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FOUNDATION INVESTIGATION

Missouri Flat Road Overcrossing (Replace)
Bridge No. 25-0121
EA 03-370001
Phase 1
U.S. Route 50/Missouri Flat Road Interchange Project
El Dorado County, California
03-ED-50-23.2/25.4

El Dorado County
Lead Agency

Quincy Engineering, Inc.
Design Engineer

1P2/399/296-1.2M
38120-F7:314N:252W

March 2006

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Introduction

A limited study of foundation conditions has been completed at the above site in accordance with the agreement between Quincy Engineering, Inc. and Taber Consultants. The purpose of this investigation is to provide earth materials criteria for use in design of proposed new bridge foundations. This study specifically addresses Phase 1 project elements for the proposed overcrossing replacement. Additional field study and supplemental geotechnical recommendations may be required for future Phase 2 design.

Earth materials criteria for design of other Phase 1 project elements are to be addressed in separate reports prepared by this office. Limitations of study are discussed below and in the attached "General Conditions."

This project is the subject of our "Geologic/Geotechnical Review" (dated March 26, 2001), letter of "Memorandum – Site Seismic Conditions" (dated January 19, 2001) and "Addendum No. 1 to Geologic/Geotechnical Review" (dated July 24, 2001). Reference is also made to a Caltrans memorandum (dated January 29, 2001) discussing site seismic conditions specific to this project. Information from these documents is incorporated herein, as appropriate.

This report supercedes our draft foundation investigation report dated August 11, 2005 and has been modified to incorporate review comments from Caltrans Division of Engineering Services, Geotechnical Services, Office of Geotechnical Design – North as outlined in a letter dated September 26, 2005. A copy of the Caltrans review comments and our response are included as Appendix-E.

Site and Project Description

The existing Missouri Flat Road overcrossing (Br. No. 25-0077) is located in El Dorado County, California (see Figure-1). It was constructed in 1969 and is a three-span continuous reinforced concrete box girder structure of length 76±m (248 ft) and width 12±m (40 ft). Substructure consists of open-style end-diaphragm type abutments and two-column bents. The southerly abutment and bents are supported on spread footings, each established within bedrock. The northerly abutment is supported by 400 mm diameter cast-in-drilled-hole piles penetrating into bedrock.

At this location existing U.S. Route 50 is established in a cut section varying from 1.5±m to 4.0±m depth below original ground surface. In the vicinity of the Missouri Flat Road overcrossing, existing U.S. Route 50 grade slopes about 1.5-2.0% from west to east. With respect to the existing overcrossing, eastbound traffic is presently carried below the southerly span; westbound traffic below the center span; and westbound off-ramp traffic below the northerly span.

The proposed Missouri Flat Road overcrossing is shown on preliminary "General Plan" drawing for Phase 1 (dated June 21, 2005) prepared by Quincy Engineering, Incorporated. The currently proposed structure is shown to be 55.92 m long by 32.41 m wide, consisting of two cast-in-place prestressed concrete box girder spans (28.555 m on the north and 27.365 m on the south) between "MFRD" Sta. 13+02.093 (Begin Bridge) and "MFRD" Sta. 13+58.013 (End Bridge). New deck grade is shown on a vertical curve passing through elev. 539.479 at Abutment-1 (north) and elev. 539.679 at Abutment-3 (south).

Substructure is shown to be wall abutments to 8.5-9.4±m high and a five-column bent with spread footings. All supports are skewed 3 degrees to match existing US 50 alignment. Plans show a structure approach slab behind each abutment. Proposed Abutment-1 will be located about 13.2-13.8 m in front of existing; proposed Abutment-3 will be about 1.3-1.9 m in front of existing. At proposed Bent-2, the two most easterly column footings are shown to be partly within the footprint of existing spread footings. Base of all spread footings are tentatively shown 1.8±m below road grade (i.e., below elev. 532±).

Construction will consist of two stages to allow traffic to be maintained on the existing overcrossing. Stage 1 will consist of a 16.2±m wide bridge left (easterly) of the "MFRD" Station Line, with Stage 2 involving removal of the original structure and construction of an additional 16.2±m wide bridge with 1.5±m closure pour at completion of Stage 2.

The approach embankments are shown to be about 6-8 m high with 1v:2h side-slopes. Retaining walls are also shown on the referenced plans located behind and on each side of abutments. They are expected to be Standard (Caltrans) Type-1 retaining walls, 12-14±m long and varying in height from 8 m to 10 m.

Future Phase 2 construction will expand the interchange to a Single Point Diamond Interchange (SPDI). This will include widening the Phase 1 structure on both sides for a total structure width to as much as 88±m.

Pertinent Structure/Site Information

Review of available structure/site information published by the State of California Bridge Department (Caltrans) pertinent to this project included the following:

- Foundation Investigation Report – Missouri Flat Road OC, dated March 23, 1965
- Foundation Review Memo – Missouri Flat Road OC, dated September 24, 1965
- As-Built "Log of Test Borings", Missouri Flat Road OC (Br. No. 25-77), dated January 29, 1969
- Post-construction "Foundation Report – Shingle Springs to Webber Creek", dated April 1969

The foundation report (March 1965) specified 250BP62 (10BP42) steel piles with design loads to 400 kN (45-tons) per pile at the abutments and spread footing support at the bents. Estimated pile tips were to elev. 532.80 m (elev. 1748 ft) at Abutment-1 and to elev. 529.75 m (elev. 1738 ft) at Abutment-4. At Bent-2 and Bent-3, spread footings with "design" bearing pressure specified to 383.1 kN/m^2 (4 tsf) were recommended to be established in bedrock at or below elev. 531.88 m (elev. 1745 ft) and elev. 530.97 m (elev. 1742 ft), respectively.

The foundation memo (September 1965) indicates that use of spread footings at each abutment with "design" bearing pressure of 239.4 kN/m^2 (2.5 tsf) was approved. Plan base of footing level was specified at elev. 533.71 m (elev. 1751 ft) at Abutment-1 and elev. 534.6 m (elev. 1754 ft) at Abutment-4.

The post-construction foundation letter (April 1969) and As-Built "Log of Test Borings" drawing by the State Bridge Department indicate the following:

- Abutment-1 (south); base of spread footing is shown at elev. 533.40 m (elev. 1750 ft).
- Bent-2 (south); base of spread footing is shown at elev. 530.21 m (elev. 1739.5 ft).
- Bent-3 (north); base of right footing was lowered 0.6-1.0 m (2-3 ft) to elev. 529.74 m (elev. 1738 ft) as a result of "over-blasting" the rock; base of left spread footing is shown at 530.36 m (elev. 1740 ft).
- Abutment-4 (north); material at planned base of footing was found to be unsatisfactory, and six, 16-inch (400 mm) diameter cast-in-drilled-hole piles with design loads to 625 kN (70 tons) per pile were drilled 0.6 m (2 ft) into "sound rock" with average pile tip shown at elev. 530.97 m (elev. 1742 ft).
- Some water was encountered in the footing excavations and successfully de-watered with a pump prior to casting the footings.

The as-built "Log of Test Borings" drawing attached to this report as "Log of Test Borings 2 of 2" shows added "MFRD" Line stationing for the current project. The locations of 1965 test borings are also shown on the "Log of Test Borings 1 of 2" prepared for this project (2005 test borings).

Exploration and Testing

State Bridge Department Study

Bridge foundation exploration performed by the State in 1965 consisted of three 57 mm (2¼-inch) cone penetration borings penetrating to lowest elev. 530.85±m (elev. 1742±). These borings were driven to effective refusal using a small compressed-air sheet-pile hammer.

Taber Study

Exploration to investigate the nature and distribution of earth materials and conditions for the proposed bridge included three drilled, sampled and logged test borings to a maximum depth of 9.8±m (lowest elev. 522±) supplemented by a short auger-identification boring to 1±m depth at proposed Abutment-3.

The borings were advanced by auger drilling through surficial unconsolidated soil and decomposed to very intensely weathered portions of the rock. Diamond-coring equipment was required to advance the borings through underlying, less weathered rock and to recover rock core for logging.

Drive samples of unconsolidated soil and decomposed to very intensely weathered rock were recovered from the borings by means of a 50 mm OD "standard penetration" sampler advanced with standard striking force (63.5 kg weight with 760 mm drop per ASTM D1586) to provide a field estimate of soils consistency. Sampler penetration resistance was recorded and, to some extent, can be correlated to strength and bearing characteristics of the foundation materials.

Portions of earth materials recovered with the drive sampler were retained in moisture-proof containers for laboratory testing and reference. Bulk samples were also obtained from auger drill cuttings. Rock cores were retained in core boxes for laboratory testing and reference and are available for inspection.

Borings were logged and earth materials field-classified by an engineer as to consistency, color, gradation and texture on the bases of sampler penetration resistance, and examination of samples, rock cores and drill cuttings. Subsequent to field investigation, rock cores were reviewed in the office by engineering geologists. Where diamond coring was used to advance the borings, the recovered cores were logged as to percent recovery, Rock Quality Designation (RQD[1]) degree of weathering, hardness and fracture density (see Drawing-1, "Engineering Geology Field Descriptors").

Laboratory tests performed on samples of both soil and decomposed rock materials to supplement field evaluation included moisture content-dry density tests. Testing on selected rock core was limited to Point-Load Index tests (utilizing a Soiltest Model RM-735 testing apparatus) in evaluation of the range of rock compressive strength. Laboratory testing on a bulk sample consisted of soils corrosivity screening (pH and minimum resistivity per CTM 643 – modified small cell, Sulfate per CTM 417 and Chloride per CTM 422). Results of laboratory testing are included in Appendix-A.

Groundwater observations were made in the borings during drilling operations. Borings 05-3, 05-4 and 05-5 were backfilled with cement-grout upon completion of drilling. Boring 05-27 was backfilled with drill cuttings.

The boring locations were referenced to project stationing as shown on the above referenced plans; elevations were referenced to project datum provided by Topographic Surveys, Incorporated. Locations, elevations, details of borings and results of tests are shown on the attached "Log of Test Borings 1 of 2" drawing and Appendix-A. Ron Loutzenhiser was field engineer for this study. Site reconnaissance and office review of rock cores was made by Martin McIlroy and Eric Nichols, both Certified Engineering Geologists.

Geologic Setting

The project site is located within the foothills of the Sierra Nevada geomorphic province of California. The Sierra Nevada has a general northwest topographic trend and is on the order of 690 km long and 64-129 km wide. The mountain ranges of the

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[1] RQD is the ratio of the total length of recovered core in pieces longer than 100 mm to the total length of boring cored, expressed as a percentage.

Sierra Nevada were created roughly 120 to 130 million years ago when sediments as thick as 9,200 m along with volcanic rocks were buckled and warped resulting in a series of low mountain ranges. The roots of these mountain ranges were then intruded by granitic rock.

The Sierra Nevada was tilted upward as a result of faulting along the east edge of the ranges. In the higher elevations of the Sierra Nevada, much of the sedimentary material has been eroded to extensively expose the granitic rock. Older rocks that remain have been metamorphosed and are exposed in the foothills of the Sierra Nevada.

Published geologic mapping (reference 4) shows surface materials within the project limits as Mesozoic granitic rock. Slate and metasedimentary rock of the Mariposa Formation and metavolcanic rock of the Logtown Ridge Formation are also shown nearby to the south and northeast of the project site.

Site reconnaissance made within project limits by personnel from this office indicates metamorphic rock exposed locally at/near each abutment and within a cut-slope along the north side of US 50 a few hundred meters east of the Missouri Flat Road Interchange. The rock is non-foliated with fine to medium grains contained within an aphanitic (i.e., grain size < 0.1 mm) matrix. Surface exposures are typically very intensely to moderately weathered.

Rock encountered in borings completed for the Weber Creek Bridge (located approximately 610 m east of the Missouri Flat Interchange; see Figure-1) is field-described similarly to rock encountered in borings completed for this project element (discussed below). Petrographic examination of two selected rock core samples from the Weber Creek site was made by personnel from Micro-Chem Laboratories (see Appendix-B). Based on petrographic examination, the two rock samples are generally classified as Hornfels – a non-foliated metamorphic rock typically formed by contact metamorphism.

At Missouri Flat Road, the existing cut-slope east of the interchange is at approximate 1:1 and has performed generally well with only minor sloughing in the more-weathered portions of the rock. The rock outcrop at existing Abutment-4 (northerly abutment) is randomly fractured with at least two prominent vertical joint/fracture sets with one set striking northwesterly and the other set striking northeasterly. Joints/fractures are spaced approximately 0.3-0.5±m.

The site is within an area of high seismicity, but no active faults are mapped within the immediate site vicinity and the site is not located within an Alquist Priolo "Earthquake Fault Zone" for fault rupture hazard. The nearest active fault is indicated to be the Forest Hill-Melones fault (FHM) located approximately 5.7 km east of the project site. This fault is indicated (per Caltrans) to have a maximum credible earthquake magnitude of 6.5.

The published mapping (references 2 and 3) shows an isolated band of near surface (or exposed) ultramafic rocks about 2.8±km east of the Missouri Flat Road overcrossing. Such ultramafic rocks locally include serpentine (or serpentinite) and can, but do not always, contain naturally occurring asbestos. Ultramafic rock materials are not, however, mapped within the limits of this project, and none were observed during our site reconnaissance.

No landslides are shown on the published mapping within the project interval, and none were observed at time of site reconnaissance. No evidence of other geologic hazards (such as settlement, very soft soils, severe erosion, etc) was observed as part of this study.

Earth Materials and Conditions

State Bridge Department Study

The foundation report indicates that native materials encountered at the site consist of a mantel of soft gravelly clay underlain by bedrock described as "...light colored porphyritic rhyolite containing feldspar and quartz in a grayish or greenish ground mass of somewhat variable texture."

Taber Study

Earth materials encountered in the borings are divided into two units considered significant to the proposed project.

Unit I (Embankment/roadway fill and/or colluvium): In all borings, embankment/ roadway fill associated with the existing facilities and/or colluvium was encountered from ground surface to nominal depth (0.15 - 0.50±m). These materials are described as stiff and hard sandy and silty clay with gravel and dense-very dense silty sand. The fill/colluvium overburden materials are considered unreliable for direct support of new structure loads, but are stable and suitable for support of light-moderate superposed fill embankment loads. Locally, materials of this unit may also include residual soil.

Unit 2 (Weathered and Fractured Rock): This unit underlies Unit 1 soils and consists of metamorphic rock (Hornfels) consistent with outcrops at the project site. The rock unit was encountered in the borings at the following depths/elevations:

Boring	Support	Depth (m)	Elevation (m)
05-5	Abutment-1	0.15	531.57
05-4	Bent-2	0.30	531.53
05-3	Abutment-3	0.55	532.54
05-27	Abutment-3	0.46	532.14

The Unit 2 rock is divided into two sub-units, defined by an upper portion (Unit 2A) ranging from "decomposed" to "intensely weathered" (i.e., effectively "soil-like") and a lower portion (Unit 2B) ranging in condition from "moderately to slightly weathered" to locally "fresh." In general, the rock unit appears to become fresher with depth. However, the transition between Unit 2A and Unit 2B rock appears to be both abrupt and gradational, and depth of Unit 2A rock may vary significantly between borings.

Unit 2A rock materials were encountered to approximate elev. 529.7± in Boring 05-4 and Boring 05-5. In Boring 05-27, Unit 2A rock materials were penetrated below 0.4 m depth to terminal depth of boring at 1.0±m (elev. 531.9±). The rock in this interval was easily augered with 100 mm solid-stem continuous flight auger and at least nominal penetration was achieved with the "Standard Penetration" sampler; coring was not appropriate in these materials and achieved poor recovery where attempted (Boring 05-5). The rock mass of this subunit is estimated to classify as "very poor" to "poor" rock (see Appendix-C). Unit 2A rock materials were not encountered in Boring 05-3.

Unit 2B rock materials were encountered below Unit 2A in Boring 05-4, 05-5 and 05-27 and below elev. 532.3± in Boring 05-3. The rock of this sub-unit is less weathered and required diamond coring for drill advancement and is field-described (modified by office review of rock cores) as moderately hard to hard-very hard, non-foliated metamorphic rock (Hornfels – similar to rock examined in thin-section from core obtained at Weber Creek; see Appendix-B). The rock texture is typically composed of fine to medium grains within an aphanitic matrix. Degree of fracturing varies significantly from "very intensely" to "slightly." Based on boring encounter, this subunit is indicated to have a Rock Mass Rating (RMR) value of 56 to 68 and to classify as "fair" to "good" rock (see Appendix-C).

Rock Quality Designation (RQD) of all cored rock ranges from 45% to 57% (average 51%) in Boring 05-5 at Abutment-1, from 0 to 75% (average 43%) in Boring 05-4 at Bent-2 and from 0 to 100% (average 62%) in Boring 05-3 at Abutment-3. Within the intervals cored, average recovery was 86% in Boring 05-5 (Abutment-1), 90% in Boring 05-4 (Bent-2) and 92% in Boring 05-3 (Abutment-3).

Point load tests were performed on selected core samples from Borings 05-3, 05-4 and 05-5 in evaluation of rock compressive strength. For this project element, a total of thirteen rock cores were broken using a basic diametral test procedure in which the core axis is oriented perpendicular to the applied load. Point load tensile-strength index values were used to estimate uniaxial compressive strength values based on correlations developed by Bieniawski (Reference 1). Factors accounting for the variability in point load strength include rock composition, fracturing, grain size and weathering characteristics.

Results of point-load tests are included with Appendix-A. Samples tested yielded ultimate compressive strength values ranging from 93.2 MPa to 421.7 MPa (13,512 psi to 61,158 psi) with a mean of 211.2 MPa (30,634 psi).

A sample earth material profile with engineering properties is shown on Figure-2.

Groundwater

State Bridge Department Study

No free groundwater was encountered at time of January 1965 exploration made by the State. As referenced above, State records indicate that some water was encountered in the footing excavations and that it was successfully de-watered with a pump prior to casting the footings.

Taber Study

At time of April/May/June 2005 field study, no seepage or groundwater was noted within the augered intervals (lowest elev. 529.7±) of Borings 05-3, -4, -5 and -27. Groundwater measurement was not made in Borings 05-3, -4 and -5 below the augered intervals due to the presence of residual drill fluid.

The soil overburden materials and decomposed rock are expected to be seasonally saturated and are considered capable of transmitting seepage to open excavations; the decomposed to very intensely weathered rock, somewhat less so then soil. Groundwater occurrences in the underlying less weathered/fractured rock are expected to be restricted to open fracture/joint planes and localized/limited in extent and quantity. Other occurrences of relatively shallow "perched" groundwater may be present, particularly during the wet season and/or wetter years.

Site Seismic Conditions

In accordance with current Caltrans Division of Structural Foundations site seismicity evaluation procedures (with reference to "Caltrans California Seismic Hazard

Map 1996" and "A Technical Report to Accompany the Caltrans California Seismic Hazard Map 1996"), "Peak Bedrock Acceleration" (PBA) of 0.40g can be assigned the site associated with a controlling event of 6.5 magnitude on the Forest Hill-Melones fault located approximately 5.7 km east. The calculated Geomatrix (1997) PBA is 0.44g. Reference 13 lists this fault type as "normal."

This site may conservatively be assigned a soil profile "Type C" per Table B.1, Caltrans "Seismic Design Criteria" (SDC) version 1.3. Based on boring encounter, a soil profile "Type B" could be considered for use in design.

Caltrans structure design practice requires certain increases in SDC response curves due to fault type and/or fault proximity. At this site, fault type is not a factor, however, the proximity of the site to the seismic source will require a staged increase in spectral accelerations depending upon structure period. Per Caltrans procedures, sites within 15 km of an active fault should receive an increase in design spectral accelerations as follows:

Structure Period (seconds)	Increase in Spectral Acceleration (%)
0-0.5	No Increase
0.5-1.0	0% to 20% Linear Increase
≥1.0	20% Increase

Based on the guidelines and published Caltrans criteria as discussed above, the following SDC seismic design parameters are recommended for this site.

- Forest Hill-Melones Fault
- Magnitude 6.5±0.25
- Soil Profile Type C
- PBA = 0.5 g
- ARS curve from SDC Figure B.4 (modified to show increases in spectral accelerations)

The modified ARS curve is attached as Figure-3.

Liquefaction

Liquefaction is a secondary effect associated with seismic loading. Other than possible distortion of remnant fill, no major soil defects with respect to seismic loading are identified in the borings and soils data do not suggest the likelihood of secondary seismic effects such as liquefaction or lurching adversely affecting bridge foundations supported in the underlying rock unit. No other significant site soils defects with respect to seismic loading (e.g., lateral spreading, ground lurching, etc.) were identified from the limited data obtained in this study.

Should there be important structural and/or economic considerations associated with more closely defining these values or other site seismicity characteristics, further study would be required.

Corrosivity

Corrosivity tests (pH, minimum resistivity, chlorides and sulfates) were performed on a bulk sample of residual soil obtained from Boring 05-04. Test results indicate a "non-corrosive" soils environment as defined by the September 2003 Caltrans "Corrosion Guidelines" publication. No special corrosion considerations with respect to concrete/steel design are required for bridge foundations and substructure. Results of corrosivity tests are included with Appendix-A.

Conclusions and Discussion

Structure support is available and should be achieved within intact (Unit 2B) rock materials. The use of spread footing foundations appears to be the most appropriate foundation type and is recommended for both the new bridge and contiguous retaining walls. For spread footings, major site foundation characteristics/constraints affecting details of support level, bearing, etc. include location of support lines on irregular rock surfaces, excavation of hard rock to bearing levels, mechanical defects of the rock (fractures/joints) and local variation in rock depth/condition. Conditions are considered suitable for use of rock anchors, bolts, etc, if/as needed to provide uplift/overturning resistance.

The use of cast-in-drilled-hole (CIDH) pile foundations or large diameter drilled-shafts is also considered technically feasible, although this would require hard rock excavation. Tip elevations would depend on pile/shaft diameter and compressive, tensile and lateral loading requirements. Further details for such foundation can be provided based on data in-hand, if desired.

Driven (displacement) piles would not be expected to achieve adequate penetration for stability and are not recommended. Steel "H"-piling could be considered at some locations, but would be short (likely < 3.0 m) – achieving only very limited rock penetration – and would provide little lateral or tensile resistance.

The existing structure foundations are to be removed prior to construction of the new bridge. At Abutment-3, existing foundations are in very close proximity to proposed. At Bent-2, existing spread footings are indicated to be within the footprint of proposed foundation elements. While existing foundations are not expected to directly conflict with new spread footing foundations established lower in elevation, disruption from their removal might require increased footing depth or other consideration.

Recommendations

Bridge Structure

Spread footings should be at least 1.0 m wide and established with minimum penetration of at least 0.6 m into intact rock (Unit 2B) as affirmed by the personnel from this office. Such footings may very conservatively be assigned allowable (service load) bearing pressure of 478 kPa (5 tsf), net at ground line. Higher bearing pressures are readily available based on specific footing size and loading and/or with increased rock penetration, higher levels of preparation, etc. Settlement of such footings is expected to be nominal (<13 mm).

The metamorphic rock is expected to be moderately to slightly weathered with rock surface along footing lines typically variable on order of 0.3-0.6±m and containing open fractures; however, local irregularities of greater magnitude cannot be precluded. Based on boring encounters, highest plan footing levels meeting the above criteria are shown in the following Spread Footing Data Table.

Table 1

Spread Footing Data Table

Support Location	Minimum Footing Width	Bottom of Footing Elevation	Recommended Bearing Limits	
			WSD[1]	LFD[2]
			Allowable Bearing Capacity (q_{all})	Nominal Bearing Resistance (q_n)
Abut-1	1.0 m	529.00	478 kPa	N/A
Bent-2	1.0 m	529.00	N/A	1434 kPa
Abut-3	1.0 m	531.50	478 kPa	N/A

Notes: 1) Working Stress Design, (WSD), the Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Gross Allowable Bearing Capacity, (q_{all}).

2) Load Factor Design, (LFD), The Maximum Contact Pressure (q_{max}) divided by the Strength Reduction Factor (ϕ) is not to exceed the Nominal Bearing Resistance (q_n).

Local surface irregularities along footing lines may be considered for field adjustment of rock penetration requirement upon review/approval of the foundation engineer.

Lateral load resistance of spread footings may be calculated as follows:

1. A base friction factor of 0.75 is recommended for intact rock.

2. Soil resistance against the face of footings can be based on passive pressure of 64.0 kN/m^2/m (based on formed footings with compacted structure backfill or footings poured neat against intact rock).

3. Per Caltrans practice, the following guidelines should be used for the force/moment equilibrium analysis of the foundations:
   - Use 100% base friction and 0% passive resistance, or
   - Use 0% base friction and 100% passive resistance, or
   - Use 50% base friction and 50% passive resistance.

Footing concrete should be poured neat, without forming, against trimmed, intact bearing materials within clean and dry excavations. Any exposed open fractures or other discontinuities should be carefully evaluated by the soils engineer with respect to bearing/stability considerations and cleaned/surface-grouted, if necessary.

Some modification of footing level may be necessary if/as disruption of bearing material occurs due to removal of existing footings, conditions differ from those anticipated and/or if previous excavation disrupted the rock to levels near proposed footing elevation. If necessary, additional excavation (up to 1 m) can be backfilled with plain (Class-C) concrete, with doweling utilized to provide positive contact between the structural footing element and plain concrete.

Retaining Walls

For Type-1 retaining walls with level backfill (Case 1) condition, Caltrans "Standard Plans" indicate a maximum toe pressure of 275 kPa (5.7 ksf) and 325 kPa (6.8 ksf) for retaining wall height 8500 mm and 10300 mm, respectively. Base of retaining wall footings established within intact rock at the same levels shown in the Spread Footing Data Table for abutment footings are considered suitable for allowable design bearing pressures up to 325 kPa (6.8 ksf), net at ground line. "Ultimate" bearing pressures are to at least 3 times allowable values.

Materials exposed at footing grades should be reviewed by the soils engineer to affirm uniformity and suitability for support of retaining wall foundations. If the rock is found to be weak or disturbed, use of plain concrete would be considered appropriate to engage suitable rock below base of structural footing, if/as necessary. Any disturbed areas along footing grade (e.g., associated with existing footing construction) should be removed to full depth and replaced with plain concrete.

Conversely, stepping of individual footings would also be considered appropriate in hard rock to achieve required penetration of bearing materials without excessive excavation.

Lateral Soil Pressures

With use of Caltrans "Structure Backfill" or equivalent, an active soil pressure of 5.6 $kN/m^2/m$ (36 pcf) is considered appropriate for use in abutment and retaining wall design with level backfill. Back of wall drainage should be established per Caltrans "Standard Plan" details (B3-8).

Seismic loading will apply additional soil pressure to abutment/retaining walls. The resultant of incremental lateral soil pressure due to seismic loading will act at 0.6 times the wall height above the base of the wall and the magnitude of resultant may be calculated on the basis of an equivalent fluid pressure of 9.1 $kN/m^2/m$ (58 pcf).

For free standing walls, expected to be capable of significant "yield" and displacement under seismic loading, it is appropriate to reduce the incremental soil loading from seismic forces by as much as 50% for evaluating wall stability with respect to sliding and overturning.

For seismic loading into abutments, passive soil resistance of up to 239 kPa is available (to be reduced for effective wall height less than 1.7 m in accordance with Caltrans SDC v.1.3).

Embankment

Embankment construction and any new fill placement should be in accordance with Caltrans "Standard Specifications", including at least 95% relative compaction on all fill within 50 m of bridge abutments. Where new fill is to be placed onto existing embankment slopes, it should be fully-bonded into the existing fill by placing on discrete horizontal benches cut fully into the slope and below any loose/soft or otherwise unsuitable materials (per Section 19 of Caltrans "Standard Specifications").

Excavation Conditions

Groundwater is not anticipated during dry season construction. However, the presence of seepage from surface infiltration cannot be precluded. Such seepage, if encountered, is expected to be readily controllable by pumping.

Existing fills and residual soils are expected to be readily excavated using typical earth moving equipment. Excavation of rock within bridge and retaining wall footing limits to depths indicated above is expected to be locally difficult (e.g., retaining wall footings), but generally achievable by use of air tools without blasting. Rock blasting may disrupt/degrade integrity of the surrounding rock and other facilities and should be performed only under carefully controlled conditions and with prior written approval of the engineer.

If required, blasting should be performed in accordance with Caltrans "Standard Specifications" (including Sections 7-1.10 and 19-2.03). The specifications and special provisions developed for blasting should address safety issues and avoidance of damage to existing pavement, utilities, structures and other natural and man-made features. Such procedures and specifications should be reviewed by this office.

Temporary (construction) backslope in rock is expected to be appropriately stable at 1:1 or flatter; lower cut sections (in less-weathered rock) may be stable at construction slopes of 2v:1h, upon positive review by the engineering geologist. Consideration for shoring will be required for local areas of weak rock, remnant embankment and/or any areas exhibiting potential for failure along daylighting fracture planes, and/or where existing supports may be jeopardized (particularly at new Abutment-3).

Excavation and shoring should conform with CalOSHA requirements and the Caltrans "Trenching and Shoring Manual."

TABER CONSULTANTS

Franklin P. Taber
R.C.E. 30920
G.E. 816

Ronald E. Loutzenhiser
R.C.E. 64089

March 23, 2006

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GENERAL CONDITIONS

The conclusions and recommendations of this study are professional opinion based upon the indicated project criteria and the limited data described herein. It is recognized there is potential for variation in subsurface conditions and modification of conclusions and recommendations might emerge from further, more detailed study.

This report is intended only for the purpose, site location and project description indicated and assumes design and construction in accordance with Caltrans practice.

As changes in appropriate standards, site conditions and technical knowledge cannot be adequately predicted, review of recommendations by this office for use after a period of two years is a condition of this report.

A review by this office of any foundation and/or grading plans and specifications or other work product insofar as they rely upon or implement the content of this report, together with the opportunity to make supplemental recommendations as indicated therefrom is considered an integral part of this study and a condition of recommendations.

Subsequently defined construction observation procedures and/or agencies are an element of work, which may affect supplementary recommendations.

Should there be significant change in the project or should soils conditions different from those described in this report be encountered during construction, this office should be notified for evaluation and supplemental recommendations as necessary or appropriate.

Opinions and recommendations apply to current site conditions and those reasonably foreseeable for the described development--which includes appropriate operation and maintenance thereof. They cannot apply to site changes occurring, made, or induced, of which this office is not aware and has not had opportunity to evaluate.

The scope of this study specifically excluded sampling and/or testing for, or evaluation of the occurrence and distribution of, hazardous substances. No opinion is intended regarding the presence or distribution of any hazardous substances at this or nearby sites.

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    (2) Foundation Review Memo – Missouri Flat Road OC, dated September 24, 1965.
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    (2) "Geologic/Geotechnical Review", (1P2/399/296), March 26, 2001.
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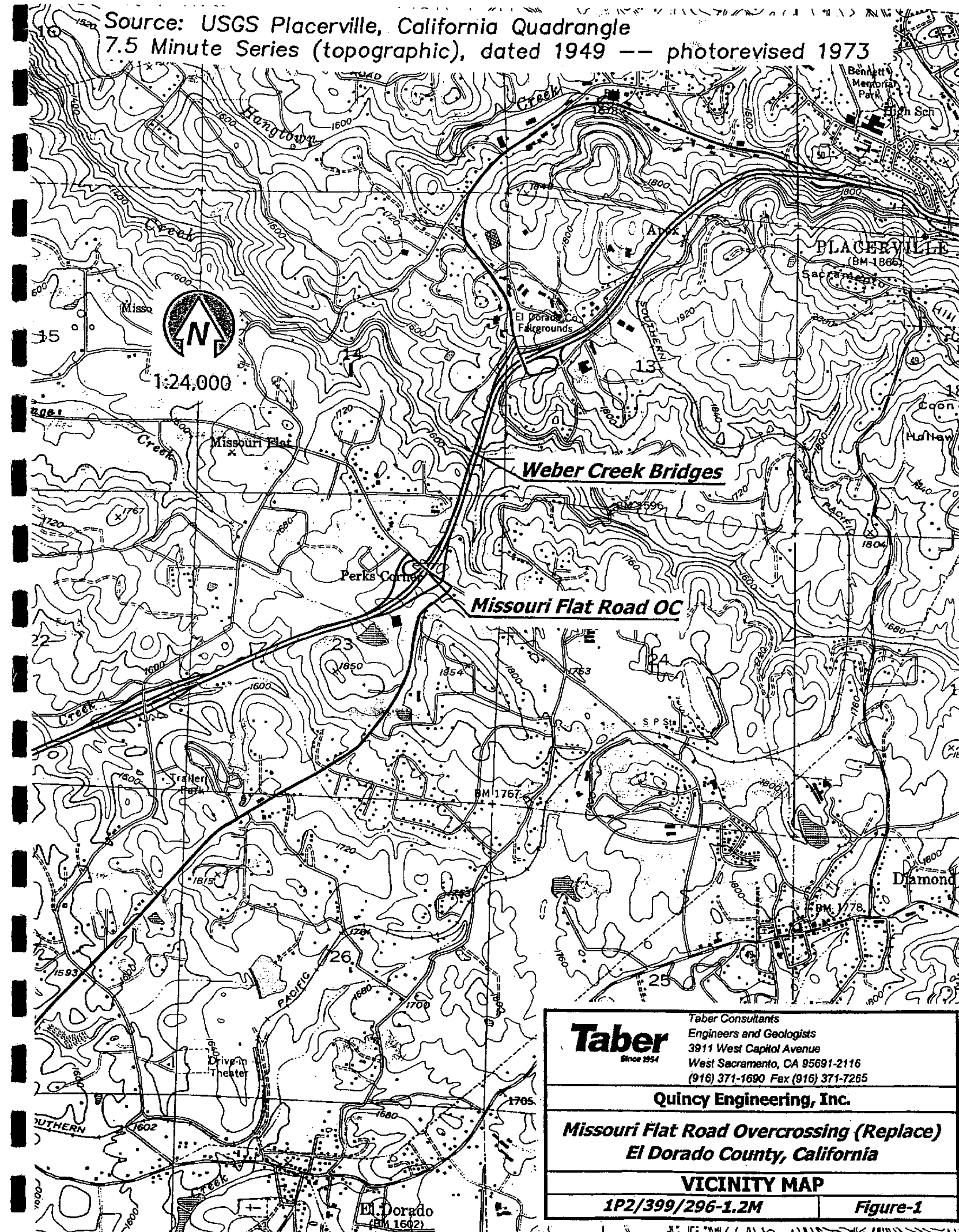
22. United States Geological Survey, "Placerville, CA Quadrangle" 7.5-Minute Series (topographic), dated 1949, photo-revised 1973.


Source: USGS Placerville, California Quadrangle
7.5 Minute Series (topographic), dated 1949 -- photorevised 1973
1:24,000
N
Weber Creek Bridges
Missouri Flat Road OC
Hangtown Creek
Missouri Flat
Perks Corner
El Dorado Co. Fairgrounds
Apex
PLACERVILLE
(BM 1866)
Bennett Memorial Park
High Sch
Trailer Park
Drive-in Theater
S P Sta
BM 1767
BM 1596
BM 1778
Diamond
El Dorado
(BM 1602)
SOUTHERN
PACIFIC
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Engineers and Geologists
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(916) 371-1690 Fax (916) 371-7265
Quincy Engineering, Inc.
Missouri Flat Road Overcrossing (Replace)
El Dorado County, California
VICINITY MAP
1P2/399/296-1.2M
Figure-1

Generalized Earth Material Unit Profile with Engineering Properties

Missouri Flat Road Overcrossing
03-ED-50-23.2/25.4
Br. No. 25-0077
El Dorado County, California

Unit Designation	Generalized Earth Material Unit Description	Boring			Earth Material Parameters			
		05-5 (Abutment-1)	05-4 (Bent-2)	05-3 (Abutment-3)	Total Unit Weight	Buoyant Weight	Estimated Friction Angle ϕ	Estimated Cohesion c
					(kN/m³)	(kN/m³)	(degrees)	(kN/m²)
Proposed top of embankment		539.48	N/A	539.62				
Existing ground at boring		531.72	531.83	533.09				
		Elevation at bottom of layer						
Unit 1 (Roadway Fill and/or Colluvium)	Stiff - hard SILTY/SANDY CLAY with GRAVEL and dense-very dense SILTY SAND	531.50	531.53	532.59	19.0 - 19.6	9.2 - 9.8	15 - 25	0 - 55
Unit 2A (Decomposed - Intensely Weathered Metamorphic Rock)	Very hard SANDY CLAY with GRAVEL and very dense CLAYEY SAND with GRAVEL	529.82	529.73	Not encountered	20.0 - 20.7	10.2 - 10.9	15 - 25	100 - 200
Unit 2B (Less Weathered Metamorphic Rock)	Moderately to slightly weathered (locally fresh), hard - very hard, very intensely to moderately fractured METAMORPHIC ROCK				25 - 28 *	N/A	25 - 45	200 - 400
Bottom elevation of referenced test boring		524.71	522.08	523.95				
Groundwater Elevation		See Note 5						

* Based on typical rock properties for Metamorphic Rock; source: "Rock Slope Engineering" (3rd Edition), Hoek and Bray, 1981.

Notes: 1) For Unit 2B Metamorphic Rock, the unit weight of the material does not vary significantly between saturated and dry states.

2) For design use the following:
Granular Layers: ϕ (varies as shown) and $S_u = 0$
Cohesive Layers: S_u (varies as shown) and $\phi = 0$

3) Friction angle and cohesion of Unit 2A and Unit 2B rock estimated based on Rock Mass Rating (see Appendix-C).

4) Depth to rock may vary along individual support lines due to sloping ground and/or irregular rock surface.

5) Based on visual logging of soil samples in borings completed in April/May/June 2005, no seepage or groundwater was noted within the augered intervals (lowest elev. 529.7) of Borings 05-3, -4 and -5. Groundwater occurrences in the underlying less weathered/fractured rock are expected to be restricted to open fracture/joint planes and localized/limited in extent and quantity. Seasonal fluctuations of groundwater would not be unexpected. Occurrences of relatively shallow "perched" groundwater overlying the rock may be present, particularly during the wet season and/or wetter years.

Soil engineering properties and strength/bearing characteristics of foundation materials selected for use in this report have been derived/established from a combination of:

- visual logging of earth materials and drilling procedures by an engineer-geologist,
- laboratory testing of earth materials obtained during field exploration,
- correlation with "Standard Penetration Test" results, and
- professional engineering experience/judgement.

These parameters are for reference and guidance only; geotechnical criteria and constraints for any project element should be evaluated with respect to sensitivity of application, source data, etc. The need for additional study and/or revision should be considered in all cases.

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Caltrans SDC: Modified ARS Curve
Missouri Flat Road Overcrossing (Replace)
El Dorado County, California

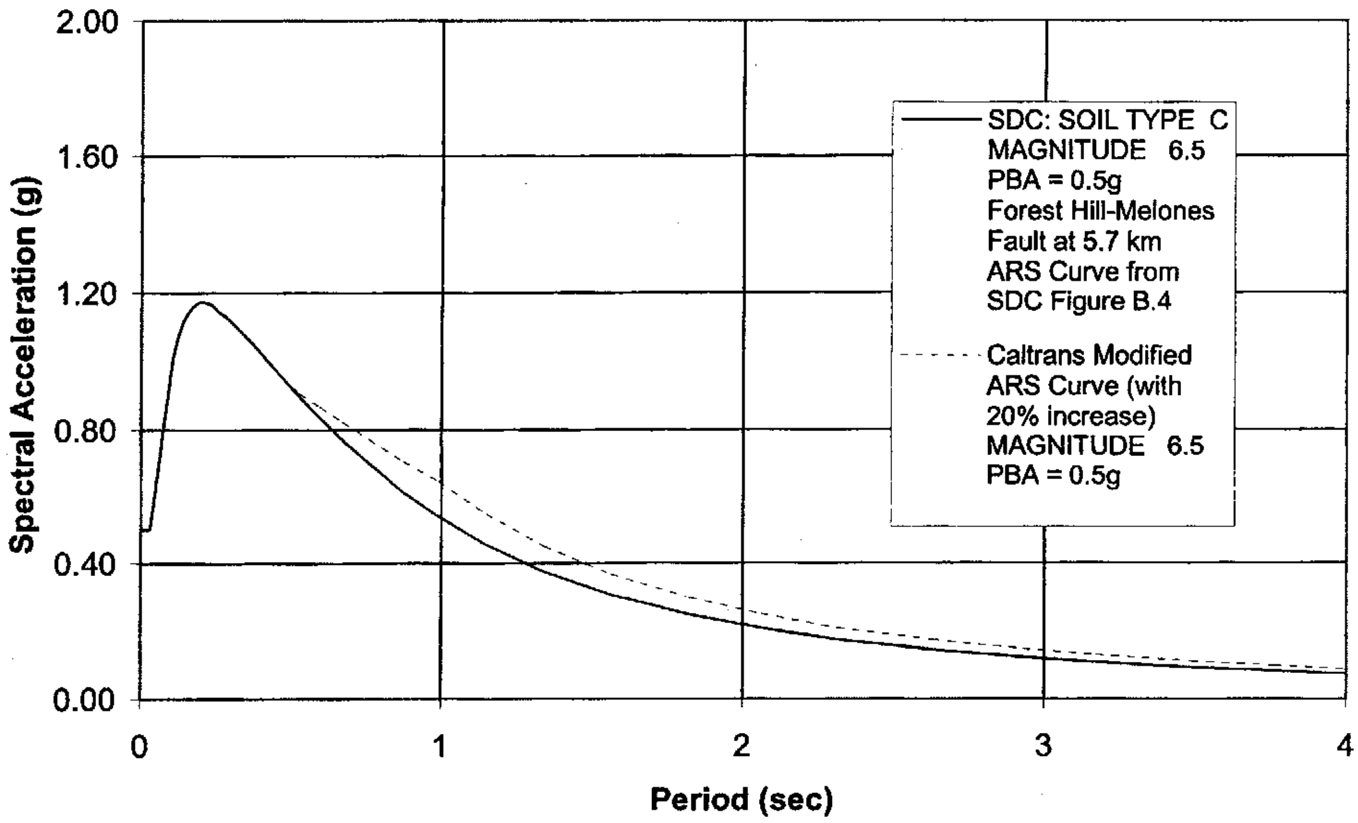

Figure-3

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APPENDIX – A

LABORATORY TEST RESULTS

Job # 1P2/399/296-1.2M

POINT LOAD TEST RESULTS

Missouri Flat Road OC

Boring	Top Hole Elevation		Core Run	Depth		Elevation		Core Diameter (inches)	Failure Load (lbf)	Point Load Index (psi)	Point Load Index (MPa)	Uniaxial Compressive Strength (psi)	Uniaxial Compressive Strength (MPa)	Remarks/Notes
	(feet)	(m)		(feet)	(m)	(feet)	(m)							
3	1748.97	533.09	A	4.0	1.22	1745.0	531.87	1.75	5300	1731	11.9	37691	259.9	60 degree brk, stepped
3	1748.97	533.09	C	9.3	2.83	1739.7	530.25	1.75	2100	686	4.7	14934	103.0	65 degree brk, smooth
3	1748.97	533.09	E	16.5	5.03	1732.5	528.06	1.75	6000	1959	13.5	42669	294.2	90 degree brk, smooth
3	1748.97	533.09	G	24.0	7.32	1725.0	525.77	1.75	5600	1829	12.6	39824	274.6	30 degree brk, stepped
4	1744.84	531.83	A	8.2	2.50	1736.6	529.33	1.75	1900	620	4.3	13512	93.2	core split
4	1744.84	531.83	C	16.6	5.06	1728.2	526.77	1.75	8600	2808	19.4	61158	421.7	random fracture, rough
4	1744.84	531.83	D	20.5	6.25	1724.3	525.58	1.75	5600	1829	12.6	39824	274.6	60 degree brk, rough
4	1744.84	531.83	G	25.6	7.80	1719.2	524.02	1.75	4900	1600	11.0	34846	240.3	40 degree brk, rough
4	1744.84	531.83	H	29.0	8.84	1715.8	522.99	1.75	3400	1110	7.7	24179	166.7	45 degree brk, smooth
5	1744.48	531.72	A	7.6	2.32	1736.9	529.40	1.75	3700	1208	8.3	26312	181.4	core split, rough
5	1744.48	531.72	B	10.2	3.11	1734.3	528.61	1.75	2500	816	5.6	17779	122.6	75-80 deg brk, smooth stepped
5	1744.48	531.72	C	15.1	4.60	1729.4	527.12	1.75	3900	1273	8.8	27735	191.2	40 deg brk, smooth stepped
5	1744.48	531.72	D	20.8	6.34	1723.7	525.38	1.75	2500	816	5.6	17779	122.6	40 deg brk, irregular rough
											AVERAGE:	30634	211.2	

Uniaxial compressive strength values based on point load test data and correlations derived from Bieniawski (1975); "Rock Mechanics for Underground Mining", Brady & Brown, 1985 (page 98-99).

<u>Equation to determine Uniaxial Compressive Strength:</u>

Uniaxial Compressive Strength = $\sigma_c = (14 + 0.175D)I_s$

Point Load Index = $I_s = P/D^2$

1 psi = 6.8948 kN/m^2 = 6.8948 kPa

1 psi = 0.0068948 Mpa

pH, Minimum Resistivity (CTM 643), Chloride (CTM 422) & Sulfate (CTM 417) Tests

Boring/Sample	Depth (m)	Description	Resistivity (ohm-cm)	pH	Chloride (ppm)	Sulfate (ppm)
4/Bag E	0.0-1.5	Brown SANDY CLAY with GRAVEL	2,360	6.82	19.4	25.5

APPENDIX – B

PETROGRAPHIC EXAMINATION OF ROCK SPECIMENS
(WEBER CREEK BRIDGES – WIDEN)

PETROGRAPHIC EXAMINATION OF ROCK SPECIMENS

PROJECT: Missouri Flat Road IC
(Weber Creek Bridge)
El Dorado County, CA
Job No. 1P2/399/296-1, 2

JOB NO. C-4571-05

JULY 29, 2005

MICRO-CHEM LABORATORIES
635 Bret Harte Drive
P.O. Box 485
Murphys, CA 95247-0485
(209) 728-8200

MICRO-CHEM LABORATORIES

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July 29, 2005

Taber Consultants Engineers & Geologists
3911 W. Capitol Avenue
West Sacramento, CA 95691-2116

Job No. C-4571-05

Attn: Mr. Martin McIlroy

Re: Petrographic Examination of Rock Specimens
Project: Missouri Flat Road IC
(Weber Creek Bridge)
El Dorado County, CA
Job No. 1P2/399/296-1,2

In response to your request, two rock specimens were received for petrographic examination. The samples were reportedly obtained from the above referenced project. The objectives of the testing were to determine the mineralogy of the rock samples by petrographic examination.

Test Methods

Sections of rock were saw cut, lapped, and examined with stereomicroscope. Thin sections were prepared from selected areas from Samples B-7 and B-10 and examined with a petrographic microscope. The samples were examined according to ASTM C295-03, "Standard Guide for Petrographic Examination of Aggregates for Concrete."

Sample Descriptions

The following rock specimens were received.

Sample ID.	Diameter, in.	Length, in.	Description	Date
B-7	1.8	8.5	Run G, 33.7'-34.4'	6/27/05
B-10	1.8	7.8	Run N, 66.0'-66.9'	6/27/05

Petrographic Examination

1. Samples B-7 and B-10 were hard and dense metamorphic rocks. Sample B-10 contained very few voids in the rock.

2. Sample B-7 is classified as a chlorite hornfels. The high quartz/feldspars content in this rock produced a very hard material.

3. Sample B-10 is classified as an epidote hornfels. Although the feldspars have mostly been altered, the rock is hard and dense (harder than stainless steel).

4. The details of the petrographic examination of Samples B-7 and B-10 are presented in Tables I and II.

Should any questions arise concerning the findings of this report, please contact the undersigned.

Respectfully submitted,
MICRO-CHEM LABORATORIES

William R Nickison

William R. Nickison
Assistant Petrographer

WRN/jamc
C457105
Attachments

Sample Disposition: The samples will be stored for a period of one month and thereafter discarded. Charges for additional sample storage time and/or shipping of the samples will be billed to the client.

TABLE I

JOB NO. C-4571-05

SAMPLE ID. B-7

PETROGRAPHIC EXAMINATION OF ROCK
ASTM C295-03

Minerals	Estimated %, by volume	Approximate Size
Quartz/Feldspars[(1)]	80-90	<2.4 μm to 500 μm
Chlorite	10-15	10 μm to 900 μm
Cassiterite[(2)]	3-6	5 μm to 1 mm
Epidote	Trace	10 μm to 100 μm
Pyrite	<1	50 μm to 4 mm
Mica	Trace	10 μm to 450 μm

The sample is fine grained, very hard and dense, green gray colored, with white veins of calcite and mica. The rock is classified as a chlorite hornfels.

[(1)] An intimate mixture of quartz and feldspars (labradorite) in a felsitic matrix. Percentages of each constituent could not be reliably estimated from thin section analysis.
[(2)] Very high relief and birefringent subhedral and anhedral mineral that appears to be cassiterite.

TABLE II

JOB NO. C-4571-05

SAMPLE ID. B-10

PETROGRAPHIC EXAMINATION OF ROCK
ASTM C295-03

Minerals	Estimated %, by volume	Approximate Size
Quartz	40-50	<2.4 µm to 450 µm
Altered Feldspars	40-50	200 µm to 4 mm
Epidote	2-4	50 µm to 400 µm
Calcite	2-4	24 µm to 250 µm
Chlorite	2-4	24 µm to 700 µm

The rock is medium to fine grained, hard to very hard and dense with few voids, green-gray colored. The rock is classified as an epidote hornfels.

PHOTOGRAPHS OF AS-RECEIVED SAMPLES
SAMPLE B-7 (scale in cm)

PHOTO NO. 1

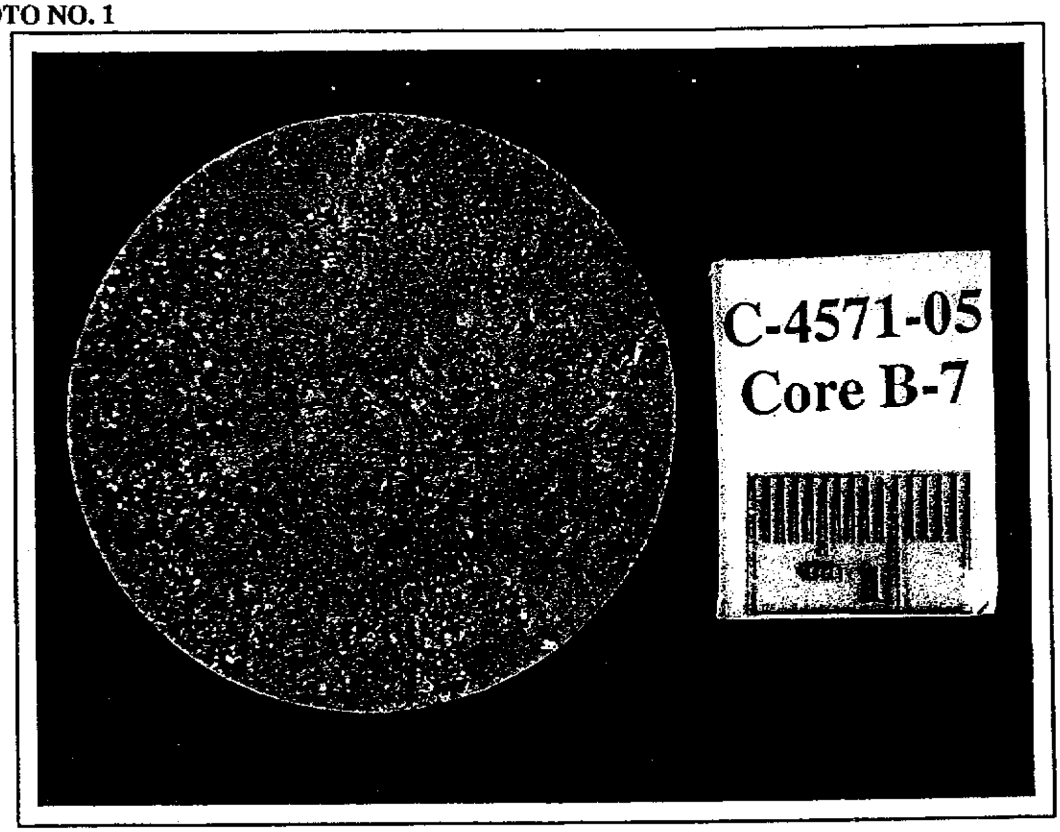


PHOTO NO. 2

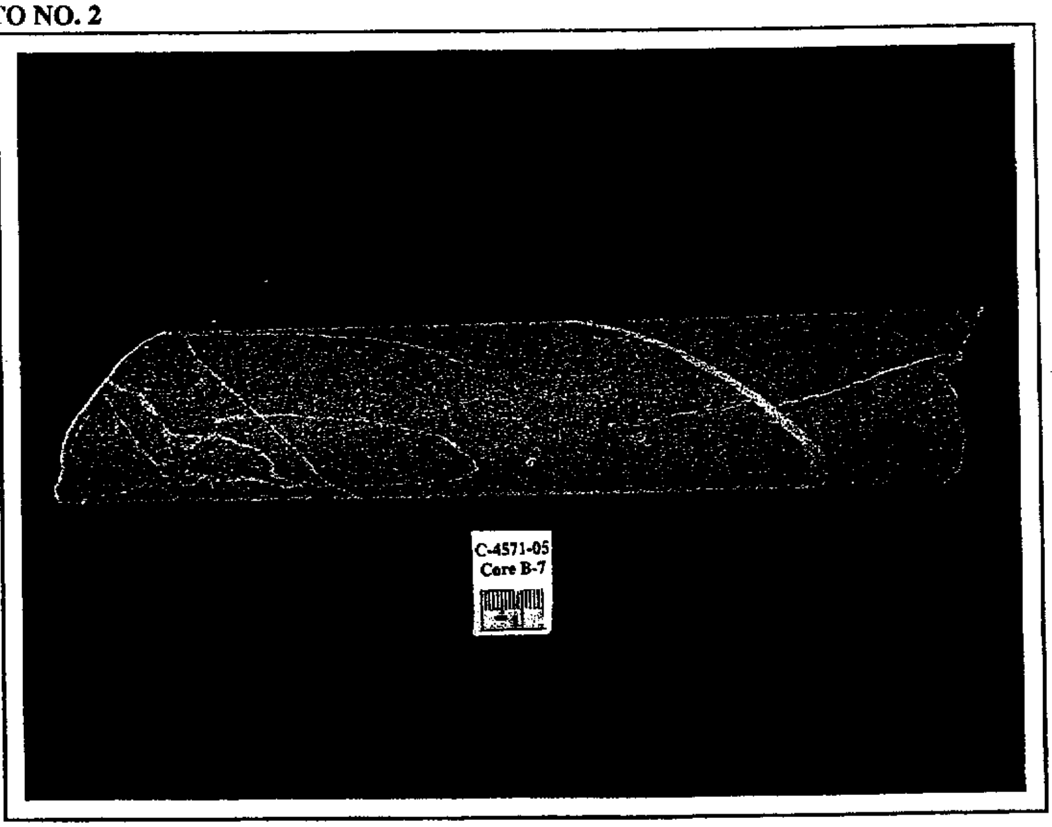


PHOTO NO. 3

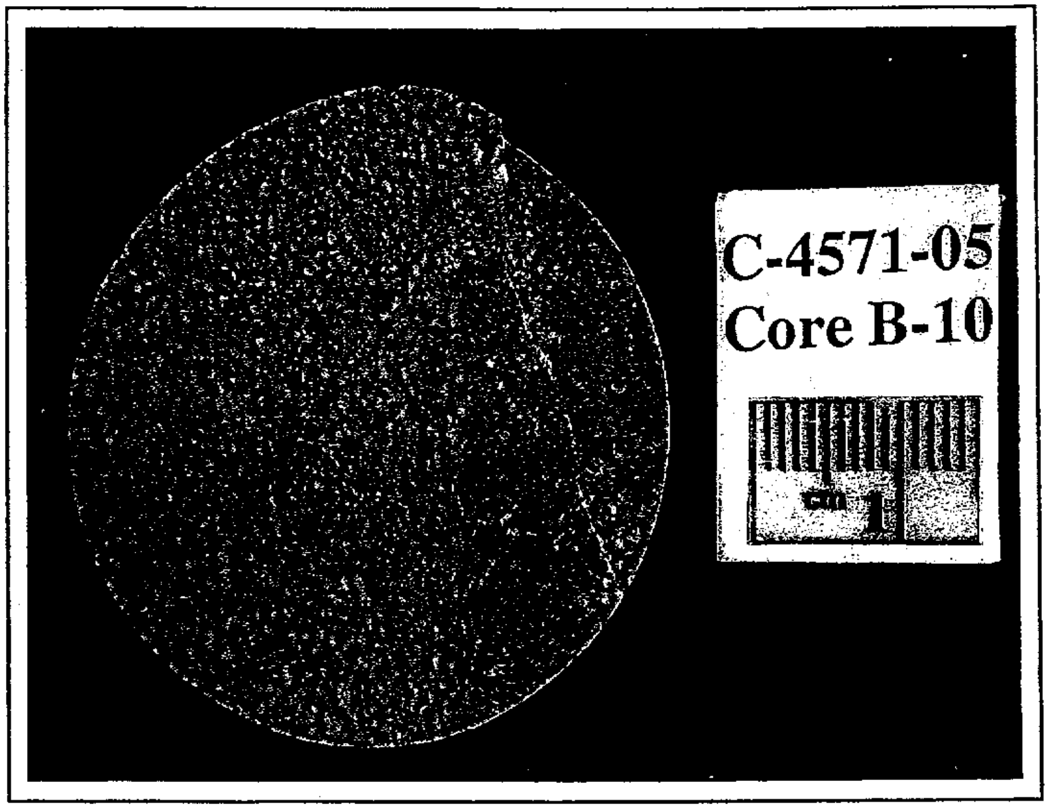
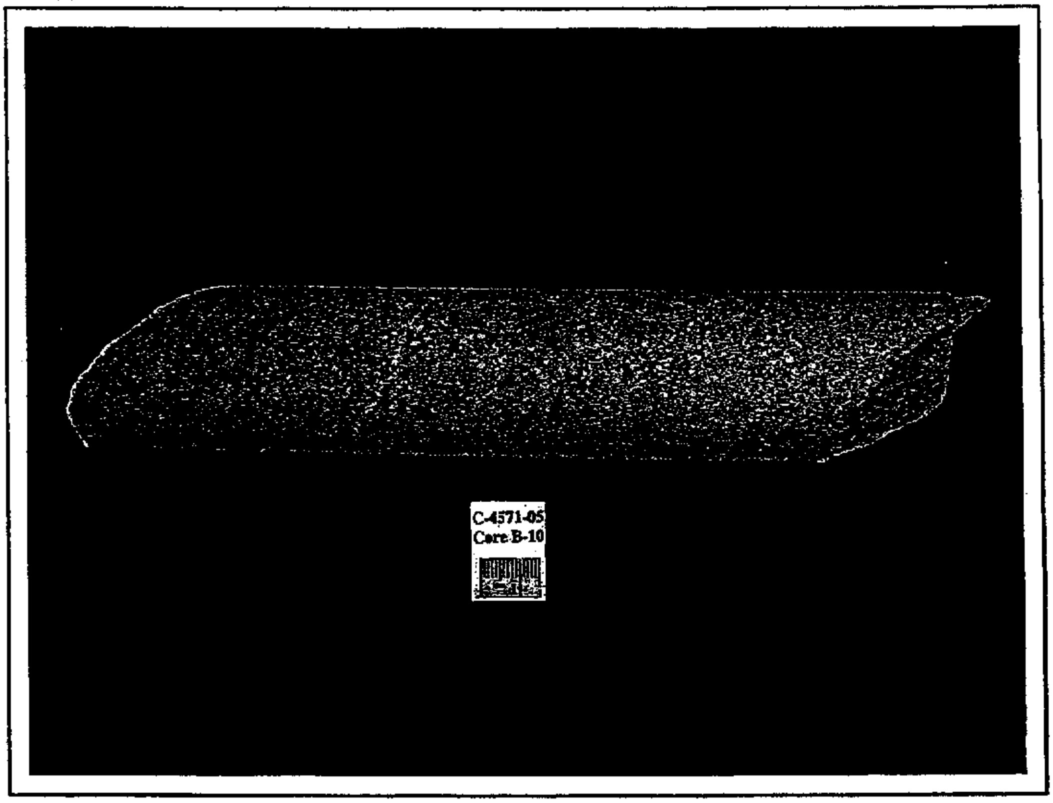


PHOTO NO. 4



PHOTOGRAPHS OF LAP SECTIONS
(scale in cm)

PHOTO NO. 5 – Sample B-7

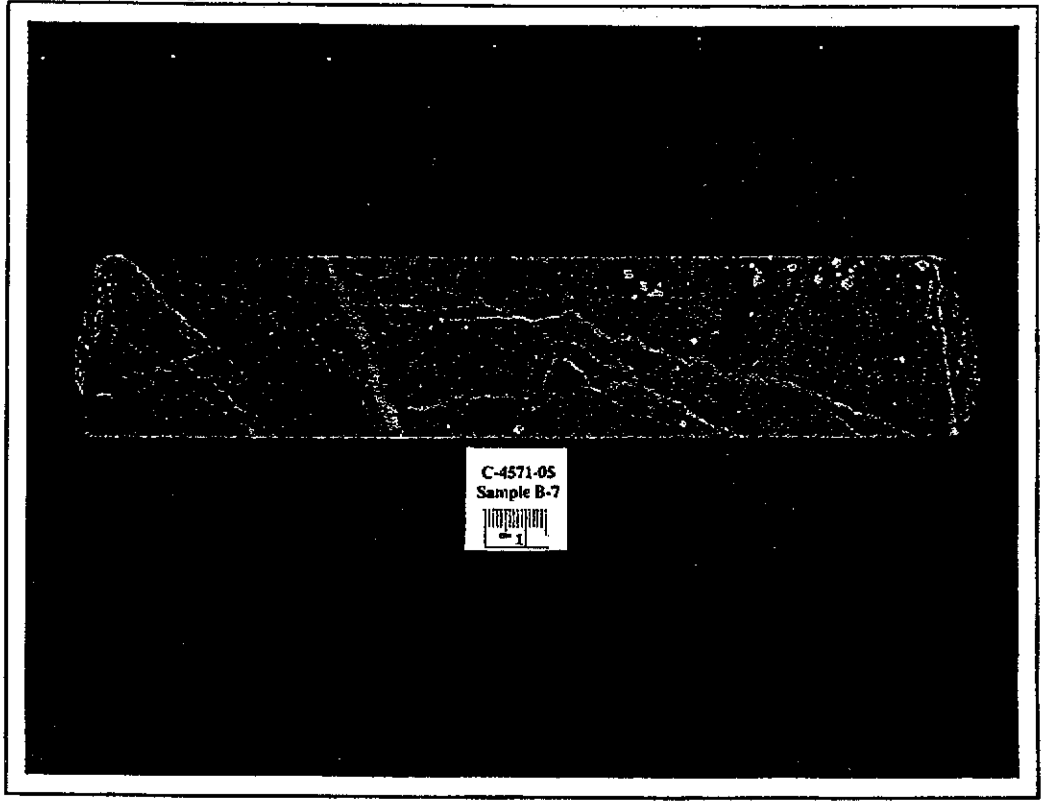
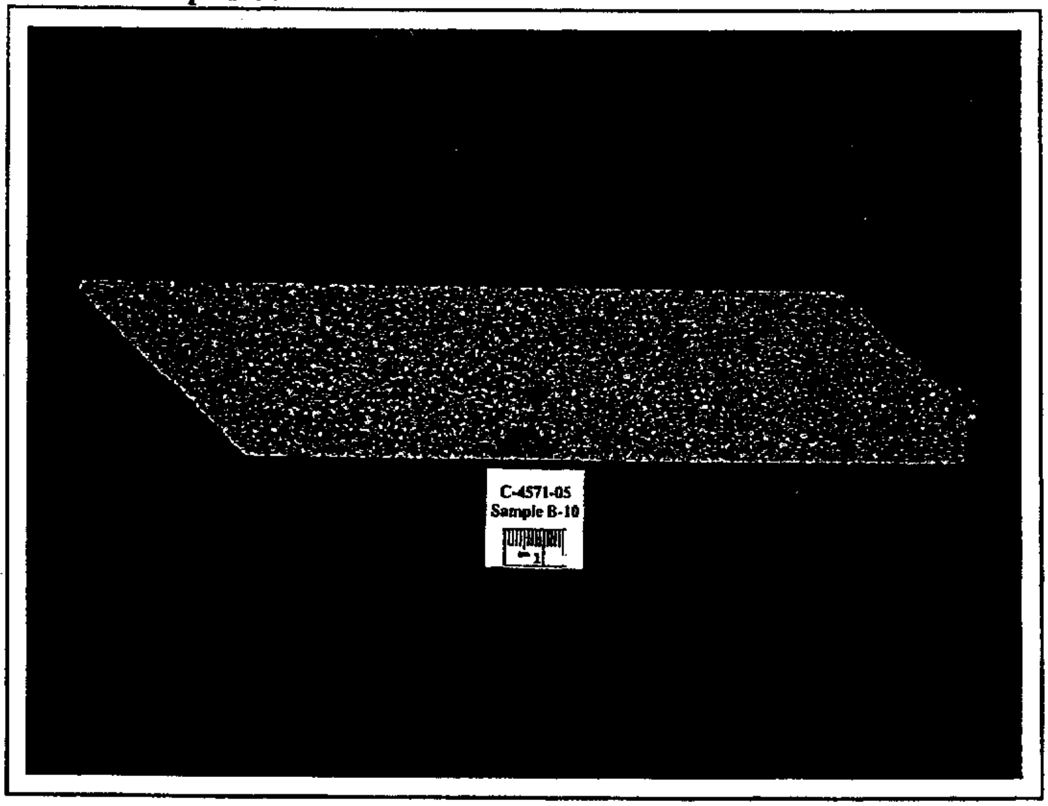
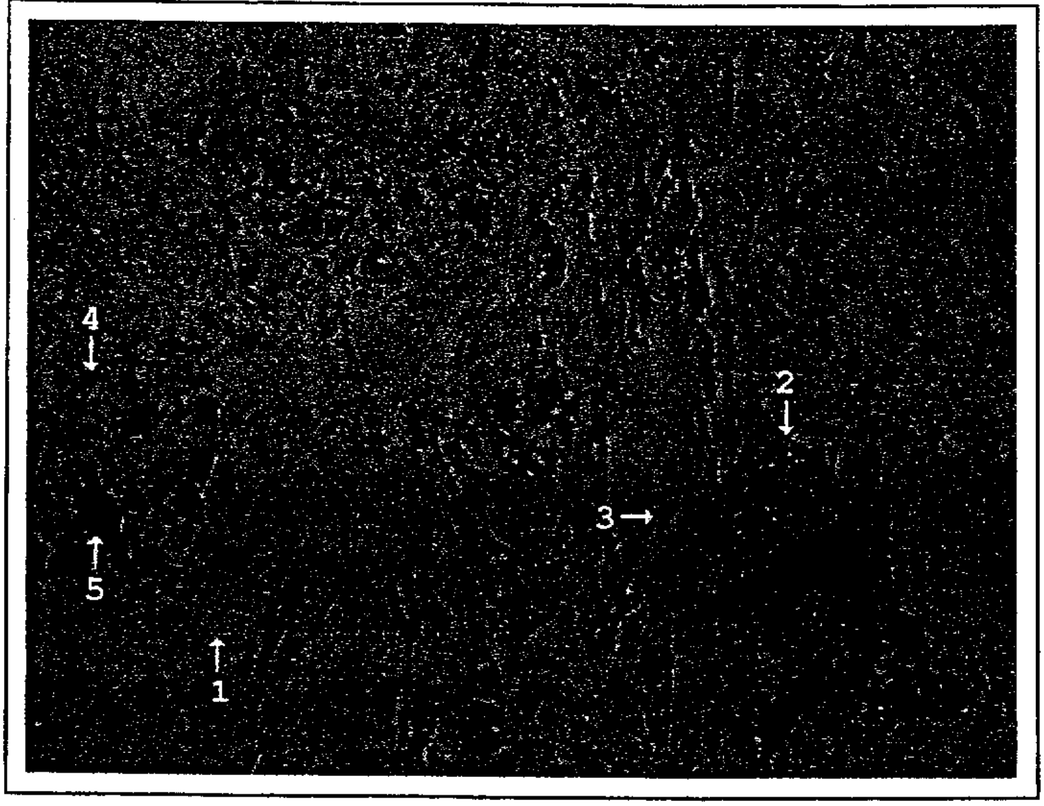


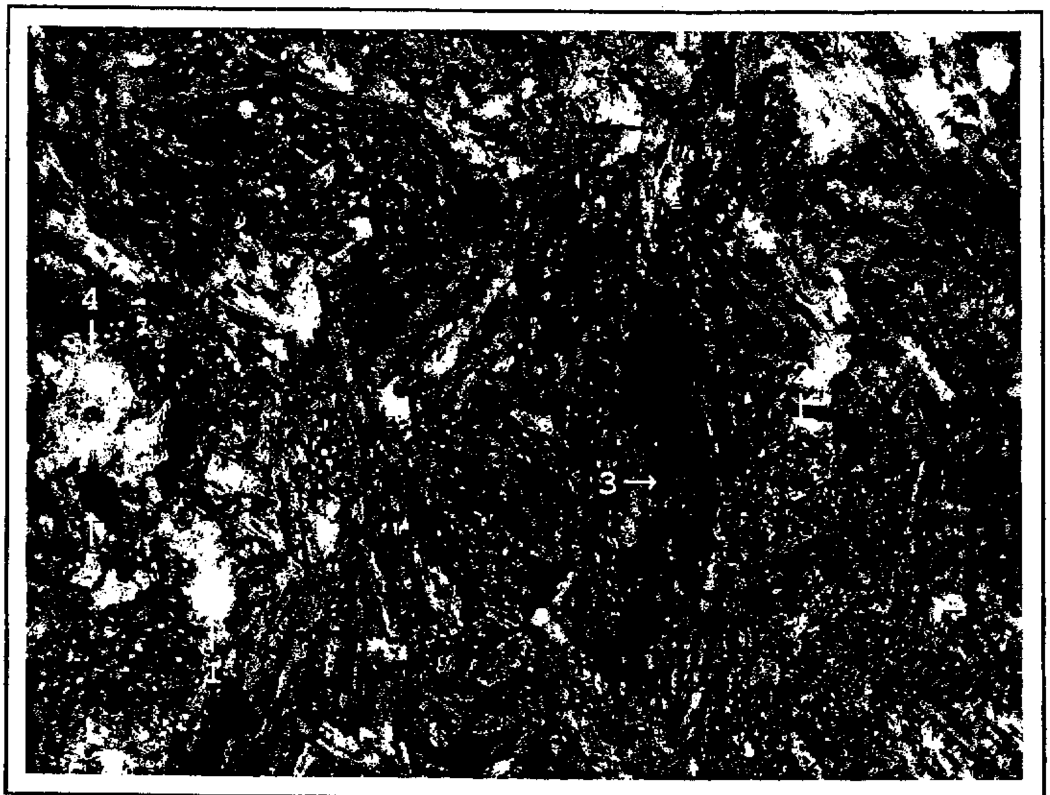
PHOTO NO. 6 – Sample B-10



PHOTOMICROGRAPHS OF THIN SECTIONS
(Magnification = 200X, Field Length = 0.6 mm)

Sample B-7. Top photo -plane polarized light, bottom photo same field of view with crossed polars.

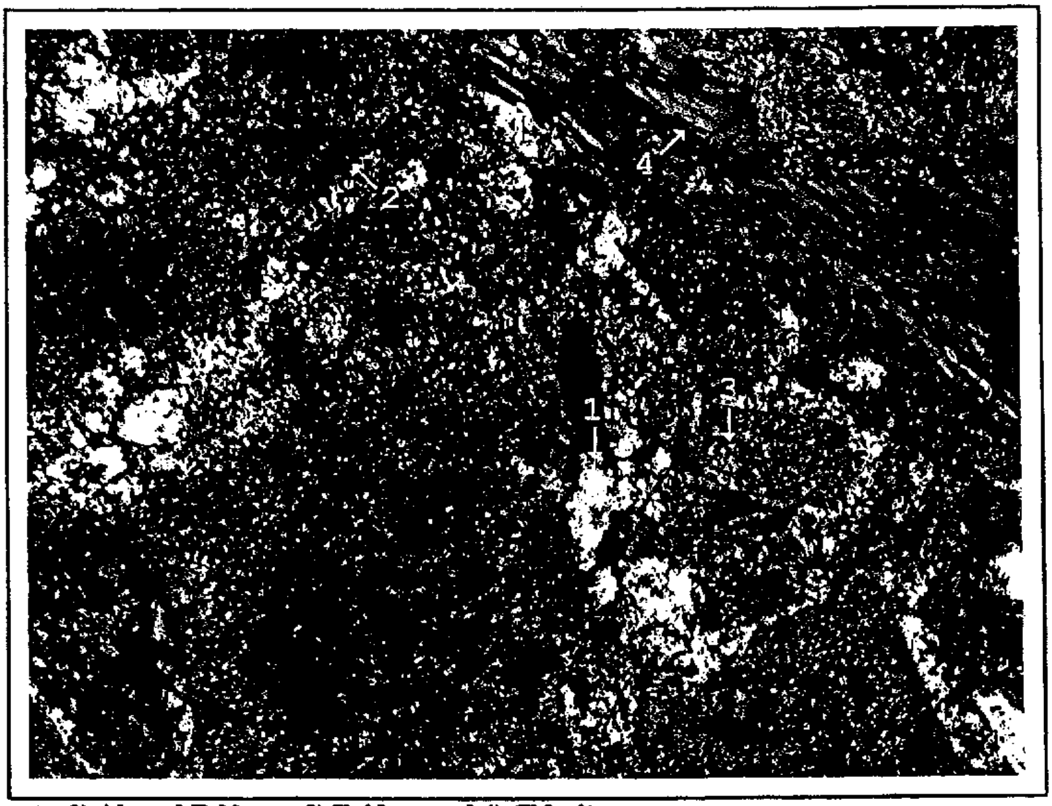




1) Quartz, 2) Epidote, 3) Chlorite, 4) Calcite, and 5) Pyrite.

PHOTOMICROGRAPHS OF THIN SECTIONS
(Magnification = 80X, Field Length = 1.7 mm)

Sample B-10. Top photo -plane polarized light, bottom photo same field of view with crossed polars.



1) Quartz, 2) Altered Feldspar, 3) Epidote, and 4) Chlorite.

APPENDIX – C

ROCK MASS RATING

Rock Mass Rating (RMR)

The Rock Mass Rating (Bieniawski 1989) is a classification system that assigns numerical values to certain properties or features of the rock and combines the individual values into one overall classification rating for the rock mass. The rock mass may be divided into separate structural regions so that each region may be evaluated separately. The boundaries of the structural regions will typically coincide with major structural features (e.g., fault, change in rock type, etc.). Significant changes in discontinuity spacing and/or characteristics within the same rock type may also necessitate dividing the rock mass into several distinct regions.

The following six parameters are used to classify a rock mass using the RMR system:

1. Uniaxial compressive strength of rock material,
2. Rock Quality Designation (RQD),
3. Spacing of discontinuities,
4. Condition of discontinuities,
5. Groundwater conditions, and
6. Orientation of discontinuities.

The first five parameters represent the basic parameters while the sixth parameter is treated separately as the influence of discontinuity orientations depends upon specific engineering applications.

The ratings of each of the five parameters are summed and can be adjusted depending on the sixth parameter (joint orientation) to provide a final value of RMR. A higher value of RMR indicates an overall better rock mass condition/quality. The final RMR value is grouped into five rock mass classes as follows:

Parameter/Properties of Rock Mass	**Rock Mass Rating (RMR)**				
Rating	100 - 81	80 - 61	60 - 41	40 - 21	< 21
Class Number	I	II	III	IV	V
Classification of rock mass	Very Good	Good	Fair	Poor	Very Poor
Cohesion (kPa)	> 400	300 - 400	200 - 300	100 - 200	< 100
Friction angle (degrees)	> 45	35 - 45	25 - 35	15 - 25	< 15

BORING DATA

Project: Missouri Flat Road OC (Replace)

Job #: 1P2/399/296-1.2M

Support: Abutment-3

Boring: 05-3

Top Hole Elevation: 1748.962 ft (elev. 533.09 m)

Proposed Footing Elevation: ______ (ft)

Existing Footing Elevation: ______ (ft)

Date: 8/5/2005

Diameter of Core: 1.75 (inches)

Layer	Run	Run Interval (ft)		Run Length	Recovery	RQD	Discontinuity Spacing	Point Load Index		UCS	
		Top	Bottom								
		(ft)	(ft)	(ft)	(%)		(inches)	(psi)	(MPa)	(psi)	(Mpa)
2B	A	2.4	5.1	2.7	85	14	1	1731	11.9		
2B	B	5.1	9.1	4.0	100	44	2				
2B	C	9.1	10.0	0.9	93	100	3	686	4.7		
2B	D	10.0	15.0	5.0	57	67	3				
2B	E	15.0	19.0	4.0	100	100	1	1959	13.5		
2B	F	19.0	20.0	1.0	100	0	1				
2B	G	20.0	25.0	5.0	100	67	4	1829	12.6		
2B	H	25.0	30.0	5.0	100	100	4				
							AVERAGE:	1551	10.7	#DIV/0!	#DIV/0!

Average Value for Tests Completed in Individual Layers

Layer	Point Load Index		UCS*		UCS	
	(psi)	(MPa)	(psi)	(MPa)	(psi)	(MPa)
1						
2	1551	10.7	33784	232.9		
3						
4						
5						
6						
7						
8						

Average Value For All Tests

UCS*	
(psi)	(MPa)
33784	232.9

*Uniaxial compressive strength values based on point load test data and correlations derived from Bieniawski (1975); "Rock Mechanics for Underground Mining", Brady & Brown, 1985 (page 98-99).

ROCK MASS RATING (RMR) SYSTEM

Date: 8/5/05

Project: Missouri Flat Road OC (Replace)
Support: Abutment-3
Boring: 05-3
Top Hole
Elevation: 1748.96167

Depth Interval (ft)		Elevation Interval (ft)	
Top Layer	Bottom Layer	Top Layer	Bottom Layer
2.4	30.0	1746.6	1719.0

Estimated Uniaxial Compressive Strength: [ ] psi

Point Load Index:	10.7	MPa
UCS:		MPa
RQD:	68	%
Spacing of Discont:	60	mm

Dscrptn: Moderately to slightly weathered, intensely to moderately fractured, fine to medium grained ROCK

* Enter value for Point Load Index or UCS

A. Classification Parameters and their Ratings

	Parameter		Range of Values							Rating
A1	Strength of Intact Rock Material	Point-Load Strength Index	>10 MPa	4 -10 MPa	2 - 4 MPa	1 - 2 MPa	For this low range -- uniaxial compressive test is preferred			15
		Uniaxial Compressive Strength	>250 MPa	100 - 250 MPa	50 - 100 MPa	25 - 50 MPa	5-25 MPa	1-5 MPa	<1 MPa	0
	Rating		*15*	*12*	*7*	*4*	*2*	*1*	*0*	
A2	Drill Core Quality RQD		90% - 100%	75% - 90%	50% - 75%	25% - 50%	<25%			13
	Rating		*20*	*17*	*13*	*8*	*3*			
A3	Spacing of Discontinuities		>2000 mm	600 - 2000 mm	200 - 600 mm	60 - 200 mm	<60 mm			8
	Rating		*20*	*15*	*10*	*8*	*5*			
A4	Condition of Discontinuities		Very rough surfaces Not continuous No Separation Unweathered wall	Slightly rough surfaces Separation <1 mm Slightly weathered	Slightly rough surfaces Separation <1 mm Highly weathered	Slickensided Surfaces or Gouge < 5 mm thick or Separation 1-5 mm Continuous	Soft gouge >5 mm thick or Separation >5 mm Continuous			20
	Rating		*30*	*25*	*20*	*10*	*0*			
A5	Groundwater (General Conditions)		Completely Dry	Damp	Wet	Dripping	Flowing			15
	Rating		*15*	*10*	*7*	*4*	*0*			

B. Rating Adjustment for Discontinuity Orientations

	Strike and Dip Orientations		Very Favorable	Favorable	Fair	Unfavorable	Very Unfavorable	
B	Ratings	Tunnels	0	-2	-5	-10	-12	-7
		Foundations	0	-2	-7	-15	-25	
		Slopes	0	-5	-25	-50	-60	

ROCK MASS				
Rating	**Class Number**	**Description**	**Cohesion (kPa)**	**Friction Angle (deg)**
64	II	Good Rock	> 400	35 - 45

> 58.0 psi

Rock Mass Rating (RMR) Summary

Project: Missouri Flat Road OC (Replace)
Job Number: 1P2/399/296-1.2M
Support Location: Abutment-3
Boring: 05-3
Top Hole Elevation: 1748.96 ft (Elev. 533.09 m)

Proposed Footing Elevation: (ft)
Existing Footing Elevation: (ft)

Date: 08/05/05

Layer	Depth Interval		Elevation Interval		Rock Description	RQD	Point Load Index		Uniaxial Comp. Strength		Estimated Rock Mass Properties					
											Rating	Class Number	Description	Cohesion		Friction Angle
	(ft)	(m)	(ft)	(m)			(psi)	(Mpa)	(psi)	(Mpa)				(psi)	(kPa)	(degrees)
2B	2.4 - 30.0	0.73 - 9.14	1746.6 - 1719.0	532.35 - 523.94	Moderately to slightly weathered, intensely to moderately fractured, fine to medium grained ROCK	68	1551	10.7	--	--	64	II	Good Rock	> 58.0	> 400	35 - 45

* Unconfined Compressive Strength (UCS) value selected based on correlations with published data, otherwise values shown for Point Load Index and UCS were determined from laboratory testing.

BORING DATA

Project: Missouri Flat Road OC (Replace)
Job #: 1P2/399/296-1.2M
Support: Abutment-1
Boring: 05-5
Top Hole
Elevation: 1744.47 ft (elev. 531.72 m)

Date: 8/5/2005

Proposed Footing Elevation: [ ] (ft)
Existing Footing Elevation: [ ] (ft)

Diameter of Core: 1.75 (inches)

Layer	Run	Run Interval (ft) Top	Run Interval (ft) Bottom	Run Length	Recovery	RQD	Discontinuity Spacing	Point Load Index		UCS	
		(ft)	(ft)	(ft)	(%)		(inches)	(psi)	(MPa)	(psi)	(Mpa)
2B	B	8.1	13.0	4.9	100	47	1	816	5.6		
2B	C	13.0	18.0	5.0	100	57	3	1273	8.8		
2B	D	18.0	23.0	5.0	100	57	3	816	5.6		
							AVERAGE:	968	6.7	#DIV/0!	#DIV/0!

Average Value for Tests Completed in Individual Layers

Layer	Point Load Index (psi)	Point Load Index (MPa)	UCS* (psi)	UCS* (MPa)	UCS (psi)	UCS (MPa)
1						
2	968	6.7	21089	145.4		
3						
4						
5						
6						
7						
8						

Average Value For All Tests

UCS* (psi)	UCS* (MPa)
21089	145.4

*Uniaxial compressive strength values based on point load test data and correlations derived from Bieniawski (1975); "Rock Mechanics for Underground Mining", Brady & Brown, 1985 (page 98-99).

ROCK MASS RATING (RMR) SYSTEM

Project: Missouri Flat Road OC (Replace)
Support: Pier-2/Left
Boring: 05-5
Top Hole
Elevation: 1744.47

Date: 8/5/05

Depth Interval (ft)		Elevation Interval (ft)	
Top Layer	Bottom Layer	Top Layer	Bottom Layer
8.1	23.0	1736.4	1721.5

Estimated Uniaxial Compressive Strength: [ ] psi

Point Load Index: 6.7 MPa
UCS: MPa
RQD: 54 %
Spacing of Discont: 59 mm

Dscrptn: Moderately to slightly weathered, intensely fractured, fine to medium grained ROCK

* Enter value for Point Load Index or UCS

A. Classification Parameters and their Ratings

	Parameter		Range of Values							Rating
A1	Strength of Intact Rock Material	Point-Load Strength Index	>10 MPa	4 -10 MPa	2 - 4 MPa	1 - 2 MPa	For this low range -- uniaxial compressive test is preferred			*12*
		Uniaxial Compressive Strength	>250 MPa	100 - 250 MPa	50 - 100 MPa	25 - 50 MPa	5-25 MPa	1-5 MPa	<1 MPa	*0*
		Rating	*15*	*12*	*7*	*4*	*2*	*1*	*0*	
A2	Drill Core Quality RQD		90% - 100%	75% - 90%	50% - 75%	25% - 50%	<25%			*13*
	Rating		*20*	*17*	*13*	*8*	*3*			
A3	Spacing of Discontinuities		>2000 mm	600 - 2000 mm	200 - 600 mm	60 - 200 mm	<60 mm			*8*
	Rating		*20*	*15*	*10*	*8*	*5*			
A4	Condition of Discontinuities		Very rough surfaces Not continuous No Separation Unweathered wall	Slightly rough surfaces Separation <1 mm Slightly weathered	Slightly rough surfaces Separation <1 mm Highly weathered	Slickensided Surfaces or Gouge < 5 mm thick or Separation 1-5 mm Continuous	Soft gouge >5 mm thick or Separation >5 mm Continuous			*20*
	Rating		*30*	*25*	*20*	*10*	*0*			
A5	Groundwater (General Conditions)		Completely Dry	Damp	Wet	Dripping	Flowing			*10*
	Rating		*15*	*10*	*7*	*4*	*0*			

B. Rating Adjustment for Discontinuity Orientations

	Strike and Dip Orientations		Very Favorable	Favorable	Fair	Unfavorable	Very Unfavorable	
B	Ratings	Tunnels	0	-2	-5	-10	-12	*-7*
		Foundations	0	-2	-7	-15	-25	
		Slopes	0	-5	-25	-50	-60	

ROCK MASS

Rating	Class Number	Description	Cohesion (kPa)	Friction Angle (deg)
56	III	Fair Rock	200 - 300	25 - 35

29.0 - 43.5 psi

Rock Mass Rating (RMR) Summary

Project: Missouri Flat Road OC (Replace)
Job Number: 1P2/399/296-1.2M
Support Location: Pier-2/Left
Boring: 05-5
Top Hole Elevation: 1744.47 ft (elev. 531.72 m)

Proposed Footing Elevation: (ft)
Existing Footing Elevation: (ft)

Date: 08/05/05

Layer	Depth Interval		Elevation Interval		Rock Description	RQD	Point Load Index		Uniaxial Comp. Strength		Estimated Rock Mass Properties					
											Rating	Class Number	Description	Cohesion		Friction Angle
	(ft)	(m)	(ft)	(m)			(psi)	(Mpa)	(psi)	(Mpa)				(psi)	(kPa)	(degrees)
2 B	8.1 - 23.0	2.47 - 7.01	1736.4 - 1721.5	529.25 - 524.70	Moderately to slightly weathered, intensely fractured, fine to medium grained ROCK	54	968	6.7	--	--	56	III	Fair Rock	29.0 - 43.5	200 - 300	25 - 35

* Unconfined Compressive Strength (UCS) value selected based on correlations with published data, otherwise values shown for Point Load Index and UCS were determined from laboratory testing.

Rock Mass Rating (RMR) Summary

Project: Missouri Flat Road OC (Replace)
Job Number: 1P2/399/296-1.2M
Support Location: Bent-2
Boring: 05-4
Top Hole Elevation: 1744.83 ft (elev. 531.83 m)

Proposed Footing Elevation: ____ (ft)
Existing Footing Elevation: ____ (ft)

Date: 08/05/05

Layer	Depth Interval		Elevation Interval		Rock Description	RQD	Point Load Index		Uniaxial Comp. Strength		Estimated Rock Mass Properties					
											Rating	Class Number	Description	Cohesion		Friction Angle
	(ft)	(m)	(ft)	(m)			(psi)	(Mpa)	(psi)	(Mpa)				(psi)	(kPa)	(degrees)
2B	7.0 - 32.0	2.13 - 9.75	1737.8 - 1712.8	529.69 - 522.07	Moderately to slightly weathered, intensely to moderately fractured, fine to medium grained ROCK	47	1593	11.0	--	--	59	III	Fair Rock	29.0 - 43.5	200 - 300	25 - 35

* Unconfined Compressive Strength (UCS) value selected based on correlations with published data, otherwise values shown for Point Load Index and UCS were determined from laboratory testing.

APPENDIX – D

CALTRANS MEMORANDUM
(DATED JANUARY 29, 2001)

ENGINEERING SERVICE CENTER
DIVISION OF STRUCTURAL FOUNDATIONS

TO: MR. ANDRE BOUTROS, Chief
Office of Special Funded Projects (OSFP)

DATE: January 29, 2001

Attention: Mr. Eric Fredrickson

FILE: 03------ED------50------XXX
District County Route PM

FDN REPORT BY: Taber Consultants DTD: 01/19/2001 Missouri Flat Rd I/C & Weber Creek Br. at
Structure Name

GENERAL PLAN DTD: N/A FDN PLAN DTD: N/A 03-37000K
EA Number Bridge Number

Submittal (*Check One*): ☐ 1st ☐ 2nd ☐ 3rd ☐ 4th ☒ Other Prelim

The following comments are based on the Memoradum (Site Seismic Conditions) dated January 19, 2001 prepared by Taber Consultants.

Caltrans concurs with/recommends the following:

1. Controlling Fault: Gillis Mountain
   Maximum Credible Event magnitude: 6.50
   Fault Type: not known/published (see *A Technical Report to Accompany the Caltrans California Seismic Hazard Map 1996*)
   Bridge to Fault Distance: approximately 3.0 km
   Peak Bedrock Acceleration: 0.5g

2. Acceleration Response Spectra:
   (i) Soil Profile Type C
   (ii) ARS curve from Caltrans' *Seismic Design Criteria* Figure B.4 (*ATC-32* Figure R3-4) modified for unknown fault type as follows -- increase the response spectra by 20% over all periods.

Please do not hesitate to call Della Leong at (916) 227-7099 for further clarification of these or other issues.

Approval: (C10) Preliminary Design

Office of Special Funded Projects

Della Leong
Office of Geotechnical Support

cc: DSF (Sacramento) ESC Office of Specifications and Estimates (All Reviews) DSC R.E. Pending File

Revised 12/99

APPENDIX – E

CALTRANS REVIEW COMMENTS

Taber
Since 1954

March 23, 2006

Subject:
Review Comments
Missouri Flat Rd OC
Br. No. 25-0121
03-ED-50
EA 03-370001

Geotechnical Comments dated September 26, 2005

Item 1: Revised.

Item 2: Revised.

Item 3: Designer has included on plans.

Additional Comments dated September 26, 2005

Item 1: Revised.

Item 2: Revised.

Item 3: Revised.

Item 4: Revised.

Item 5: Included as Appendix F.

Item 6: Revised.

Item 7: Revised.

Item 8: Revised.

Item 9: Revised.

Item 10: Revised.

Item 11: Revised.

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
TRANSMITTAL MEMORANDUM
DS-EF 0001 (REV. 10/04)

DIVISION OF ENGINEERING SERVICES
STRUCTURES
Office of Special Funded Projects
1801 30th Street - MS #9-2/7G
Sacramento, CA 95816

TO: **MARIO QUEST**	DATE: **10-5-05**
ADDRESS: **Quincy Engineering 3247 Ramos Circle Sacramento, CA 95827**	PROJECT DESCRIPTION: **Missouri Flat Rd OC Br. No. 25-0121 03-ED-50**
PHONE NO. **(916) 368-9181**	EA: **03-370001**
SUBJECT: **Draft Foundation Report**	FROM: **Eric Fredrickson**

BY:
- ☐ FC MAIL
- ☐ UPS
- ☐ OVERNIGHT MAIL
- ☐ MESSENGER
- ☐ PP
- ☐ HAND DELIVERED
- ☐ UNDER SEPARATE COVER
- ☐ ROUTE SLIP

FOR:
- ☐ APPROVAL
- ☐ YOUR USE
- ☐ AS REQUESTED
- ☐ REVIEW AND COMMENT
- ☐ INFORMATION ONLY
- ☐ APPROVED AS SUBMITTED
- ☐ APPROVED AS NOTED
- ☐ RETURN WHEN DONE
- ☐ REVIEWED-NO ADDITIONAL COMMENTS
- ☐ REVIEWED-SEE ADDITIONAL COMMENTS
- ☐ RETURN _____ CORRECTED PLANS
- ☐ SIGN AND RETURN _____ COPIES

ENCLOSURES:

Mario-

Attached are comments on the Draft Foundation Investigation.

Please forward a copy to Taber and have them revise and resubmit the report for approval.

If you have any questions please call Eric Fredrickson at (916) 227-8916.

Thank you. Eric

cc: Clark Peri - Dist 3	By: Eric Fredrickson
File: w/o Attachments	

For individuals with sensory disabilities, this document will be made available, upon request, in Braille, large print, audiocassette, or computer disk. To obtain a copy of one of these alternate formats, please call Della Moore at (916) 227-8185 or TTY (916) 227-8454 or write to Della Moore, Division of Engineering Services, PO Box 168041 Sacramento, CA 95816-8041.

"Caltrans improves mobility across California"

GEOTECHNICAL CONSULTANT SUBMITTAL REVIEW

DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES

[X] MR. EARL SEABERG, CHIEF, OSFP
[ ] MR. VONG TOAN, CHIEF, OSCM
Attention: Eric Fredricson

DATE: September 26, 2005

FILE: 03 (District) ED (County) 50 (Route) 23.2/25.4 (PM)

SUB CONSULTANT: Taber Report Date: 8/11/05 Missouri Flat Road OC (Replace)
PRIME CONSULTANT: Quincy Eng Contract No.: Structure Name
GENERAL PLAN DATED: 8/10/05 FDN PLAN DATED: 03-370001 (EA Number) ~~22-0077~~ 25-0121 (Bridge Number)

Submittal (Check One): [X] 1st [ ] 2nd [ ] 3rd [ ] 4th [ ] Other:

The following comments are based upon our review of the "Draft Foundation Investigation Report, Missouri Flat Road Overcrossing (Replace), Bridge No. 25-0077, Phase 1 – US Route 50/Missouri Flat Road Interchange Project, El Dorado County, California" prepared by Taber Consultants (dated August 11, 2005).

1. According to the errata for the Caltrans Seismic Hazards Map, the Gillis Mountain fault is no longer used. Please update the report to reflect this and incorporate all errata notes into the report.
2. The spread footing data table (Table 1) is not consistent with the Bridge Memo to Designers, section 4-1. Caltrans uses Nominal Bearing Resistance, not Ultimate. The table values will be either nominal or allowable, but not both at each foundation location. Please revise accordingly.
3. The spread footing data table should be shown on the foundation plan.

The above referenced report was reviewed with respect to geotechnical related items only. If you have any questions regarding the contents of this review, please call Steve Mahnke at (916) 227-7181.

[X] Special Funded Project (OSFP) [ ] Local Assistance Project (OSFP) [ ] OSCM Project

Approval: (C3) Not approved (resubmittal to GS required)

OSFP/OSCM

Steve Mahnke
Office of Geotechnical Design - North

cc: OGDN, Lab File Room (Sacramento) DES Specifications and Estimates (JStayton-4 copies) Structure Construction R.E. Pending File

Revised 05/04

DRAFT FOUNDATION INVESTIGATION
REVIEW COMMENTS
MISSOURI FLAT ROAD OC (REPLACE)
BR. NO. 25-0121

03-370001 9-26-05
03-ED-50

To: Mario Quest – Quincy Engineering, Inc., Sacramento
From: Eric Fredrickson – Special Funded Projects, Structures 916-227-8916
Copy: Clark Peri – District 3 Special Funded Projects, Sacramento

ADDITIONAL COMMENTS TO OFFICE OF GEOTECHNICAL SERVICES COMMENTS, DATED 9-26-05

GENERAL

- Revise Br. No. to "25-0121" to reflect the new structure throughout report and appendices.

TITLE PAGE

- Revise Br. No. Include "EA 03-370001"

PAGE 1

- Heading – Revise Br. No. Include "EA 03-370001".
- Site and Project Description – Include "(Br. No. 25-0077)" to describe the existing overcrossing. Add "reinforced" concrete to description. Revise "seat" to "end-diaphragm" type abutment.

PAGE 2

- 3rd paragraph – Include referenced General Plan as an attachment in the report.

PAGE 13

- Last paragraph – Verify and revise "Abutment-1" to "Abutment-3" where foundation locations are similar. Abutment-1 of the new structure will be constructed at the existing off-ramp location.

PAGE 14

- Table 1 – Verify and revise table to correspond to Memo to Designers 4-1 (specifically LFD column and Note 2). Verify that "N/A" should be used for WSD/ Bent-2 and LFD/ Abutments.

Figure 2

- Revise Br. No.

Figure 3

- Include "(with 20% increase)" in ARS description.

Log of Test Boring sheets

- Revise Br. No.
- Revise EA 03-370001

For Taber

APPENDIX – F

GENERAL PLAN

WEATHERING DESCRIPTORS

Modified from United States Bureau of Reclamation, Engineering Geology Field Manual.

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

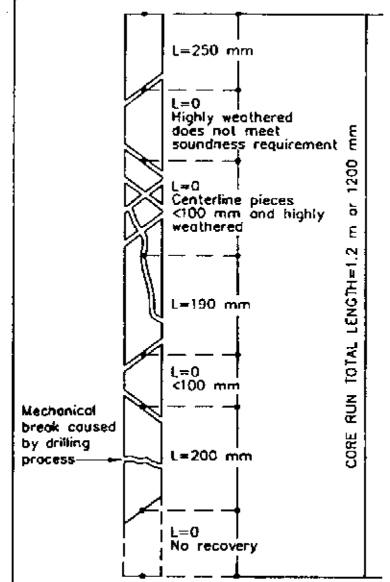
NOTE: This chart and its horizontal categories are more readily applied to rocks with feldspars and mafic minerals. Weathering in various sedimentary rocks, particularly limestones and poorly indurated sediments, will not always fit the categories established. This chart and weathering categories may have to be modified for particular site conditions or alterations such as hydrothermal effects; however, the basic framework and similar descriptors are to be used.

* Combination descriptors are permissible where equal distribution of both weathering characteristics are present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, dual descriptors should not be used where significant, identifiable zones can be delineated. When given as a range, only two adjacent terms may be combined (i.e., decomposed to slightly weathered or moderately weathered to fresh) are not acceptable.

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

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

RQD LOGGING



$$RQD = \frac{\sum \text{Length of sound core} >100 \text{ mm pieces}}{\text{Total core run length}}$$

$$RQD = \frac{250+190+100}{1200} \times 100\%$$

RQD= 53% (fair)

RQD (ROCK QUALITY DESIGNATION)	DESCRIPTION OF ROCK QUALITY
0 - 25%	VERY POOR
25 - 50%	POOR
50 - 75%	FAIR
75 - 90%	GOOD
90 - 100%	EXCELLENT

After Deere & Deere, 1989

IGNEOUS AND METAMORPHIC ROCK GRAIN SIZE DESCRIPTORS

Descriptor	Average crystal Diameter
Very coarse-grained or pegmatic	>10 mm (>3/8 in)
Coarse-grained	5-10 mm (3/16-3/8 in)
Medium-grained	1-5 mm (1/32-3/16 in)
Fine-grained	0.1-1 mm (0.04-1/32 in)
Aphanitic (cannot be seen with the unaided eye)	<0.1 mm (<0.04 in)

FRACTURE DENSITY

Modified from United States Bureau of Reclamation, Engineering Geology Field Manual.

FRACTURE DENSITY–Based on the spacing of all natural fractures in an exposure or core recovery lengths in boreholes; excludes mechanical breaks, shears, and shear zones; however, shear-distributed zones (fracturing outside the shear) are included. Descriptors for fracture density apply to all rock exposures such as tunnel walls, dozer trenches, outcrops, or foundation cut slopes and inverts, as well as boreholes. Descriptive criteria presented below are based on borehole cores where lengths are measured along the core axis, for other exposures the criteria is distance measured between fractures (size of blocks).

UNFRACTURED (FD0): No fractures.

VERY SLIGHTLY FRACTURED (FD1): Core recovered mostly in lengths greater than 1 m.

SLIGHTLY TO VERY SLIGHTLY FRACTURED (FD2) *

SLIGHTLY FRACTURED (FD3): Core recovered mostly in lengths from 300 to 1000 mm, with few scattered lengths less than 300 mm or greater than 1000 mm.

MODERATELY TO SLIGHTLY FRACTURED (FD4) *

MODERATELY FRACTURED (FD5): Core recovered mostly in 100 to 300 mm lengths with most lengths about 200 mm.

INTENSELY TO MODERATELY FRACTURED (FD6) *

INTENSELY FRACTURED (FD7): Lengths average from 30 to 100 mm with scattered fragmented intervals. Core recovered mostly in lengths less than 100 mm.

VERY INTENSELY TO INTENSELY FRACTURED (FD8) *

VERY INTENSELY FRACTURED (FD9): Core recovered mostly as chips and fragments with a few scattered short core lengths.

* Combinations of fracture densities (e.g. very intensely to intensely fractured or moderately to slightly fractured) are used where equal distribution of both fracture density characteristics are present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions.

ROCK HARDNESS/STRENGTH DESCRIPTORS

Alphanumeric Descriptor	Descriptor	Criteria
H1	Extremely hard	Core, fragment, or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows.
H2	Very hard	Can be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.
H3	Hard	Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
H4	Moderately hard	Can be scratched with knife or sharp pick with light or moderate pressure. Core or fragment breaks with moderate hammer blow.
H5	Moderately soft	Can be grooved 1/16 inch (2 mm) deep by knife or sharp pick with moderate or heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
H6	Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
H7	Very soft	Can be readily indented, grooved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

Any bedrock unit softer than H7, very soft, is to be described using soil consistency descriptors.

NOTE: Although "sharp pick" is included in these definitions, descriptions of ability to be scratched, grooved or gouged by a knife is the preferred criteria.
Modified from United States Bureau of Reclamation, Engineering Geology Field Manual.

BEDDING, FOLIATION, OR FLOW TEXTURE DESCRIPTORS

Descriptors	Thickness/spacing
Massive	Greater than 3 m
Very thickly (bedded, foliated, or banded)	1 to 3 m
Thickly	300 mm to 1 m
Moderately	100 to 300 mm
Thinly	30 to 100 mm
Very thinly	10 to 30 mm
Laminated (intensely foliated or banded)	Less than 10 mm

Modified from United States Bureau of Reclamation, Engineering Geology Field Manual.

DESIGN OVERSIGHT	DESIGN	By M. D. Robertson	FIELD INVESTIGATION BY:
SIGN OFF DATE	CHECKED	By W. E. Nichols	R. E. Loutzenhiser, April–June 2005

PREPARED FOR THE
COUNTY OF EL DORADO
DEPARTMENT OF TRANSPORTATION

PROJECT ENGINEER

CU 03198
EA 370001

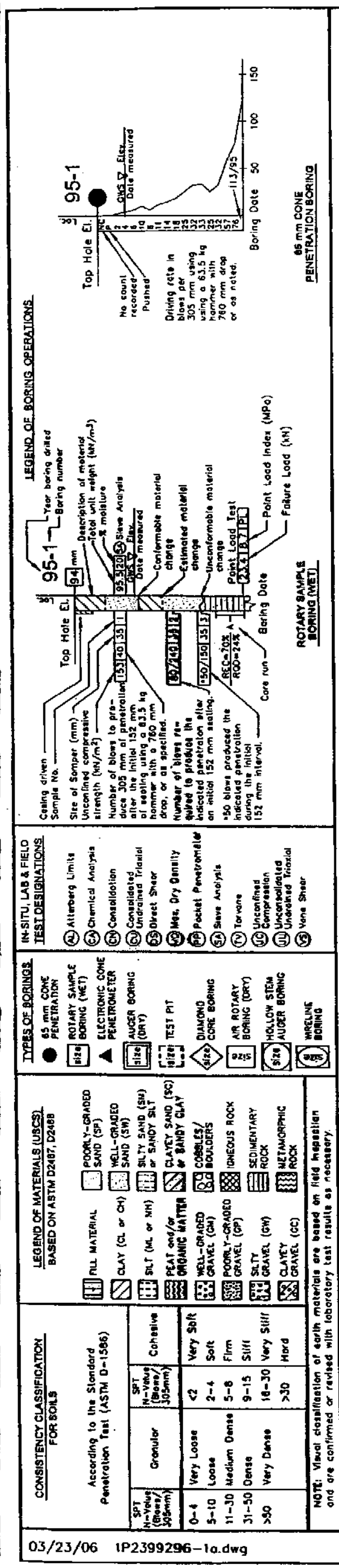
BRIDGE NO. 25-0121
KILOMETER POST 24.24(R15.06)

ENGINEERING GEOLOGY FIELD DESCRIPTORS
MISSOURI FLAT ROAD O.C. (Replace)

Drawing - 1

Caltrans Metric

03/23/06 1P2399296-1a.dwg

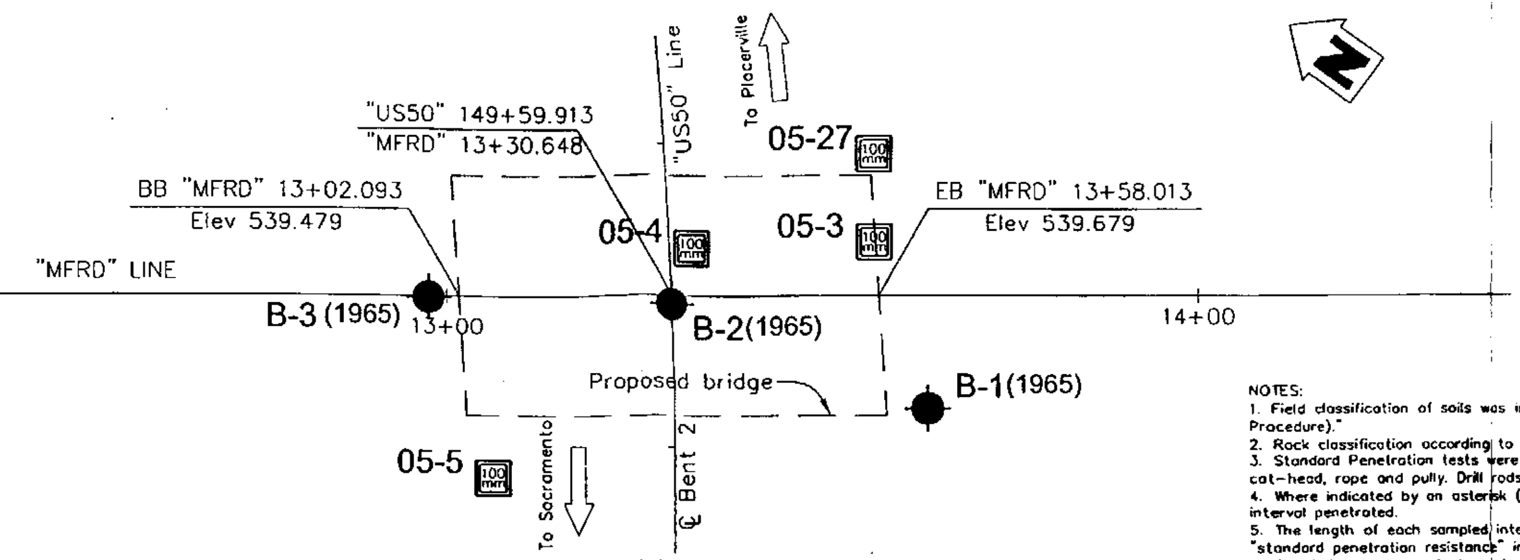


BENCH MARKS

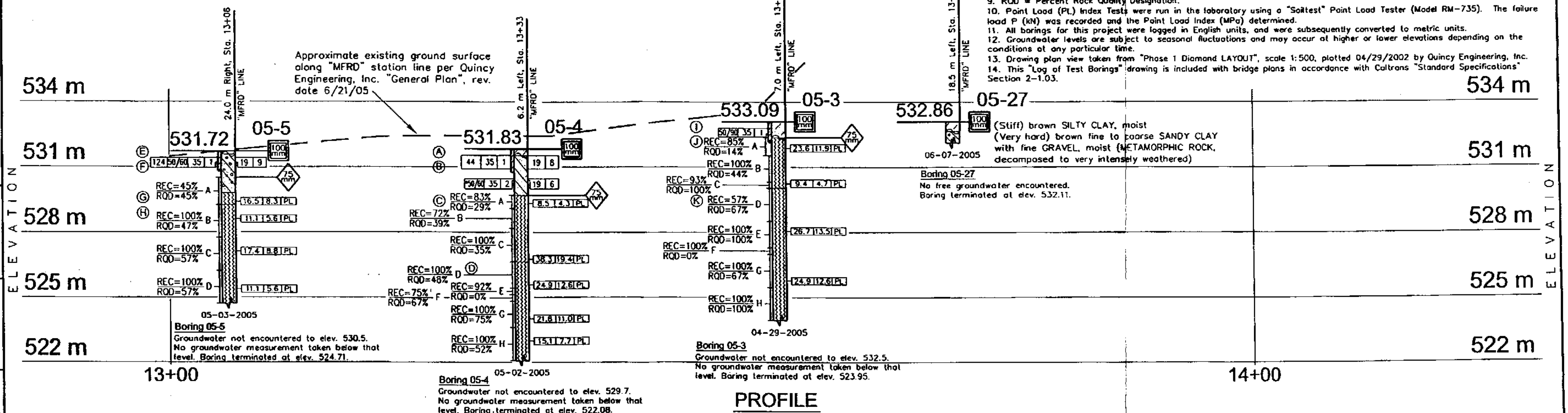
Boring Locations and elevations established by Topographic Surveys, Inc. using NGVD 1929 – Metric for the vertical datum

MISSOURI FLAT ROAD PROJECT BENCHMARKS

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
#2	[illegible]	[illegible]	[illegible]	PK Nail
25-107	[illegible]	[illegible]	540.100	Brass Disc
25-108	[illegible]	[illegible]	540.124	Brass Disc
Bridge	[illegible]	[illegible]	[illegible]	Nail
HPGN 03 DM	[illegible]	[illegible]	541.484	Brass Disc in Monument Well
HY-13	[illegible]	[illegible]	[illegible]	Nail
HY-14	[illegible]	[illegible]	[illegible]	Nail
MF-1	[illegible]	[illegible]	[illegible]	PK Nail
MF-2	[illegible]	[illegible]	533.053	PK Nail & Shiner
MF-3	[illegible]	[illegible]	[illegible]	PK Nail & Shiner
MF-4	[illegible]	[illegible]	540.124	PK Nail & Shiner
MF-5	[illegible]	[illegible]	[illegible]	PK Nail & Shiner
MF-6	[illegible]	[illegible]	[illegible]	PK Nail & Shiner
MF-7	[illegible]	[illegible]	[illegible]	PK Nail & Shiner
MF-8	[illegible]	[illegible]	[illegible]	Iron Pin & Cap
MF-9	[illegible]	[illegible]	[illegible]	40d Nail
MF-10	[illegible]	[illegible]	[illegible]	PK Nail
MF-11	[illegible]	[illegible]	[illegible]	40d Nail
MF-12	[illegible]	[illegible]	[illegible]	PK Nail & Shiner
MF-13	[illegible]	[illegible]	[illegible]	Iron Pin
MF-14	[illegible]	[illegible]	[illegible]	Iron Pin & Cap
MF-15	[illegible]	[illegible]		Iron Pin & Cap
MF-16	[illegible]	[illegible]	[illegible]	Iron Pin & Cap
Median	[illegible]	[illegible]	[illegible]	[illegible]
NAIL1	[illegible]	[illegible]	[illegible]	CTL
PT10	[illegible]	[illegible]	[illegible]	PK Nail & Shiner
PT15	[illegible]	[illegible]	[illegible]	CTL
PT802	[illegible]	[illegible]	[illegible]	CH2M Hill PK Nail & Washer
RW Mon 1	[illegible]	[illegible]	[illegible]	Iron Pin & Cap
RW Mon 2	[illegible]	[illegible]	[illegible]	Iron Pin & Cap
RW Mon 3	[illegible]	[illegible]	[illegible]	Iron Pin & Cap
TR 32E	[illegible]	[illegible]	[illegible]	PK Nail
PK Nail			512.570	[illegible]



PLAN
1:500



PROFILE
HOR. 1:200
VER. 1:100

(E) (Stiff) brown fine SANDY CLAY, moist

(F) Very dense yellow brown to gray brown CLAYEY fine SAND with GRAVEL, moist (decomposed to very intensely weathered and fractured METAMORPHIC ROCK)

(G) METAMORPHIC ROCK (HORNFELS), medium gray, predominately aphanitic with fine–medium grains, non foliated, moderately to slightly weathered, moderately hard to hard, slightly fractured (dipping at 40–45°), fractures slightly open, surfaces slightly rough and stained dark orange brown and black

(H) METAMORPHIC ROCK (HORNFELS), medium gray, predominately aphanitic with fine–medium grains, non foliated, moderately–slightly weathered, intensely to moderately fractured (dipping at 15°, 40°–50°, and 90°), fractures slightly open to tight with very thin white and green mineralization to clean, surfaces slightly rough and commonly stained dark orange brown––a thick (30–40 mm), totally healed fractures (dipping at 40°) with purple and greenish yellow mineralization present at approximate elev. 525.62

(A) (Stiff–hard) brown fine–coarse SANDY CLAY with fine GRAVEL, moist

(B) Very hard brown fine–coarse SANDY CLAY with fine GRAVEL, moist (decomposed to very intensely weathered METAMORPHIC ROCK)

(C) METAMORPHIC ROCK (HORNFELS), medium gray, mostly aphanitic with fine–medium grains, non foliated, moderately to slightly weathered, hard to very hard, very intensely to intensely fractured (dipping at 35°, 60°–65° and 90°), fractures moderately to slightly open, some with very thin white mineralization, surfaces smooth to slightly rough and commonly stained dark orange brown

(D) METAMORPHIC ROCK (HORNFELS), medium gray, predominately aphanitic with fine–medium grains, non foliated, slightly weathered to fresh, hard to very hard, intensely to moderately fractured (dipping at 15°, 40°–45° and 90°), fractures slightly open to tight with very thin white mineralization to clean, surfaces smooth to slightly rough––a few thin, totally healed fractures dipping 60° to near vertical present between elev. 523.60 to elev. 525.43

(I) (Dense) to very dense brown SILTY fine–medium SAND, moist

(J) METAMORPHIC ROCK (HORNFELS), medium gray, predominantly aphanitic with fine–medium grains, non foliated, moderately weathered, moderately hard to hard, very intensely to intensely fractured (dipping at 25° and 45°), fractures slightly rough and commonly stained dark orange brown and black

(K) METAMORPHIC ROCK (HORNFELS), medium gray, predominantly aphanitic with fine–medium grains, non foliated, moderately to slightly weathered, hard to very hard, moderately fractured with very intensely fractured zones at approximate elev. 529.59 to 529.74, elev. 526.69 to 527.30 and 525.47 to 525.78 (fractures dip 40° to 55°), fractures slightly open to tight, smooth to slightly rough

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	ED		13.2/25.4		

REGISTERED CIVIL ENGINEER — DATE 3/23/06

PLANS APPROVAL DATE

Registered Professional Engineer, Ronald E. Loutzenhiser, No. 64089, Exp. 9-30-06, Civil, State of California

TABER CONSULTANTS
3911 West Capitol Avenue
West Sacramento, CA 95691-2116

JOB No. 1P2/399/296-1.2M — LOCATION: 38120-F7:314N:252W

El Dorado County
2850 Fairlane Court
Placerville, CA 95667

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

NOTES:

1. Field classification of soils was in accordance with ASTM D 2488-00 "Description and Identification of Soils (Visual–Manual Procedure)."
2. Rock classification according to Caltrans "Soil & Rock Logging Classification Manual (Field Guide)", August 1996.
3. Standard Penetration tests were performed in accordance with ASTM D 1586-99 using a safety hammer operated with cat-head, rope and pully. Drill rods were 41 mm diameter "A"-rods; sampler was driven with brass liners.
4. Where indicated by an asterisk (*) the number of blows shown is for only that fraction of the initial 0.15 m "seating drive" interval penetrated.
5. The length of each sampled interval is shown graphically on the boring log. Whole number blow counts ("N") represent the "standard penetration resistance" interval in accordance with ASTM D1586-84. Where less than 0.45 m of penetration is achieved, the blow count shown is for that fraction of the "standard penetration resistance" interval actually penetrated.
6. Consistency of soils shown in ( ) where estimated.
7. Rock Quality Designation (RQD), Weathering, Rock Hardness and Fracture Density, as shown on this sheet, were used to describe all rock core from borings drilled in 2005. Descriptors were determined in the field.
8. REC = Percent Core Recovery.
9. RQD = Percent Rock Quality Designation.
10. Point Load (PL) Index Tests were run in the laboratory using a "Soiltest" Point Load Tester (Model RM-735). The failure load P (kN) was recorded and the Point Load Index (MPa) determined.
11. All borings for this project were logged in English units, and were subsequently converted to metric units.
12. Groundwater levels are subject to seasonal fluctuations and may occur at higher or lower elevations depending on the conditions at any particular time.
13. Drawing plan view taken from "Phase 1 Diamond LAYOUT", scale 1:500, plotted 04/29/2002 by Quincy Engineering, Inc.
14. This "Log of Test Borings" drawing is included with bridge plans in accordance with Caltrans "Standard Specifications" Section 2-1.03.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DESIGN	By M. D. Robertson	FIELD INVESTIGATION BY:	PREPARED FOR THE COUNTY OF EL DORADO DEPARTMENT OF TRANSPORTATION	PROJECT ENGINEER	BRIDGE NO. 25-0121	MISSOURI FLAT ROAD O.C. (Replace)
SIGN OFF DATE	CHECKED	By W. E. Nichols	R. E. Loutzenhiser, April–June 2005			KILOMETER POST 24.24(R15.06)	LOG OF TEST BORINGS 1 OF 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 03198
EA 370001

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 18 OF 19

03/23/06 1P2399296-1a.dwg

OFFICE OF STRUCTURE FOUNDATIONS - ENGINEERING SERVICE CENTER

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. It does not attest to the accuracy or validity of the information contained in the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	KILOMETER POST - TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	ED	50	23.2/25.4		

CERTIFIED ENGINEERING GEOLOGIST

PHASE 1

MISSOURI FLAT ROAD O.C. (Replace)

LOG OF TEST BORINGS 2 OF 2

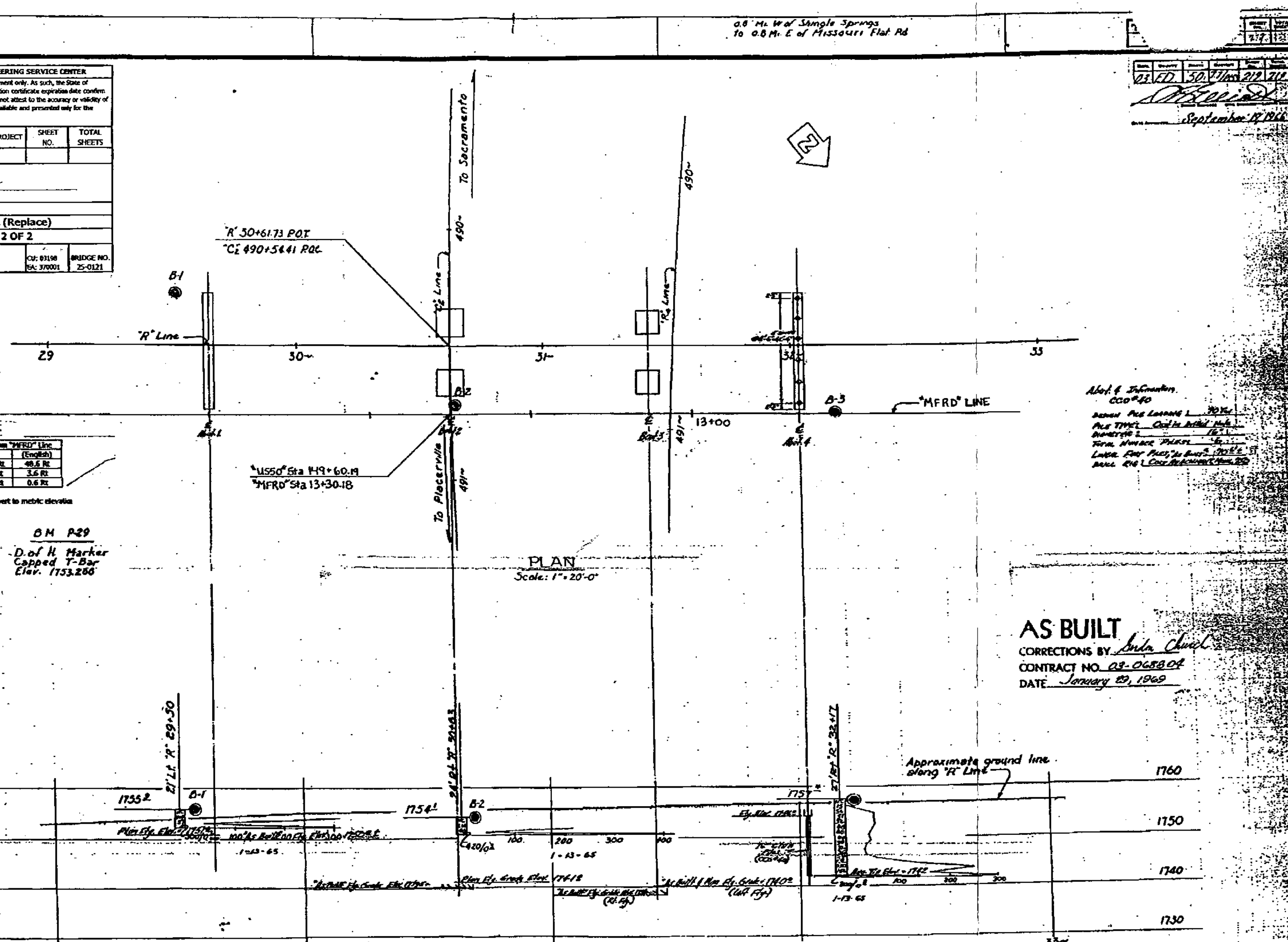
NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA — CU: 03198, EA: 370001 — BRIDGE NO. 25-0121

Revisions made to this Log of Test Borings from the original dated January 29, 1969 consist of the addition of "MFRD" Line and the following table:

1. Metric to English station equation: "MFRD" Sta. 13+30.00 (Metric) = Sta. 43+63.50 (English).
2. The data presented in the table below was produced based upon a conversion of the original English stations and offsets referenced to the centerline of the existing structure and US 50 to Metric stations and offsets referenced to "MFRD" Line.
3. Boring locations, referenced to "MFRD" Line are as follows:

Boring	Station (Metric)	Station (English)	Offset from "MFRD" Line (Metric)	Offset from "MFRD" Line (English)
B-1	13+63.90	44+75	14.80 m Rt	48.6 Rt
B-2	13+30.24	43+64	1.09 m Rt	3.6 Rt
B-3	12+82.93	42+09	0.17 m Rt	0.6 Rt

4. Multiply english boring elevation by 0.3048 to convert to metric elevation



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SHEET 15 OF 15

MISSOURI FLAT ROAD OVERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 25-77 | DRAWING 2577-9

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
03	ED	50	23.2/25.4		

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER DON NGUYEN-TAN No. C57510 Exp. 12-31-05 CIVIL STATE OF CALIFORNIA

Quincy Engineering, Inc.
3247 Ramos Circle
Sacramento, CA 95827

Caltrans Metric

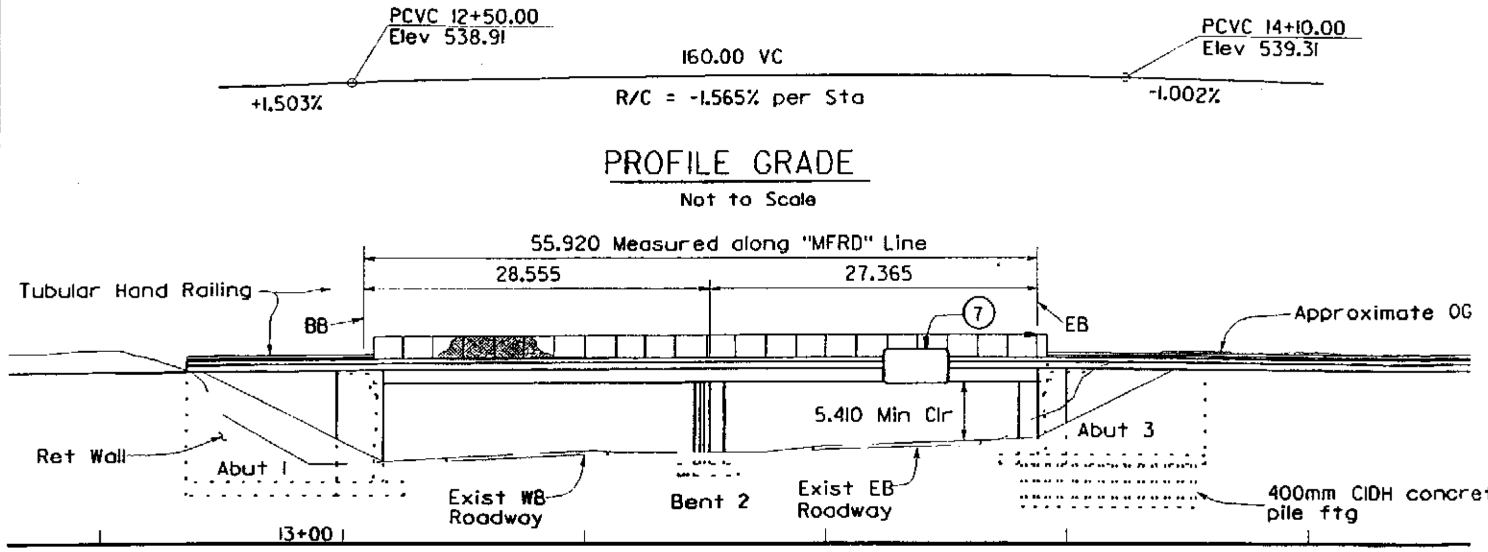
Notes:

1. Paint Bridge No. 25-0077
2. Paint Missouri Flat Road OC
3. Structure Approach Type N(3S)
4. Temporary Railing (Type K), See "Road Plans"
5. Closure Pour
6. Remove existing Bridge No. 25-0077
7. Relocate bridge mounted sign

—— Existing Structure

● Point of Minimum Vertical Clearance

For General Notes, Index to Plans and Quantities, see "Deck Contours sheet"

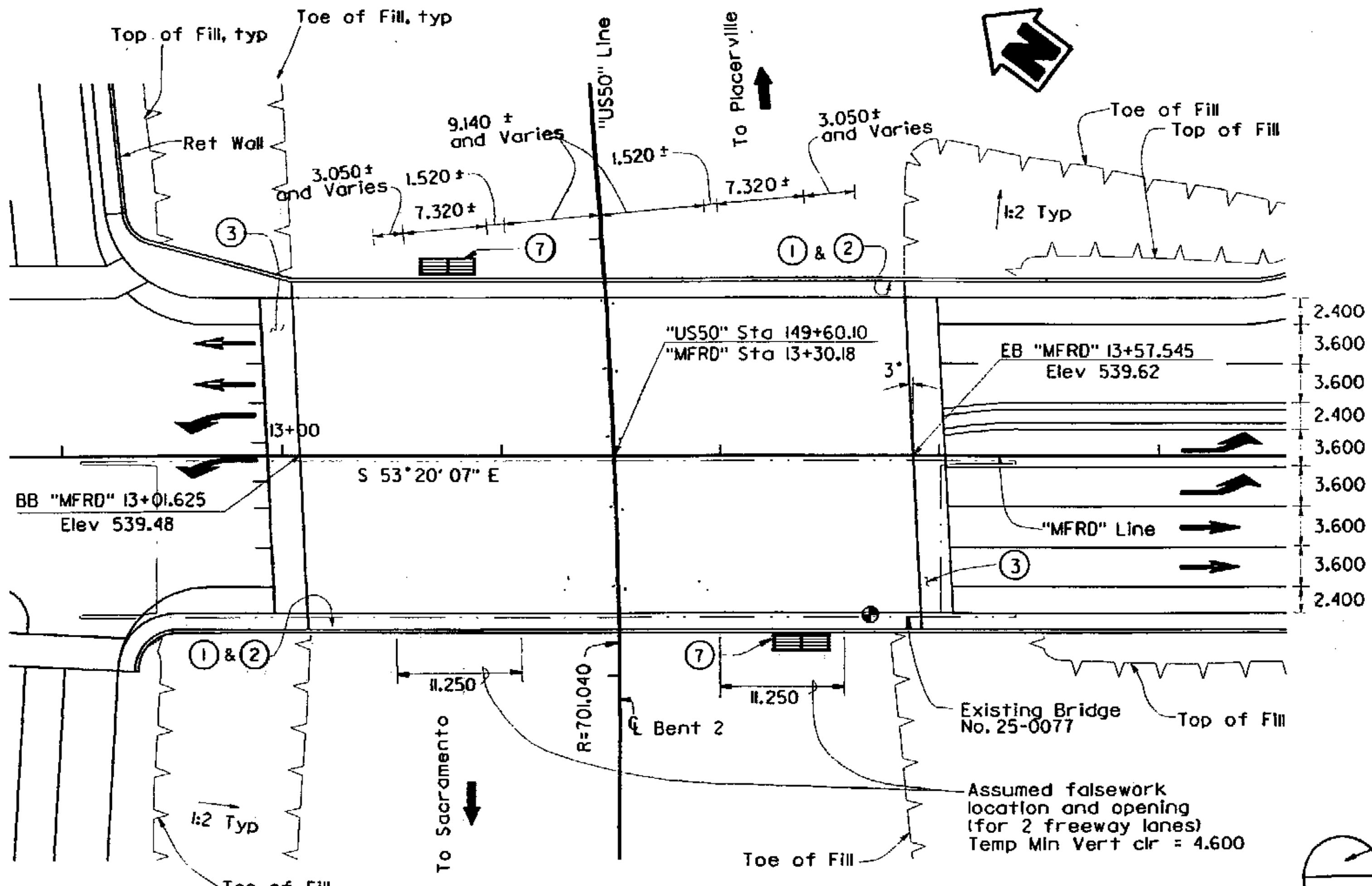


PROFILE GRADE

Not to Scale

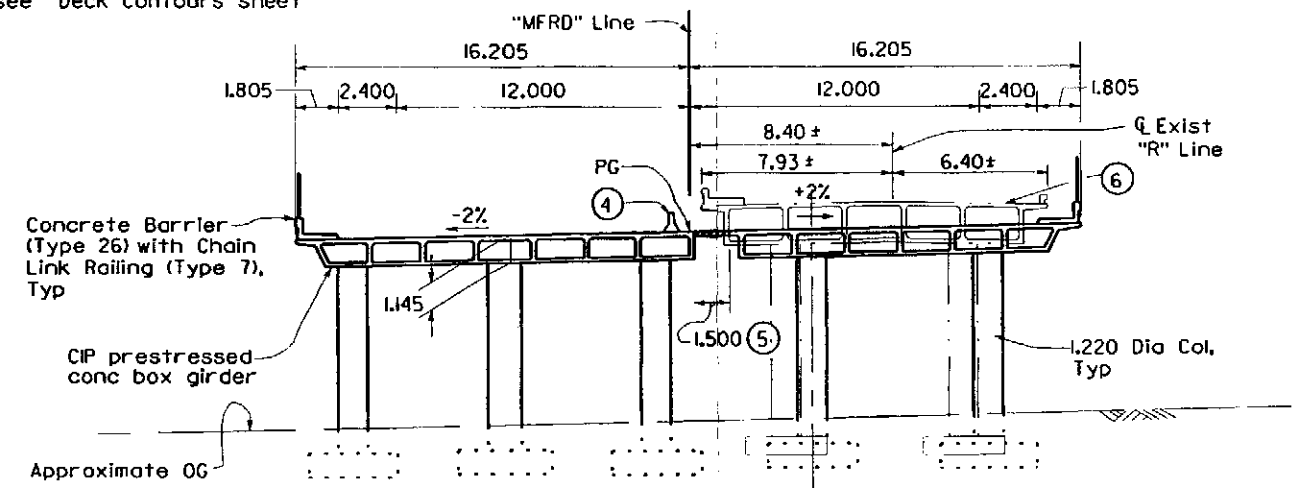
ELEVATION

1:300



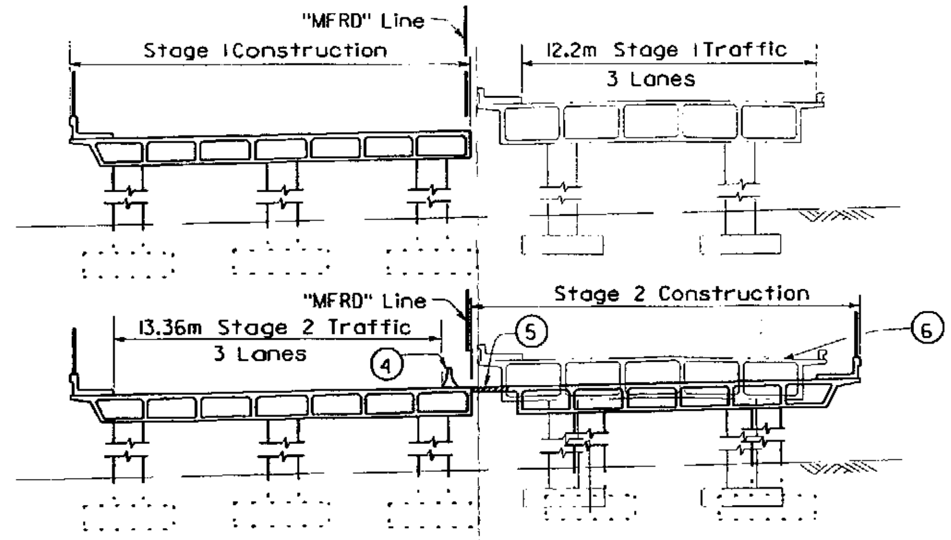
PLAN

1:300



TYPICAL SECTION

1:150



CONSTRUCTION STAGING

No Scale

STANDARD PLAN SHEET NO.

DETAIL NO.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

PHASE 1

DESIGN OVERSIGHT	DESIGN	BY D. Nguyen-Tan	CHECKED	LOAD FACTOR DESIGN	LIVE LOADING: HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Mario Quest PROJECT ENGINEER	BRIDGE NO. 25-0077	MISSOURI FLAT ROAD O.C. (Replace)
SIGN OFF DATE	DETAILS	BY E. Buño	CHECKED	LAYOUT	BY D. Nguyen-Tan			KILOMETER POST 24.24(R15.06)	GENERAL PLAN
	QUANTITIES	BY	CHECKED	SPECIFICATIONS	BY PLANS AND SPECS COMPARED		CU 03198 EA 370000	DISREGARD PRINTS BEARING EARLIER REVISION DATES	

DESIGN GENERAL PLAN SHEET (METRIC) (REV.3/1/99)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

FILE => C:\dan\Missouri Flat Road\09-25077-a-gp0l.dgn

08/02/2005 02:40:24 PM

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	ED	50	23.2/25.4		

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER DON NGUYEN-TAN No. C57510 Exp. 12-31-05 STATE OF CALIFORNIA

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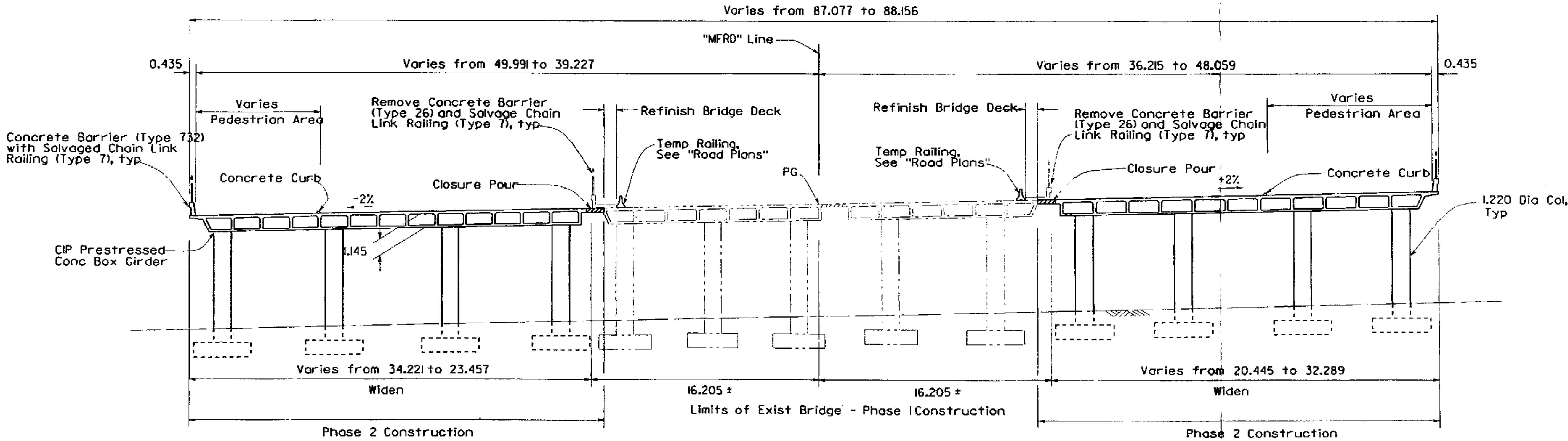
Quincy Engineering, Inc.
3247 Ramos Circle
Sacramento, CA 95827



TYPICAL SECTION

1:150

Notes:

1. All dimensions are shown in meters unless otherwise noted.

Eric Fredrickson	DESIGN	BY D. Nguyen-Tan	CHECKED	LOAD FACTOR DESIGN	LIVE LOADING: HS-20 AND ALTERNATIVE AND PERMIT DESIGN LOAD	
DESIGN OVERSIGHT	DETAILS	BY D. Nguyen-Tan	CHECKED	LAYOUT	BY D. Nguyen-Tan	CHECKED
SIGNOFF DATE	QUANTITIES	BY	CHECKED	SPECIFICATIONS	BY	PLANS AND SPECS COMPARED

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Mario Quest
PROJECT ENGINEER

BRIDGE NO. 25-0077
K.P. (P.M.) 24.24 (R15.06)

PHASE 2: SPDI

MISSOURI FLAT ROAD O.C. (Widen)

STAGE CONSTRUCTION

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 03198
EA 370000

DISREGARD PRINTS BEARING EARLIER REVISION DATES → REVISION DATES (PRELIMINARY STAGE ONLY) SHEET OF

E082AAP2.DGN Rev. 03 DLN 7/1/02