GEOTECHNICAL REPORT

KLEINFELDER
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September 28, 2006
File No.: 74401.GEO

Bibb and Associates
8455 Lenexa Drive
Lenexa, Kansas 66214

Attention: Mr. Michael Swofford

SUBJECT: Geotechnical Investigation Report
Proposed Bullard Energy Facility
Fresno, California

Dear Mr. Swofford:

The attached report presents the results of a geotechnical investigation for the Proposed Bullard Energy facility located on Golden State Boulevard south of Bullard Avenue, in Fresno, California. The report describes the study, findings, conclusions and recommendations for use in project design and construction.

Kleinfelder appreciates the opportunity to provide geotechnical engineering services to Bibb and Associates during the design phase of this project. If there are any questions concerning the information presented in this report, please contact this office at your convenience.

Respectfully submitted,
KLEINFELDER, INC.

Michael R. Beltran
Staff Engineer

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Senior Project Engineer

MRB:JAM:llp

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GEOTECHNICAL INVESTIGATION REPORT
PROPOSED BULLARD ENERGY FACILITY
FRESNO, CALIFORNIA

Prepared For:

Bibb and Associates
8455 Lenexa Drive
Lenexa, Kansas 66214

September 28, 2006

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Kleinfelder Job No.: 74401.GEO

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1. INTRODUCTION

1.1 GENERAL

This report presents the results of a geotechnical investigation for the Proposed Bullard Energy facility located on Golden State Boulevard south of Bullard Avenue, in Fresno, California. The report describes the study, findings, conclusions and recommendations for use in project design and construction. The location of the project site is illustrated on Plate 1, “Site Vicinity Map”.

This report includes recommendations related to the geotechnical aspects of project design and construction. Conclusions and recommendations presented in this report are based on the subsurface conditions encountered at the locations of the exploration and the provisions and requirements outlined in the “Additional Services” and “Limitations” Sections of this report. Recommendations presented herein should not be extrapolated to other areas or used for other projects without prior review.

1.2 PROPOSED CONSTRUCTION

Understanding of the project is based on a review of the furnished site plan and Specifications for Geotechnical Investigation, Bibb Spec. 024A, dated July 27, 2006.

The proposed project will involve construction of various equipment and structures, including a LMS100, generator, intercooler heat exchanger, hot SCR, wet cooling tower, a concrete basin, a 27-foot diameter raw water storage tank and generator step-up transformers. Equipment loads are not anticipated to exceed 1100 psf. Appurtenant construction will include underground utilities.

Grading plans were not available at the time this report was prepared; however based on the site topography, cuts and fills of approximately 1 to 2 feet in vertical extent are anticipated to create pad grades and positive site drainage.

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1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of this investigation was to explore the site subsurface conditions and provide recommendations and opinions to aid in project design and construction. This report addresses the following items:

- A description of the proposed project, including a site vicinity map showing the approximate location of the site and a site plan showing the approximate locations of the exploration points for this study
- A description of the site surface and subsurface conditions encountered during the field investigation, including boring logs
- A summary of the field exploration and laboratory testing programs
- Recommendations for site preparation and earthwork, including a discussion of over-excavation, moisture conditioning, compaction and the use of on-site and quality of imported soils for engineered fill
- Recommended geotechnical design parameters for building and equipment foundations, including soil bearing pressures and anticipated settlements
- Recommendations for resistance of lateral loads on foundations
- Recommended subgrade preparation for conventional concrete building slabs supported-on-grade
- Recommended subgrade modulus for elastic evaluation of static loads
- Recommended dynamic shear modulus (G), Poisson's ratio (μ), mass density (ρ), soil modulus of elasticity (E_s), and angle of internal friction (ϕ) for use in evaluating foundations for vibrating machinery
- Recommended seismic design criteria (1997 UBC/2001 CBC)
- Comments on the general engineering seismology of the site, including a description of the site geologic setting
- Comments on the corrosion potential of on-site soils to buried metal and concrete
- Comments on field electrical resistivity for evaluation of facility grounding
- Comments on groundwater conditions

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2. FIELD AND LABORATORY EXPLORATION

2.1 FIELD EXPLORATION

The field exploration was performed on August 11, 2006 and consisted of drilling fifteen (15) test borings within the project site and site reconnaissance by a staff engineer. The test borings were drilled with a CME 75 and CME 85 truck-mounted drill rigs using 6- and 8-inch diameter hollow stem auger. The boring depths were 41.5 feet below the existing ground surface with the exception of one (1) boring to a depth of 101.5 feet below existing ground surface. The locations of the test borings are indicated on Plate 2, “Site Plan”.

The soils encountered in the borings were visually classified in the field and a continuous log was recorded. Relatively undisturbed samples were collected from the test borings at selected depths by driving a 2.5-inch I.D. split barrel sampler containing brass liners into the undisturbed soil with a 140-pound automatic hammer free falling a distance of 30 inches. In addition, samples of the subsurface material were obtained using a 1.4-inch I.D. standard penetrometer, driven 18 inches in accordance with ASTM D1586 test procedures. The sampler was used without liners. Resistance to sampler penetration was noted on the boring logs as the number of blows per foot over the last 12 inches of sampler penetration. The blow counts listed in the boring logs have not been corrected for the effects of overburden pressure, rod length, sampler size, or hammer efficiency. Bulk samples were also obtained from auger cuttings at selected boring locations.

2.2 FIELD AND LABORATORY TESTS

Penetration rates, determined in general accordance with ASTM D1586, were used to aid in evaluating the consistency, compression, and strength characteristics of the foundation soils.

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The field resistivity of the soil was measured at the site using the Wenner four-electrode method and a Model 4620 Ground Resistance Tester, manufactured by AEMC, Inc. The Wenner method involves the use of four metal probes or electrodes driven into the ground, along a straight line, with equal spacing. Resistance measurements were conducted with probe spacing of 5, 10, 20, and 30 feet corresponding to the depth of measurement, respectively. Results of the field resistivity tests are provided in Section 5.5.

Laboratory tests were performed on selected near surface samples to evaluate certain physical characteristics. The following laboratory tests were used to develop the design geotechnical parameters:

- Unit Weight (ASTM D2937)
- Moisture Content (ASTM D2216)
- Direct Shear (ASTM D3080)
- Collapse Potential (ASTM D5333)
- Grain-Size Distribution (ASTM D422, without hydrometer)
- Moisture Density Relationship (ASTM D1557)
- pH and Electrical Resistivity (California Test Method No. 643)
- Soluble Sulfate Content (California Test Method No. 417)
- Soluble Chloride Content (California Test Method No. 422)

The dry density and moisture content test results are shown on the boring logs in Appendix A. The soluble sulfate, soluble chloride, pH and minimum resistivity are discussed in the “Corrosion Potential” section (Section 5.5). The remaining test results are provided in Appendix B.

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3. SITE CONDITIONS

3.1 SURFACE CONDITIONS

The proposed site is located on Golden State Boulevard south of Bullard Avenue, in Fresno, California. The site is relatively flat. It is generally bound by industrial developments to the north and south, Golden State Boulevard east, and Highway 99 to the west. At the time of the field reconnaissance, the eastern half of the site was paved with asphalt concrete with a building, a fueling and truck washing station. The western portion of the site had a sparse growth of annual grasses and weeds and used for storage of some heavy equipment.

3.2 EARTH MATERIALS

The following description provides a general summary of the subsurface conditions encountered during the field exploration and further validated by the laboratory testing program. For a more thorough description of the actual conditions encountered at specific boring locations, refer to the boring logs presented in Appendix A. All soils have been classified according to the Unified Soil Classification System (ASTM D2487).

The upper natural earth material consists of Pleistocene alluvial sediments. The general soil profile encountered by the subsurface exploration consisted of silty sand with laterally discontinuous layers of sandy silt and poorly graded sand. The soils encountered generally had relative densities ranging from loose to very dense.

3.3 GROUNDWATER CONDITIONS

Groundwater was not encountered within the maximum depths explored, 101.5 feet below existing grade. The State of California Department of Water Resources, “Lines of Equal Elevation of Water in Wells”, Spring 2004 indicates the depth to groundwater exceeds 100 feet. It is possible that groundwater conditions at the site could change at

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some time in the future due to variations in rainfall, groundwater withdrawal, construction activities, or other factors not apparent at the time the test borings were made.

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4. ENGINEERING SEISMOLOGY

4.1 FAULTS LOCAL TO THE PROJECT

The project site and its vicinity are located in an area traditionally characterized by low seismic activity. There are no known faults that cut through the local soils in or near the site, and the site is not located within an Alquist-Priolo Earthquake Fault Zone as defined by Special Publication 42 (revised 1994) published by the California Geologic Survey (CGS).

Based on review of published data and a current understanding of the geologic framework and tectonic setting of the proposed development, the primary sources of seismic shaking at this site are anticipated to be the Great Valley, Segment 11, and Foothills fault systems, which are located approximately 38 miles northeast and 32 miles southwest of the site, respectively.

4.2 SEISMIC DESIGN CRITERIA

There are no anticipated geotechnical factors at this site that are unique and would necessitate special seismic consideration for design of the structures. Use of the 1997 UBC/2001 CBC design criteria would be appropriate, unless the structural engineer deems more specific data (e.g. elastic response spectra) necessary. The site is in Seismic Zone 3. The Soil Profile is considered S_D and the governing Seismic Source Type is B. The Seismic Zone Factor (Z) is 0.3.

4.3 LIQUEFACTION

In order for liquefaction and possible associated settlement of soils due to ground shaking to occur, it is generally accepted that four conditions will exist:

- The subsurface soils are in a relatively loose state,
- The soils are saturated,
- The soils are non-plastic,

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- Ground shaking is of sufficient intensity to act as a triggering mechanism.

Geologic age also influences the potential for liquefaction. Sediments deposited within the past few thousand years are generally much more susceptible to liquefaction than older Holocene sediments; Pleistocene sediments are even more resistant; and pre-Pleistocene sediments are generally immune to liquefaction (Youd, 2001).

The absence of groundwater would preclude the occurrence of liquefaction. Based on the ground shaking which may be expected at this site, the relative density, soil type, and geologic age of the sediments, analysis utilizing Youd (2001) indicates liquefaction or seismically induced settlement or bearing loss is considered unlikely, even if there should be a significant rise in ground water.

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5. DESIGN RECOMMENDATIONS

5.1 GENERAL

The proposed structure may be designed using conventional spread footing foundations supported on approved undisturbed native soil or properly compacted fill. The following recommendations are based on the assumption that the recommendations in Section 6, “EARTHWORK”, have been implemented. Specific comments and recommendations regarding the geotechnical aspects of project design are presented in subsequent sections.

5.2 SPREAD FOUNDATIONS

5.2.1 Allowable Vertical Bearing Pressures and Settlements

Mat foundations or conventional spread footings can be used to support the equipment. The following design parameters are applicable to footings supported on approved undisturbed native soil or engineered fill placed in accordance with the earthwork recommendations presented in Section 6 of this report.

Generally, two geotechnical issues determine the design bearing pressure for conventional spread footing foundations: (1) strength of the foundation soil and (2) tolerable settlement. For lightly loaded structures, design bearing may be dictated by code-required minimum footing geometry or constructability considerations.

The available bearing capacity, based only on the shear strength of the soil, will be dependent upon the footing geometry. Presented in Table 5.2-1 are the expressions for the allowable bearing capacity (shear strength considerations only) for static loading (D.L. + L.L.) and total combined loading (D.L. + L.L. + transient loading, such as wind or seismic).

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TABLE 5.2-1
AVAILABLE ALLOWABLE BEARING

Loading Condition	Available Allowable Bearing (psf)
Static Loading	900B + 1600D
Total Combined Loading	1350B + 2400D
Note: B is footing width in feet and D is footing embedment depth in feet	

Analysis, based on Schmertmann, determined the following estimated static settlement for equipment supported on engineered fill. The settlements provided consider only response to structural loads based on sustained loading equal to 100 percent of total static (DL + LL) loading. Settlement is anticipated to occur rapidly after load application.

TABLE 5.2-3
ESTIMATED SETTLEMENT DUE TO STATIC

Footing Type	Loading (DL +LL)	Design Bearing (psf)	Estimated Settlement (inch)
Mat	To 25 kips	700	Less than 0.25
	60 kips	600	Less than 0.25
	200 kips	400	Less than 0.25
	400 kips	900	0.4
	1500 kips	400	Less than 0.25
	1850 kips	1100	0.5
	8700 kips	800	0.4

If deemed necessary by the design engineer, Kleinfelder can provide the estimated settlement for other loading conditions and footing geometries.

The design bearing pressures are net values so the weight of embedded concrete does not need to be included in the foundation loading.

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A modulus of subgrade reaction, K_p (B_p = 1 foot), of 420 pci can be used for undisturbed native or properly compacted fill when considering analysis of a beam on an elastic foundation.

5.2.2 Lateral Resistance

Lateral loads applied to foundations can be resisted by a combination of passive lateral bearing and base friction. The allowable and ultimate passive pressures and frictional coefficients for undisturbed native or properly compacted fill are presented in Table 5.2-4.

TABLE 5.2-4
PASSIVE PRESSURES AND FRICTIONAL COEFFICIENTS

	Allowable		Ultimate
	Static	Total Combined	
Frictional Coefficient	0.48	0.58	0.72
Passive Pressure (psf/ft of depth)	420	550	830
Lateral Translation Needed to Develop Passive Pressure	0.005D	0.011D	0.045D

Note D is footing depth.

If the deflection resulting from the strain necessary to develop the passive pressure is within structural tolerance, the passive pressure and frictional resistance can be used in combination. Otherwise, additional passive pressure values could be provided based on tolerable deflection. The allowable values already incorporate a factor of safety and, as such, would be compared directly to the driving loads. If analytical approaches require the input of a ratio of available resisting forces and driving loads greater than unity, the ultimate values would be used.

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5.2.3 Dynamic Geotechnical Properties

The parameters presented in Table 5.2-5 can be used in evaluating the dynamic structure/soil interaction of vibrating foundations.

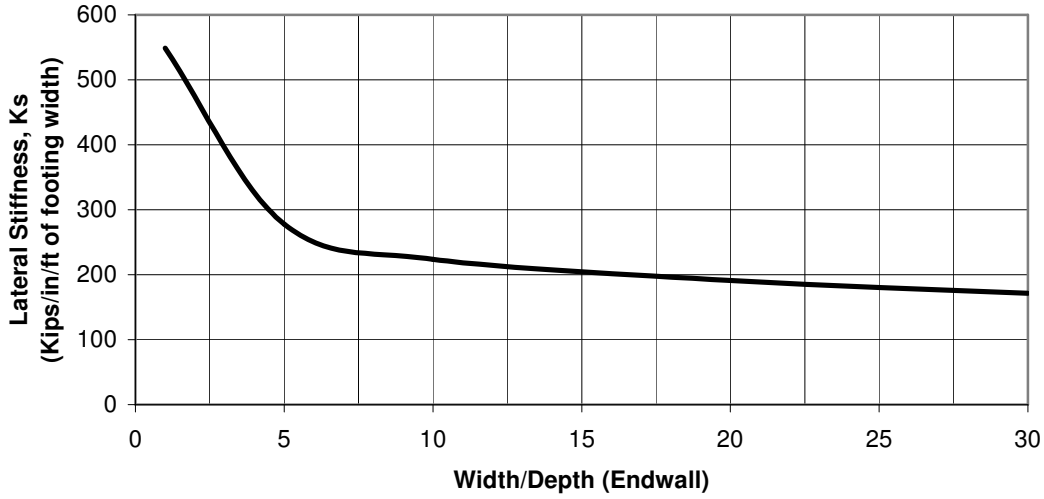
TABLE 5.2-5
DYNAMIC SOIL PROPERTIES

Soil Density, γ	120 pcf
Mass Density, ρ	3.7 lbs-sec^2/ft^4
Poisson's Ratio, μ	0.3
Dynamic Shear Modulus, G_{max}	2400 ksf
Modulus of Elasticity, E_s	5000 ksf
Soil Strength	Angle of Internal Friction, Φ = 35

5.2.4 Dynamic Stiffness

The dynamic lateral stiffness against the ends of the mat will be dependent upon the mat embedment depth and width. Figure 5.2-1 indicates the dynamic lateral stiffness of soil for foundations with varying width to depth ratios. The dynamic lateral stiffness presented assumes properly engineered fill against the side of the mat.

FIGURE 5.2-1
DYNAMIC LATERAL FOUNDATION STIFFNESS



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This stiffness does not consider any tractional shear developed along the base of the mat. The dynamic tractional stiffness can be estimated utilizing the following expressions.

Dynamic Tractional Stiffness = $435(BL)^{0.5}$ (kips/in)
Where; B = mat width (feet)
L = mat length (feet)

The dynamic vertical translational stiffness at the bottom of the mat is dependent on the width and length of the mat. The dynamic vertical translational stiffness can be estimated utilizing the following expression.

Dynamic Vertical Translational Stiffness = 530(BL)0.5 (kips/in)
Where; B = mat width (feet)
L = mat length (feet)

5.2.5 Construction Considerations

Prior to placing steel or concrete, foundation excavations should be cleaned of any debris, disturbed soil, and water. All foundation excavations should be observed by a representative of the project Geotechnical Engineer just prior to placing steel or concrete. The purpose of these observations is to check that the bearing soils actually encountered in the foundation excavations are similar to those assumed in analysis and to verify the recommendations contained herein are implemented during construction. In addition, the moisture content subgrade soil under conventional building slab-on-grade should be checked immediately prior to the placement of concrete.

5.3 TANK FOUNDATIONS

It is our understanding that the walls of large tanks will be supported on a ringwall footing. It is assumed that a nominal, sand or gravel, shaping layer will be used under the tank bottom.

5.3.1 Vertical Bearing Capacity and Settlement - Tank

Considering the anticipated base dimensions (approximately 27-foot diameter) of the tanks, the allowable bearing capacity associated with soil strength is extremely high.

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The stress increase from the product load of 1750 psf over the 27-foot diameter will influence foundation soil to a depth of approximately 20 feet at the center and 15 feet at the edge. It is estimated the settlement produced by this stress increase will be about 0.3 inches at the tank perimeter and 0.6 inches at the tank center. Considering the foundation soil is predominately granular, settlement is anticipated to occur shortly after load application. It is anticipated the post-construction differential settlement along the tank perimeter due to the product load will be less than 0.25 inch.

5.3.2 Vertical Bearing Capacity and Settlement - Ringwall Footings

Table 5.3-1 presents the allowable bearing capacities based on shear strength for static (D.L. + long-term L.L.) and the total combined load (D.L. + L.L. + dynamic) loading conditions, assuming the tank is empty and full.

TABLE 5.3-1
ALLOWABLE BEARING CAPACITY

Tank Condition	Allowable Bearing Capacity (psf)	
	Sustained Loading	Total Combined Loading
Empty	900B + 1600D	1350B + 2400D
Full	1690B + 3080D	2535B + 4625D

The above bearing capacities consider only the shear strength of the soil. Given the high available shear bearing, tolerable settlement will likely govern the design bearing pressure. It is estimated the settlement of a 2.0 foot wide ring footing will be about 0.2 inch per 2,000 psf of long-term (static) bearing (excluding product load), and about 0.1 inch per 2,000 psf of dynamically induced bearing.

5.3.3 Resistance To Lateral Loads

Lateral loads on the base of the tank or ring footing could be resisted by friction between the tank bottom plate or footing bottom and supporting soil. The allowable frictional coefficients for static (long-term) and total combined (long-term plus transient) loads are noted below.

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TABLE 5.3-2
FRICTIONAL COEFFICIENTS

Base Material	Allowable Frictional Coefficient	
	Static Loads	Total Combined Loads
Steel Tank Bottom on Native Soil or Imported Sand	0.21	0.26
Steel Tank Bottom on Gravel	0.25	0.30
Concrete Footing on Native	0.47	0.56

Lateral loads transmitted to ring footings can be resisted by passive lateral bearing. The passive pressures presented in Table 5.2-4 can be used for resistance of lateral loads.

The uniform lateral earth pressure against the interior of the ring footing would be 0.26 times the vertical product load (or surcharge load).

5.4 CONVENTIONAL CONCRETE BUILDING SLABS-ON-GRADE

5.4.1 Subgrade Preparation

Conventional slabs-on-grade should be supported on engineered fill as described in Section 6 of this report. The subgrade should have a moisture content of at least optimum to a depth of 12 inches immediately prior to placing any vapor retarding membrane or pouring the slab.

5.4.2 Capillary and Moisture/Vapor Break

Considering the soil type and regional groundwater depth, a capillary break (i.e. clean sand or gravel layer) is not necessary.

In buildings where equipment or other components are moisture-sensitive, it is recommended the subgrade be covered by a vapor retarding membrane, such as 10 mil PVC. The subgrade surface should be smooth and care should be exercised to avoid tearing, ripping, or otherwise puncturing the vapor retarding membrane. If the vapor retarding membrane becomes torn or disturbed, it should be removed and

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replaced or properly patched. The vapor retarding membrane could be covered with approximately 1 to 2 inches of saturated surface dry (SSD), relatively clean sand to protect it during construction. Concrete should not be placed if sand overlying the vapor barrier has been allowed to attain a moisture content greater than about 5% (due to precipitation or excessive moistening). Excessive water beneath interior floor slabs could result in future significant vapor transmission through the slab, adversely affecting moisture-sensitive floor coverings and could inhibit proper concrete curing. Concrete could be placed directly on the vapor retarding membrane if care is taken to not damage the membrane. If the protective sand layer is not used, the building designer should be in agreement. Many slab designers feel the sand cushion is important to proper concrete curing.

It should be noted that, although the slab support discussed above is currently the industry standard, this system might not be completely effective in preventing floor slab moisture vapor transmission problems. This system will not necessarily assure that floor slab moisture transmission rates or indoor humidity levels will not inhibit mold growth. A qualified specialist(s) with knowledge of slab moisture protection systems and other potential components that may be influenced by moisture, should address these post-construction conditions separately. The purpose of a geotechnical study is to address subgrade conditions only, and consequently, it does not evaluate future potential conditions.

5.4.3 Conventional Slab Design

There are no geotechnical considerations (e.g. expansive soil), which would require special design of slabs. Therefore, the thickness and reinforcement of slabs-on-grade should be determined by structural considerations and should be designed by the project structural engineer. A modulus of subgrade reaction, K_p (B_p = 1 foot), of 440 pci may be used for elastic analysis of slabs on properly compacted subgrade.

Slab concrete should have good density, a low water/cement ratio, and proper curing to promote a low porosity. It is recommended the water/cement ratio not to exceed 0.45 to minimize vapor transfer.

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5.5 IN-SITU SOIL RESISTIVITY TESTING

The resistivity of the soil was measured at the site to assist designers in evaluation of a potential grounding system. Soil resistivity was measured using the Wenner four-electrode method and a Model 4620 Ground Resistance Tester, manufactured by AEMC, Inc. The Wenner method involves the use of four metal probes or electrodes driven into the ground, along a straight line, an equal distance from each other. An alternating current from the soil resistance meter is induced into the soil. The current creates a voltage gradient that is proportional to the average resistance of the soil mass to a depth equal to the distance between probes. The resistivity of each layer of soil was then calculated using the Megger Method as follows:

$$\rho = A\ 2\ \pi\ R$$

where;

ρ= soil resistivity at depth (ohm-cm)
A = distance between the electrodes (cm)
R = resistance of soil layer from a to b (ohms)
π= constant 3.1416

Two resistivity test lines were performed at the project site. Two resistivity lines were taken in the center of the property (R-1 and R-2. Resistance measurements were conducted with probe spacing of 5, 10, 20, and 30 feet at the project site. The result of the field resistivity testing is provided in Table 5.5-1.

TABLE 5.5-1
FIELD RESISTIVITY TEST RESULTS

Location	Spacing in feet	Reading	X	Factor	Resistivity ohm-cm
R-1	5	6.20		957.6	5,937
	10	4.51		1915.1	8,637
	20	3.07		3830.2	11,759
	30	2.39		5745.3	13,731
R-2	5	5.56		957.6	5,324
	10	4.02		1915.1	7,699
	20	2.91		3830.2	11,146
	30	2.07		5745.3	11,893

Note: Tests were performed at an ambient temperature of approximately 90 degrees.

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The average resistivity of a layer in ohm-cm is the average resistivity of soil to a depth equal to the pin spacing (i.e. a 10-foot spacing is a 10-foot thick layer).

5.6 CORROSION POTENTIAL

Soil samples obtained from test borings B-5, B-9 and B-12 at depths of 1 to 5 feet were tested for pH, minimum resistivity, soluble sulfate content, and soluble chloride content. The test results are presented in Table 5.6-1.

TABLE 5.6-1
SUMMARY OF CORROSION TESTS

Sample Location	pH	Minimum Resistivity (ohm – cm)	Soluble Sulfate (mg/kg)	Soluble Chloride (mg/kg)
B-5	7.5	4945	20.8	44.7
B-9	8.2	1846	72.5	240
B-12	7.7	3033	73.5	8.5

Note: The designer should be aware the minimum resistivity value is generally used to identify potential corrosiveness of subgrade soil to unprotected buried metal and should not be used for design of project electrical grounding systems.

The test results suggest that the levels of soluble sulfates and chlorides present are within usually tolerable limits for normal reinforced concrete structures. Therefore, normal Type II cement concrete cover of reinforcement should be adequate for foundation concrete.

The resistivity at field moisture is relatively high and generally indicative of a very low corrosion potential to unprotected metal at the present soil moisture. However, as soil moisture increases, the resistivity reduces and the corrosive potential increases. The minimum resistivity may indicate the soil could have the potential to be severely corrosive to unprotected metal.

Corrosion is dependent upon a complex variety of conditions, which are beyond the geotechnical practice. Consequently, a qualified corrosion engineer should be

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consulted if the owner desires specific recommendations regarding material types and/or mitigation.

5.7 PAVEMENT DESIGN

5.7.1 Asphalt Concrete Pavement

The subgrade Resistance-value (R-value) for the on-site soil was evaluated in the laboratory on two (2) near surface soil samples taken the test borings B-9 and B-12. The laboratory tests were performed in conformance to Caltrans Test Method 301. The soil tested had measured R-values of 67 and 47 by exudation, respectively. Expansion pressures were not observed during testing. A design R-value of 47 is recommended.

Detailed vehicular load and frequency information is not available for this project. Traffic on the site is anticipated to consist primarily of automobile traffic with regular trash collection and occasional delivery trucks. Pavement sections have been provided for Traffic Indexes (T.I.'s) of less than 5.0, 6.0, 7.0 and 8.0. It is assumed the City of Fresno will furnish the actual design traffic indexes.

A design R-value of 47 is recommended and has been used in design. The flexible asphalt concrete pavement sections associated with the assumed T.I.'s are summarized in Table 5.7-1.

TABLE 5.7-1
RECOMMENDED MINIMUM PAVEMENT SECTIONS

Traffic Index	Asphalt Concrete	Aggregate Base (Min. R-value: 78)
5.0 or less	2.5"	4.0"
6.0	3.0"	5.0"
7.0	4.0"	5.0"
8.0	4.5"	6.5"

The flexible pavement should conform to, and be placed in accordance with, Caltrans Standard Specifications, May 2006. The aggregate base (Class 2) should comply with Section 26 of the Caltrans Standard Specifications. Aggregate base and the upper 6

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inches of subgrade should be compacted to a minimum of 95 percent relative compaction as determined by the ASTM D1557 or California Test Method 216/231 (dry method) test procedure. Subgrade compaction should be achieved immediately prior to placing the pavement section.

5.8 SITE DRAINAGE

Drainage should be directed away from the improvements to prevent ponding and/or saturation of the soils. Final pad grading should provide discernable gradients and drainage paths which direct surface run-off away from the structures. No water should be allowed to pond on-site. Where applicable, design should consider the use of roof drains with downspouts which discharge to areas (hardscape or pipes) that convey water away from structures and appurtenances.

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6. EARTHWORK

6.1 GENERAL

It is anticipated that site grading can be accomplished with conventional equipment and techniques. Recommendations regarding site grading are presented in subsequent sections of this report. All reference to relative compaction, maximum density and optimum moisture is based on ASTM Test Method D1557.

6.2 SITE PREPARATION

6.2.1 Stripping and Grubbing

At the time of the reconnaissance sparse vegetation was present on the site. It is likely the amount of surface vegetation will vary with time. Any surface vegetation and any miscellaneous surface obstructions should be removed from the project area, prior to any site grading. Surface strippings should not be incorporated into fill unless they can be sufficiently blended to result in an organic content less 3 percent by weight (ASTM D2974).

6.2.2 Over-Excavation

Over-excavation is typically reserved for soils that, in their natural state, will not provide adequate bearing for structures. The native soils at the project site should provide adequate bearing for the proposed structures. Therefore, provided the recommendations provided in Section 6 are followed, no over-excavation is required.

6.2.3 Scarification and Compaction

After stripping and performing any necessary removals, all areas to receive fill should be scarified at least 8 inches below the exposed subgrade elevation. The subgrade soil should be uniformly moisture conditioned to at, or above, optimum and compacted to 90% of the maximum dry density.

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6.3 ENGINEERED FILL

6.3.1 Materials

All engineered fill soils should be nearly free of organic or other deleterious debris and less than 3 inches in maximum dimension. The on-site soil materials, exclusive of debris, may be used as engineered fill provided they contain less than 3 percent organics by weight (ASTM D2974).

Recommended requirements for any imported soil to be used as engineered fill, as well as applicable test procedures to verify material suitability are provided on Table 6.3-1.

TABLE 6.3-1
SOIL MATERIALS TEST PROCEDURES

Gradation		Test Procedures	
Sieve Size	**Percent Passing**	**ASTM[1]**	**Caltrans[2]**
76 mm (3 inch)	100	C136	202
19 mm (¾ inch)	80 – 100	C136	202
No. 4	60 - 100	C136	202
No. 200	20 – 50	C136	202
Plasticity			
Liquid Limit	Plasticity Index		
< 25	< 9	D4318	204
Soluble Sulfates			
< 2000 ppm		-	417
Soluble Chloride			
<150 ppm		-	422
Resistivity			
>2000 ohm x cm		-	532

Notes:
[1] American Society for Testing and Materials Standards (latest edition)
[2] State of California, Department of Transportation, Standard Test Methods (latest edition)

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Any imported fill materials to be used for engineered fill should be sampled and tested by a representative of the project Geotechnical Engineer prior to being transported to the site.

6.3.2 Compaction Criteria

Soils with a Plasticity Index (PI) of less than 9 used for engineered fill should be uniformly moisture conditioned to at, or above, the optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness and compacted to at least 90 percent relative compaction. Disking and/or blending may be required to uniformly moisture condition soils used for engineered fill.

Soils with a PI of 9 or greater should be uniformly moisture-conditioned to at least 3% above optimum moisture, placed in horizontal lifts less than 8 inches in loose thickness and compacted to at least 90%, but not more than 95%, of the maximum dry density. Disking and or blending may be required to uniformly moisture condition soils used for engineered fill.

6.3.3 Construction Considerations

Should site grading be performed during or subsequent to wet weather, near-surface site soils may be significantly above optimum moisture content. These conditions could hamper equipment maneuverability and efforts to compact site soils to the recommended compaction criteria. Disking to aerate, chemical treatment, replacement with drier material, stabilization with a geotextile fabric or grid, or other methods may be required to mitigate the effects of excessive soil moisture and facilitate earthwork operations. Any consideration of chemical treatment (e.g. lime) to facilitate construction would require additional soil chemistry evaluation and could affect landscape areas and some construction materials (e.g. aluminum).

If construction is performed during dry, hot or windy weather, it may be necessary to periodically apply surface watering to counter evaporative loss or re-establish moisture prior to constructing slabs (see Section 5.3.1).

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6.4 TEMPORARY EXCAVATIONS

6.4.1 General

All excavations must comply with applicable local, State, and Federal safety regulations including the current OSHA Excavation and Trench Safety Standards. Construction site safety is generally the responsibility of the contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. The information below is provided as a service to the client. Under no circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

6.4.2 Excavations and Slopes

The contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, State, and/or Federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Such regulations are strictly enforced and, if they are not followed, the owner, contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties.

Near surface excavations should be constructed and maintained in conformance with current OSHA requirements (29 CFR Part 1926) for a Type B soil. Excavations deeper than about 4 feet should be constructed and maintained in conformance with current OSHA requirements (29 CFR Part 1926) for a type C soil.

6.4.3 Construction Considerations

Heavy construction equipment, building materials, excavated soil, and vehicular traffic should be kept sufficiently away from the top of any excavation to prevent any unanticipated surcharging. If it is necessary to encroach upon the top of an excavation, Kleinfelder can provide comments on slope gradients or loads on shoring to address surcharging, if provided with the geometry. Shoring, bracing, or underpinning required

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for the project (if any), should be designed by a professional engineer registered in the State of California.

During wet weather, earthen berms or other methods should be used to prevent runoff water from entering all excavations. All runoff should be collected and disposed of outside the construction limits.

6.5 TRENCH BACKFILL

6.5.1 Materials

Pipe zone backfill (i.e., bedding, haunching, and initial backfill per ASTM D2321) should consist of soil compatible with design requirements for the specific types of pipes. Consideration should be given to use of Class III or better material. It is recommended the project designer or pipe supplier develop the final material specifications based on planned pipe types, bedding conditions, tolerable deflection and other factors beyond the scope of this study. Randomly excavated on-site soil will likely be Class IV material per ASTM D2321. Selective excavation and striping would produce useable quantities of Class III material.

Trench zone backfill (i.e., material placed between the pipe zone backfill and finished subgrade) may consist of native soil that meets the requirements for engineered fill.

6.5.2 Compaction Criteria

All trench backfill should be placed and compacted in accordance with recommendations provided for engineered fill. Reduced compaction (85% minimum) could be specified for trench zone backfill in non-structural areas. Mechanical compaction is recommended; ponding or jetting should not be used.

Table 6.6-1 provides estimated geotechnical parameters for designers to consider in evaluating pipe zone backfill criteria that is compatible with pipe types and deformation tolerances.

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TABLE 6.6-1
PIPE ZONE BACKFILL PARAMETERS

Soil Stiffness Modulus (psi)			Backfill Density (pcf)	
E'_n (Trench Sidewall)	E'_b (Backfill)		85% Compaction	90% Compaction
	85% Compaction	90% Compaction		
Class III				
4000	900	1350	121	128

E'_n represents the modulus for the trench wall soil and is based on relative density and data by Howard (1996). E'_b is the modulus for backfill derived from random excavation of on-site soil and is based on data by Hartley and Duncan (1982) and Watkins and Anderson (2000). The design E' will be dependent upon the pipe diameter and trench width, which dictates the relative influence of E'_n and E'_b. Methods by Howard (1996) are suggested for evaluating the design E'. Kleinfelder can furnish a recommended design E', if provided with pipe diameter and specifications for trench construction.

In evaluating the maximum load (Wc) on pipes, a Kμ' of 0.19 (K = 0.27 and μ' = 0.7) can be used in determining the load coefficient Cd.

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7. ADDITIONAL SERVICES

7.1 PLANS AND SPECIFICATIONS REVIEW

It is recommended Kleinfelder conduct a general review of plans and specifications to evaluate that the earthwork and foundation recommendations have been properly interpreted and implemented during design. In the event Kleinfelder is not retained to perform this recommended review, no responsibility will be assumed for misinterpretation of the recommendations.

7.2 CONSTRUCTION OBSERVATION AND TESTING

It is recommended that all earthwork during construction be monitored by a representative from Kleinfelder, including site preparation, placement of all engineered fill and trench backfill, construction of slab and pavement subgrades, and all foundation excavations. The purpose of these services would be to provide Kleinfelder the opportunity to observe the soil conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes in design or construction procedures if conditions differ from those described herein.

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8. LIMITATIONS

Recommendations contained in this report are based on the field observations and subsurface explorations, laboratory tests, and present knowledge of the proposed construction. It is possible that soil conditions could vary between or beyond the points explored. If soil conditions are encountered during construction that differ from those described herein, Kleinfelder should be notified immediately in order that a review may be made and any supplemental recommendations provided. If the scope of the proposed construction changes from that described in this report, the recommendations provided should also be reviewed.

This report has been prepared in substantial accordance with the generally accepted geotechnical engineering practice, as it exists in the general area at the time of the study. No warranty is expressed or implied. The recommendations provided in this report are based on the assumption that Kleinfelder will conduct an adequate program of tests and observations during the construction phase in order to evaluate compliance with the recommendations.

This report may be used only by Bibb and Associates, their designated representatives and designers, and governing regulatory agencies, and only for the purposes stated, within a reasonable time from its issuance, but in no event later than one year (without review) from the date of the report. Land use, site conditions or other factors may change over time, and additional work may be required with the passage of time. Any other party who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

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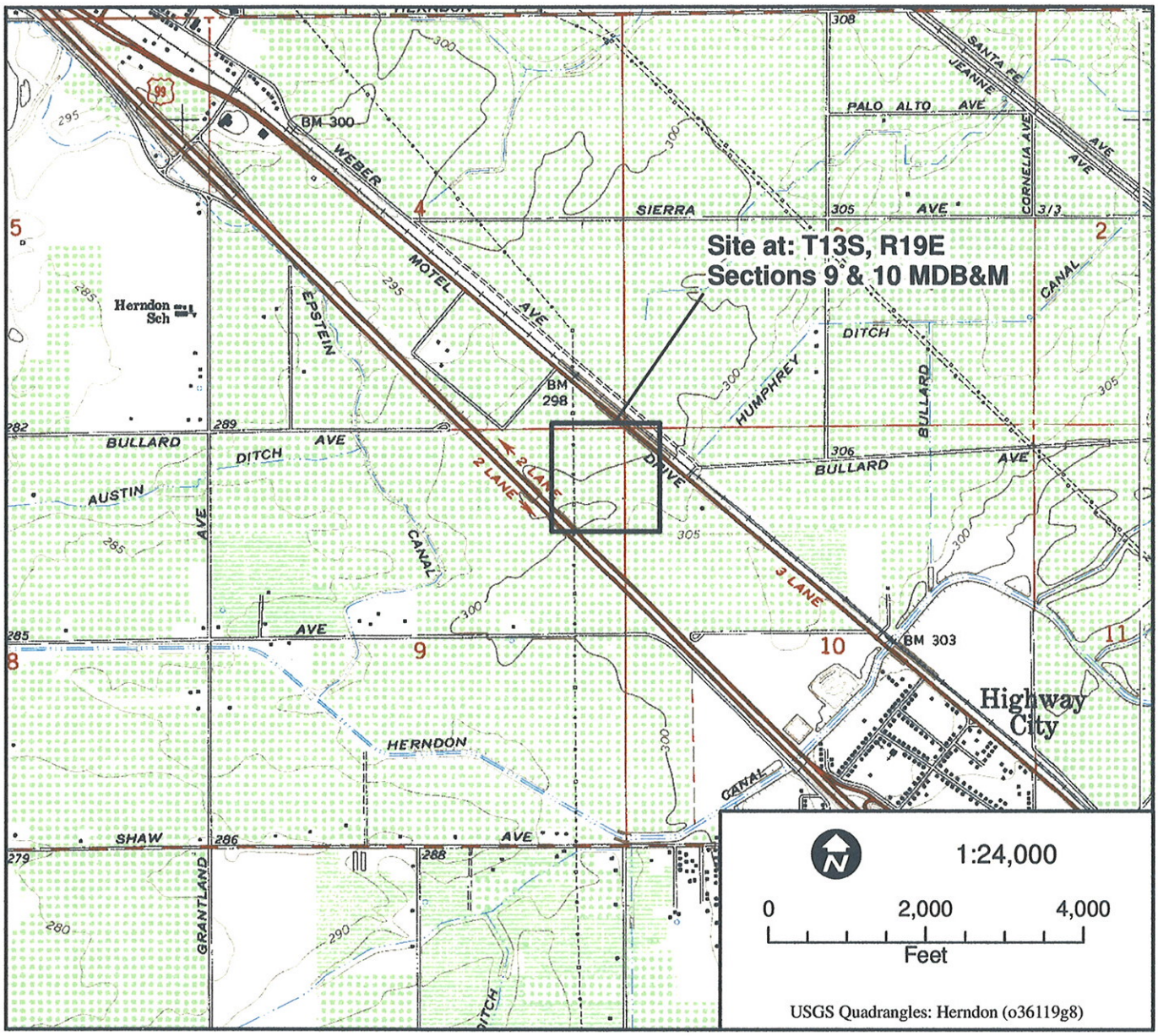
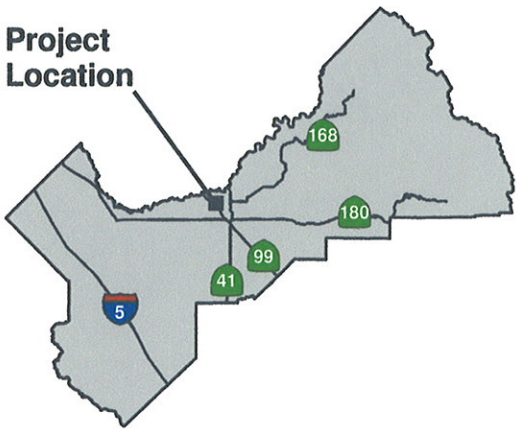
PLATES





KLEINFELDER
1410 F Street, Fresno, California, 93706
(559) 486-0750 • Fax: (559) 442-5081

Project Number: 74401.GEO | Date: September 28, 2006

PROJECT VICINITY MAP
Bullard Energy Facility
Golden State Blvd.
Fresno, California

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PLATE 1

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PROJECT SITE MAP

Bullard Energy Facility
Golden State Blvd.
Fresno, California

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PLATE 2

APPENDIX A

Date Completed: 8/11/06

Logged By: C.Davis

Total Depth: 41.5 feet

Surface Conditions: Asphalt and parking lot

Rig Type: CME 75 Auger Type: 6" H.S.

Groundwater: No free groundwater encountered.

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
								SILTY SAND (SM)- light brown, moist, medium dense, fine to medium grained
		8	109.0	3.3				
5		8						
10		11	101.0	2.1				
15		27						
20								**POORLY GRADED SAND (SP)**- light brown,

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PROJECT NO. 74401.GEO

LOG OF BORING SB- 1

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		32						moist, medium dense, fine to medium grained
25		16						**SILTY SAND (SM)**- brown, moist, medium dense, fine grained
30		35	101.4	3.8				**POORLY GRADED SAND (SP)**- light brown, moist, medium, fine to medium grained
35		45						**SILTY SAND (SM)**- brown, moist, dense, fine grained
40		33	99.9	1.7				**POORLY GRADED SAND (SP)**- light brown, moist, medium dense, fine to medium grained
								Notes:

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PROJECT NO. 74401.GEO

LOG OF BORING SB- 1

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								1.) Bottom of boring at 41.5 feet.
								2.) No free groundwater encountered.
								3.) Boring backfilled with soil cuttings 8/11/06.
45								
50								
55								
60								
65								

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PROJECT NO. 74401.GEO

LOG OF BORING SB- 1

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: 8/11/06

Logged By: C.Davis

Total Depth: 41.5 feet

Surface Conditions: Asphalt and parking lot

Rig Type: CME 75 Auger Type: 6" H.S.

Groundwater: No free groundwater encountered.

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
		50						**SILTY SAND (SM)**- red brown, moist, medium dense, fine grained
5		29						
10		15	93.9	4.2				**POORLY GRADED SAND (SP)**- light brown, moist, medium dense, fine to medium grained
15		16						
20								

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PROJECT NO. 74401.GEO

LOG OF BORING SB- 2

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

PLATE 1 of 3

A2

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		34						
25		26						**SILTY SAND (SM)**- brown, moist, medium dense, fine grained
30		56	106.8	3.9				**POORLY GRADED SAND (SP)**- light brown, moist, medium dense, fine to medium grained
35		17						
40		40	96.3	1.9				

Notes:

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PROJECT NO. 74401.GEO

LOG OF BORING SB- 2

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								1.) Bottom of boring at 41.5 feet.
								2.) No free groundwater encountered.
								3.) Boring backfilled with soil cuttings 8/11/06.
45								
50								
55								
60								
65								

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PROJECT NO. 74401.GEO

LOG OF BORING SB- 2

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: 8/11/06

Logged By: C.Davis

Total Depth: 41.5 feet

Surface Conditions: Asphalt and parking lot

Rig Type: CME 75 Auger Type: 6" H.S.

Groundwater: No free groundwater encountered.

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
								SILTY SAND (SM)- moist, medium dense, fine grained
		6						
5								
								POORLY GRADED SAND (SP)- light brown, moist, medium dense, fine to medium grained
10								
		8	107.1	4.2				
15								
20								

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PROJECT NO. 74401.GEO

LOG OF BORING SB- 3

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

PLATE 1 of 3

A3

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
25		42	107.2	11.3				**SILTY SAND (SM)**- light brown, moist, medium dense, fine grained
30								
35								
40		46	94.4	3.3				**POORLY GRADED SAND (SP)**- light brown, moist, medium dense, fine to medium grained
								Notes:

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PROJECT NO. 74401.GEO

LOG OF BORING SB- 3

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								1.) Bottom of boring at 41.5 feet.
								2.) No free groundwater encountered.
								3.) Boring backfilled with soil cuttings 8/11/06.
45								
50								
55								
60								
65								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 3

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: 8/11/06
Logged By: C.Davis
Total Depth: 31.5 feet

Surface Conditions: Asphalt and parking lot
Rig Type: CME 75 Auger Type: 6" H.S.
Groundwater: No free groundwater encountered.

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
		12	100.8	6.5				**SILTY SAND (SM)**- red brown, moist, loose to medium dense, fine grained
5		38	112.7	6.7				
10		4						
15		10	100.1	2.9				**POORLY GRADED SAND (SP)**- light brown, moist, medium dense, fine to medium grained
20								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 4
BULLARD ENERGY PROJECT
GOLDEN STATE BOULEVARD AND BULLARD AVENUE
FRESNO, CALIFORNIA

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		22						
25		86	112.7	5.9				**SILTY SAND (SM)**- light brown, moist, medium dense, fine grained
30		33						
35								
40		42						

Notes:
1.) Bottom of boring at 41.5 feet.
2.) No free groundwater encountered.

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 4
BULLARD ENERGY PROJECT
GOLDEN STATE BOULEVARD AND BULLARD AVENUE
FRESNO, CALIFORNIA

PLATE 2 of 3

A4

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								3.) Boring backfilled with soil cuttings 8/11/06.
45								
50								
55								
60								
65								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 4

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: **8/11/06**	*Surface Conditions:* **Asphalt and parking lot**
Logged By: **C.Davis**	*Rig Type:* **CME 75** *Auger Type:* **6" H.S.**
Total Depth: **41.5 feet**	*Groundwater:* **No free groundwater encountered.**

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
		19						**SILTY SAND (SM)**- red brown, moist, medium dense, fine grained
5								
10		7	105.4	3.1				
15								
20								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 5

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								POORLY GRADED SAND (SP)- light brown, moist, medium dense, fine to medium grained
25								
		40						**SILT (ML)**- gray, moist, medium dense, fine grained
30								
35								
								POORLY GRADED SAND (SP)- light brown, moist, medium dense, fine to medium grained
40								
		43	104.2	1.9				
								Notes:

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PROJECT NO. 74401.GEO

LOG OF BORING SB- 5

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								1.) Bottom of boring at 41.5 feet.
								2.) No free groundwater encountered.
								3.) Boring backfilled with soil cuttings 8/11/06.
45								
50								
55								
60								
65								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 5

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: 8/11/06
Logged By: M. Beltran
Total Depth: 101.5 feet

Surface Conditions: Asphalt and parking lot
Rig Type: CME 75 Auger Type: 6" H.S.
Groundwater: No free groundwater encountered.

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
		50/6	118.8	7.8				**SILTY SAND (SM)**- brown, moist, very dense, fine to medium grained
5		8						
10		8						**POORLY GRADED SAND (SP)**- light brown, moist, medium dense, fine to medium grained
15		77	101.7	19.1				**SANDY SILT (ML)**- gray, moist, very dense, fine grained
20								**SILTY SAND (SM)**- brown, moist, dense, fine grained

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 6
BULLARD ENERGY PROJECT
GOLDEN STATE BOULEVARD AND BULLARD AVENUE
FRESNO, CALIFORNIA

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		37						
25								
		45	92.9	19.7				
30								
		32						**POORLY GRADED SAND (SP)**- light brown, moist, dense, fine to medium grained
35								
		50/6	120.9	4.4				
40								
		32						

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 6

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
45		50/6	97.1	28.4				**SANDY SILT (ML)**- gray, moist, very dense, fine grained
50		43						**POORLY GRADED SAND (SP)**- brown, moist, very dense, fine grained
55		57						
60		34						**SILTY SAND (SM)**- brown, moist, dense, fine grained
65								**SANDY SILT (ML)**- brown, moist, very dense, fine grained

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 6

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		50/5	97.9	23.6				
70								
		50/5						
75								
		50/4	107.4	3.9				
80								
		50/4						
								POORLY GRADED SAND (SP)(- gray, moist, very dense, fine grained
85								
		56	91.6	5.6				

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 6

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								SILTY SAND (SM)- brown, moist, dense, fine to medium grained
90		50/3						
								POORLY GRADED SAND (SP)- gray, wet, very dense, fine
95		60	98.5	17.3				
100		31						
								Notes: **1.) Bottom of boring at 101.5 feet.** **2.) No free groundwater encountered.** **3.) Boring backfilled with soil cuttings 8/11/06.**
105								
110								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 6

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: 8/11/06

Logged By: M. Beltran

Total Depth: 41.5 feet

Surface Conditions: Asphalt and parking lot

Rig Type: CME 75 Auger Type: 6" H.S.

Groundwater: No free groundwater encountered.

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
			116.4	6.3				**SILTY SAND (SM)**- brown, moist, very dense, fine grained
		50/5						
5								
10								
		19	95.8	3.5				**POORLY GRADED SAND (SP)**- gray, moist, medium dense, fine to coarse grained
15								**SANDY SILT (ML)**- gray, moist, fine grained
20								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 7

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		61						**POORLY GRADED SAND (SP)**- light brown, moist, very dense, fine to medium grained
25								**SILTY SAND (SM)**- brown, moist, dense, fine to coarse grained
30		36						
35								
								POORLY GRADED SAND (SP)- brown gray, moist, very dense, fine to coarse grained
40		41	92.2	1.9				
								Notes:

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 7

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								1.) Bottom of boring at 41.5 feet.
								2.) No free groundwater encountered.
								3.) Boring backfilled with soil cuttings 8/11/06.
45								
50								
55								
60								
65								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 7

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: 8/11/06

Logged By: C.Davis

Total Depth: 41.5 feet

Surface Conditions: Asphalt and parking lot

Rig Type: CME 75 Auger Type: 6" H.S.

Groundwater: No free groundwater encountered.

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
		35	117.3	7.4				**SILTY SAND (SM)**- red brown, moist, medium dense, fine grained
5								
10		16	71.7	41.9				**POORLY GRADED SAND (SP)**- brown, moist, medium dense, fine to medium grained
15								
20								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 8

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

PLATE 1 of 3

A8

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		68	104.1	1.0				
25								
30								
35								
								SILTY SAND (SM)- light gray, moist, medium dense, fine grained
40								
		68	99.2	13.6				
								Notes:

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 8

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								1.) Bottom of boring at 41.5 feet.
								2.) No free groundwater encountered.
								3.) Boring backfilled with soil cuttings 8/11/06.
45								
50								
55								
60								
65								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 8

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: 8/11/06
Logged By: C.Davis
Total Depth: 41.5 feet

Surface Conditions: Asphalt and parking lot
Rig Type: CME 75 Auger Type: 6" H.S.
Groundwater: No free groundwater encountered.

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
		50/5	114.7	9.6				**SILTY SAND (SM)**- red brown, moist, very dense, fine grained, moderately cemented
5		16						
10		15	102.0	3.4				**POORLY GRADED SAND (SP)**- light brown, moist, medium dense, fine to coarse grained sand
15		9						
20								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 9
BULLARD ENERGY PROJECT
GOLDEN STATE BOULEVARD AND BULLARD AVENUE
FRESNO, CALIFORNIA

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		57	106.1	1.7				
25		36						**SILTY SAND (SM)**- light brown, moist, medium dense, fine grained
30		26	99.4	4.9				**POORLY GRADED SAND (SP)**- light brown, moist, medium dense, fine to medium grained
35		57						**SILTY SAND (SM)**- light brown, moist, medium dense, fine grained
40		46	96.5	2.4				**POORLY GRADED SAND (SP)**- light brown, moist, medium dense, fine grained
								Notes:

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 9

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								1.) Bottom of boring at 41.5 feet.
								2.) No free groundwater encountered.
								3.) Boring backfilled with soil cuttings 8/11/06.
45								
50								
55								
60								
65								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB- 9

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: 8/11/06

Logged By: C.Davis

Total Depth: 41.5 feet

Surface Conditions: Asphalt and parking lot

Rig Type: CME 75 Auger Type: 6" H.S.

Groundwater: No free groundwater encountered.

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
		50/4	111.9	8.2				**SILTY SAND (SM)**- red brown, moist, loose to medium dense, fine grained
5		48						
10		4						
15		13						**POORLY GRADED SAND (SP)**- light brown, moist, medium dense, fine to medium grained
20								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-10

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		24						
25		34						**SILTY SAND (SM)**- brown, moist, medium dense, fine to medium grained
30		22						
35		26						**POORLY GRADED SAND (SP)**- light brown, moist, medium dense, fine to medium grained
40		36						
								Notes:

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-10

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								1.) Bottom of boring at 41.5 feet.
								2.) No free groundwater encountered.
								3.) Boring backfilled with soil cuttings 8/11/06.
45								
50								
55								
60								
65								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-10

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: 8/11/06

Logged By: C.Davis

Total Depth: 41.5 feet

Surface Conditions: Asphalt and parking lot

Rig Type: CME 75 Auger Type: 6" H.S.

Groundwater: No free groundwater encountered.

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
								SILTY SAND (SM)- red brown, moist, medium dense, fine grained
		10						
5								
								POORLY GRADED SAND (SP)- light brown, moist, medium dense, fine to medium grained
10		24						
15								
20								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-11

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
25		48						**SILTY SAND (SM)**- brown, moist, medium dense, fine grained
30								
35								
40		58						**POORLY GRADED SAND (SP)**- light brown, moist, medium dense, fine to medium grained
								Notes:

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-11

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								1.) Bottom of boring at 41.5 feet.
								2.) No free groundwater encountered.
								3.) Boring backfilled with soil cuttings 8/11/06.
45								
50								
55								
60								
65								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-11

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: **8/11/06**	*Surface Conditions:* **Asphalt and parking lot**
Logged By: **M. Beltran**	*Rig Type:* **CME 75** *Auger Type:* **6" H.S.**
Total Depth: **41.5 feet**	*Groundwater:* **No free groundwater encountered.**

Depth, ft	FIELD: Sample	FIELD: Blows/ ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
		6						**SILTY SAND (SM)**- brown, moist, medium dense, fine to medium grained
5		8						
10								
								POORLY GRADED SAND (SP)- light brown, moist, medium dense, fine to medium grained
15		14						
20								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-12
BULLARD ENERGY PROJECT
GOLDEN STATE BOULEVARD AND BULLARD AVENUE
FRESNO, CALIFORNIA

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								SILTY SAND (SM)- brown, moist, very dense, fine grained
25		76						
30								
35		59						**POORLY GRADED SAND (SP)**- light brown, moist, very dense, fine to coarse grained
40		48						
								Notes:

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-12

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								1.) Bottom of boring at 41.5 feet.
								2.) No free groundwater encountered.
								3.) Boring backfilled with soil cuttings 8/11/06.
45								
50								
55								
60								
65								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-12

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: 8/11/06

Logged By: C.Davis

Total Depth: 41.5 feet

Surface Conditions: Asphalt and parking lot

Rig Type: CME 75 Auger Type: 6" H.S.

Groundwater: No free groundwater encountered.

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
		12						**SILTY SAND (SM)**- red brown, moist, medium dense, fine to medium grained
5		8						
10		11						
15		18						**POORLY GRADED SAND (SP)**- light brown, moist, medium dense, fine to coarse grained sand
20								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-13

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		34						
25		39						**SILTY SAND (SM)**- light brown, moist, medium dense, fine grained
30		19						
35								
40		22						
								Notes:

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-13

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								1.) Bottom of boring at 41.5 feet.
								2.) No free groundwater encountered.
								3.) Boring backfilled with soil cuttings 08/11/0606.
45								
50								
55								
60								
65								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-13

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: 8/11/06

Logged By: M. Beltran

Total Depth: 41.5 feet

Surface Conditions: Asphalt and parking lot

Rig Type: CME 85 Auger Type: 6" H.S.

Groundwater: No free groundwater encountered.

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
		36						**SILTY SAND (SM)**- brown, moist, dense, fine to medium grained
5		46						**SANDY SILT (ML)**- brown, moist, very dense, fine grained
10		14						**SILTY SAND (SM)**- brown, moist, medium dense, fine to medium grained
15		26						**POORLY GRADED SAND (SP)**- light brown, moist, dense, fine to coarse grained
								SILTY SAND (SM)- brown, moist, dense, fine to medium grained
								POORLY GRADED SAND (SP)- light brown, moist, dense, fine to coarse grained with fine gravel
20								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-14

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
		32						
25		30						**SILTY SAND (SM)**- brown, moist, dense, fine to medium grained
30		92						
								Notes: **1.) Bottom of boring at 31.5 feet.** **2.) No free groundwater encountered.** **3.) Boring backfilled with soil cuttings 8/11/06.**
35								
40								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-14

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Date Completed: 8/11/06

Logged By: M. Beltran

Total Depth: 41.5 feet

Surface Conditions: Asphalt and parking lot

Rig Type: CME 75 Auger Type: 6" H.S.

Groundwater: No free groundwater encountered.

Depth, ft	FIELD Sample	FIELD Blows/ ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								Approximate Surface Elevation (feet):
		30						**SILTY SAND (SM)** - brown, moist, medium dense, fine to medium grained
5		28						
10								**POORLY GRADED SAND (SP)**- light brown, moist, dense, fine to medium grained
15		34						
20								

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-15

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

PLATE 1 of 3

A15

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Approx. Saturation %	LABORATORY Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
25		38						**SANDY SILT (ML)** - brown, moist, dense, fine grained
30								
35		66						**POORLY GRADED SAND (SP)** - gray, moist, very dense, fine to coarse grained
40		56						
								Notes:

KLEINFELDER

PROJECT NO. 74401.GEO

LOG OF BORING SB-15

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Approx. Saturation %	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
								(Continued from previous plate)
								1.) Bottom of boring at 41.5 feet.
								2.) No free groundwater encountered.
								3.) Boring backfilled with soil cuttings 8/11/06.
45								
50								
55								
60								
65								

KLEINFELDER

PROJECT NO. 74401.GEO

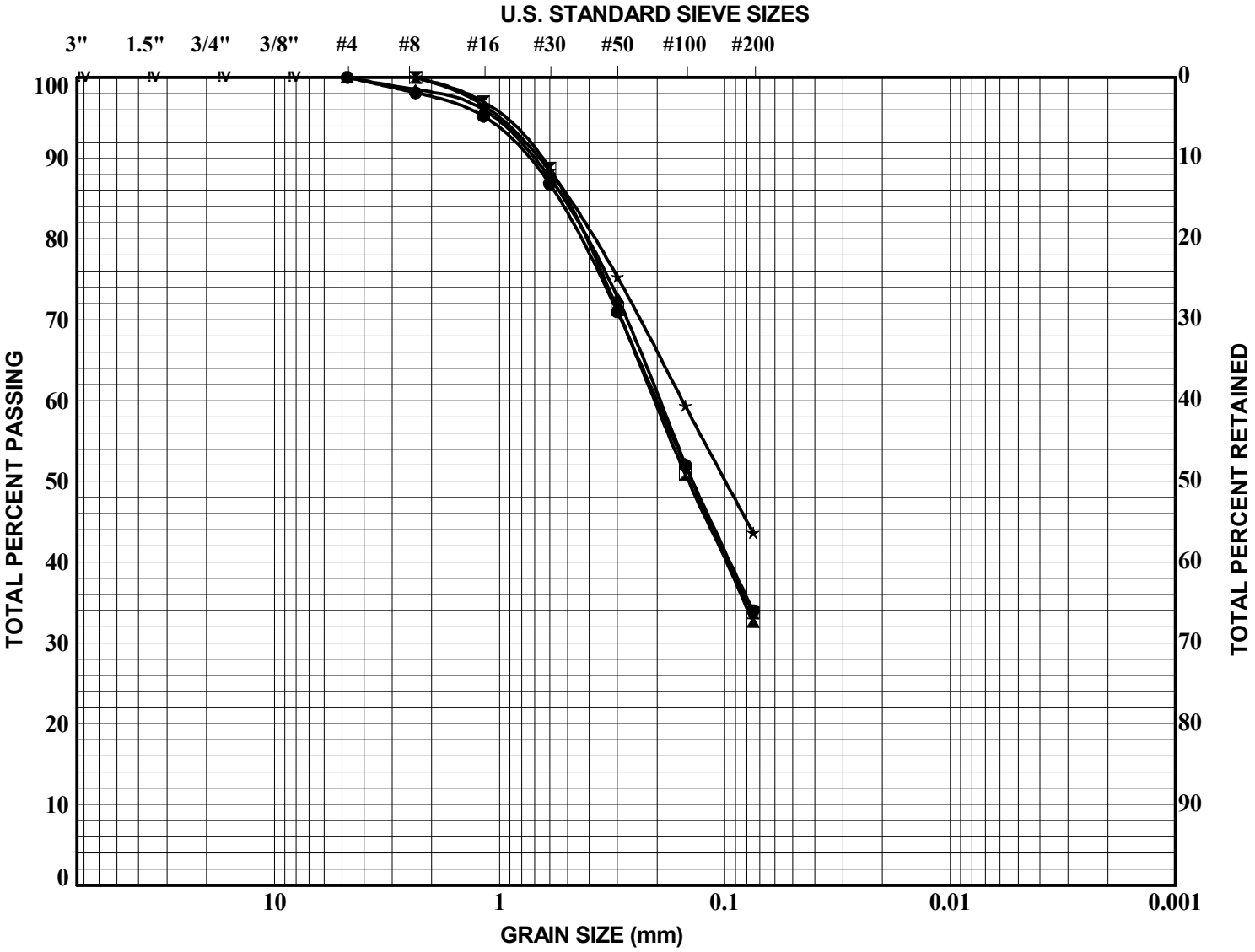
LOG OF BORING SB-15

BULLARD ENERGY PROJECT

GOLDEN STATE BOULEVARD AND BULLARD AVENUE

FRESNO, CALIFORNIA

APPENDIX B



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Sample	Depth (ft)	Description	Classification
●	SB- 2	0.0 - 5.0	Silty Sand	SM
⧗	SB- 5	0.0 - 5.0	Silty Sand	SM
▲	SB- 9	0.0 - 5.0	Silty Sand	SM
★	SB-12	0.0 - 5.0	Silty Sand	SM

KLEINFELDER

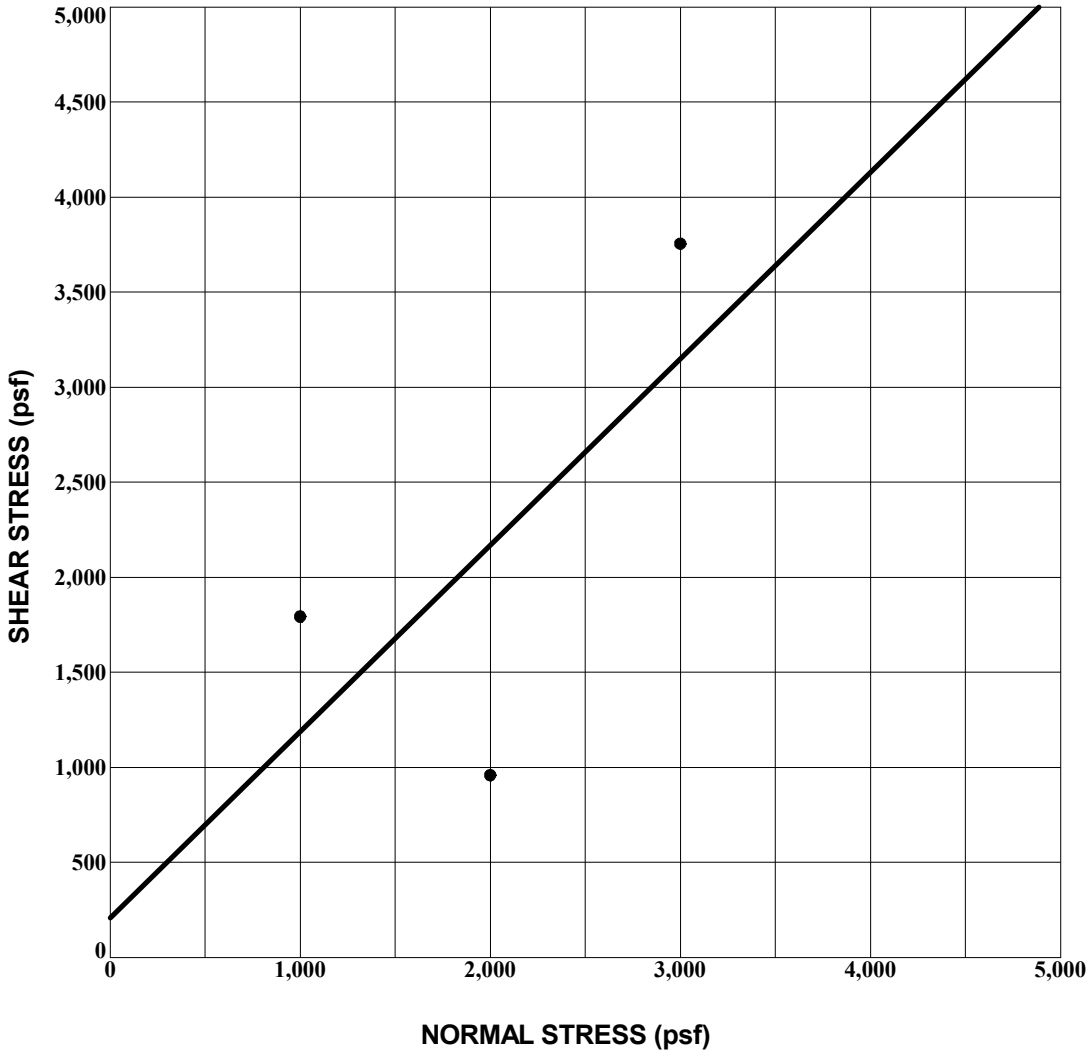
PROJECT NO. 74401.GEO

GRAIN SIZE DISTRIBUTION
BULLARD ENERGY PROJECT
GOLDEN STATE BOULEVARD AND BULLARD AVENUE
FRESNO, CALIFORNIA

PLATE

B-1

DIRECT SHEAR



Source:	SB- 8	Friction Angle =	44.0 deg
Depth:	2.0 ft	Cohesion =	0 psf
Test Type:	Consolidated - Drained		
Soil Description:	Silty Sand (SM)		

Dry Density (pcf)	117.3	117.3	117.3
Initial Water Content (%)	7.4	7.4	7.4
Final Water Content (%)	12.8	11.2	19.3
Normal Stress (psf)	1000	2000	3000
Shear Stress(psf)	1794	959	3755

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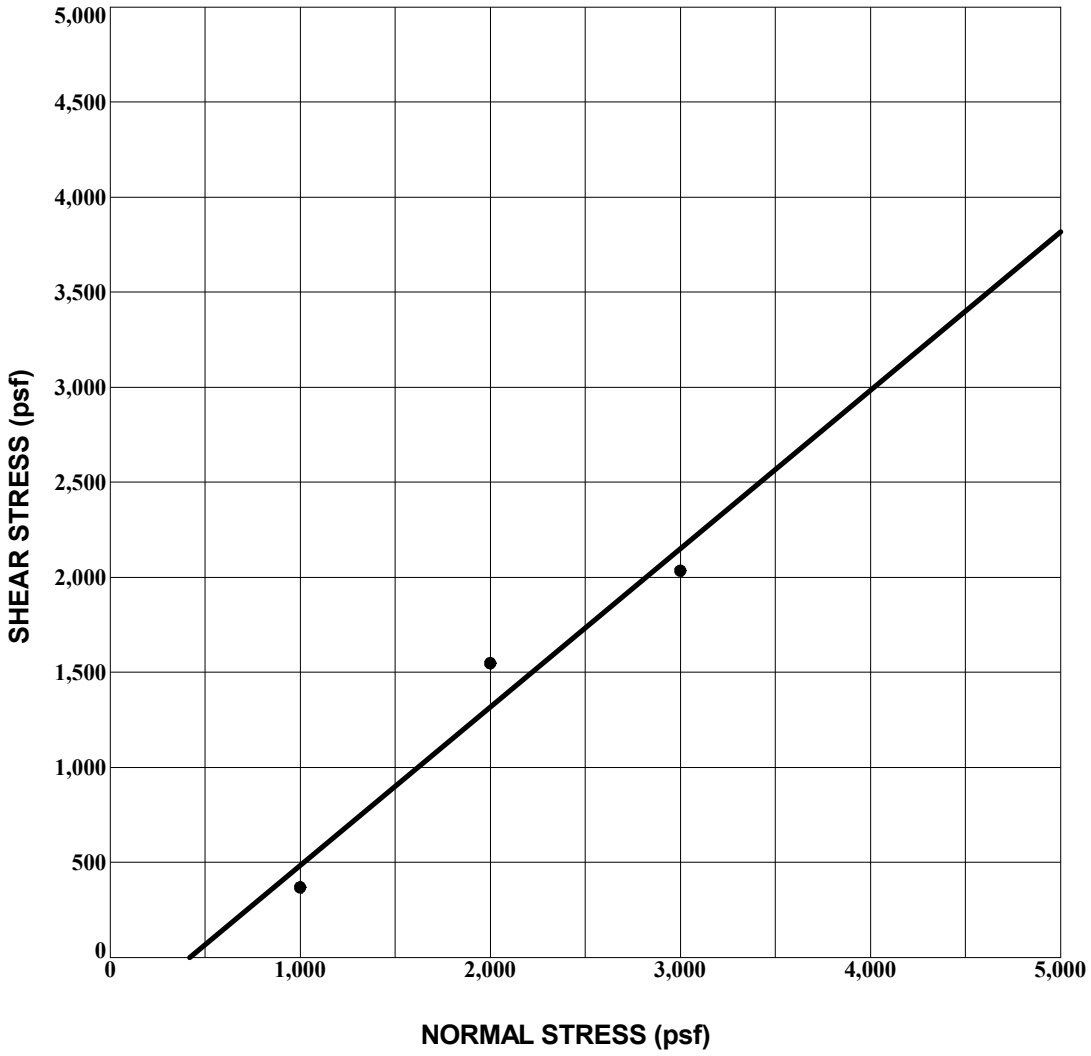
PROJECT NO. 74401.GEO

DIRECT SHEAR TEST
BULLARD ENERGY PROJECT
GOLDEN STATE BOULEVARD AND BULLARD AVENUE
FRESNO, CALIFORNIA

PLATE
B-2

DIRECT SHEAR



Source:	SB-10	Friction Angle =	40.0 deg
Depth:	2.0 ft	Cohesion =	0 psf
Test Type:	Consolidated - Drained		
Soil Description:	Silty Sand (SM)		

Dry Density (pcf)	111.9	111.9	111.9
Initial Water Content (%)	8.2	8.2	8.2
Final Water Content (%)	19.0	18.4	19.7
Normal Stress (psf)	1000	2000	3000
Shear Stress(psf)	369	1548	2035

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DIRECT SHEAR TEST
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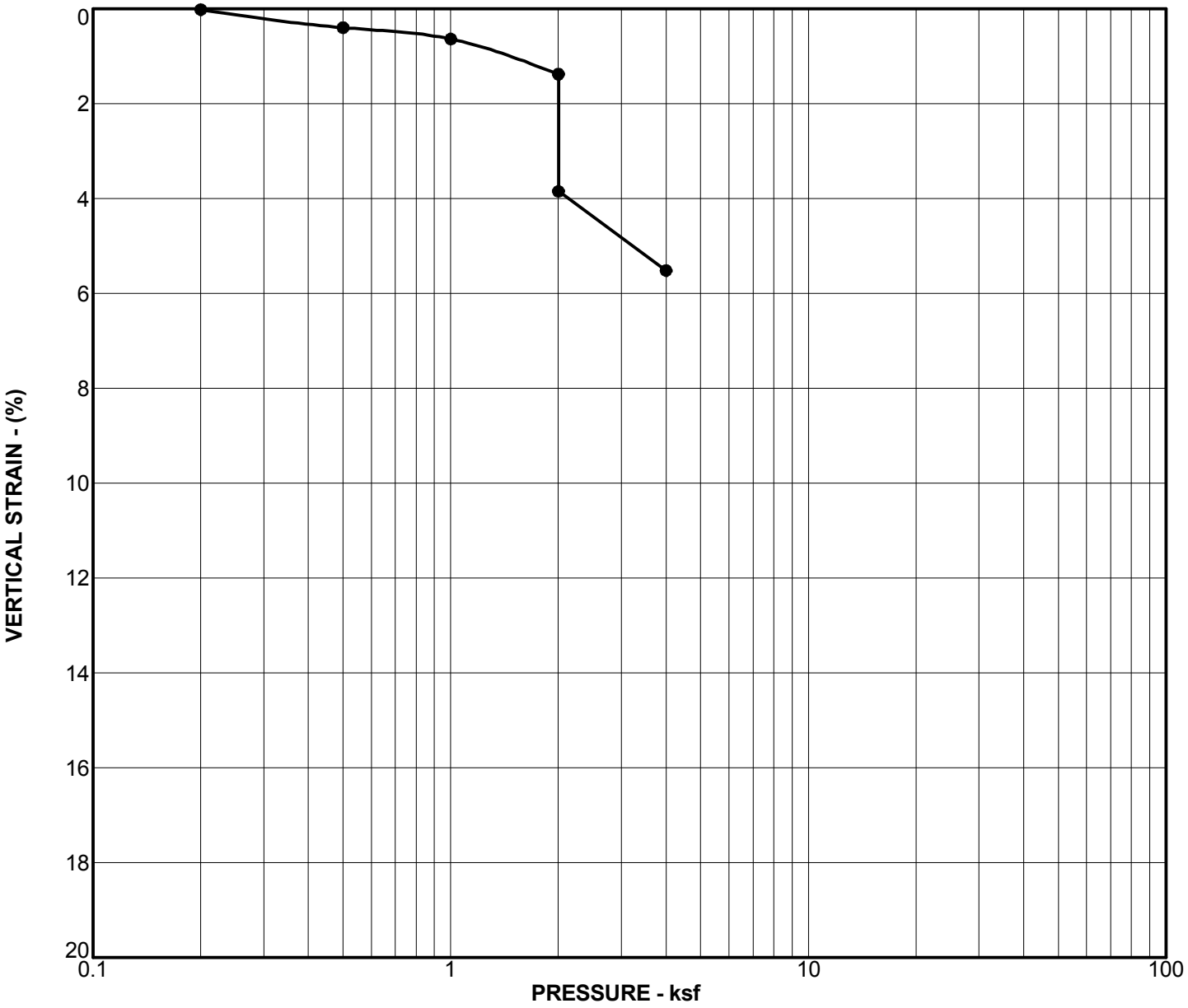
FRESNO, CALIFORNIA

PLATE
B-3



Sample	SB- 4
Depth	2.0 ft
Description	Silty Sand
Classification	SM

	Initial	Final
Dry density, pcf	115.9	122.7
Water content, %	6.5	11.9
Sample height, in.	1	0.9448

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CONSOLIDATION TEST
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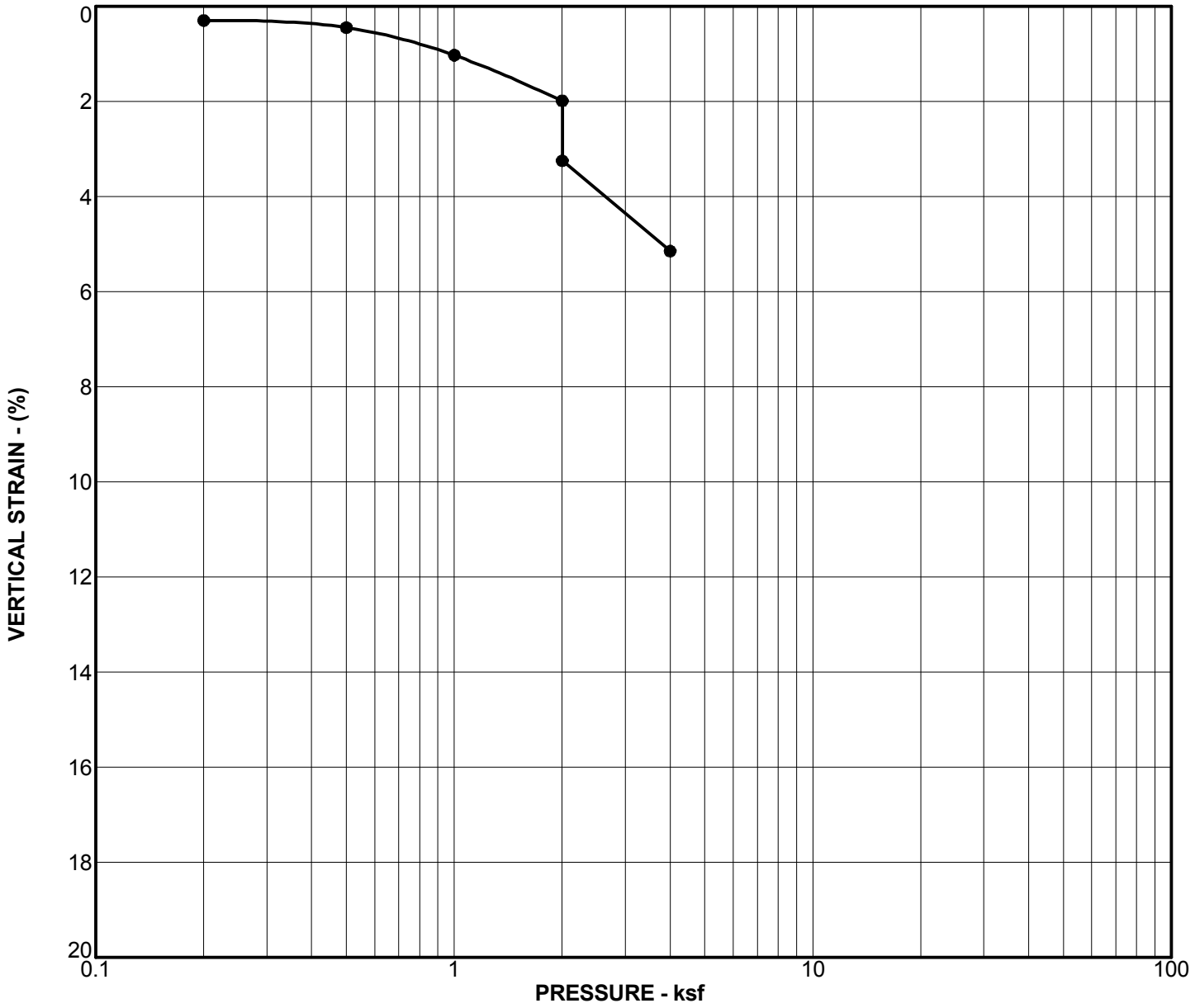
GOLDEN STATE BOULEVARD AND BULLARD AVENUE
FRESNO, CALIFORNIA

PLATE

B-4



Sample	SB- 4
Depth	6.0 ft
Description	Silty Sand
Classification	SM

	Initial	Final
Dry density, pcf	104.0	117.3
Water content, %	14.1	19.1
Sample height, in.	1	0.9485

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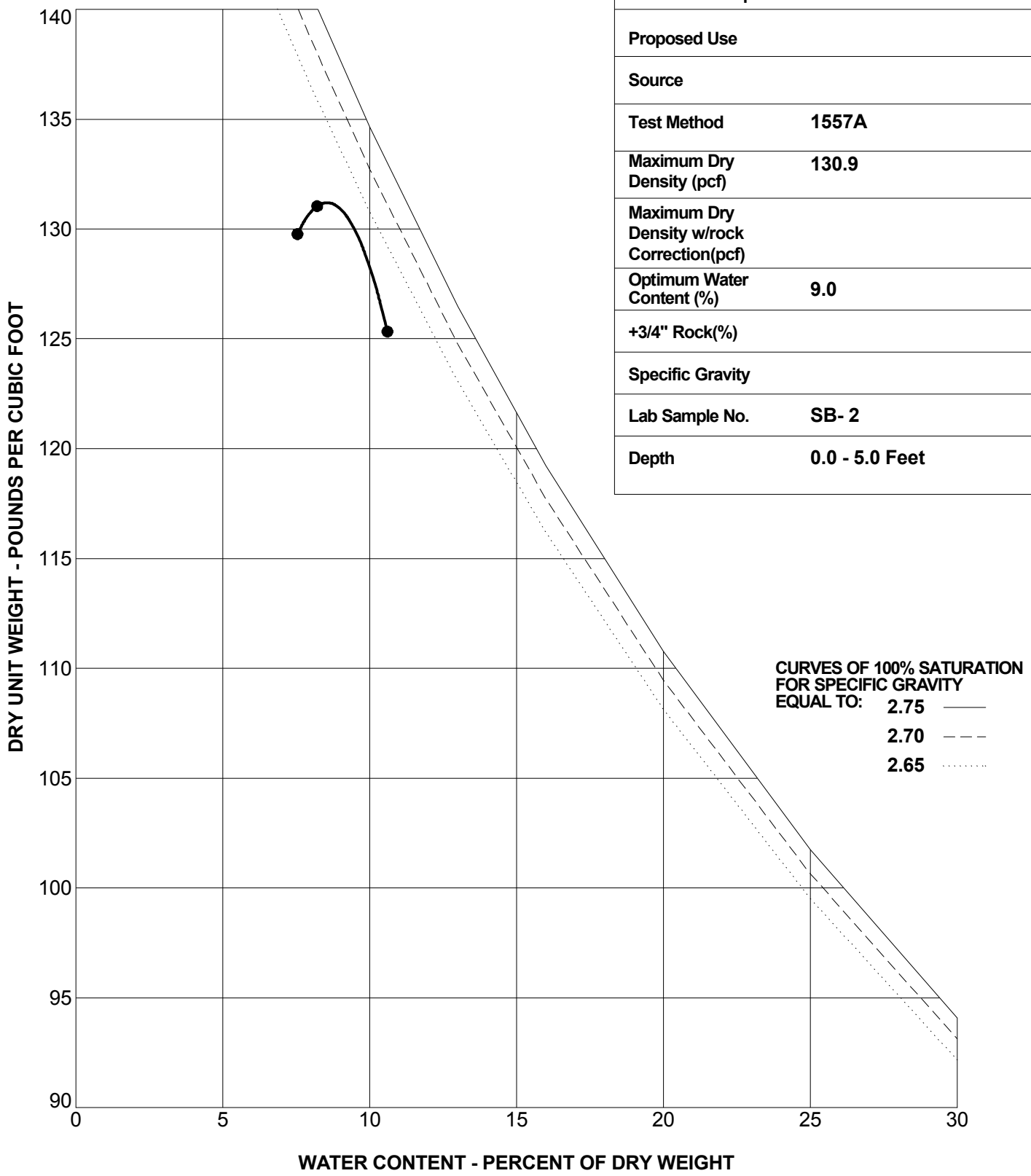
CONSOLIDATION TEST
BULLARD ENERGY PROJECT
GOLDEN STATE BOULEVARD AND BULLARD AVENUE
FRESNO, CALIFORNIA

PLATE

B-5

SUMMARY OF TEST RESULTS	
Material Description	Silty Sand
Proposed Use	
Source	
Test Method	1557A
Maximum Dry Density (pcf)	130.9
Maximum Dry Density w/rock Correction(pcf)	
Optimum Water Content (%)	9.0
+3/4" Rock(%)	
Specific Gravity	
Lab Sample No.	SB- 2
Depth	0.0 - 5.0 Feet



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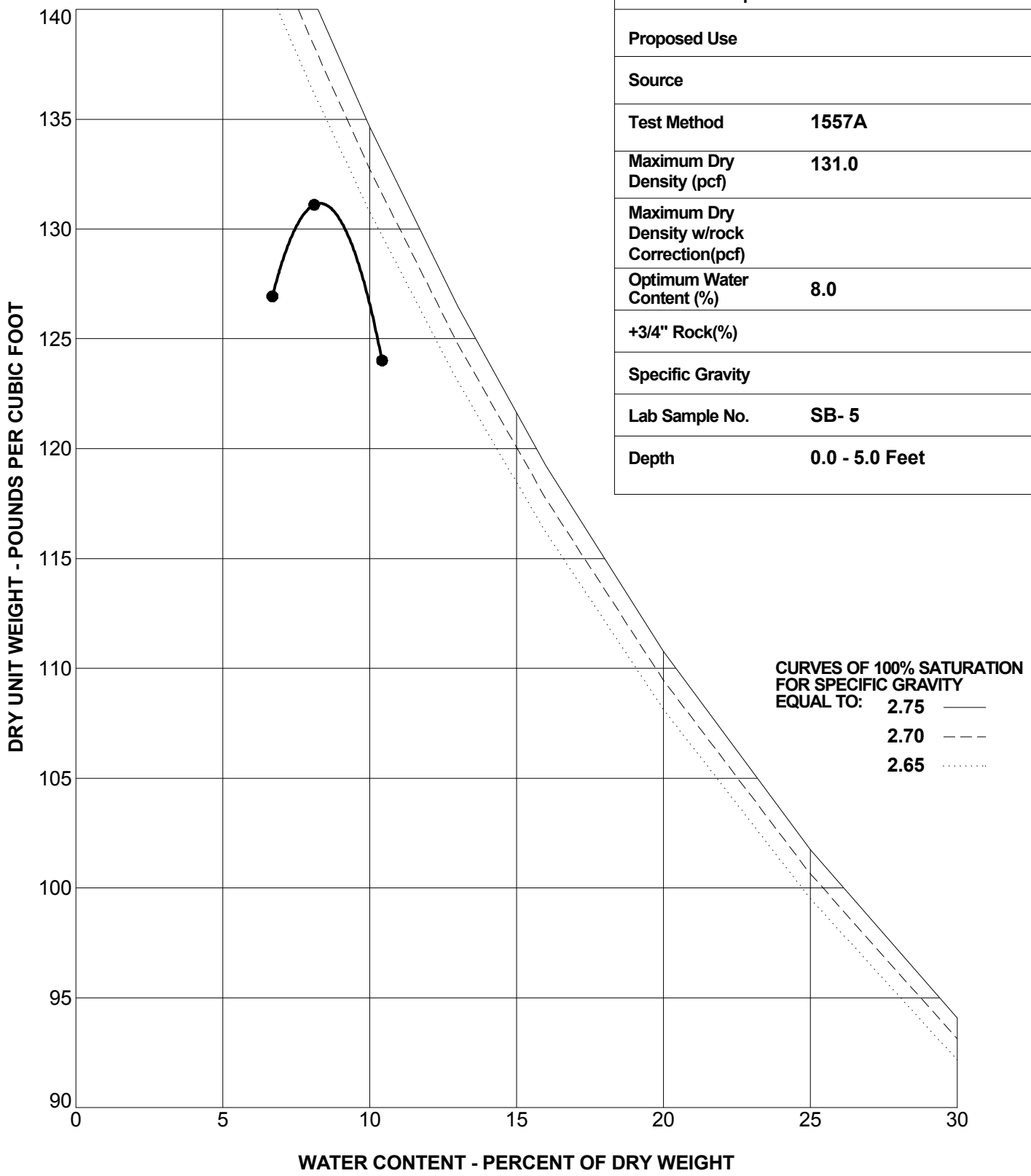
PROJECT NO. 74401.GEO

MOISTURE DENSITY RELATIONSHIP
BULLARD ENERGY PROJECT
GOLDEN STATE BOULEVARD AND BULLARD AVENUE
FRESNO, CALIFORNIA

PLATE

B-6

SUMMARY OF TEST RESULTS	
Material Description	Silty Sand
Proposed Use	
Source	
Test Method	1557A
Maximum Dry Density (pcf)	131.0
Maximum Dry Density w/rock Correction(pcf)	
Optimum Water Content (%)	8.0
+3/4" Rock(%)	
Specific Gravity	
Lab Sample No.	SB- 5
Depth	0.0 - 5.0 Feet



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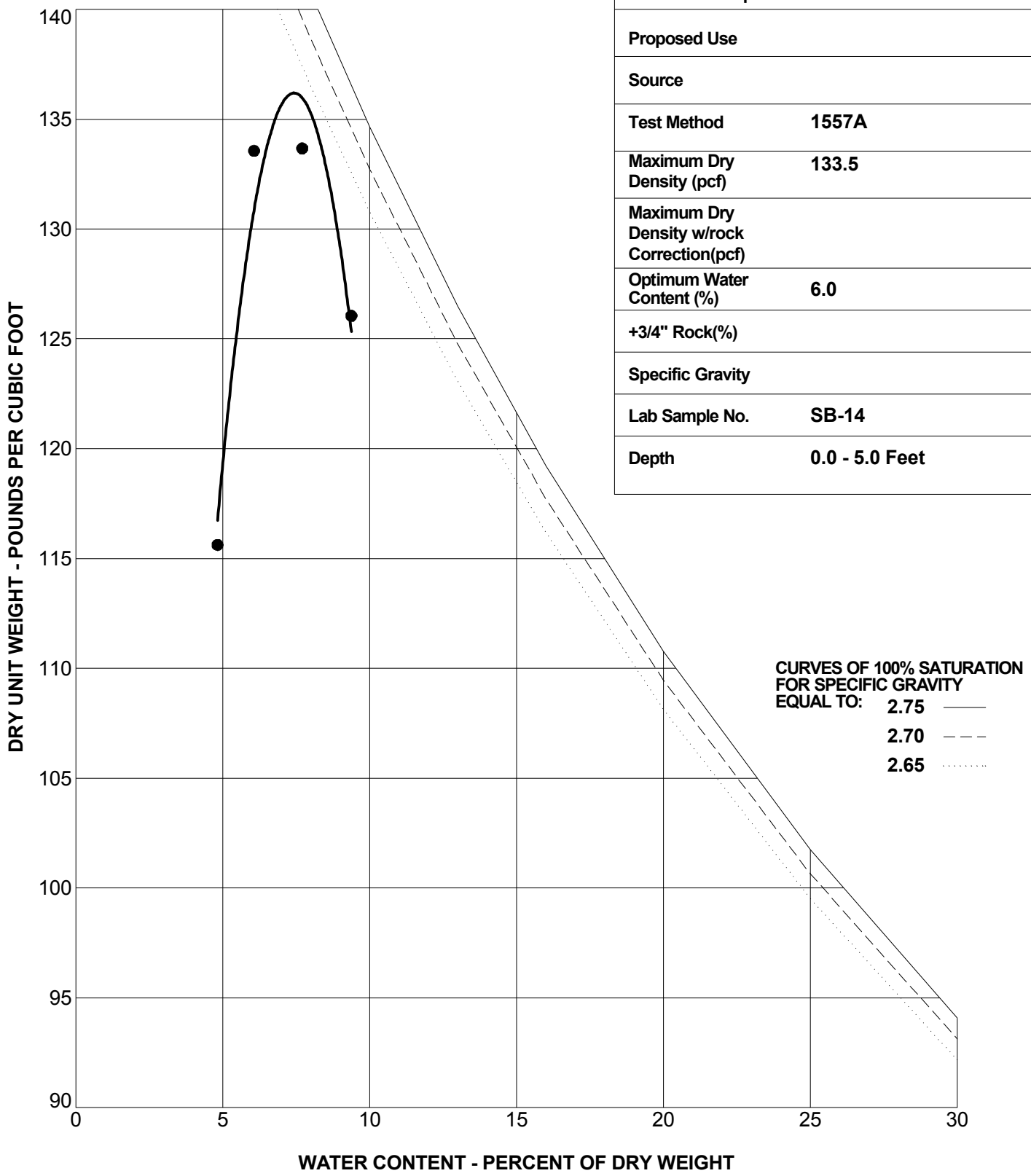
PROJECT NO. 74401.GEO

MOISTURE DENSITY RELATIONSHIP
BULLARD ENERGY PROJECT
GOLDEN STATE BOULEVARD AND BULLARD AVENUE
FRESNO, CALIFORNIA

PLATE

B-7

SUMMARY OF TEST RESULTS	
Material Description	Silty Sand
Proposed Use	
Source	
Test Method	1557A
Maximum Dry Density (pcf)	133.5
Maximum Dry Density w/rock Correction(pcf)	
Optimum Water Content (%)	6.0
+3/4" Rock(%)	
Specific Gravity	
Lab Sample No.	SB-14
Depth	0.0 - 5.0 Feet



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MOISTURE DENSITY RELATIONSHIP
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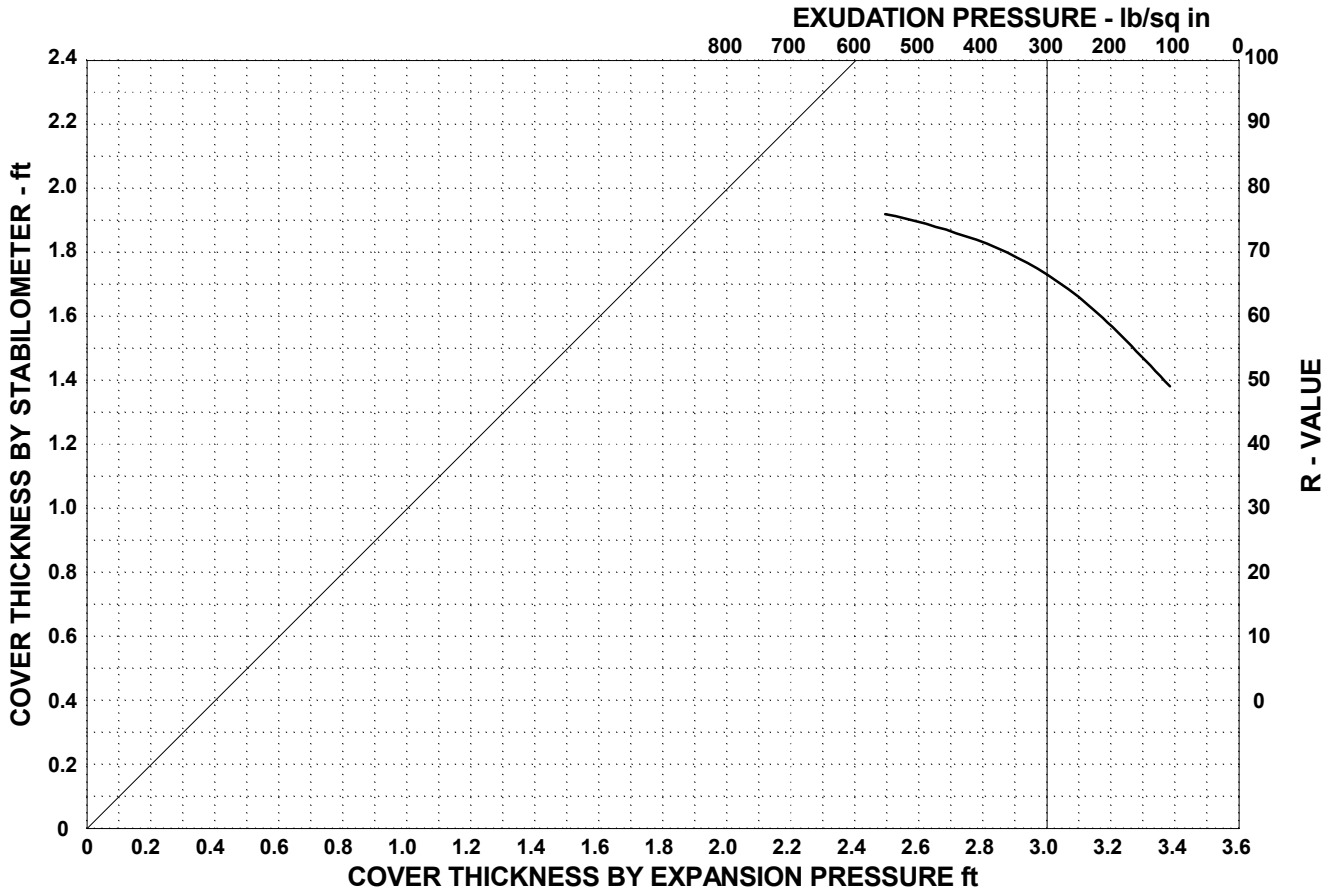
PLATE

B-8

RESISTANCE VALUE

SAMPLE LOCATION: SB- 9
SAMPLE DEPTH: 0.0 - 5.0 Feet
SAMPLE DESCRIPTION: Silty Sand (SM)



SPECIMEN	A	B	C
EXUDATION PRESSURE, lb/sq in	107	250	552
EXPANSION DIAL (0.0001")	0	0	0
EXPANSION PRESSURE, lb/sq ft	0	0	0
RESISTANCE VALUE, R	49	63	76
MOISTURE AT TEST, %	11.9	11	10.2
DRY DENSITY AT TEST, lb/cu ft	116.7	118.5	119.3
R-VALUE AT 300 lb/sq in EXUDATION PRESSURE		67	
R-VALUE BY EXPANSION PRESSURE(TI=)			

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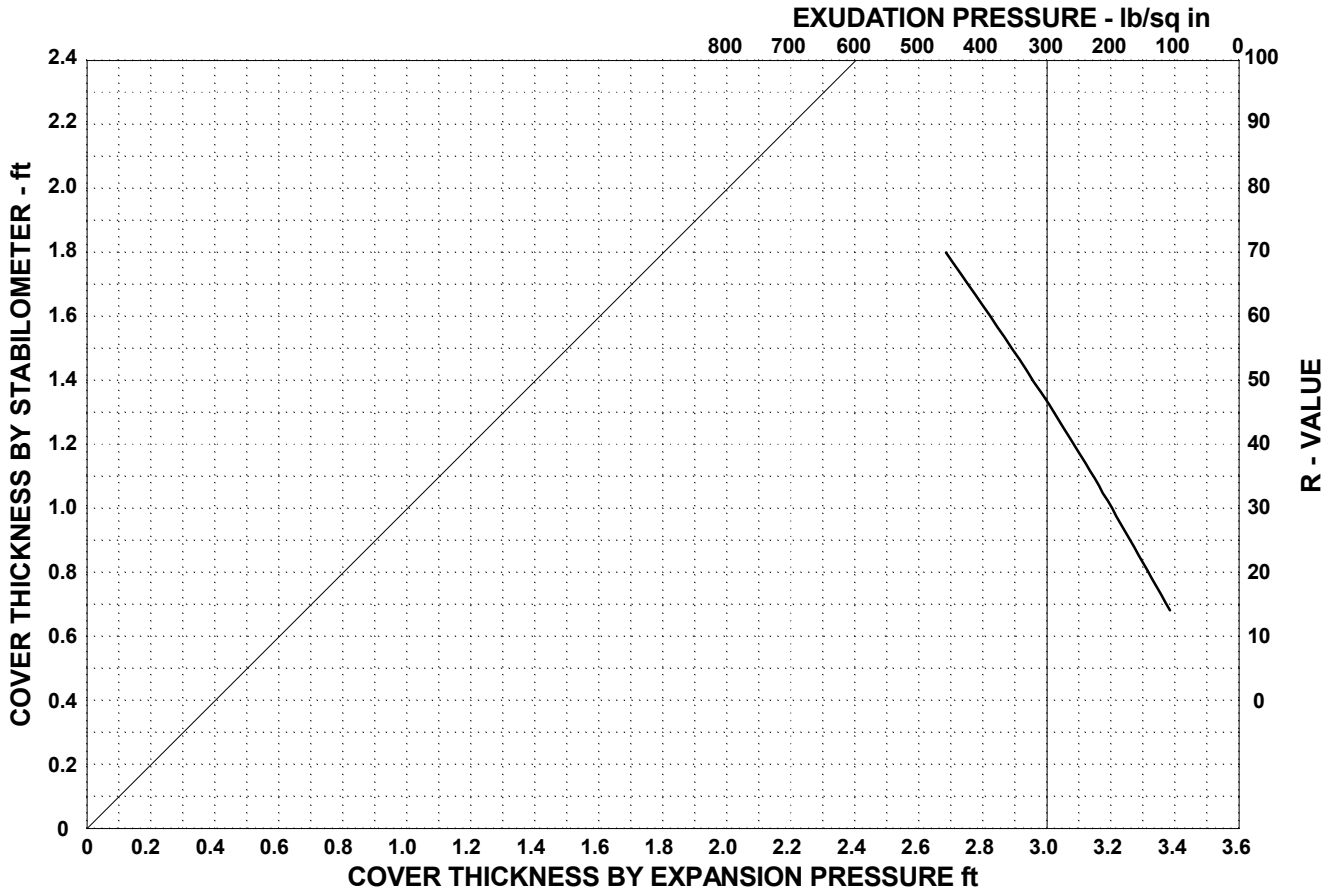
RESISTANCE VALUE
BULLARD ENERGY PROJECT
GOLDEN STATE BOULEVARD AND BULLARD AVENUE
FRESNO, CALIFORNIA

PLATE B-9

RESISTANCE VALUE

SAMPLE LOCATION: SB-12
SAMPLE DEPTH: 0.0 - 5.0 Feet
SAMPLE DESCRIPTION: Silty Sand (SM)



SPECIMEN	A	B	C
EXUDATION PRESSURE, lb/sq in	107	239	457
EXPANSION DIAL (0.0001")	0	0	0
EXPANSION PRESSURE, lb/sq ft	0	0	0
RESISTANCE VALUE, R	14	37	70
MOISTURE AT TEST, %	12.5	9.9	8.6
DRY DENSITY AT TEST, lb/cu ft	118	123.2	125.2
R-VALUE AT 300 lb/sq in EXUDATION PRESSURE		47	
R-VALUE BY EXPANSION PRESSURE(TI=)			

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RESISTANCE VALUE
BULLARD ENERGY PROJECT
GOLDEN STATE BOULEVARD AND BULLARD AVENUE
FRESNO, CALIFORNIA

PLATE B-10