Geotechnical Design Reports

State of California
Department of Transportation

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. LOU DONADA
Design Manager
Office of Design IV, Branch H

Attention: Patricia Teczon
Project Design Engineer

Date: March 24, 2008

File: 10-MPA-140
PM 42.0/42.7
EA: 10-0P9201

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

Subject: Geotechnical Design Report Addendum 1

Introduction

Per your request, we are providing an addendum to the Geotechnical Design Report (GDR) dated October 31, 2007 for the Ferguson Slide highway restoration. The GDR provided information and recommendations for the five alternatives that have been evaluated to restore two-way traffic through this area. This report provides information and recommendations for the feasibility study of the two Bureau of Land Management proposed alignments. One alignment would consist of constructing a tunnel underneath the slide. The other alignment would consist of constructing two skewed bridges and widening Incline Road to a two-lane roadway.

Pertinent Reports and Investigations

The following publications and plans were reviewed to assist in the assessment of feasibility studies:

1. Beck, T.J., August 31, 2007, *Preliminary Geotechnical Report.*
2. Beck, T.J., October 31, 2007, *Geotechnical Design Report.*
3. Denlinger, R.P., 2007, *Simulations of Potential Runout and Deposition of the Ferguson Rockslide, Merced River Canyon, California,* United States Geological Survey, Open File Report 2007-1275.
4. Feasibility Studies Alignments and Cross-Sections, undated.
5. Gallegos, A.J., and DeGraf, J., June 20, 2006, *Ferguson Rock Slide Geology Report,* United States Forest Service.
6. Harp, E.L., Reid, M.E., and Godt, J.W., June 23, 2006, *Ferguson Rock Slide, Mariposa County, California,* United States Geological Survey.
7. Turner, A.K., and Schuster, R.L., 1996, *Landslides Investigation and Mitigation,*

Special Report 247, Transportation Research Board, National Academy Press.
8. Wyllie, D.C., and Mah, C.W., 2004, *Rock Slope Engineering Civil and Mining 4th Edition,* Spon Press.

Conclusions

Proposed Alignments

Both of these alignments are feasible; there are no geotechnical issues that would prevent them from being successfully constructed and made operational.

Past and Future Slide Activity

The Office of Geotechnical Design North (OGDN) has concluded that there is an extremely low probability that the Ferguson Rockslide will fail catastrophically and in one rapid motion dam the Merced River and bury Incline Road. That conclusion is based on evidence derived from mapping the slide and surrounding terrain. There is evidence that there were a minimum of two other previous prehistoric episodes of slide movement. This is based on the head scarp morphology and vegetation patterns on the scarp. The time between slide episodes is assumed to be on the order of thousands of years. There is no evidence that slide debris from previous events was deposited on the Incline Road side of the river even though the conditions are favorable for preserving such a deposit. Across from the slide Incline Road is on the inside bend of the river. At this location both above Incline Road and in the river channel below the road are cobble and boulder deposits. The cobbles and boulders are rounded, less than 2 feet in diameter, and are composed mostly granitic rock with a minor amount of metamorphic rock. Slide debris is composed entirely of elongated (up to 20 feet), angular, metamorphic boulders. Some of the debris from previous slide episodes appears to have been dragged down-river by high flows producing a bar composed almost entirely of large, angular metamorphic boulders that stretches at least a ¼ of a mile downstream on the slide side of the river.

Denlinger (2007) did computer modeling that assumed the Ferguson Rockslide could move extremely rapidly like a sand and gravel flow or similar to a debris flow. That assumption is contrary to the OGDN geologic mapping that found that the slide moves at a slow to moderate rate as relatively intact blocks of rock in a translational motion. Other published reports on the Ferguson Rockslide (Harp et al, 2006; Gallegos and DeGraf, 2006) are in agreement that the slide moves as an intact block(s). Denlinger does not explain how the Ferguson Rockslide changes its style and rate of motion from a translational slide to a debris flow. His modeling leads him to the conclusion it was possible for the Ferguson Slide to fail extremely rapidly, damming the Merced River and burying Incline Road. The Denlinger report states that his study does not address the likelihood of rapid failure. The OGDN site observations lead to the conclusion that there is little or no probability of Denlinger's theorized rapid failure.

The OGDN expects that future movement episodes on the Ferguson Rockslide will be smaller than the 2006 episode. This is due to the loss of potential energy during each slide episode. Slide episodes will add to the existing talus pile further aggrading into the river channel gradually narrowing the channel and forcing flows toward Incline Road and gradually raising river levels.

Geotechnical Considerations

The cuts, tunnel, and bridge foundations for these two alignments would be excavated in phyllite and chert. Nearby shallow exploration borings classified this rock as slightly weathered to fresh, slightly fractured to unfractured, very hard to extremely hard. The rock was cored for those borings and the boring notes reported Rock Quality Designations ranging from 70% to 100%. Unconfined Compression tests were performed on representative core samples. The tests found that the compressive strength of the rock ranges from 11,500 to 12,000 pounds per square inch.

Recommendations

There are no geotechnical reasons for the OGDN to recommend either of these alignments over the other five alternatives previously studied. Preliminary recommendations for these new alignments are discussed below. If either of these alignments is chosen as the preferred alignment more studies and detailed recommendations will be required during the design phase.

Tunnel Alignment

This alignment will require the construction of a tunnel that passes through the intact rock underneath the Ferguson Rockslide.

Tunnel Portals

The portals should be located at least 150 feet away from the flanks of the slide. That setback would prevent rockfalls generated by the slide from rolling onto the roadway. It would also provide enough separation to prevent the talus accumulating below the slide from building out to the portals.

The cut slopes needed to construct the portals can be excavated at slope ratios of ¼:1 (horizontal:vertical). If steeper slopes are needed; pattern rock bolt reinforcing will be required.

The natural slopes above the portals will produce rockfall. Catchment area at grade, rockfall barriers, or a combination of the two will be required to protect the roadway from rockfall.

The specifics of the rock bolting and the rockfall protection will be determined during the design phase for this alignment if it is chosen as the preferred alignment.

Tunneling Conditions

The tunnel excavation is expected to encounter fresh, unfractured, extremely hard rock. The rock fracture spacing and strength is expected to be generally favorable for tunneling. Ground water is expected to be encountered by the tunnel. The tight curves of this alignment and the narrow winding highway access to the site probably will not allow the use of a tunnel-boring machine on this project. Excavation of this tunnel will probably require conventional drilling and blasting. Tunneling under the unstable mass will eliminate the possibility of using adits or shafts for natural ventilation and would require mechanical means of ventilation.

Foundation Investigation

A foundation investigation will be required for the tunnel during the design phase of this project if it is chosen as the preferred alignment. That investigation will include rotary core borings (vertical and horizontal) and seismic refraction lines. Many of the borings would be located on the slide and would require a rig lifted into place by a helicopter. The borings on slide will require specialized equipment to drill through the loose unconsolidated slide debris. The horizontal borings and helicopter assisted drilling will have to be contracted out. The contracting out and drilling may require 9 to 12 months to complete. In addition, our contracting out budget is completely expended and no more task orders can be written until the start of the next fiscal year.

At-grade Incline Road Alignment

This alignment will include the construction of two permanent bridges, retaining walls and the widening of Incline Road into the hillside to add a second lane.

Cut/Embankment Slope Design

The cut slope for the at-grade alignment ranges in height up to 125 feet. A slope ratio of ¼:1 (horizontal:vertical) or flatter is recommended for that cut.

The natural slope above the road and the cuts will produce minor rockfalls. A 20-foot-wide catchment area at grade is recommended to prevent rockfall from landing/rolling onto the roadway. The catchment area must be back-sloped from the edge of pavement to the toe of the cut at a 6:1 (horizontal:vertical) slope ratio. The catchment area is expected to retain over 95% of the rockfall. Small slides and sloughing are expected in the first few winters after the slope is excavated. The top 7 feet of the cut should be rounded at a 7-foot radius to reduce erosion and raveling. Intermediate cut slope benches are not recommended.

Standard embankment slope ratios should be adequate for the embankment in this area. Fill slopes should be stable at 2h:1v or flatter. If the alternatives have a net excess of earth materials the embankments may have flatter slopes to accommodate excess material. Fill within the river channel should be armored (riprap, gabions, etc.) to prevent erosion.

Cut Excavation

The at-grade alignment cut will be almost entirely in extremely hard, unfractured rock that will require blasting for excavation. Controlled blasting techniques are recommended to stop flyrock, limit ground vibrations, and limit noise to prevent damage to the detour bridges and retaining walls; the proposed bridges and retaining walls; and the natural surroundings. The OGDN can supply an example Non-standard Special Provision for controlled blasting and get the necessary approvals. Pre-splitting blasting is also recommended to form the cut face; that would minimize the amount of rockfall that the slope will generate. There is a Standard Special Provision for pre-splitting.

Control of Subsurface Water

Ground water will probably be encountered during excavation of the proposed cut slopes. Horizontal drains may be required to control unanticipated ground water flows to maintain slope stability and prevent rockfall.

Structures Foundation Investigations

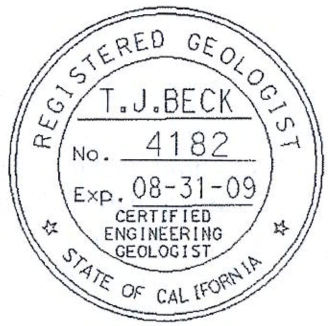
Foundation investigations will be required for the bridges and retaining walls of the at-grade crossing during the design phase of this project if it is chosen as the preferred alignment. That investigation will include rotary core borings and seismic refraction lines. Some of the borings and seismic lines might be located in the river channel. The current permits might have to be renewed or amended to do that work. Winter weather and high river flows will delay that work. Caltrans crews will perform the drilling and seismic work. It may take 6 to 9 months to complete the exploration based on the crew's current workload.

Future Slide Activity

When the next episode of slide activity will occur and how much the talus pile will build out in that event is unknown. Removing the talus pile down old road level will provide a storage area for future slide debris; prevent it from immediately encroaching on the river channel; diverting the river toward the at-grade alignment; or prevent it from encroaching on the portals of the tunnel alignment.

If you have any questions or comments, please call Tim Beck (916) 227-1038

Report By:



TIMOTHY J. BECK, C.E.G #1399
Senior Engineering Geologist
Office of Geotechnical Design-North
Special Studies

Attachments

c: John Huang
John Bowman
John Duffy
OGDN File
GS File Room

State of California
Department of Transportation

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. LOU DONADA
Design Manager
Office of Design IV, Branch H

Attention: Patricia Teczon
Project Design Engineer

Date: October 31, 2007

File: 10-MPA-140
PM 42.0/42.7
EA: 10-0P9200

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

Subject: Geotechnical Design Report

Introduction

Per your request, we are providing a Geotechnical Design Report (GDR) for State Route 140 from PM 42.0 to 42.7 in Mariposa County, California. This section of the highway was buried by a large rockslide. Five alternatives have been evaluated to restore two-way traffic through this area. This report provides geotechnical design information for Alternative S, the "locally preferred" restoration alternative.

This report is based on extensive fieldwork and a review of published data. Recommendations are based on geologic mapping, measurements of structural features (bedding, fractures, shears, etc.), field observations, local reconnaissance, aerial photograph interpretation, and review of available geologic literature. Fifteen borings and 4 seismic lines were done to characterize the soil and rock at this site. Representative samples of the rock retrieved from the borings will be tested to determine the rock's unconfined compressive strength.

Pertinent Reports and Investigations

The following publications and plans were reviewed to assist in the assessment of site conditions:

1. Bateman, P.C, 1992, *Pre-Tertiary Bedrock Geologic Map of the Mariposa 1° by 2° Quadrangle, Sierra Nevada, CA*, United States Geological Survey, Miscellaneous Investigations Series Map I-1960.
2. Bateman, P.C, and Krauskopf, K.B., 1987, *Geologic Map of the El Portal Quadrangle, West-Central Sierra Nevada, CA*, United States Geological Survey MF-1998.
3. Beck, T.J., August 31, 2007, *Preliminary Geotechnical Report.*

4. Gallegos, A.J., and DeGraff, J., June 20, 2006, *Ferguson Rockslide Geology Report,* United States Forest Service.
5. Harp, E.L., Reid, M.E., and Godt, J.W., June 23, 2006, *Ferguson Rock Slide, Mariposa County, California,* United States Geological Survey.
6. Mualchin, L., 1996, *California Seismic Hazard Map 1996*, California Department of Transportation.
7. Pierson, L.A, and Gullixson, C.F., November 2001, *Rockfall Catchment Area Design Guide,* Federal Highway Administration, Report No. FHWA-OR-RD-02-04.
8. Ritchie, A.M., 1963, *Evaluation of Rockfall and Its Control,* Highway Research Record Number 17.
9. Schweickert, R.A., 1981, *Tectonic Evolution Of The Sierra Nevada Range,* in The Geotectonic Development Of California, W.G. Ernst, Editor.
10. Stienberg, S.M., June 18, 2006, *Preliminary Report – Highway 140 Ferguson Ridge Landslide,* Pacific Gas & Electric.
11. Wyllie, D., June 6, 2006, *Ferguson Rockslide, Highway 140, Mariposa to El Portal, Stability Evaluation,* California Department of Transportation.
12. Monthly Climate Summary, Mariposa Ranger Station, California 1957-2006, Western Regional Climate Center.
13. Monthly Climate Summary, Yosemite Park HQ, California 1948-2006, Western Regional Climate Center.
14. Various Caltrans aerial photographs:

Date	Type	Roll & Frame	Scale	Flight Number
6/8/06	Black & White	10-Mpa-140 4C-021 through 031	1:3,600	ASC 0627-37C
6/15/06	Black & White	10-Mpa-140 4C-033 through 041	1:3,600	ASC 0627-37C

15. Project Alternative Alignments and Typical Cross-Sections, undated.

Existing Facilities and Description of Project Alternatives

California Route 140 at this site is a two-lane undivided highway paved with asphalt concrete. Lanes are 12 feet wide and shoulder widths range from 1 to 5 feet. The roadway was built on a series of low (20 feet or less) cuts and fills just above the Merced River channel on an easement through the Sierra National Forest. High voltage electricity transmission lines obliquely cross over the highway.

At the end of May 2006 numerous rock falls from a large rockslide buried the highway. Continued rockfalls made it impossible to re-establish the roadway on the existing alignment. Two temporary bridges and the abandoned rail grade on the other side of the river were used to construct a bypass around the slide. A tight 90-degree turn at the downstream bridge required that traffic be restricted to a maximum vehicle length of 28 feet. The one-way signal-controlled detour was opened in mid-August 2006.

Five alternatives have been evaluated for this project. The "locally preferred" Alternative S would bypass the slide with two bridges and a viaduct that hugs the slope to minimize cuts and fills. The information, conclusions and recommendations in this report are specifically tailored for Alternative S and might not be suitable for the other alternatives.

Physical Setting

Climate

The Western Regional Climate Center temperature data from the Yosemite National Park Headquarters (located 11 miles east of the project site) gives an average maximum monthly temperature of 89.5° F in August and an average minimum of 27.2° F in December from 1971 to 2000. The average of annual precipitation totals at the Park Headquarters (located 12 miles southwest of the site) is 37.07 inches for the last 44 years.

Topography and Drainage

This site is in the Merced River canyon approximately 11 miles west of Yosemite Valley and 12 miles northeast of Mariposa. This portion of the Merced River canyon is steep and narrow. The roadway elevation is about 1375 feet. The steep (approximately 35° to 40°) east-facing slope above the highway rises to the ridgeline at about elevation 3000 feet.

Site Geology

Bateman (1992) published geologic mapping of the Mariposa 1° by 2° Quadrangle that includes the project area. The rocks at the site are part of the Calaveras Complex that is complexly folded but generally trends northwest and dips to the northeast. Part of Bateman's geologic map is shown below (Figure 1).

West of the project site the rocks are mapped as the Briceburg phyllite unit of the Calaveras Complex (Trb). This phyllite is a dark, fine-grained metamorphic rock that was inferred to be of Triassic Age (approximately 225 million years before the present). The Hite Cove phyllite and chert unit of the Calaveras Complex (Trh) underlies the project site and is also considered to be of Triassic Age. East of the site the rocks are mapped as the Paleozoic Pilot Ridge quartzite. The Pilot Ridge quartzite (metamorphosed sandstone) is considered part of the Shoo Fly Complex. The Calaveras-Shoo Fly Thrust Fault is a shear zone separating the two complexes. North and east of the site the Hite Cove and Pilot Ridge rocks are intruded by the Bass Lake tonalite, a medium gray, medium grained granitic rock.

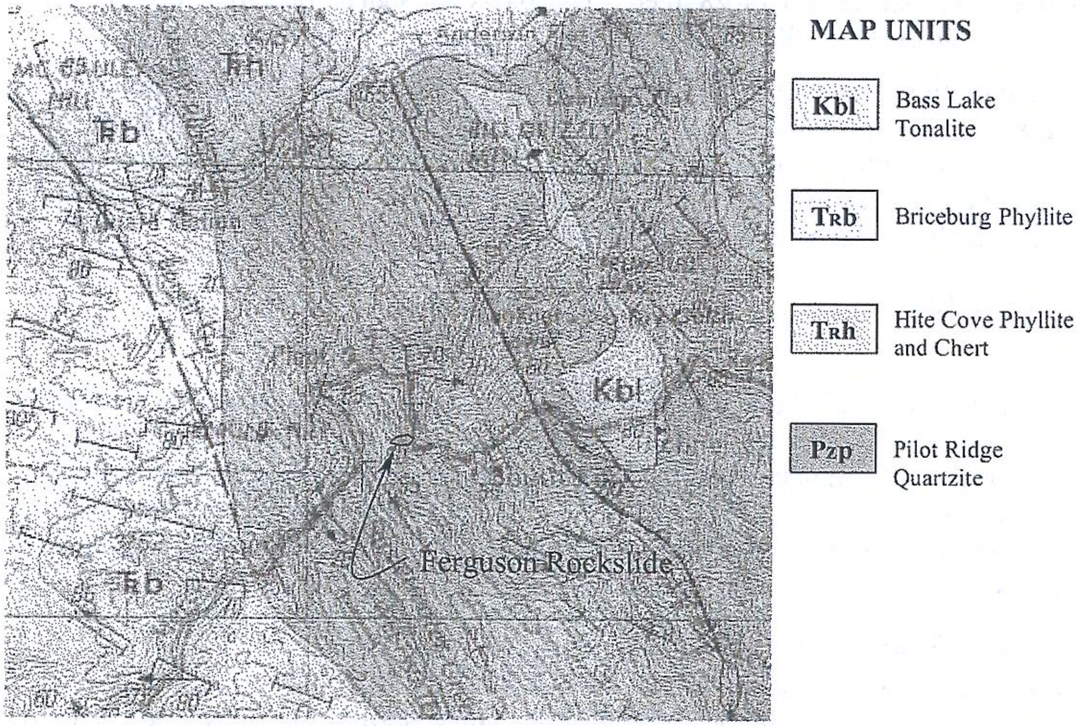


Figure 1. This is a portion of Bateman's 1992 geologic map that includes the Ferguson Rockslide.

Ferguson Rockslide

On April 29, 1999 a moderate-sized failure occurred in the slope adjacent to State Route 140. The failure occurred on the south side of an old talus deposit that had accumulated below a large dormant prehistoric slide. On April 29, 2006 another landslide occurred on the north side of the old talus deposit. Between the end of April and the end of May there were several large rockfalls that originated from the toe area of the dormant slide. From May 25^{th} to May 31^{st} 2006, the previously dormant slide reactivated and rockfall from the toe area buried a 600-foot-long section of the highway. The Preliminary Geotechnical Report gives a detailed chronology of the events that led up to the slide reactivation.

At that time there was a concern that if the slide movement continued to accelerate, it could possibly block the river. Caltrans personnel undertook an intensive slide movement-monitoring program to predict and anticipate future slide activity. The monitoring methods included estimating the daily rockfall volumes, measuring the movement rate of the toe of the slide with radar, and measuring the displacement of 54 survey monuments. The Preliminary Geotechnical Report gives the details of the movement-monitoring program.

After rockfall from the reactivated slide buried the road it became known as the "Ferguson" rockslide. Immediately after the road was closed the Office of Geotechnical Design – North began geologic mapping of the area to assist in the design of the highway restoration. Plate 1 is a map of the slide area and Plate 2 is a geologic cross section.

The reactivated slide occurred in very hard metamorphic rock (phyllite) that has been fractured and folded so that the bedding and foliation dip is near vertical. The slide mass remaining on the slope is approximately 700,000 cubic yards - 650 feet wide, 1000 feet long (see Plate 1) and an estimated 90 feet thick (see Plate 2). The failure plane is approximately 200 feet above the highway (based on the radar monitoring and geologic mapping) and dips out of the slope at about 30 degrees below horizontal (based on measured joint orientations and site topography). The slide appears to be a translational failure; evidence for that failure mechanism is the large closed depression (a tension feature) in the upper portion of the slide. As the slide moves forward the toe area over-steepens, dilates, and produces rockfalls. The rockfalls are composed of large angular blocks of rock with one axis usually twice as long as the other two. Approximately 80,000 to 90,000 cubic yards of rockfall (the talus map unit) has accumulated on the slope below the slide plane and does not appear to buttress the slide.

There appear to have been two or three previous prehistoric periods of slide activity. Evidence of the previous activity is vegetation patterns on the scarp and changes in scarp morphology. Talus from the current slide activity buried older talus (see Figure 2). Just downstream of the talus, on the left bank (slide side) of the river, is a bar composed of large angular blocks of metamorphic rock, which is interpreted to be older slide talus that the river has moved downstream. There are no deposits of slide material on the opposite side of the canyon although there is a bar of Recent Alluvium (well-rounded boulders and cobbles). The boulders in the alluvium are much smaller than the blocks in slide talus and most of alluvium is granitic rock. This indicates that slide material has not crossed the river in the past.

The volume of slide material remaining on the slope is estimated to be only 40% of the original volume, assuming a pre-slide ground surface based on the nearby slopes (See Plate 2). In other words, 60% of the original potential energy of the slide has been dissipated.

The data indicate that it is not possible for the Ferguson Rockslide to block the river and bury the detour in one rapid movement. However, it is possible that after several years of continued slide movement the talus could build out into the channel and change the river flow toward the right bank (detour side).

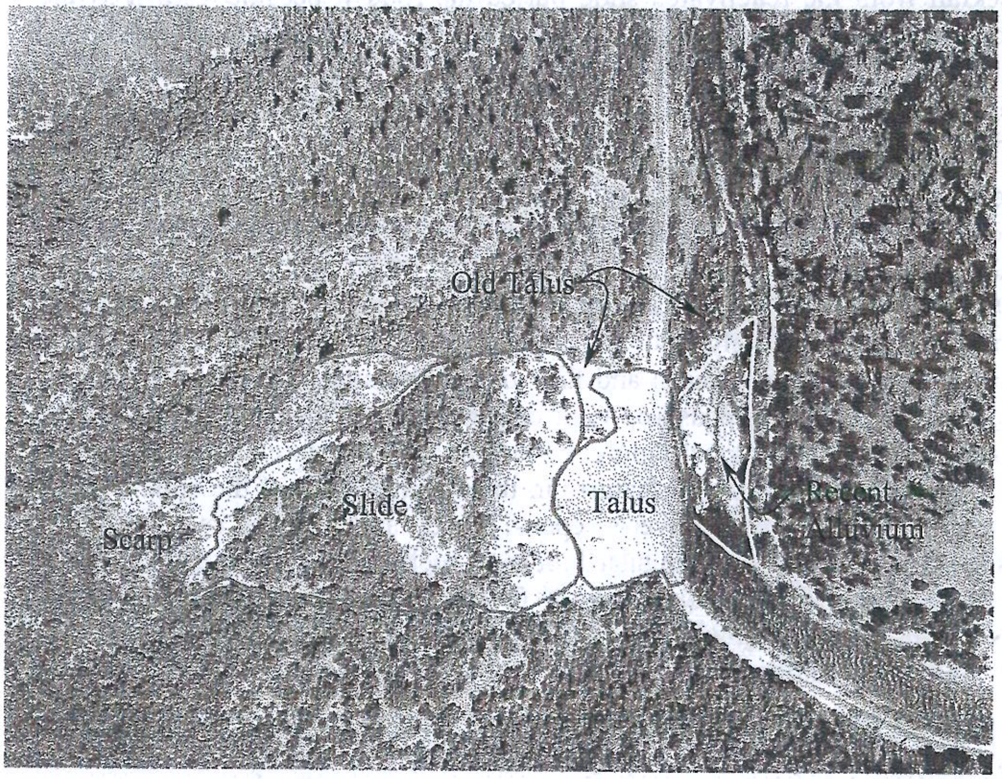


Figure 2. This photograph shows some of slide features and other deposits at the site.

Geologic Considerations

Petrology

The bedrock at the site is classified as phyllite and chert, metamorphic rock. Phyllite makes up approximately 75% of the rock and the remaining 25% is chert. In some places a thin layer of either colluvium or alluvium covers the bedrock. The colluvium occurs on the slopes and consists of soil and angular pieces of rock. The alluvium occurs in the river channel and consists of rounded cobbles and boulders.

There is no serpentinite at the project site, therefore we do not expect any naturally occurring asbestos there.

Aggregate/Construction Material Sources

Materials excavated for the viaduct should be suitable for common borrow for the embankments. Some of the rock may be suitable for crushing and screening for use as structure backfill material.

Excavation Characteristics

It should be assumed that the rock would require blasting or other hard rock excavation equipment (hoe rams, hydraulic splitters, etc.). An earthwork factor for planning should be 1.20. In other words compacted fills made from the excavated rock may be volumetrically as much as 20 % larger than in-place rock.

Erosion

Rock at the project site will not be erodible. However the colluvium and near surface weathered rock will be erodible. Excavated material used for embankment fill is likely to be coarse grained and not highly erodible.

Scour

The alluvium and embankments within the river channel will scour during high river flows, however the bedrock will not scour.

Ground Water

Sources - Ground water is assumed to be at, or just above, the elevation of the Merced River. Several seeps were identified along the highway and the detour. The groundwater is restricted to the fractures in the rocks. It is not likely that there will be enough ground water encountered in the excavations for the proposed alternatives to be useful for construction or for permanent use in landscaping.

Effects on Ground Water Regime - The cut for the viaduct might intercept the ground water surface. This will have the effect of lowering the ground water surface in the immediate area. There are no known nearby offsite water users that would be affected.

Faulting

At least three active fault zones are located to the east of the project area. There are no known active faults that cross the site.

The following table summarizes the details of the nearby faults including their movement style, distance from the project, and maximum credible earthquake.

Fault	*Style*	*Distance from project*	*MCE*
Silver Lake	Normal	40 miles northeast	6.5
Hartley Springs	Normal	45 miles northeast	6.5
Mono Lake	Normal	45 miles northeast	7.0

Local Geologic Structure

The rock at the site is intensely folded and moderately to slightly jointed (fractured). There are three major joint sets and several minor joint sets.

Landslides and Rockfall

There are several other topographic features adjacent to the Ferguson slide that could be dormant slides, which could reactivate in the future. These features are on the opposite of the river from Alternative S and are not expected to affect it. The new cut for the viaduct is expected to generate minor rockfalls and the natural slopes above the viaduct are also expected to produce occasional small rockfalls.

Geotechnical Considerations

Embankment Foundations

The embankments for the "S" Alignment will be minor, heights of 10 feet or less. The foundation materials will be either rock or thin surficial deposits (existing highway embankments, colluvium, and alluvium less than 20 feet thick). There will be no settlement of the rock. Settlement of the surficial deposits will be minor and nearly simultaneous with the addition of the fill.

Embankment Materials

The embankment borrow source will be from the proposed viaduct cut. The excavated material is likely to be classified as poorly graded gravel with cobbles and boulders. The gravel, cobbles, and boulders are expected to be angular. Some of the material is likely to crush during compaction and should be easily compacted. Moderate moisture conditioning should be needed during embankment fill construction.

Erosion

The cut and fill slopes (out of the river channel) for "S" Alignment should not be erodible. Embankment fills placed within the river channel will erode during high flow events. Intermediate cut slope benches in the rock are not recommended.

Seismicity

The Caltrans Seismic Map is currently being revised. Based on the new map, the site is about 40 miles southwest of the Silver Lake Fault (Mw=6.5, normal). Based on this fault, the peak bedrock acceleration would be less than 0.2 g and would round up to 0.2 for design. Earthquake induced surface rupture and liquefaction will not occur at the site.

Cut Slopes

The existing cut slopes along the highway and detour appear to be performing well. The slope angles for the cuts range between ½:1 (horizontal: vertical) to near vertical, and the cut heights range up to an estimated 60 feet.

Almost all of the proposed viaduct cut will be excavated within fractured phyllite and chert. Joint (rock fracture) orientations will control the stability of rock slopes. Unfavorable fracture orientations, steeper than the friction angle and intersecting the cut slope, result in plane, wedge, or toppling failures.

A kinematic analysis was performed to determine a stable cut slope ratio for this project using the measured joint orientations. Kinematic analyses determine whether the common types of rock failures (plane, wedge and toppling) are possible. Stereographic projection was used to perform the kinematic analyses. Stereographic projection is a tool that allows the representation of three-dimensional features (e.g. joints, cut slope, etc.) in two dimensions. The analysis indicates that a slope ratio as steep as ¼:1 (horizontal: vertical) should be stable for the viaduct cut. Bedrock in the area will have a low potential for erosion.

The proposed cut will encounter a surface layer of colluvium. The colluvium varies in thickness from 25 feet near Station 211+30 to 5 feet near Station 213+15.

Corrosion

The earth materials or ground water in the project area are not expected to be corrosive. No mineral springs or other signs of corrosive soils were observed.

Recommendations

General

The following recommendations are based upon the information available at the time of writing this report.

Cut/Embankment Slope Design

The cut slope for the "S" Alignment ranges in height up to 30 feet. We recommend a slope ratio of ¼:1 (horizontal:vertical) or flatter for those cuts based on a kinematic analysis of the rock fracture orientations.

The cuts will produce minor rockfalls and we recommend a 10-foot wide catchment area at grade to prevent rockfall from landing/rolling onto the roadway. The catchment area must be back-sloped from the edge of pavement to the toe of the cut at a 6:1 (horizontal:vertical) slope ratio. The catchment area is expected to retain over 95% of the rockfall. Small slides and sloughing are expected in the first few winters after the slope is excavated. The top 7 feet of the cut should be rounded at a 7-foot radius to reduce erosion and raveling. Intermediate cut slope benches are not recommended.

Standard embankment slope ratios should be adequate for the embankment in this area. Fill slopes should be stable at 2h:1v or flatter. If the alternatives have a net excess of earth materials the embankments may have flatter slopes to accommodate excess material. Fill within the river channel should be armored (riprap, gabions, etc.) to prevent erosion.

Rippability in cut sections

Based on an examination of existing cut slopes, blasting will be required to excavate the "S" Alignment cut. Controlled blasting techniques are recommended to stop flyrock, limit ground vibrations, and limit noise to prevent damage to the detour, proposed structures, existing highway and the natural surroundings. An example non-standard special provision for controlled blasting is included in Appendix A. Pre-splitting blasting techniques are also recommended to form the cut faces to minimize the amount of rockfall that these slope will generate. There is a Standard Special Provision for pre-splitting.

Control of Subsurface Water

Sub-drainage blankets are recommended at the contact of embankment fill and natural ground.

Ground water might be encountered during excavation of the proposed cut slopes. Horizontal drains may be required to control unanticipated ground water flows to maintain slope stability and prevent rockfall.

Structures Foundation Investigations

A foundation investigation is currently underway for the bridges, viaduct and retaining walls of the "S" Alignment. That investigation included six rotary core borings, nine one-inch soil tube probes and four seismic lines. The foundation investigation will be completed by late-October or early-November of 2007. The findings of that investigation will be documented in the Structures Foundation Report.

If you have any questions or comments, please call Tim Beck (916) 227-1038

Report By:

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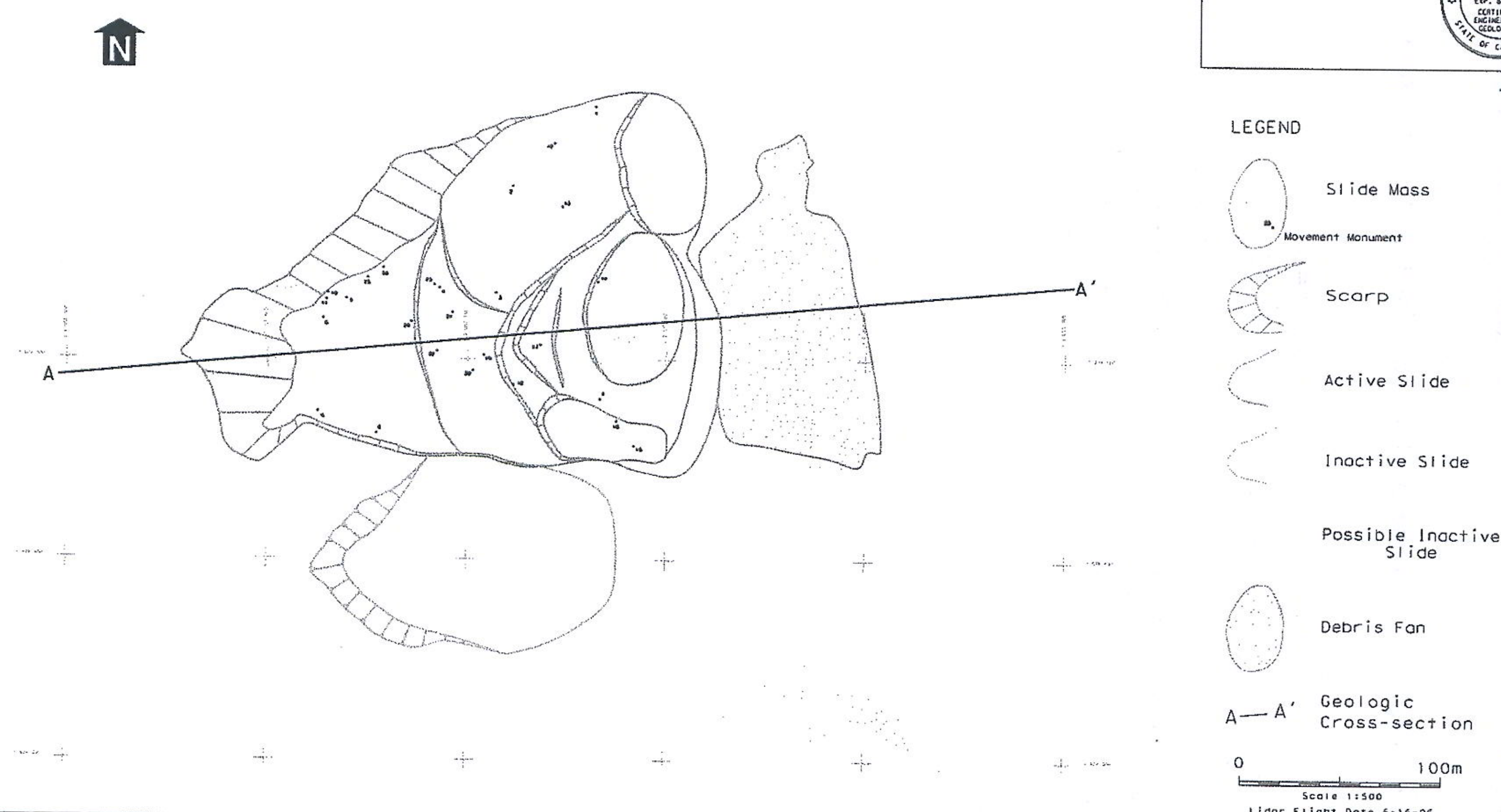
Attachments

c: John Huang
John Bowman
GDN File
GS File Room



DISTRICT	COUNTY	ROUTE	POST MILE	SHEET NUMBER	TOTAL SHEETS
10	MPA	140	42.0/42.7	1	2

10-31-07
DATE

REGISTERED GEOLOGIST
TIMOTHY J. BECK
No. 1399
EXP. 6-31-09
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

DESIGN	BY:	CHECKED:	
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STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

CU 10
EA 0P4401

PLATE 1. SLIDE MAP
FERGUSON ROCKSLIDE

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 9-5-06 | 9-16-06 | 10-31-07

SHEET | OF

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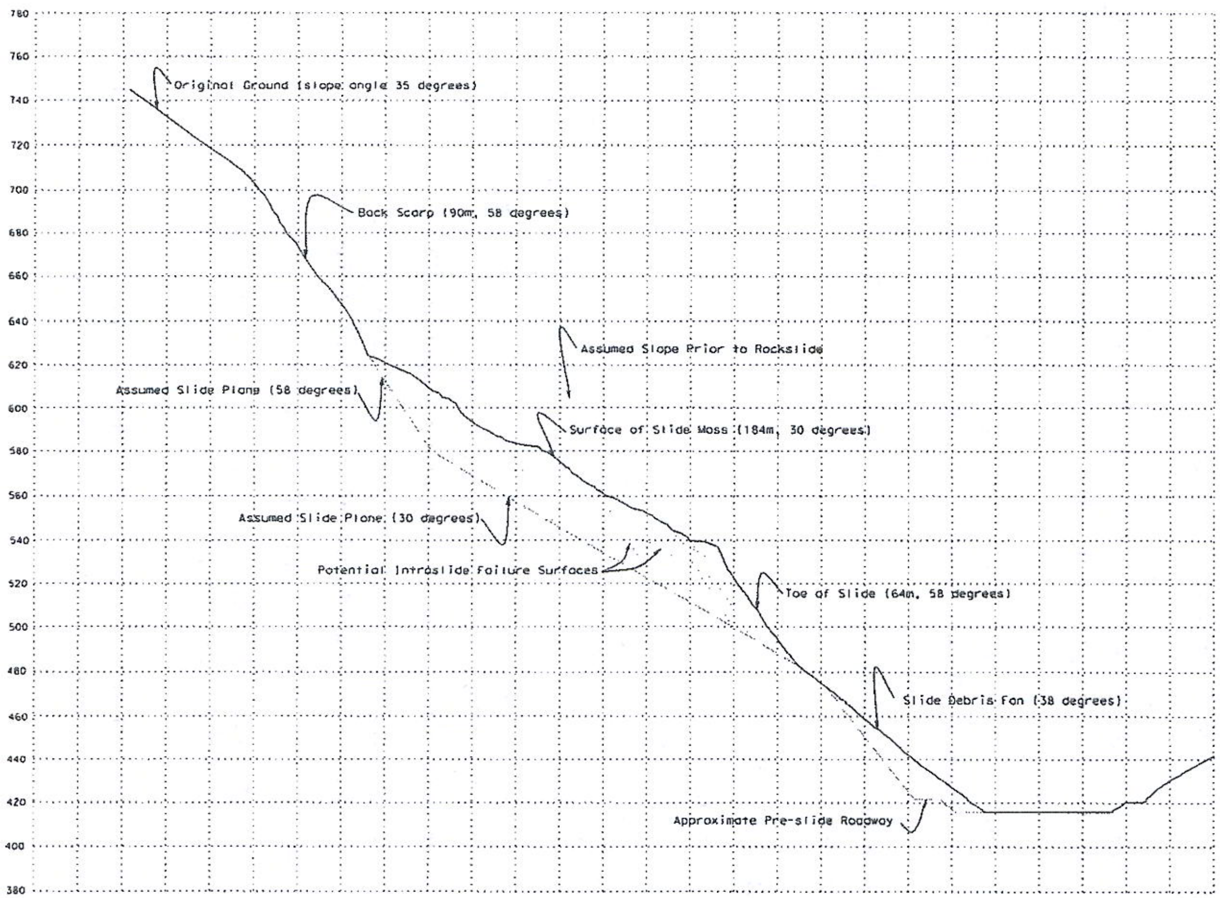
DISTRICT	COUNTY	ROUTE	POST MILE	SHEET NUMBER	TOTAL SHEETS
10	MPA	140	42.0/42.7	2	2

10-31-07
DATE

REGISTERED GEOLOGIST
TIMOTHY J. BECK
No. 1399
EXP. 8-31-09
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA



Metric

DESIGN	BY:	CHECKED:
DETAILS	BY:	CHECKED:
QUANTITIES	BY:	CHECKED:

STATE OF
CALIFORNIA
DEPARTMENT OF TRANSPORTATION

CU 10
EA 0P4401

PLATE 2. GEOLOGIC CROSS-SECTION

FERGUSON ROCKSLIDE

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 9-5-06, 9-16-06, 10-31-07

SHEET OF

APPENDIX A

The following is an example non-standard rock excavation/controlled blasting special provision. It can be modified to suit the project requirements and then it must be sent to the Office of Geotechnical Support for the approval process.

10-1. ROCK EXCAVATION

Rock excavation shall conform to the provisions in Section 19, "Earthwork," of the Standard Specifications and these special provisions.

Rock excavation shall consist of removing rock, durable rocky material and earthen material as shown on the plans using hydraulic hammers, pneumatic hammers, roadway excavation techniques, controlled blasting or other methods approved by the Engineer in writing.

At the option of the Contractor, controlled blasting may be used for rock excavation and structure excavation in conformance with the requirements of these special provisions.

Geotechnical reports are available to the Contractor in the Materials Information handouts for this project.

CONTROLLED BLASTING

Blasting shall be limited to the cut areas shown on the plans and shall conform to all pertinent federal, state, and local regulations; to California Occupational Safety and Health Standards Title 8, Chapter 4, Subchapter 7, Group 18 "Sections 5236-5374 Explosives and Pyrotechnics"; and to Sections 7-1.10, "Use of Explosives," and 19-2.03, "Blasting," of the Standard Specifications and these Special Provisions.

No blasting operation, including drilling, shall start until the Engineer has reviewed and approved the Blasting Plan(s) in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications.

The Contractor shall control project blasting so that fly rock, ground vibrations, air noise levels do not exceed the requirements of these special provisions.

The Contractor shall be responsible for all damage resulting from blasting.

Controlling fly rock, ground vibrations, air noise levels as specified herein shall not relieve the Contractor of the responsibility for assuring the complete safety of the operation.

Unless otherwise permitted by the Engineer, blasting shall be restricted to full facility closures only. Attention is directed to the Traffic Management Plan and lane closure charts.

Personnel Qualifications

The licensed blaster (the blaster in charge) shall have a minimum of 10 years experience directly related to the specific types of blasting they are supervising. All blasters and supervisors shall be properly qualified and licensed in conformance with applicable federal, state, and local government regulations.

The Contractor shall retain the services of a consultant with at least 5 years documented experience in monitoring blasting operations and interpreting ground vibration, air overpressure and blasting noise for similar construction projects. The monitoring consultant shall not be a sub contractor to the blasting contractor.

Blasting Plans

The Contractor shall submit a written General Blasting Safety Plan, Pre-blast Survey(s) and Controlled Blasting Plan(s) to the project Resident Engineer for approval.

The Controlled Blasting Plan(s) shall include provisions for performing and monitoring blasting.

The Controlled Blasting Plan(s) shall include copies of required licensing and documentation for blasting supervisors, blasting personnel and monitoring consultant.

All Controlled Blasting Plan(s), including test blasting, and revisions to these plans shall be reviewed and approved by the Engineer.

Drilling and other work for blasting shall not commence until the Contractor has received written approval from the Engineer for the Controlled Blasting Plan(s).

The Controlled Blasting Plan(s) shall provide for limiting the maximum peak particle velocity of any one of the three mutually perpendicular components of ground motion in the vertical and horizontal directions, or their resultant, to 2 inches/second, air noise to 128 DbL and for controlling fly rock during blasting.

The Contractor shall use appropriate blast hole patterns, detonation systems, and stemming to prevent venting of blasts, to control air noise and fly rock produced by blasting operations.

The Controlled Blasting Plan(s) shall indicate the type and method of instrumentation proposed to determine maximum peak particle velocity and air noise levels.

Within 60 days after approval of the contract, the Contractor shall submit 3 copies of the General Blasting Safety Plan to the project Resident Engineer. The Engineer will have 21 working days to review the General Blasting Safety Plan. If revisions are required, as determined by the Engineer, the Contractor shall revise and resubmit the General Blasting Safety Plan within 10 working days of receipt of the Engineer's comments. The Engineer will have 15 working days to review the revisions. Upon the Engineer's approval of the General Blasting Safety Plan, 3 additional copies of the General Blasting Safety Plan incorporating the required changes shall be submitted to the Engineer. Minor changes or clarifications to the initial submittal may be made and attached as amendments to the General Blasting Safety Plan.

The Contractor shall submit 3 copies of the Pre-blast Survey(s) to the Engineer, 10 working days prior to commencement of blasting. The Engineer will have 10 working days to review the Pre-blast Survey(s). If revisions are required, as determined by the Engineer, the Contractor shall revise and resubmit to the Engineer for comments. The Engineer will have 10 working days to review the revisions. Upon the Engineer's approval of the Pre-blast Survey(s), 3 additional copies of the Pre-blast Survey(s) incorporating the required changes shall be submitted to the Engineer. Minor changes or clarifications to the initial submittal may be made and attached as amendments to the Pre-blast Survey(s).

The Contractor shall submit 3 copies of the Controlled Blasting Plan(s) to the Engineer. The Engineer will have 10 working days to review the Controlled Blasting Plan(s). If revisions are required, as determined by the Engineer, the Contractor shall revise and resubmit to the Engineer for comments. The Engineer will have 10 working days to review the revisions. Upon the Engineer's approval of the Controlled Blasting Plan(s), 3 additional copies of the Controlled Blasting Plan(s) incorporating the required changes shall be submitted to the Engineer. Minor changes or clarifications to the initial submittal may be made and attached as amendments to the Controlled Blasting Plan(s).

Approval of the Contractor's General Blasting Safety Plan, Pre-blast Survey(s) or Controlled Blasting Plan(s) shall not relieve the Contractor of any responsibilities under the contract for assuring the complete safety of all project operations or for the successful completion of the work in conformity with the requirements of the plans and specifications.

General Blasting Safety Plan

The Contractor shall submit a detailed General Blasting Safety Plan to the Engineer. No blasting operation, including drilling, shall start until the Engineer has reviewed and accepted the blasting safety plan. The safety plan shall be in accordance all pertinent federal, state, and local regulations; to California Occupational Safety and Health Standards Title 8, Chapter 4, Subchapter 7, Group 18 "Sections 5236-5374 Explosives and Pyrotechnics"; and to Sections 7-1.10, "Use of Explosives," and

19-2.03, "Blasting," of the Standard Specifications and these Special Provisions. As a minimum, the safety plan shall include and/or address:

A. The generalized identification of the applicable codes, regulations, and permitting governing blasting operations at the project site.

B. The business name, contractor license number, the address, and telephone number of the blasting subcontractor.

C. Proof of current liability insurance and bonding.

D. The name, address, blaster's license number, and telephone number of the responsible blaster, include a copy of the current blasting license.

E. The name, address, and telephone number of the contact person responsible for resolving situations concerning blasting at the project site.

F. The name, address, and telephone number of the controlled blasting plan(s) designer.

G. The name, address, and telephone number of the subcontractor's safety officer.

H. The name, address, and telephone number of the local fire station and law enforcement agency responsible for the area containing the project.

I. Copies of all federal, state, county, and local permits required to conduct blasting at the project site.

J. The location where explosives are to be stored, security measures employed to protect and limit access to the explosives, how explosives are to be transported, who is permitted to handle the explosives, and how the areas where explosives are stored or are being used are protected from errant or extraneous personnel and/or the public.

K. The effective exclusion zone and/or limited entry zone for non-blast related operations and personnel surrounding loading and blasting operations.

L. The warning signals used to alert employees on the job site of an impending blast and/or indicate the blast is completed and the area is safe to re-enter.

M. How blasting operations will be conducted.

N. The measures used to protect blasting operations and personnel from lightning.

O. The emergency evacuation procedures for areas where explosives may be present.

P. How misfires will be recognized, handled, and resolved including who is to be contacted, and how the blast zone will be secured until the misfire is resolved. Identify the type(s) of equipment that may be needed to resolve misfires.

Q. The signage needed around blasting zones. Indicate when the signage is to be posted relative to a specific blast and provide the name and contact telephone number of the person responsible for placing the signage.

R. How traffic will be controlled during loading and blasting operations.

S. The traffic control in the event that a misfire or other blast related phenomenon causes a transportation corridor to remain closed to the public.

T. Noxious gas generation and define safeguards that will be used to protect employees, work zones adjacent to the shot, private property and the public in the vicinity of the shot from exposure to blast generated noxious gasses.

U. The procedure to be implemented to resolve complaints, report and resolve blast related accidents.

V. Provide the Engineer with copies of the Material Safety Data Sheets (MSDS) and manufacturer data sheets for all explosives, caps, primers, initiators and other compounds that will be used on the project site.

W. Provide names, contact information, license numbers, and resume(s) of experience of all personnel responsible for designing, loading, and conducting the blasting operation(s) to the Engineer.

Pre-Blast Survey(s)

The Contractor shall make and document Pre-blast Survey(s) of all buildings and structures within 330 ft. of blasting. The survey method used shall be acceptable to the Contractor's insurance company. The Contractor shall make the Pre-blast Survey(s) within 45 calendar days in advance of the planned commencement or resumption of blasting operations and the Pre-blast Survey(s) shall be made available to the Engineer for review. The Pre-blast Survey(s) shall, as a minimum, contain the following:

A. The name of the person making the inspection.

B. The names of the property owner(s) and occupants, the addresses of the property, the date and time of the inspection.

C. A complete description of the structure(s) or other improvement(s) including culverts and bridges.

D. A detailed inspection with each interior room (including attic and basement spaces) designated and described. All existing conditions of the walls, ceiling and floor such as cracks, holes and separations shall be noted.

E. A detailed exterior inspection fully describing the existing conditions of all foundations, walls, roofs, doors, windows, and porches.

F. A detailed listing, inspection and documentation of existing conditions of garages, outbuildings, sidewalks, driveways and swimming pools.

G. A detailed listing of highway signposts, light fixtures and overhead power lines.

H. A survey of any wells or other private water supplies including total depth and existing water surface levels.

I. Identification of sites conducting procedures, processes, or operations which may be sensitive to construction blasting phenomenon.

J. Scaled map(s) or aerial photo(s) depicting the locations of all structures and/or properties reviewed for the pre-blast survey and location of all proposed blasting sites. Properties surveyed shall be identified by their physical street address. Other structures shall be identified by structure name or type.

Unless exempted by the Engineer, the Contractor shall perform a re-survey of buildings or structures whenever blasting operations are either terminated or suspended for a period in excess of 45 calendar days. At the Engineer's option, to accommodate unique project conditions, the period of 45 days between the temporary suspension of blasting operations and the requirement to resurvey all or some of the buildings or structures may be increased.

The Pre-blast Survey(s) documentation shall consist of a written report including sketches or photos. A video tape recording with narration may be used in lieu of written reports. The videotape, if used, must include date and time displayed on the image. The Contractor shall provide copies of the Pre-blast Survey(s) to the Engineer at the time that the Controlled Blasting Plan(s) are submitted.

Pre-Blast Notifications to Occupants

The Contractor shall provide written notification to occupants of the local buildings within 330 ft. the blasting area a minimum of 7 days prior to the commencement or resumption of blasting operations. In addition, the contractor shall provide verbal notification of pending blasts to occupants of local buildings within 330 ft. of the blasting area the day of blasting.

Near Field Blasting

Near field blasting is considered any shot that will be within 30 ft. of a critical structure. These blasts shall be designed and overseen by a Blasting Consultant hired by the Contractor. The Blasting Consultant must be a licensed engineer or geologist whose primary source of income is derived from providing specialized blasting consulting services. The Blasting Consultant must have a minimum of 10 years experience providing specialized blasting services in near field blasting. The Contractor must submit a resume of credentials and a list of projects on which the Blasting Consultant has worked. The consultant shall not be an employee of or a subcontractor to the blasting subcontractor, the explosives manufacturer, or the explosives distributor. The Engineer must approve the consultant prior to the beginning of any drilling and blasting work.

Controlled Blasting Plans

The Contractor shall control project blasting so that vibration, flyrock, ground movement (including burden), and air noise levels do not cause damage to nearby structures including highway signposts, light fixtures and parked vehicles. Blast design(s) should prevent undue annoyance to nearby residents, and shall not endanger employees on the project site. The Contractor shall coordinate the traffic control during blasting operations. Prior to loading a shot, the Contractor shall confirm that groundwater conditions are consistent with the shot design and the explosive types being used. The Contractor shall be responsible for all damages that result from blasting.

The Contractor shall submit Controlled Blasting Plan(s) to the Engineer for each shot on the project. The Controlled Blasting Plan(s) shall detail how each blast will be controlled. The Engineer should contact Geotechnical Services for assistance in reviewing Controlled Blasting Plan(s). No blasting operation, including drilling, shall start until the Engineer has reviewed and accepted the Controlled Blasting Plan(s) in accordance with the provisions in Section 5-1.02, "Plans and Working Drawings," of the Standard Specifications. The Contractor shall allow not less than 10 working days for the Engineer to complete the review of the plan. In the event that additional blasting plans are required or if a blasting plan must be resubmitted regardless of the reason, the Contractor shall provide at least 10 working days for the review of each additional plan. If the Engineer fails to complete this review within the time allowed, and if, in the opinion of the Engineer, the Contractor's operations are delayed or interfered with by reason of this delay, an extension of the time commensurate with the delay will be granted as provided in Section 8-1.07, "Liquidated Damages," of the Standard Specifications. Acceptance of the Contractor's blasting plan shall not relieve the Contractor of any responsibility under the contract for assuring the complete safety of blasting related operations or for the successful completion of the work in conformity with the requirements of the plans and specifications. The Controlled Blasting Plan(s) shall contain the following data as a minimum:

A. Blast Identification by numerical and chronological sequence.
B. Location (referenced to stationing), date and time of blast.
C. Blast plan depicting drill hole pattern, spacing, burden, and initiation sequence.
D. Typical Cross-sections through zone to be blasted. Groundwater table must be depicted if present within the prism to be blasted.
E. An initiation-sequence diagram depicting the actual firing time of each delay.
F. The type of material to be blasted.
G. Number of drill holes.

H. Diameter, depth and spacing of holes.

I. Height or length of stemming.

J. Types and characteristics of explosives used including the explosive's density, relative strength and date of manufacture.

K. Type of caps and delay periods used and their date of manufacture.

L. Total amount of explosives used.

M. Maximum amount of explosives per delay period of 9 milliseconds or greater.

N. Powder factor (pounds of explosive per cubic yard of material blasted).

O. Method of firing type.

P. Direction and distance to nearest structure or structures of concern.

Q. Type and method of instrumentation.

R. Location and placement of instruments.

S. Measures taken to limit air noise and fly rock.

T. Measures to limit overbreak

U. Name of Contractor.

V. Name and signature of responsible blaster.

W. Site plan depicting location, spacing and proximity of shot guards to blast location.

X. Drill cuttings shall not be utilized as stemming in controlled blasting operations.

Minor changes may be made to the blasting plan to adjust for site conditions. The changes must be provided as written amendments signed by the responsible blaster and submitted to the Engineer. Significant changes to a blast design require that the Controlled Blasting Plan(s) be resubmitted for review.

Post Blast Reports

The Contractor shall make a Post Blast Report of each shot and it shall be provided to the Engineer within 48 hours of the blast. Post Blast Reports shall contain all data required in the Controlled Blasting Plan for that shot. The Post Blast Report shall accurately reflect the site conditions, loading, and timing of the actual blast; any changes or amendments to an accepted Controlled Blasting Plan shall be reflected in Post Blast Report. The Post Blast Report shall include a copy of the Vibration Report and shall also include documentation of any complaints arising from the blast or blast related phenomena. The Post Blasting Report shall also include the weather conditions (including wind direction and cloud cover) at the time of the shot. The drillers boring record for each shot hole shall provided as a portion of the Post Blast Report.

Suspension of Blasting Operations

The Engineer may suspend blasting operations for any of the following conditions:

A. Safety precautions, monitoring equipment and traffic control measures are inadequate.

B. Ground motion particle velocity or air noise exceeds the specification limits.

C. Blasting Control Plans have not been approved.

D. Required records are not being kept.

E. Excessive overbreak as determined by the Engineer.

F. If fly-rock leaves the construction site; or if fly-rock damages structures, equipment, or vehicles or endangers and/or injures construction personnel or the public.

G. Damage to permanent improvements or existing structures occurs as a result of any blasting related operation.

Suspension of blasting operations shall in no way relieve the Contractor of his/her responsibilities under the terms of this contract. Blasting operations shall not resume until modifications have been made to correct the conditions that resulted in the suspension.

Vibration Monitoring

The Contractor shall control ground vibrations by the use of properly designed delay sequences and allowable charge weights per delay. Vibration levels shall be held below peak particle velocity of 2 inches/second at the nearest structure(s) or designated location(s).

During blasting, the Contractor shall employ a qualified Vibration Consultant who is subject to the approval of the Engineer. The Vibration Consultant shall monitor each blast with approved seismographs placed between the blast area and the closest structures subject to blast damage. The Vibration Consultant shall also interpret the seismograph records to ensure that the seismograph data are utilized effectively in the control of the basting operations with respect to the existing structures. The Vibration Consultant shall have an education equivalent to a two year Associates Degree in science or engineering and at least 5 years experience in seismic monitoring. The Vibration Consultant should not be an employee of or a subcontractor to the blasting subcontractor. The Vibration Consultant used shall be subject to the Engineer's approval.

The location and number of seismographs used should be approved by the Engineer and should be relevant to the number, location, and distance of the structures of concern. A minimum of three seismographs shall be available for deployment. The seismographs shall be capable of recording particle velocities for three mutually perpendicular components of vibration and the instantaneous resultant peak vector sum in the range generally found with controlled blasting.

Seismographs shall be a type generally accepted and used within the blasting industry. The seismographs must be capable of continuously measuring, recording and reporting vibrations along the three component primary axes (vertical, transverse and longitudinal), measure and record frequency, and measure and record air over pressures. The output should report the resultant peak particle velocity and the component peak particle velocities along primary axes as well as the relevant frequencies. The seismographs must be capable of providing a printed record of each event. The printed record should include a plot of peak particle velocity versus vibration frequency. The seismograph should have minimum frequency response range of 2 to 300 Hz. The seismograph should provide full waveform event storage. The air-overpressure transducer should be detachable from the main unit so that it can be placed at an elevation that provides a clear line of sight without any barriers between the transducer and the blast.

Data recorded for each shot shall be furnished to the Engineer within 48 of the blast as part of Post Blast Report or immediately upon completion of a blast if requested by the Engineer. The data record shall include the following information:

A. Identification of Instrument used.
B. Name of qualified observer and interpreter.
C. Distance and direction of recording station from blast area.
D. Type of ground at recording station and material on which instrument is sitting.
E. Maximum particle velocity in each component and the resultant Peak Particle Velocity of the shot.
F. A dated and signed copy of seismograph readings record.
G. The Air Over Pressure value in units of Decibels (DbL).

Blasting Near Uncured Concrete

Unless permitted by the Engineer, no blasting shall be performed within 1200 ft. of concrete has been placed within the previous 72 hours.

Air Over-Pressure and Noise Control

The Contractor shall install an air blast monitoring systems between the main blasting area and the nearest structures subject to blast damage or annoyance. The equipment used to make the air over-pressure measurements shall be the type specifically manufactured for that purpose. Noise levels shall be held below 128 DbL (decibels) at the nearest structure or designated location. The Contractor shall use appropriate blast hole patterns, detonation systems, cover and stemming to prevent venting of blasts and to minimize air blast and noise levels produced by the blasting operations. The air over-pressure levels shall be lowered if damage occurs or there are excessive complaints. The Contractor shall furnish a permanent, signed and dated record of the noise level measurement to the Engineer after each shot as a part of the Post Blast Report.

Video Recordings of Blasts

The Contractor shall record each blast on videotape. The recordings should be taken from a safe location, and when possible, from a location that has a clear overview of the blast area, the blast and its progression. The tapes or sections of tapes will be indexed in a manner to properly identify each blast. Copies of videotapes of blasts will be furnished on a weekly basis to the Engineer.

Flyrock Control

Before the firing of any blast in areas where flying rock may result in personnel injury or unacceptable damage to property, parked vehicles or the work, the Contractor shall cover the rock to be blasted with approved blasting mats, soil, or other equally serviceable material, to prevent flyrock.

If flyrock leaves the construction site and lands on the adjacent roadway the Contractor will be responsible for clearing all lanes of flyrock. If flyrock leaves the construction site and lands on private property all blasting operations shall cease until a qualified Blasting Consultant, hired by the Contractor, reviews the site and determines the cause and solution to the flyrock problem. Before blasting proceeds, a written report shall be submitted by the Contractor to the Engineer for approval. The necessary qualifications of an acceptable Blasting Consultant are included under Near Field Blasting section of these special provisions.

Blasting Complaints

Blasting complaints shall be accurately recorded by the Contractor as to complainant, address, date, time, nature of the complaint, and name of person receiving the complaint, the complaint investigation conducted, and the disposition of the complaint. The Contractor shall make complaint information available to the Engineer, as soon as practical, but no later than at the beginning of the following day's shift unless otherwise approved by the Engineer.

A. Name and address of complainant.

B. Date, time, and nature of complaint.

C. Dated photo or video documentation if physical damage complaint is involved.

D. Name of person receiving complaint.

E. Complaint investigation conducted.

F. Resolution of complaint.

Measurement and Payment

Rock excavation will be measured in the same manner specified for roadway excavation in Section 19, "Earthwork", of the Standard Specifications.

The contract price paid per cubic yard for rock excavation shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in rock excavation, complete in place, including controlled blasting plan, pre-blast and post-blast surveys, controlled blasting, test blasting, monitoring and reporting, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.