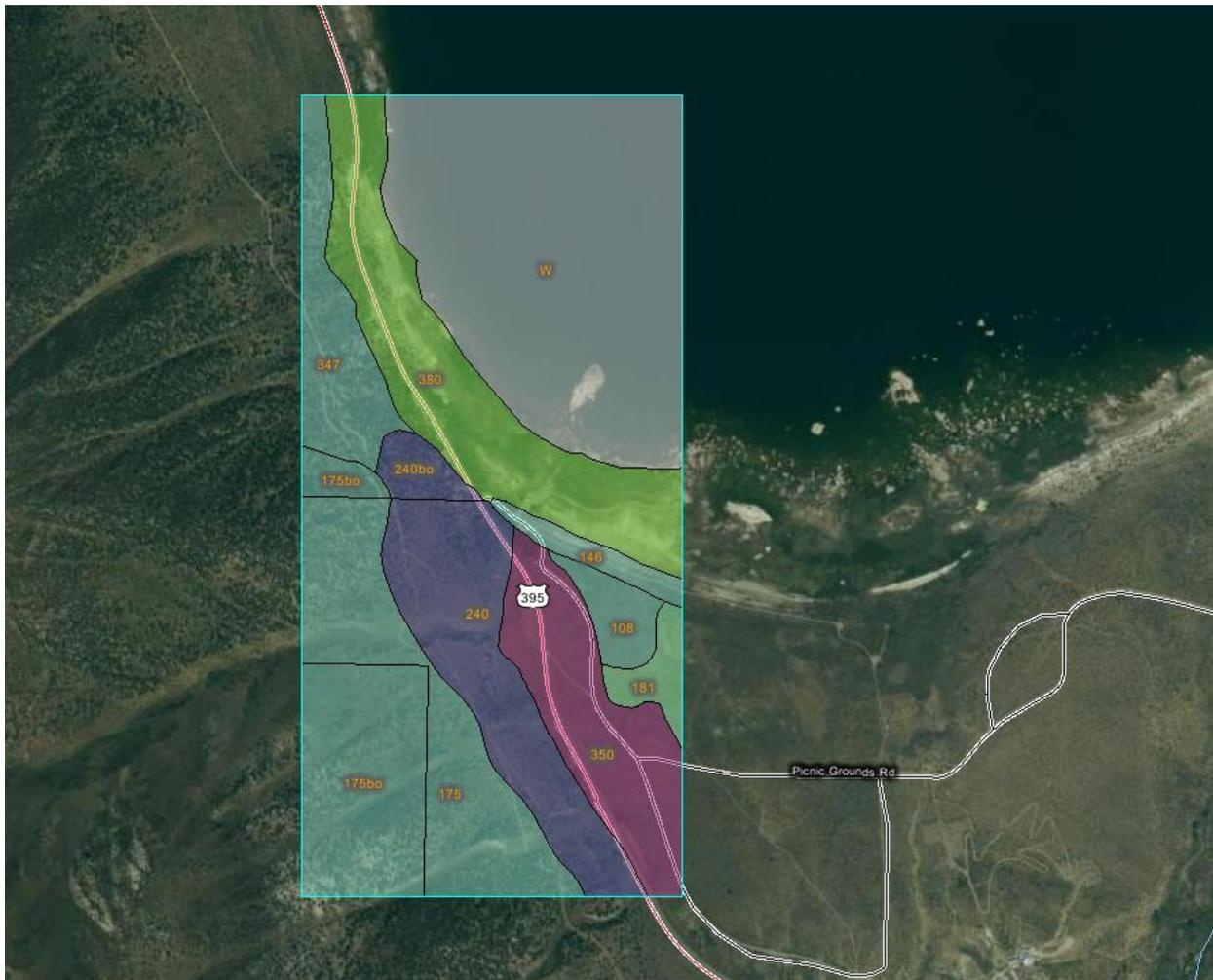


Figure 11: Map denoting the soil units described in the online Web Soil Survey <http://websoilsurvey.nrcs.usda.gov>.

Map Unit Symbol	Map Unit Name	Erodability	USC soil classification
108	Alamedawell-Orecart complex	Slight	SM
175	Cryoborolls bouldery- Cryoborolls- Rock outcrop complex	Moderate	SM
181	Dechambeau very gravelly- Dechambeau complex	Slight	GC-GM
240	Lithic Xeric Torriorthents- Xeric Torriorthents-Rock outcrop complex	moderate	SC-SM
350	Watterson gravelly loamy sand	Slight	GM
146	Lakash-Brantel families complex	Slight	SM
175bo	Cryoborolls boulder-Cryoborolls- Rock outcrop complex	Moderate	SM
240bo	Lithic Xeric Torriorthents- Xeric Torriorthents-Rock outcrop complex	Moderate	SC-SM
347	Nanamkin family-Rock outcrop complex	Severe	SM
380	Vitrandic Torriorthents, ashy- Vitrandic-Haplodurids	Slight	SP-SM
W	Water	N/A	N/A

Table 1: Summary of the map units described in the Web Soil Survey.

5. Exploration

5.1 Drilling and Sampling

Due to limited access for drilling equipment and presumed rippability of the rock, no drilling or subsurface sampling was performed.

5.2 Geologic Mapping

The local geology consist of Quaternary lake terrace deposits (Qt) as depicted on the “Geologic Map of Long Valley Caldera, Mono-Inyo Craters Volcanic Chain and Vicinity, eastern California (USGS, 1989, Figures 9 and 10). The fine-grained deposits are interfaced with talus on the western side of the lake. The facies are mixed in this area due to the juxtaposition of the Sierra Nevada mountains with Mono Lake.

5.3 Geophysical Studies

No geophysical surveys were performed.

5.4 Instrumentation

No instrumentation was installed at the site.

6. Geotechnical Testing

6.1 In Situ Testing

No in-situ testing was performed.

6.2 Laboratory Testing

No laboratory testing was performed.

6.3 Corrosion

The web soil survey indicates the embankment and cut slope materials adjacent to Mono Lake are highly corrosive. It also indicates the embankment and cut slope materials along the project alignment south of Mono Lake have a low corrosivity.

7. Geotechnical Conditions

7.1 Site Geology

7.1.1 Lithology

According to the “Geologic Map of the Long Valley Caldera, Mono-Inyo Craters Volcanic Chain and Vicinity, Eastern California” (USGS, 1989), the primary geologic lithology encountered at the site consists of Quaternary Lake Terrace Deposits (Qlt). These deposits are Pleistocene in age and consist of lake terrace gravels, deltaic deposits and interbedded stream and lake deposits surrounding Mono Lake.

Travertine and calcareous tufa (Qct) is situated in localized areas in the project alignment. The tufa is coincident in age with the lake deposits (Pleistocene) and were created by bacteria precipitating calcium carbonate through their life processes. The tufa is considered an environmental and educational resource.

Paleozoic metasedimentary rocks (Pzms) are present in the hills to the west of Mono Lake. These were originally sedimentary deposits that have been metamorphosed

through high heat and pressure from the intrusion of the underlying granitic rocks.

Cretaceous granodiorite is locally present in the hills to the west of Mono Lake.

7.1.2 Structure

Due to the interbedding of the lake and stream deposits, there is very little structure to the deposits contained in the cut slopes.

7.1.3 Natural Slope Stability

All of the slopes along the project alignment appeared globally stable. The natural slopes above the cut slopes have had rock fall. The rock fall from the natural slopes appears to be a small contributor compared to the rock fall generated from the cut slopes.

The cut slopes appear globally stable. The cut slopes within the project alignment are locally unstable, generating rock fall.

7.2 Soil and Ground Water Conditions

According to the online Web Soil Survey (Section 4.5), the soils at the site are primarily sands, silty sands and gravels.

7.3 Water

7.3.1 Surface Water

According to the climate information presented in Section 4, average annual rainfall is about 14 inches. The average annual snow depth is 1-inch. The average maximum snow depth is 7-inches in January. Mono Lake is situated to the east of the project alignment.

7.3.1.1 Scour

Scour is not applicable.

7.3.1.2 Erosion

Based on the Web Soil Survey and site reconnaissance, the materials at the site vary from slightly erodible to severely erodible.

7.3.2 Ground Water

According to the Department of Water resources well **01S26E03C001M** south of the Town of Lee Vining, the groundwater has fluctuated between 33-feet and 119-feet below ground surface. The last groundwater reading of 100.6-feet below ground surface was performed in 1984.

The groundwater surface at the project site can be presumed to be that of the surface elevation of Mono Lake.

7.4 Project Site Seismicity

7.4.1 Ground Motions

Ground motion was not evaluated based on the scope of the project.

7.4.2 Ground Rupture

Ground rupture was not evaluated based on the scope of the project.

8. Geotechnical Analysis and Design

8.1 Dynamic Analysis

Dynamic Analysis was not performed due to the scope of the project.

8.2 Cuts and Excavations

8.2.1 Stability

Slopes 1 through 3 are recommended to be cut at 1.5:1 (h:v) or flatter. These new cuts will be globally and locally stable.

The "Rockfall Hazard Rating System" (RHRS) was employed on this project to rate the potential for rock fall for the six slopes relative to each other. The following table summarizes the results of the evaluation. As anticipated, Slope 6 has the highest rating, primarily due to the lack of site distance.

Location	Postmile	Slope Length	Vertical Slope Height	RHRS Rating
1	52.39/52.43	212	37	92
2	52.50/52.54	211	36	87
3	52.93/52.98	264	35	69
4	53.05/53.23	1000	22-85	190
5	53.30/53.49	750	116	262
6	53.59/53.66	370	58	567

Table 2: Summary of the Rockfall Hazard Rating System (RHRS) for slopes 1 through 6.

8.2.2 Rippability

All of the material encountered should be rippable with conventional equipment.

8.2.3 Grading Factors

For excavation purposes on slopes 1 through 3, the excavation factor should be 1.1 to 1.2.

8.3 Embankments

New embankments are not proposed for this project.

8.4 Earth Retaining Systems

No retaining walls are proposed for this project.

8.4.1 Rock Fall Mitigation

Slope 4 is recommended to be draped with Double Twisted Wire Mesh (DTWM) secured to the slope with a cable infrastructure anchored to the slope with grouted cable anchors.

Slope 5 is recommended to have a rock fall attenuator system installed with approximate ten-foot steel posts, placed approximately twenty-feet on center, suspending a drapery consisting of cable net under DTWM.

Slope 6 is also recommended to have a rock fall attenuator system installed with approximate ten-foot steel posts, placed approximately twenty-feet on center, suspending a drapery consisting of cable net under DTWM.

Details of the DTWM and attenuator systems are contained in the Recommendations, Section 12.

8.5 Minor Structure Foundations

It is anticipated that the DTWM drapery on Slope 4 will be held in place by a perimeter cable anchor system consisting of grouted steel cables in a three-inch diameter hole.

The steel posts for the attenuator systems on Slopes 5 and 6 will need concrete foundations consisting of 2-foot by 2-foot by 2-foot spread footings. The top of the footing will remain exposed.

It is anticipated that boulder lashing may be needed on up to ten boulders in Slope 6. The cable lashing will be held in place by cable anchors similar to the perimeter anchor system for Slope 4.

9. Material Sources

It is our understanding that fill will not be needed for this project; any fill that is not structural backfill may be utilized from cutting Slopes 1 through 3.

10. Material Disposal

If the material cut from Slopes 1 through 3 is not utilized for the project it must be disposed of. The anticipated disposal location is in the State Right of Way near the Conway Summit Maintenance Station.

11. Construction Considerations

1. All earthworks shall follow Section 19 of Caltrans Standard Specifications.
2. Difficult drilling conditions and caving are expected while drilling the cable anchors and excavation of the spread footings for the steel posts.

12. Recommendations and Specifications

Slope 1

Due to the relatively low generation of rock fall on this slope corresponding to the low RHRS number of 92, as well as a reasonable upslope catchment area, we feel that the proposed 1.5:1 (h:v) cut slopes are constructible. Excavation should be performed according to the 2006 Caltrans Standard Specifications.

Slope 2

Due to the presence of an avalanche shoot at the top of the cut slope, it is not recommended to construct a structure at this location. The most feasible alternative for rock fall mitigation would be to grade the slope at a new ratio of 1.5:1 (h:v) or flatter. Excavation should be performed according to the 2006 Cal Ttrans Standard Specifications.

Slope 3

Slope 3 had the lowest RHRS number for all of the slopes analyzed. Due to the presence of a fifteen-foot unpaved shoulder and a close upslope catchment area, we recommend to grade the slope at a new ratio of 1.5:1 (h:v) or flatter. Excavation should be performed according to the 2006 Cal Ttrans Standard Specifications.

Slope 4

The average size of the rocks falling from this location is typically less than 3-feet in diameter. The use of Double Twisted Wire Mesh (DTWM) drapery would be applicable at this location. Hand scaling and light grading can be performed prior to the mesh being draped on the slope to provide a more uniform surface especially the block of soil and rock at the southerly portion of the slope. The DTWM is anchored along the top. A seed bearing mat and erosion control fabric can be placed beneath the DTWM. If such a system is anticipated Geotechnical Design can aid in the design.



Figure 12: Depiction of the DTWM drapery for Slope 4 which can provide an indication of the vegetation that will need to be removed and/or trimmed.

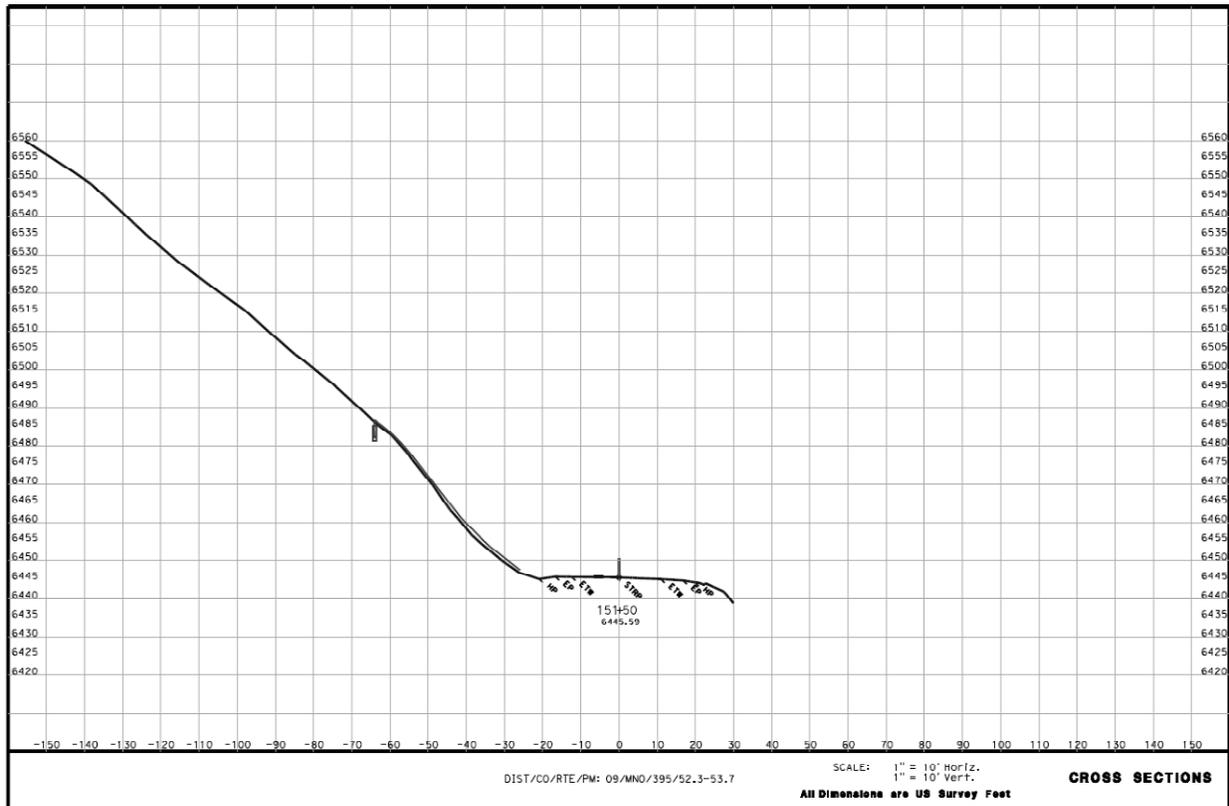


Figure 13: Cross Section of the drapery for Slope 4.

Slope 5

Slope 5 has a relatively high RHRS rating, no upslope catchment area, and narrow shoulder widths. A drapery system is the most feasible option for mitigating rock fall generated from the slope. Due to the presence of large (greater than 4-foot) boulders in the cut slope material, and the potential for material to be released above the existing cut slope, the recommended system is an attenuator style system with cable net underlying DTWM (Figure 14). The system would span the large debris shoot in order to contain the material. The steel posts would be approximately ten-feet in height and spaced approximately twenty-feet on center.



Figure 14: Depiction of the attenuator system for Slope 5 which can provide an indication of the vegetation that will need to be removed and/or trimmed.

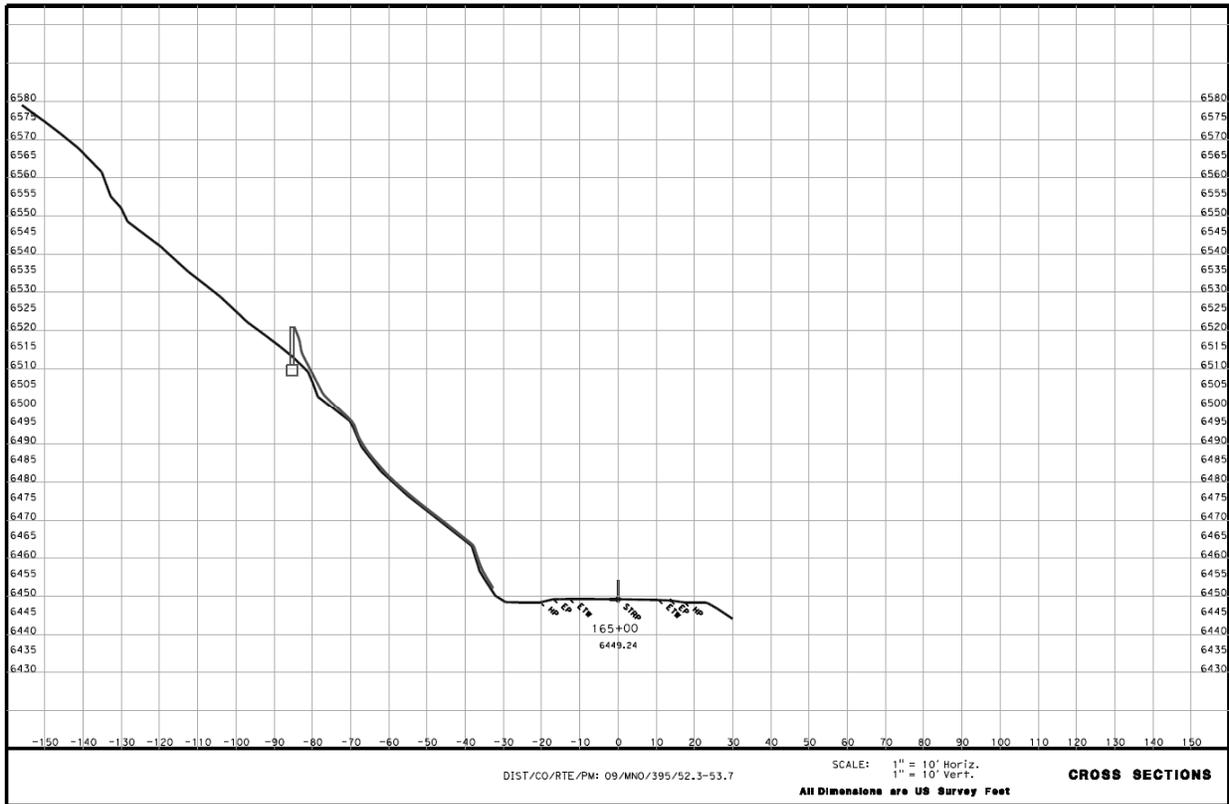


Figure 15: Cross section of the attenuator system for Slope 5.

Slope 6

Slope 6 has the highest RHRS rating of 567, primarily due to the lack of decision sight distance. There is very little shoulder (4-foot on either side). Due to the presence of large (greater than 4-foot) boulders in the cut slope material, and the potential for material to be released above the existing cut slope, the recommended system is an attenuator style system with cable net underlying DTWM (Figure 16). The upper posts should be approximately ten-feet in height and spaced approximately twenty-feet on center.



Figure 16: Depiction of the attenuator system for Slope 6 which can provide an indication of the vegetation that will need to be removed and/or trimmed.

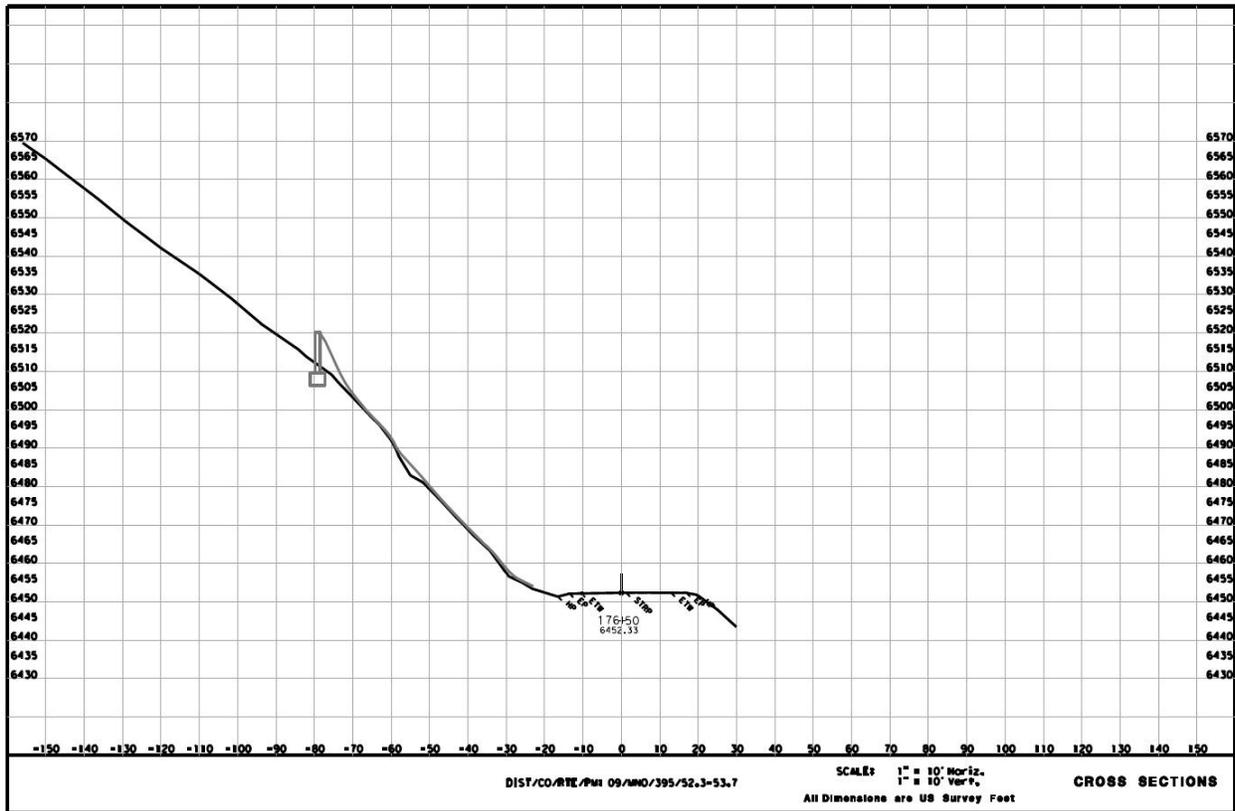


Figure 17: Cross section of the attenuator system for Slope 6.

Alternatively, to aid in the revegetation effort for slopes 5 and 6, an anchored mesh consisting of cable net backed by DTWM may be utilized. A seed bearing mat and erosion control fabric can be placed beneath the anchored cable net. If such a system is anticipated Geotechnical Design can aid in the design. Light hand scaling and grading may be necessary to bring the anchored mesh in conformance with the slope face. Likewise, Caltrans personnel will need to maintain close working conditions with the contractor to maintain tolerances that allow for revegetation.

Project Information

Standard Special Provision 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:

None

Data and information included in the Information Handout provided to the bidders and contractors are:

Geotechnical Design Report for EA 09-33501, dated March 15, 2012.

Data and information available for inspection at the District Office:

None.

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

None.