Geotechnical Evaluation

Support for Design of New Gas Compressor Foundation
Crockett Cogeneration Natural Gas Power Plant
Crockett, California

Prepared for:
Crockett Cogeneration

Prepared by:
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Bakersfield, California 93308

Subject: Geotechnical Evaluation
New Gas Compressor Foundation
Crockett Cogeneration Natural Gas Power Plant
Crockett, California

Dear Mr. Sanchez:

AMEC Geomatrix, Inc. (AMEC) is pleased to submit this geotechnical evaluation report for a new natural gas compressor foundation design at the Crockett Cogeneration Natural Gas Power Plant in Crockett, California. This report was developed in accordance with our proposal dated October 13, 2011 and Purchase Order Number 2011511, dated October 13, 2011. Our evaluation included compiling and reviewing existing data, performing a site reconnaissance, performing engineering evaluations and analyses, developing geotechnical recommendations for the design and construction of the foundation elements, and preparing this report.

If you have any questions about this report, please do not hesitate to call any of the undersigned. It has been a pleasure working with you and we look forward to working with you on other future phases of the project.

Sincerely yours,
AMEC Geomatrix, Inc.

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Project Engineer

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TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1
1.1 PURPOSE AND SCOPE 1
1.2 REPORT ORGANIZATION 1

2.0 PROJECT DESCRIPTION 2

3.0 DATA REVIEW AND SITE RECONNAISSANCE 2
3.1 DATA REVIEW 2
3.2 SITE RECONNAISSANCE 3

4.0 SITE AND SUBSURFACE CONDITIONS 3
4.1 GEOLOGIC SETTING 3
4.2 SEISMICITY 4
4.3 LOCAL DEVELOPMENT HISTORY 5
4.4 EXISTING SURFACE AND SUBSURFACE CONDITIONS 5
4.4.1 Existing Surface Conditions 5
4.4.2 Subsurface Conditions 6
4.4.3 Groundwater Conditions 7
4.5 GEOLOGIC HAZARDS 7
4.5.1 Surface Fault Rupture 7
4.5.2 Liquefaction 7
4.5.3 Site Instability/Landsliding 8
4.5.4 Soil Swelling or Shrinkage Potential 9

5.0 DISCUSSIONS AND PRELIMINARY GEOTECHNICAL RECOMMENDATIONS 9
5.1 EQUIPMENT FOUNDATION 9
5.2 SEISMIC DESIGN PARAMETERS 10
5.3 EARTHWORK 11
5.3.1 Site Preparation 11
5.3.2 Excavation Conditions and Ground Support 11
5.3.3 Dewatering Requirements 13
5.3.4 Subgrade Preparation / Protection of Exposed Foundation Surfaces 14
5.3.4.1 Subgrade Preparation for Bearing Scenario “A” 14
5.3.4.2 Subgrade Preparation for Bearing Scenario “B” 14
5.3.4.3 Subgrade Preparation for Bearing Scenario “C” 15
5.3.5 Fill Materials and Compaction Criteria 15
5.3.5.1 Select Fill 15
5.3.5.2 Crushed Rock 16
5.3.5.3 Aggregate Base 16
5.3.5.4 Controlled Density Fill 16
5.3.6 Drainage and Erosion Control 17
5.4 CONDITIONS DURING CONSTRUCTION 17

6.0 BASIS OF RECOMMENDATIONS 17

7.0 REFERENCES 17

TABLE OF CONTENTS
(Continued)

FIGURES

Figure 1 Site Location Map
Figure 2 Site Plan and Proposed Locations for New Gas Compressor

APPENDICES

Appendix A Logs of Borings from Woodward, Clyde & Associates (1986b) and Lowney-Kaldveer Associates (1956)
Appendix B Photos of Proposed Locations taken October 19, 2011

GEOTECHNICAL EVALUATION
New Gas Compressor Foundation
Crockett Cogeneration Natural Gas Power Plant
Crockett, California

1.0 INTRODUCTION

This report presents the results of the geotechnical evaluation that AMEC performed to support the design of a proposed new gas compressor at the Crockett Cogeneration Natural Gas Power Plant (CCNGPP) in Crockett, California. The location of the project is shown on the Site Location Map (Figure 1).

1.1 PURPOSE AND SCOPE

The purpose of this study was to provide a geotechnical evaluation for two specific locations at the site and provide geotechnical engineering recommendations for the foundation design of the proposed equipment. The following information, recommendations, and schematic design criteria are presented in this report:

- Summary of previous geotechnical and geologic studies performed at the site;
- Description of subsurface soil and groundwater conditions encountered in the logs of the borings performed by others;
- Description of site terrain, site history, geology, site seismicity, and geologic hazards;
- Site classification in accordance with ASCE 7-05 to be used for seismic design; and,
- Preliminary discussion of primary geotechnical considerations and preliminary design recommendations.

Our scope of services to accomplish the above-stated purposes was outlined in our proposal dated October 13, 2011.

1.2 REPORT ORGANIZATION

A brief project description is presented in Section 2.0. Section 3.0 discusses the previous geotechnical and geologic studies performed at the site. A general description of the site conditions is provided in Section 4.0. Section 5.0 discusses the key geotechnical considerations associated with the project and provides geotechnical recommendations for preliminary design of the equipment foundation elements. Section 6.0 describes the basis for our recommendations and Section 7.0 includes a list of references.

This report includes two appendixes. A summary of the existing data reviewed is included in Appendix A. Appendix B contains photographs taken during a site visit to the CCNGPP on October 19, 2011.

2.0 PROJECT DESCRIPTION

It is our understanding that the CCNGPP is considering an equipment upgrade that will feature a new natural gas compressor and skid weighing up to 65,000-lbs with plan dimensions of about 8 feet by 18 feet. Two locations are being considered for the placement of the compressor and skid (Figure 2); both are in relatively congested areas containing existing plant facilities. Location 1 is an area near the center of the plant currently surfaced with concrete slabs with nearby structural mats, spread footings, piers, and grade beams for the support of the adjacent facilities. Location 2 is at the far eastern edge of the plant, adjacent to a three-story steel-framed pedestrian bridge tower. It is currently surfaced with asphaltic concrete and occupied by a pipe and tool storage shed.

The project will consist of preparing one of the two selected sites by moving, or removing existing facilities in the proposed footprint, demolishing existing surface features (concrete slab or asphaltic concrete), installing the selected foundation elements, and installing the gas compressor skid at grade. This geotechnical evaluation report was prepared to support the design of the foundation elements for the new compressor.

3.0 DATA REVIEW AND SITE RECONNAISSANCE

The preliminary evaluation performed for the proposed equipment upgrade consisted of a detailed review of existing geotechnical/geologic reports prepared for the existing facilities and a cursory site reconnaissance to examine existing conditions at the ground surface.

3.1 DATA REVIEW

AMEC reviewed existing geologic and geotechnical information provided by Crockett Cogeneration that was issued primarily for the design of the existing plant facilities. The following sources contained information pertinent to our evaluation of the geotechnical conditions:

- Geofon, Inc. (1991) Geotechnical Investigation, Proposed Aqueous Ammonia Storage Tanks, C&H Cogeneration Project, Crockett, California
- Woodward-Clyde Consultants (1986a) Preliminary Geotechnical Engineering and Seismic Exposure Study, Crocker Cogeneration Project
- Woodward-Clyde Consultants (1986b) Supplementary Geotechnical Studies – Western Portion of Crockett Cogeneration Plant
- Woodward-Clyde Consultants (1984) Preliminary Geotechnical Engineering Seismic Exposure Study, Crocker Cogeneration Project

A total of seven (7) auger borings have been drilled at the plant site in the general vicinity of the two proposed locations, as shown on Figure 2. Logs of these seven borings are presented in Appendix A. Six of the borings were advanced through undocumented fill and into underlying bedrock. Section 4.4 includes a discussion of the subsurface stratigraphy in more detail. Samples collected from the exploratory borings were tested in the laboratory for moisture content, unit weight, and undrained shear strength Woodward-Clyde Consultants (1986a, 1986b).

3.2 SITE RECONNAISSANCE

On October 19, 2011 AMEC representative, Mr. Justin Phalen, met with Mr. David Poling, Operation and Maintenance Manager for the CCNGPP, and observed conditions at the two proposed locations for the new gas compressor. These observations were generally intended to evaluate the geotechnical performance of the existing site facilities and to note whether there were any obvious signs of foundation distress that may have been a result of long-term movements (e.g., noticeable cracks or offsets in concrete slabs that may indicate settlement or heave). In both proposed locations, there were no immediately clear signs of distress to existing foundation elements, indicating that the facilities have been performing well (from a geotechnical standpoint) since construction in 1994. Individual hairline cracks (approximately 1 to 2 mm wide) were noted running through the middle of three of the concrete slabs at Location 1. However, there was no vertical offset associated with the cracks, and it was unclear whether or not they was associated with differential settlement of the slab or with thermal expansion/contraction of the concrete. Photos taken during the site reconnaissance are included in Appendix B.

4.0 SITE AND SUBSURFACE CONDITIONS

This section summarizes the overall site and subsurface conditions at the CCNGPP site. Sections 4.1 and 4.2 describe the general geologic and seismic setting, respectively. The local development history of the site is described in Section 4.3. Site-specific descriptions of existing site, subsurface, and groundwater conditions are provided in Section 4.4. Geologic hazards are discussed in Section 4.5.

4.1 GEOLOGIC SETTING

The CCNGPP is located at the water's edge on the south shore of the Carquinez Strait near where the strait drains into the northeast end of San Pablo/San Francisco Bay (Figure 1). The bay occupies a broad, shallow depression that developed in response to minor crustal extension between the San Andreas fault on the west and Hayward fault on the east. The San Francisco Bay depression appears to be a pull-apart basin that has been slowly subsiding during late Quaternary time (the past 700,000 years) and perhaps longer. The basin and associated waterways are predominantly filled with late Quaternary alluvial, fluvial, and estuarine deposits, overlying older basement rocks.

The oldest rocks in the San Francisco Bay area are Jurassic to Cretaceous (195 to 65 millions of years [Ma] before present) marine sedimentary rocks and associated igneous and metamorphic rocks of the Franciscan Complex. The Franciscan Complex is predominantly graywacke (sandstone) and interbedded shale, with lesser amounts of submarine basalt (greenstone), chert, serpentinite, and rare high-pressure metamorphic rocks known collectively as blueschist. The local bedrock at the CCNGPP is comprised of the sedimentary Great Valley Complex formed during the Cretaceous period (146 to 65 Ma), (Graymer et al., 2006). Great Valley bedrock is described as interbedded layers of sandstone, siltstone, claystone and shale. The siltstone and claystone units have the potential to be particularly dispersive, friable, and prone to slaking when exposed to water. Outcrops of Great Valley are observed in the vicinity along the shoreline on the upslope side of the Union Pacific Railroad tracks where the rock was cut for the railroad alignment.

Younger alluvial deposits (locally known as Bay Mud) of Holocene age (less than 11,000 years old) overlie the older bedrock at some areas, particularly below the water level elevation at the edge of the old shoreline. These deposits are soft to medium stiff and are historically very compressible.

4.2 SEISMICITY

Based on the record of historical earthquakes and its position astride the North American-Pacific plate boundary, the San Francisco Bay region is considered to be one of the more seismically active regions of the world. During the past 200 years, faults within this plate boundary zone have produced numerous small-magnitude and at least fifteen moderate to large (i.e., M > 6) earthquakes affecting the Bay Area (Toppozada et al., 1981; Ellsworth, 1990; Bakun, 1999). The U.S. Geological Survey (USGS) 2007 Working Group on California Earthquake Probabilities (WGCEP, 2008) estimated an approximately 67 percent probability that at least one major moment magnitude earthquake ($M_W \geq 6.7$) would occur in the San Francisco Bay Area before 2037.

Many active faults within the Bay Area contribute to this aggregate probability, and several may have significance with regard to potential earthquake ground shaking at the CCNGPP. Major active faults near the project site include the Concord-Green Valley, Hayward and San Andreas faults, situated, respectively, approximately 6.3 miles [10.2 km] east, 8.8 miles [14.2 km] southwest, and 26.7 miles [42.9 km] west-southwest of the site (Jennings and Bryant, 2010). The WGCEP (2008) estimated a 31 percent probability of a M_W 6.7 or larger earthquake on the northern Hayward fault, the closer of the fault's segments to the site. The WGCEP (2008) estimated a 21 percent probability of a M_W 6.7 or larger earthquake on the San Andreas fault during that same period. Several moderate-magnitude, nineteenth and early twentieth century events on the Hayward and San Andreas faults produced Modified Mercalli Intensity (MMI) VII to VIII effects in the site vicinity (Toppozada et al., 1981; Toppozada and

Parke, 1982a, 1982b), including the magnitude 6.9 event on the southern Hayward fault in October 1868 and the magnitude 8 (M_W 7.8) San Francisco earthquake in April 1906 (Bakun, 1999). The 1989 M_W 6.9 Loma Prieta earthquake produced MMI effects of VI-VII in the general site vicinity (Plafker and Galloway, 1989).

Other faults mapped in the vicinity of the CCNGPP include the Franklin and Pinole faults.

4.3 LOCAL DEVELOPMENT HISTORY

Review of historic Sanborn Fire Insurance Maps for Crockett, California indicates that the CCNGPP property has been through a series of development and redevelopment stages since the latter part of the 19th century (Sanborn 1899, 1906, 1913, 1924, 1929, 1945). The earliest maps from 1899 show that the majority of the existing plot had already been created from fill, most likely generated from the railroad cut immediately to the south. The land was primarily used as a warehouse lot for the Pacific Coast Grain Warehouse Company and subsequently owned and operated by Western Grain and Sugar Product Company, and then by California and Hawaiian Sugar Refining Corporation. The September 1906 map shows little improvement since 1899 and does not mention any damage to the facility resulting from the M_w 7.8 San Francisco Earthquake of April 1906. By 1913, three 60-foot diameter steel storage tanks were installed near the eastern edge of the property. By 1929, nearly the entire plot was used for sugar processing and storage and remained in this capacity for most of the 20th century. Construction of the current natural gas plant facilities commenced in 1994 with the plant becoming fully operational in 1996.

4.4 EXISTING SURFACE AND SUBSURFACE CONDITIONS

As mentioned in Section 4.1, the CCNGPP is located at the water's edge on the south shore of the Carquinez Strait near where the strait drains into the northeast end of San Pablo/San Francisco Bay. The facility is bordered by the Union Pacific railroad and Loring Avenue to the south, the C&H Sugar Factory to the west, and the waters of the Carquinez Strait to the north and east. The following sections describe existing surface and subsurface conditions at the plant and, specifically, at the two proposed gas compressor locations.

4.4.1 Existing Surface Conditions

The CCNGPP occupies the eastern end of a large marine fill constructed for the Bulk Raw Sugar Wharf in the late 1800's. The plant is roughly rectangular in shape with maximum plan dimensions of approximately 150 feet by 900 feet. The surface is primarily covered with concrete slabs and mats for the support of existing facilities, asphaltic concrete in areas that are used as walkways and for supporting minor transient loads, and areas of crushed rock to protect exposed grades. The site is relatively level within the plant boundaries with minor grading to facilitate surface drainage. Based on the original plant drawings, existing surface elevations in the vicinity of the site range between about +10 to +13 feet (project datum).

The existing site facilities and structures are supported on various configurations of large diameter (2.5 to 4 feet) cast-in-place drilled piers with connecting grade beams between 2 and 6 ½ feet deep, shallow spread footings, and structural mats up to 6 feet thick.

The proposed Location 1 is in a congested area between the main turbine generator to the south and a steel structure that houses boiler feed pumps to the north (Figure 2). The roughly 16-feet by 24-feet of workable area is surfaced with a reinforced concrete slab about 8-inches thick and is flanked on the east and west by two 2½ foot diameter drilled piers approximately 30 deep that are supporting an overhead pipe bridge. There exists a natural gas filter with footing plan dimensions of about 5½ by 5½ feet within the footprint of proposed Location 1 that is planned to be moved a few feet east to accommodate the new gas compressor.

The proposed Location 2 is at the far eastern edge of the plant immediately east of a three-story steel-framed pedestrian bridge tower. The tower is founded on four 2½ foot diameter drilled piers approximately 30 feet deep. The roughly 22-feet by 35-feet of workable area is surfaced with asphaltic concrete and occupied by a pipe and tool storage shed.

4.4.2 Subsurface Conditions

Our understanding of the subsurface conditions is based on review of the available geotechnical borings logs described in Section 3.1. No additional investigation work was performed for this project. The site stratigraphy generally consists of old (pre-1900) undocumented marine fill overlying normally consolidated soft to medium stiff marine sediments (Bay Mud) overlying bedrock of the Great Valley Complex. It is postulated that the materials used to create the marine fill were predominantly borrowed from the spoils generated from the shoreline excavation cut for the adjacent railroad. Based on available boring data, the fill consists of a variable mix of gravel, sand and clay with most samples collected from the fill being characterized as “gravelly clay” and “clayey sand and gravel.” The fill is generally described as loose to dense and soft to medium stiff. In the vicinity of Location 1, the fill is expected to be about 6 to 8 feet thick. In the vicinity of Location 2, the fill is expected to be about 3 to 5 feet thick.

The Bay Mud in the vicinity of the CCNGPP is described from the borings as being predominantly medium stiff with localized areas of softer and stiffer pockets. Bay Mud is typically characterized as being particularly clayey, highly plastic, and highly compressible. Being that the existing site fills have been compressing the native marine sediments for over 100 years, it is likely that the Bay Mud is in a more favorably consolidated state than if it were undisturbed. In the vicinity of Location 1, the Bay Mud is expected to be about 2 to 7 feet thick, becoming thicker from south to north. Less than two feet of Bay Mud is expected in vicinity of Location 2.

Great Valley bedrock is exposed at the southern end of the site in the cut for the railroad, and generally dips moderately to the north through the middle of the CCNGPP where it then dips quickly off into the channel of the Carquinez Straight. Figure 2 shows top of bedrock elevation contours interpreted by Woodward Clyde Consultants (1986b) based on borings drilled at the site. Depth to bedrock from the top of the concrete slab at Location 1 is expected to be about 7 to 15 feet, becoming deeper from south to north. Depth to bedrock from the top of the asphaltic concrete at Location 2 is expected to be about 3 to 5 feet.

Because of the age of the fill materials it is possible that they contain constituents of concern (particularly heavy metals) known to be hazardous. According to the documents provided to AMEC for the review of existing site conditions, there exists no current study to specifically address soil contamination concerns. Field exploration and other evaluations that are commonly used to assess the presence of substances that may be of an environmental concern were beyond the scope of this study.

4.4.3 Groundwater Conditions

Groundwater was encountered at fairly consistent depths of about 6 to 8 feet (elevation +4 to +6 ft) in all existing borings in the vicinity of the two proposed locations. Fluctuations in local groundwater levels are expected to be tidally influenced and directly related to the free water elevation in the Carquinez Strait.

4.5 GEOLOGIC HAZARDS

Potential geologic/geotechnical hazards assessed for the site include surface fault rupture, liquefaction and related phenomena, site slope stability, and swelling or shrinking soils. The assessment of these potential hazards is presented in this section. Discussion of site classification related to seismic analysis and design of the proposed facility is presented in Section 5.2.

4.5.1 Surface Fault Rupture

No active or potentially-active faults have been identified in the immediate vicinity of the CCNGPP according to the California Geological Society (Jennings and Bryant, 2010). The site is located approximately 6.3 miles west of the fault rupture zone established along the Concord-Green Valley fault. Additionally, observations of the site and surrounding areas do not indicate the presence of geologic conditions, geomorphic features or lineaments suggestive of active or inactive faults crossing the project site. Based on this information, we judge that the potential for surface fault rupture at the new CCNGPP is negligible.

4.5.2 Liquefaction

Liquefaction is a soil behavior phenomenon in which a soil loses a substantial amount of strength due to high excess pore-water pressure generated by strong earthquake ground shaking. Recently-deposited (i.e., within about the past 11,000 years) and relatively

unconsolidated soils and artificial fills located below the ground water surface are considered susceptible to liquefaction (Youd and Perkins, 1978). Typically, the soils that are most susceptible to liquefaction include relatively clean, loose, uniformly graded sand, silty sand, and non-plastic silt deposits (e.g., National Research Council, 1985).

As discussed previously in this report, the geotechnical data gathered during previous investigations indicate that the fill soils at the CCNGPP are predominantly loose to dense clayey gravels, clayey sands, and gravelley clays most likely sourced from bedrock excavated for the adjacent railroad alignment. Predominantly clayey soils typically are not considered to be susceptible to earthquake-induced liquefaction. Predominantly granular soils, such as sand and gravels with low fines contents, do comprise some zones of the undocumented fill in the vicinity of Location 1. However, most of these zones are above the groundwater table and are therefore not considered to be susceptible to liquefaction. There does exist the possibility of more granular soils existing below the groundwater table that may generate unacceptable levels of excess pore pressure as a result ground shaking from design-level earthquakes. These soils are more commonly found closer to the existing wharf as the fill slopes down into the channel.

We note that no evidence of liquefaction and/or related effects was reported for the CCNGPP site or vicinity for the great 1906 San Francisco earthquake (Lawson, 1908; Youd and Hoose, 1978), nor for the 1989 Loma Prieta Earthquake (Tinsley and others, 1998). However, short of a performing current and thorough geotechnical investigation study, the potential for liquefaction cannot be eliminated. USGS indicates that the areas in the vicinity of the CCNGPP that are largely comprised of fill materials have a very high liquefaction susceptibility (Witter et al., 2006). Therefore, we are of the opinion that the hazard due to potential soil liquefaction at the proposed CCNGPP site is low to very high, depending on soil and rock conditions in the immediate vicinity of the facility in question. Location 1, in this case, has a much higher potential for liquefaction than Location 2, primarily due to the thicker fill section that is potentially below the ground water table. Location 2 has a much thinner fill section, which is not anticipated to be below the groundwater table.

4.5.3 Site Instability/Landsliding

Lateral spreading, which is the lateral displacement of surficial soils, is usually associated with the liquefaction of underlying soils. Because the potential liquefaction hazard at the site is judged to be low to very high, and a significant portion of the CCNGPP is built on an undocumented fill that is sloped into the adjacent waterway, we expect that the potential for lateral spreading to occur also is low to very high.

4.5.4 Soil Swelling or Shrinkage Potential

The surficial fill clayey soils and Bay Mud are likely critically expansive, and are prone to significant volume change (shrinkage and swelling) with seasonal fluctuations in soil moisture. Such shrink/swell behavior can damage shallow foundation elements, such as footings and slabs-on-grade, which are supported by these soils, if not properly designed. Measures to mitigate for soil expansion are discussed in Section 5.3.

5.0 DISCUSSIONS AND PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

Based on the results of our evaluation, it is our opinion that both Locations 1 and 2 are suitable for the proposed natural gas compressor and skid, provided proper foundation support is provided. Based on discussions with the owner's representative, the preferred foundation alternative is a shallow structural mat (rather than any type of deep foundation system, such as drilled piers, micropiles, etc.). We are of the opinion that the proposed natural gas compressor and skid can be supported on a structural mat foundation that bears on undisturbed competent native rock or a thickened section of Select Fill on existing fill. The recommendations presented below are considered appropriate for a shallow foundation design given the variable soil conditions at the site.

The key geotechnical issues for design and construction of the proposed foundation are the excavation support that will be required to excavate to the design depth, groundwater considerations during construction, mitigation of expansive soils, effect of new loads on existing adjacent foundation elements, seismic considerations, and groundwater considerations during and after construction. These issues are discussed in more detail in the following sections.

5.1 EQUIPMENT FOUNDATION

The proposed natural gas compressor and skid can be supported on a structural mat foundation that will have one of three different bearing scenarios: A) bearing directly on native, undisturbed bedrock (Location 2), B) bearing on a pad of Select Fill that is supported by undisturbed bedrock (Location 2), or C) bearing on a thickened section of Select Fill on top of undocumented fill/Bay Mud (Location 1). Recommendations for associated earthwork associated with the three scenarios mat foundation are presented in Section 5.3. A mat foundation subgrade prepared in accordance with the requirements described in Section 5.3.4 can be designed with the geotechnical parameters provided below.

A mat foundation constructed in accordance with the recommendations provided in Section 5.3.4 will have an allowable net bearing capacity as shown below:

Loading Condition	Allowable Bearing Capacity		
	(A) Directly on Bedrock	(B) Pad of Select Fill on Bedrock	(C) Pad of Select Fill on Undocumented Fill
Dead Load	8,000 psf	4,000 psf	1,000 psf
Dead + Long-Term Live Load	12,000 psf	6,000 psf	1,500 psf
Total Load (Including Seismic)	16,000 psf	8,000 psf	2,000 psf

These bearing capacities are net values; therefore, the weight of the foundations can be neglected for design purposes. Lateral loads can be dissipated through the interface friction of the mat foundation and the prepared subgrade using a coefficient of friction of 0.35.

We anticipate that some settlement of the proposed mat will occur as a result of elastic compression and/or consolidation of the underlying rock, Select Fill, undocumented fill, and Bay Mud directly beneath the new equipment. For bearing scenario A, we estimate that total settlement of the equipment due to elastic compression of the underlying rock will not exceed ¼-inch. For bearing scenario B, we estimate that total settlement of the equipment due to elastic compression of the pad of Select Fill will not exceed ½-inch. For bearing scenario C, we estimate that total settlement of the equipment due to consolidation of the undocumented fill and/or Bay Mud will not exceed 2½ -inches. Differential settlement for all three bearing scenarios can be expected to be about half of the total settlement. In order to accommodate any expected settlement and not allow any new loads from the compressor to be transferred to existing facilities, the mat foundation should not be allowed to be structurally connected to any existing foundation mat, grade beam, or slab. Additionally, the vertical capacity of adjacent drilled piers within 5 feet of the edge of the new mat should be reevaluated for newly imposed loads.

5.2 SEISMIC DESIGN PARAMETERS

This section presents seismic design parameters as recommended by the 2010 California Building Code (CBC), similar to those recommended by ASCE/SEI 7-10 (ASCE, 2010). Dames & Moore (1954) and Woodward-Clyde Consultants (1986b) measured undrained shear strengths in the Bay Mud generally in the range of about 900 to 1,200 psf and measured undrained shear strengths in the undocumented fill generally in the range of 725 to 2,100 psf in the upper 15 feet. The measured shear strength of bedrock in the CCNGPP is generally greater than 10,000 psf. Based on this information, soil profile type D is appropriate for Location 1 and soil profile type C is appropriate for Location 2 for characterizing seismic design parameters in accordance with the CBC.

In accordance with the CBC, the following seismic design parameters would be the minimum requirement for the seismic design aspects of the structure at ***Location 1***.

- Soil Profile Type (site class): D “Stiff Soil”
- Site Risk Category: IV
- Seismic Design Category: D
- MCE Mapped Short Period Acceleration: S_{MS} = 1.50g
- MCE Mapped Long Period (T=1 second) Acceleration: S_{M1} = 0.90g
- MCE Design Short Period Spectral Response Acceleration: S_{DS} = 1.00g
- MCE Design Long Period (T=1 sec) Spectral Response Acceleration: S_{D1} = 0.60g

In accordance with the CBC, the following seismic design parameters would be the minimum requirement for the seismic design aspects of the structure at ***Location 2***.

- Soil Profile Type (site class): C “Very Dense Soil and Soft Rock”
- Site Risk Category: IV
- Seismic Design Category: D
- MCE Mapped Short Period Acceleration: S_{MS} = 1.50g
- MCE Mapped Long Period (T=1 second) Acceleration: S_{M1} = 0.78g
- MCE Design Short Period Spectral Response Acceleration: S_{DS} = 1.00g
- MCE Design Long Period (T=1 sec) Spectral Response Acceleration: S_{D1} = 0.52g

5.3 EARTHWORK

This section generally describes the work necessary to prepare Location 1 and Location 2 for construction of the new natural gas compressor and skid foundation. Excavation conditions, groundwater conditions, and backfilling associated with subgrade preparation are discussed. Procedures that should be followed to protect the soils exposed in excavations are also discussed.

5.3.1 Site Preparation

Any existing facilities within the footprint of the selected location should be removed and/or relocated. Concrete slabs or asphaltic concrete should be saw-cut to at least the dimensions of the proposed mat and should be completely broken up and removed. Any below-ground utilities within the mat footprint should be identified and planned to be relocated.

5.3.2 Excavation Conditions and Ground Support

Excavations of the site soils should be possible with conventional small to mid-size heavy earth moving equipment (e.g., backhoes, bobcats). AMEC recommends that the contractor be required to exercise extreme caution when excavating the final two feet of the foundation areas. Excavation equipment that can disturb the structure subgrades (e.g., backhoes with buckets having large claws to loosen the earth) should be avoided when excavating to final subgrade. The exposed foundation area surfaces of the planned structures also must be

protected as described in Section 5.3.4, Subgrade Preparation / Protection of Exposed Foundation Surfaces.

As indicated in Section 4.4.2, Location 1 is expected to have about 6 to 8 feet of undocumented fill over 2 to 7 feet of Bay Mud. If Location 1 is selected, it is recommended that at least 5 feet of fill be excavated and replaced with Select Fill (Section 5.3.5) under the footprint of the proposed mat foundation. Location 2 is expected to have about 3 to 5 feet of undocumented fill or Bay Mud over bedrock. If Location 2 is selected, it is recommended that the fill and Bay Mud be excavated to undisturbed bedrock and replaced with Select Fill (Section 5.3.5) under the footprint of the proposed mat foundation.

The methods required to maintain stable conditions in excavations and temporary slopes during construction will depend on the nature of the material exposed in the excavation, the construction schedule, and the contractor's operation and equipment, among other factors. Because of the relatively confined working space at Location 1, excavations with inclined side slopes will not likely be used during construction. Location 2 may have enough room to facilitate sloped excavations on one or two sides. Vertical cuts will require appropriate measures to support the adjacent ground and nearby existing facilities. Construction costs associated with ground support measures are sometimes underestimated when project-specific requirements are not identified. Excavations having vertical sidewalls deeper than 3 feet will require effective means to adequately support the ground and to protect workers. Excavations shallower than 3 feet may require support depending on the location of the excavation relative to the existing facilities, the anticipated soil conditions, and/or the contractor's activities in the vicinity of the excavation. Adequate protection of workers in excavations must be provided by the contractor at all times during construction. Anywhere that excavations are made, unexpected caving of trench and excavation walls could occur at any time or place, regardless of the depth of the excavation or trench.

If inclined side slopes are to be used (portions of Location 2, perhaps) temporary excavation slopes in site soils should conform to CAL-OSHA requirements. Flatter side slopes may be required (and should be anticipated) if the contractor intends to stockpile materials and/or use heavy equipment adjacent to the cut. Flatter slopes also may be necessary if localized instability is observed during construction.

The ground support system should be installed without leaving nearby improvements unsupported. Installation and removal of the support measures must not affect nearby structures/facilities. The support measures should be left in place if their removal might cause: (1) the excavation bottom or adjacent ground to become disturbed, (2) the excavation wall to collapse, and/or (3) damage a nearby structure or facility or the newly-completed structure. If pressure-treated wood is used, it should be left in place and cut off about 2 feet below the ground surface. Wood that is subject to rotting should not be used.

Existing structures, foundations, and improvements adjacent to the required excavations may require underpinning during construction. AMEC recommends that the contractor be responsible for the evaluation of underpinning and ground support requirements and for the design of all underpinning and ground support measures. The contractor also should be required to submit underpinning and excavation plans for review prior to construction.

Project specifications should place full responsibility on the contractor for the planning, design, construction, maintenance, and removal of the ground support measures required for worker protection and the prevention of ground movement/settlement that may damage nearby facilities/structures, underground utilities, and other improvements. Ground support measures and temporary cut slopes used in construction should conform to all state and federal safety regulations and requirements. To help mitigate ground movement/settlement, stockpiling earth and other construction materials near open excavations should be avoided. In no case should stockpiling occur closer to excavations than federal or state regulatory agencies allow.

Structures, pipelines, and any other improvement that may be subject to distress/damage during construction should be periodically monitored and/or surveyed. If movement is detected, measures should be undertaken immediately to prevent additional movement and damage. The contractor should be made responsible for the repair of all damage that results from the new construction.

Precautions should be taken to limit access to the excavations by people and equipment. Workers entering excavations should be protected from raveling and sloughing soils; safety railings should be installed around the excavations.

5.3.3 Dewatering Requirements

Groundwater is not expected in excavations shallower than about elevation +6 feet. If possible, excavations should be made in the drier months (i.e., June through September) to minimize difficulties associated with higher groundwater levels that may occur during the winter rainy season and rain/surface water inflows. For excavations that extend below groundwater, a sump system will likely be required to control groundwater and to prevent the bottom of the excavation from heaving or becoming quick.

The contractor should be made responsible for the design, construction, operation, maintenance, and removal of any system that is implemented to control the inflow of surface water and groundwater. The system should be designed to prevent migration and pumping of soil fines with discharge water. The contractor must plan the dewatering and excavations carefully so that stable and dry excavations are maintained continuously throughout construction. The dewatering design proposed by the contractor should be presented in an excavation dewatering plan.

Disposal of water from construction dewatering must also be planned carefully. Because of regulatory requirements, discharging pumped groundwater directly into nearby drainages or storm drain systems may require permits from the regulatory agencies having jurisdiction over the project. Groundwater should be tested prior to disposal for substances that are of an environmental concern. If encountered during construction, this water will require special handling. Options that the contractor may use for disposal of pumped groundwater should be identified and evaluated during design.

5.3.4 Subgrade Preparation / Protection of Exposed Foundation Surfaces

The subgrade soils exposed in the excavation should be protected from erosion, air or water slaking, and changes in moisture content that could cause expansion, shrinkage, and/or degradation of the exposed surface. The subgrade should be prepared as soon as possible after excavation.

If work is done during the winter rainy season in exposed areas (i.e, Location 2), AMEC recommends that a minimum 4-inch thick pad of controlled density fill (CDF) be poured on the excavated subgrade as quickly as possible (i.e., within 24 hours) after the foundation area is exposed in the final cut surface. Before the CDF pad is prepared, the exposed soil surface should be clean and dry. Under no circumstances should groundwater, rainfall, surface runoff, or construction water be allowed to pond on the exposed or unprotected soil surfaces. If left unprotected, the subgrade soils could degrade quickly; their properties will change under the action of earthmoving equipment, worker activities, and wetting or drying caused by the elements.

5.3.4.1 Subgrade Preparation for Bearing Scenario "A"

We recommend that the subgrade in areas excavated to bedrock with the mat foundation bearing directly on bedrock be prepared as follows:

1. The final exposed excavation subgrade surface should be undisturbed, leveled, and moisture conditioned
2. If the final excavation surface is anticipated to be open for more than 24 hours, or exposed to wet weather conditions, a 4-inch thick pad of CDF should be placed in the excavation bottom.

5.3.4.2 Subgrade Preparation for Bearing Scenario "B"

We recommend that the subgrade in areas excavated to bedrock with the mat foundation bearing on a pad of Select Fill prepared as follows:

1. The final exposed excavation subgrade surface should be undisturbed, leveled, and moisture conditioned
2. If the final excavation surface is anticipated to be open for more than 24 hours, or exposed to wet weather conditions, a 4-inch thick pad of CDF should be placed in the excavation bottom.

3. Select Fill or CDF should be placed to bring the area to the finished subgrade elevation.

5.3.4.3 Subgrade Preparation for Bearing Scenario "C"

To provide a uniform bearing surface for the mat foundation in the undocumented fill area, we recommend that the subgrade in this area be prepared as follows:

1. The final exposed excavated subgrade surface should be leveled, moisture conditioned, and compacted to 90 percent relative compaction using standard walk-behind compaction equipment.
2. A non-woven geotextile filter fabric (Mirafi 140NC or equivalent) should be placed on the exposed subgrade surface. Adjacent sections of filter fabric should be overlapped. Filter fabric at the edges should extend up the sidewalls of the excavation.
3. Crushed Rock described in Section 5.3.5 should be placed at least one foot thick over the entire excavation subgrade.
4. The non-woven geotextile filter fabric should be wrapped over the top of the Crushed Rock so that it overlaps and fully encapsulates the crushed rock.
5. Select Fill and/or CDF should be placed over the filter fabric and used to bring the area to the finished subgrade elevation.

5.3.5 Fill Materials and Compaction Criteria

It is anticipated that the following fill types will be used during construction of the project:

- Select Fill
- Crushed Rock
- Aggregate Base
- Controlled Density Fill (CDF)

These fill types and associated compaction criteria are discussed in more detail below. It should be noted that when relative compaction is discussed in the text, it is based on the maximum dry density and optimum moisture content of the subject material as determined by ASTM Method D 1557 (latest edition). When the relative density is discussed in the text, it is based on ASTM Methods D 4253 and D 4254 (latest edition). Compaction operations should be performed using mechanical means only; compaction by jetting or flooding is not recommended.

5.3.5.1 Select Fill

Select fill can be used to backfill the excavations under the mat foundation subgrade. Select Fill should have a maximum plasticity index of 15 and a percentage passing the No. 200 sieve between 5 and 50, and organic content less than 3 percent by volume. The requirement that at least 5 percent pass the No. 200 sieve precludes the use of cohesionless sand as Select Fill. It is anticipated that some of the excavated soils will be suitable for use as Select fill. Select Fill

should contain no rocks larger than 3 inches in the greatest dimension or more than 15 percent larger than 2 inches. Select Fill should be blended and uniformly moisture conditioned to 1 to 3 percent above optimum moisture compacted to at least 95 percent relative compaction. Select Fill should be placed on a firm, unyielding surface in horizontal lifts not exceeding 8 inches in uncompacted thickness.

5.3.5.2 Crushed Rock

Crushed Rock should be an imported material that consists of durable rock and gravel that is free of deleterious material and free from slaking or decomposition under the action of alternate wetting and drying. We recommend that this material be used to provide support if the excavation is in unstable ground (i.e., Location 1), and be used directly beneath the mat foundation as a moisture break. If placed on soft, saturated, or unstable ground, this material should be underlain and wrapped by a filter fabric selected to prevent the migration of fines into the gravel. Crushed Rock should have a durability index of not less than 40 and should meet the gradation requirements that 90 to 100 percent of the particles pass the ¾-inch sieve and not more than 2 percent pass the No. 200 sieve. Crushed Rock should be uniformly moistened and compacted with at least three passes of approved vibratory compaction equipment, to a relative density of at least 75 percent, or to at least 90 percent relative compaction, whichever results in the highest density. The material should be placed in horizontal lifts that do not exceed 8 inches before being compacted.

5.3.5.3 Aggregate Base

Imported Aggregate Base material may be used in lieu of, or in conjunction with, Select Fill as backfill of the excavation. This material should meet the requirements in the Caltrans Standard Specifications (most recent edition), Section 26, Class 2 Aggregate Base (¾-inch maximum particle size). Aggregate Base should be uniformly moisture conditioned to a moisture content of 1 to 3 percent above optimum and compacted to at least 95 percent relative compaction. The material should be placed in horizontal lifts that do not exceed 8 inches before being compacted.

5.3.5.4 Controlled Density Fill

Controlled Density Fill (CDF) may be used in lieu of, or in conjunction with, Select Fill as backfill of the excavation. CDF is also recommended to protect the exposed excavation surface if it is anticipated to be open for more than 24 hours. CDF is also termed “Slurry Cement Backfill” in Section 19 of the Caltrans Standard Specifications (most recent edition). CDF consists of a fluid, workable mixture of aggregate, Portland cement, fly ash, and water and should meet the gradation requirements listed in the Caltrans Standard Specifications.

5.3.6 Drainage and Erosion Control

Proper site drainage is important for the long-term performance of the new equipment foundation. Final grades and pavements should be sloped to direct surface water away from the foundation. Collected water should be directed toward suitable discharge facilities. Ponding of surface water should not be allowed anywhere on the site.

5.4 CONDITIONS DURING CONSTRUCTION

An AMEC representative should observe earthwork and foundation construction to confirm that subsurface conditions encountered during construction are comparable to those used for developing the recommendations presented in this report. Unanticipated subsurface conditions, which cannot be disclosed fully by exploratory borings and test pits, commonly are encountered and frequently require additional expenditures to attain a properly constructed project. Some contingency funding is recommended in case conditions encountered during construction require additional exploration, testing, or design modifications.

6.0 BASIS OF RECOMMENDATIONS

The evaluations made in this report are based on the assumption that soil conditions at the site do not deviate appreciably from those described herein, and are disclosed in the exploratory borings. In the performance of our professional services, AMEC, its employees, and its agents comply with the standards of care and skill ordinarily exercised by members of our profession practicing in the same or similar localities. No warranty, either express or implied, is made or intended in connection with the work performed by us, or by the proposal for consulting or other services or by the furnishing of oral or written reports or findings. We are responsible for the evaluations contained in this report, which are based on data related only to the specific project and location discussed herein. In the event conclusions based on these data are made by others, such conclusions are not our responsibility unless we have been given an opportunity to review and concur in writing with such conclusions.

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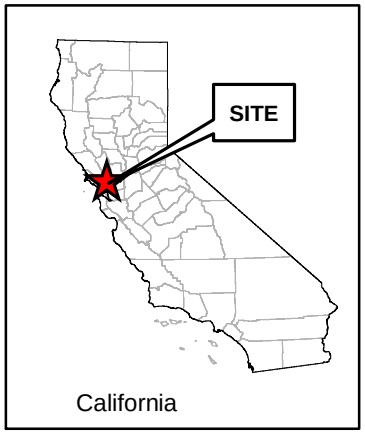
FIGURES



0 4,000 Feet

SITE LOCATION MAP
Crockett Cogeneration Natural Gas Power Plant
Crockett, California

By: JP	Date: 11/03/2011	Project No. OD11162010
amec		Figure 1

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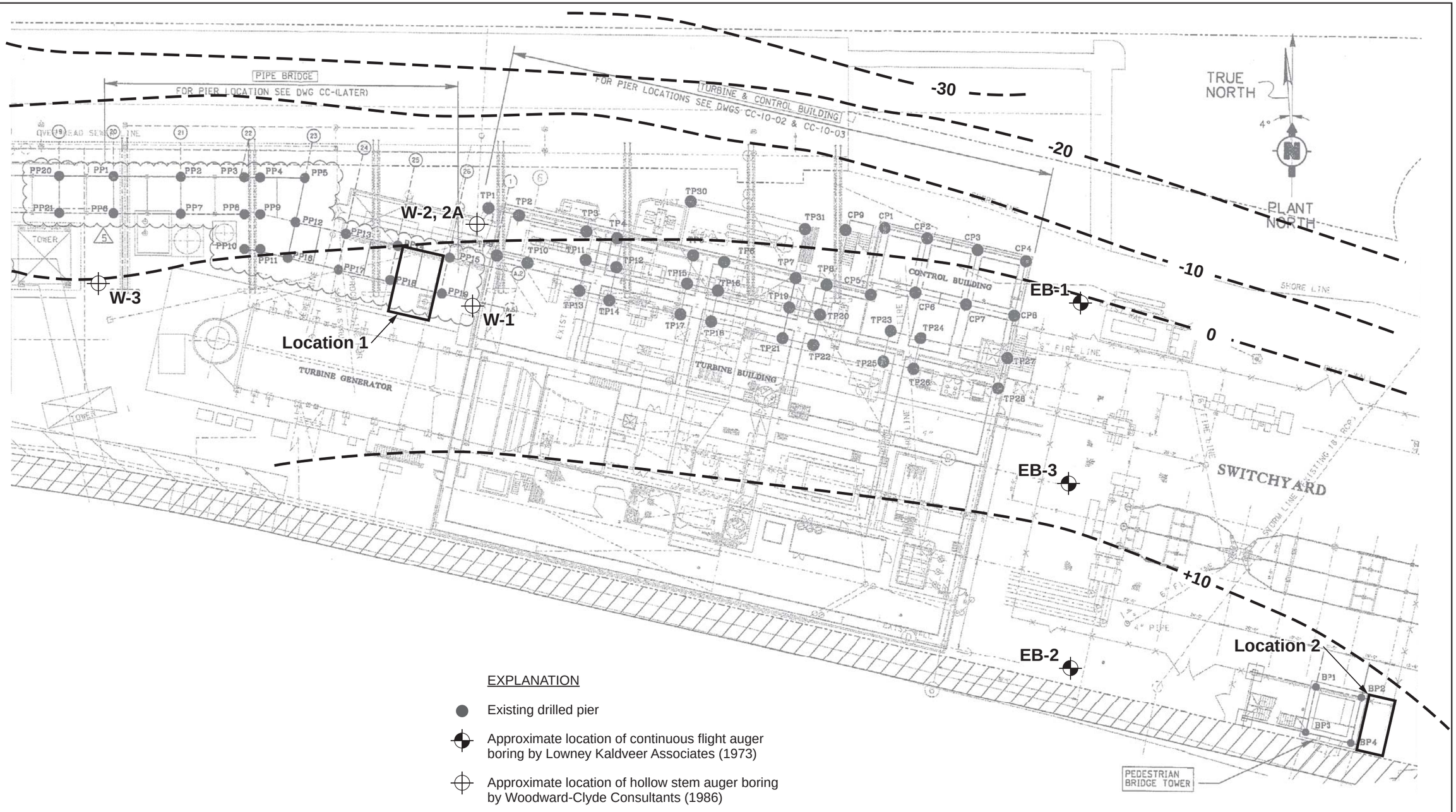

EXPLANATION

- Existing drilled pier
- Approximate location of continuous flight auger boring by Lowney Kaldveer Associates (1973)
- Approximate location of hollow stem auger boring by Woodward-Clyde Consultants (1986)
- Proposed location for new natural gas compressor
- Approximate bedrock elevation contour, feet, (project datum), Woodward-Clyde Consultants (1986b)

Basemap Source:
Bechtel DWG No. CC-10-01, Rev. 5, July 13, 1994.

0 40 Feet
(approximate)

SITE PLAN OF EXISTING FACILITIES AND PROPOSED GAS COMPRESSOR LOCATIONS
Crockett Cogeneration Natural Gas Power Plant
Crockett, California

By: _	Date: 11/04/2011	Project No.	OD11162010
amec		Figure	2

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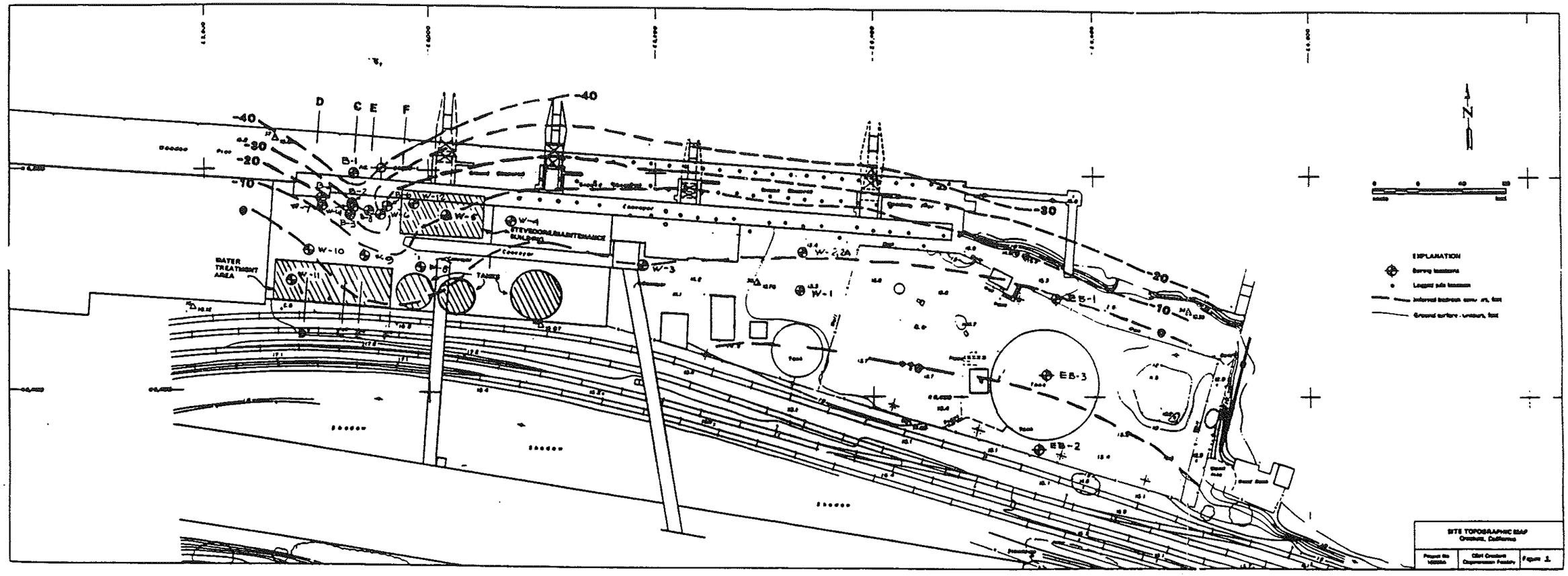
APPENDIX A

Logs of Borings from Woodward, Clyde & Associates (1986b) and Lowney-Kaldveer Associates (1956)



NOTE: PROPOSED CONSTRUCTION IN WESTERN REGION OF COGENERATION SITE SHOWN CROSS HATCHED; SEE FLUOR'S PLOT PLAN DRAWING NO. 227009-A0-00-5000.

FIGURE 1

Project: CROCKETT COGENERATION PLANT Crockett, California	Log of Boring No. W-1

Date Drilled: January 13, 1986
Type of Boring: 6" Hollow Stem Auger
Hammer Weight: 140 lbs., 30" drop

Remarks: Two turns of rope on the rig cathead.

Depth, ft	Samples	Blows/ft	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation: Ground Surface			
			5" or 6" Asphalt Concrete			
			AGGREGATE BASE: SILTY SAND AND GRAVEL (SM-SW) Light brown, dry, all grain sizes, gravel to 1"			
			FILL Gravel, sand, silty clay			
	1	9		100% Recovery		
5			SILTY GRAVELLY CLAY (CL) Medium stiff, dark brown, wet, moderately plastic, with sand lenses and shiny metallic particles (FILL ?)			
	2	7		100% Recovery		
			CLAYSTONE FRAGMENTS: Severely weathered, dark blue, mixed with dark blue clay			
			▽ ATB CLAY (CH) Medium stiff to stiff, blue-gray, wet, highly plastic, some rock fragments			
10	3	35				
			BEDROCK:			
	4		CLAYSTONE Friable, blue-gray, broken fragments become plastic with water	85% Recovery		
	5			72% Recovery		
			SILTSTONE AND SANDSTONE Hard, brown greenish-gray, interbedded, with multiple joints, iron staining			
	6			72% Recovery		
15	7		(PANOCHE FORMATION)	100% Recovery		
			BOTTOM OF BORING @ 16 feet			
20			LEGEND FOR ALL BORINGS: Soil sample obtained with a 24-in. modified California sampler Bedrock sample by rock coring ▽ Water level at time of drilling			

Proj. No. 16660A | Woodward-Clyde Consultants | Figure A-1

Project	CROCKETT COGENERATION PLANT Crockett, California	Log of Boring No. W-2

Date Drilled: January 13, 1986
Type of Boring: 6" Hollow Stem Auger
Hammer Weight: 140 lbs. 30" drop
Remarks: See "Remarks" in Figure A-1.

Depth, Ft	Samples	Blows/Ft	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation: Ground Surface			
			5" or 6" Asphalt Concrete			
			AGGREGATE BASE: SILTY SAND AND GRAVEL (SM-SW) Light brown, dry, all grain sizes, gravel to 1"			
			FILL Gravel, sand, silty clay			
5	1	4	No recovery (piece of blacktop in tube)			
	2	7			75% Recovery	
			CLAYSTONE FRAGMENTS Weathered, friable, blue-gray			
	3	5	CLAY (CH)		85% Recovery	
			ATD Soft to medium stiff, blue-gray, wet, highly plastic, with friable, dark blue-gray rock fragments (claystone). Wood fragments in the shoe			
10						
	4	50/2"	Wood, solid, seems from a pile or bulkhead, filling 12" of liners and the shoe		100% Recovery	
			BOTTOM OF BORING @ 12' (Hole abandoned. Boring 2 is continued in Boring 2A, located some 6' west of Boring 2)			
15						
20						

Proj. No. 16660A | Woodward-Clyde Consultants | Figure A-2

Project: CROCKETT COGENERATION PLANT
Crockett, California

Log of Boring No. W-2A

Date Drilled: January 13, 1986
Type of Boring: 6" Hollow Stem Auger
Hammer Weight: 140 lbs. 30" drop

Remarks: See "Remarks" on Figure A-1.

Depth, ft	Samples	Blows/ft	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation: Ground Surface			
			5" or 6" Asphalt Concrete			
			AGGREGATE BASE: SILTY SAND AND GRAVEL (SM-SW) Light brown, dry, all grain sizes, gravel to 1"			
			FILL Gravel, sand, silty clay			
5						
			CLAYSTONE FRAGMENTS Weathered, friable, blue-gray			
			ATD CLAY (CH) Soft to medium stiff, blue-gray, wet, highly plastic, with friable, dark blue-gray claystone fragments			
10						
			CLAYSTONE FRAGMENTS Severely weathered, blue-gray mixed with blue-gray clay			
15	1	50/3"	BEDROCK:			
	2		SANDSTONE Hard, brown, fine-grained. Top 10" or 12" only. Moderately weathered	100% Recovery		
	3		SILTSTONE Hard, greenish-gray, interbedded with brown sandstone, multiple joints, iron staining	90% Recovery		
20			(PANOCHE FORMATION)			
	4			90% Recovery		
			BOTTOM OF BORING @ 22 feet			

Proj. No. 16660A | Woodward-Clyde Consultants | Figure A-3

Project: CROCKETT COGENERATION PLANT
Crockett, California

Log of Boring No. W-3

Date Drilled: October 6, 1986
Type of Boring: 8" Hollow Stem Auger
Hammer: 140 lb, 30" Drop
Remarks

Depth, Ft	Samples	Blows/Ft	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compress Strength, psf
			Surface Elevation: approx. 12 feet			
			6" Asphalt Concrete			
			AGGREGATE BASE: SANDY GRAVEL (GW) Dry, red-brown			
			FILL: Clayey Gravel (GC), dry, dense, gray, with some sand			
5	1	10				
		ATD				
10	2	12	CLAYSTONE/SANDSTONE with clay-filled seams, dark gray-green, highly fractured			
15	3	50/3"	BEDROCK: CLAYSTONE/SANDSTONE with clay-filled seams, dark gray-green, hard drilling; becoming medium hard drilling, silty claystone with sandstone seams			
	4	50/6"				
20			BOTTOM OF BORING @ 18.5 FEET			
25			LEGEND FOR ALL BORINGS: 2" Diam. modified California sampler; Water level at time of drilling (ATD); 2-1/2" Diam. modified California sampler			
30						

Project: 16660A | Woodward-Clyde Consultants | Figure A-1

DRILL RIG Continuous Flight Auger	SURFACE ELEVATION ---	LOGGED BY [illegible]
DEPTH TO GROUNDWATER [illegible]	BORING DIAMETER 8 inches	DATE DRILLED 6/15/73

DESCRIPTION AND CLASSIFICATION				DEPTH (feet)	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT %	PENETRATION RESISTANCE (BLOWS/FT)
DESCRIPTION AND REMARKS	COLOR	CONSIST	SOIL TYPE							
GRAVELLY SAND, silty with some clay	reddish brown	very loose	SM-GM	1	x				12	98
				2						
				3	x				8	87
				4	x				15	9
SILT, gravelly and sandy with some clay	blue-green	stiff	ML-GM	5						
				6						
				7					▽	
				8						
				9						
				10	x				12	12
SHALE, highly weathered and fractured with interbedded clay	dark gray	BEDROCK		11	x				21	8
				12						
				13						
				14						
(interbedded with weathered sandstone)	brown			15	x				24	29
	dark gray			16						
				17						
CLAYSTONE, with interbedded sandstone	dark gray & brown			18						
				19	x				14	100/7"
				20						

LOWNEY · KALDVEER ASSOCIATES

Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG

55,000-BARREL FUEL STORAGE TANK
Crockett, California

PROJECT NO	DATE	SHEET NO.	BORING NO.
354-1	June, 1973	1 OF 2	EB-1

DRILL RIG [illegible]	SURFACE ELEVATION ----	LOGGED BY [illegible]
DEPTH TO GROUNDWATER [illegible]	BORING DIAMETER 8 inches	DATE DRILLED 6/15/73

DESCRIPTION AND CLASSIFICATION				DEPTH (feet)	JARS	SACKS	SPLIT SPOON	SPLIT BY TUBE	MOISTURE CONTENT %	PENETRATION RESISTANCE BLOWS/FT
DESCRIPTION AND REMARKS	COLOR	CONSIST	SOIL TYPE							
CLAYSTONE with interbedded sandstone (Con't.)	Dark gray & brown		BEDROCK	21						
				22						
				23						
				24	[illegible]				14	[illegible]
[illegible] = 24.3 feet				25						

Notes: (1) The stratification lines represent the approximate [illegible] between material types and the transition may be gradual.

(2) Water level recorded 3 hours after drilling.

LOWNEY · KALDVEER ASSOCIATES

Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG

55,000-BARREL FUEL STORAGE TANK
Crockett, California

PROJECT NO	DATE	SHEET NO.	BORING NO.
354-1	June, 1973	2 OF 2	EB-1

DRILL RIG [illegible]	SURFACE ELEVATION [illegible]	LOGGED BY [illegible]
DEPTH TO GROUNDWATER [illegible]	BORING DIAMETER [illegible]	DATE DRILLED 6/15/73

DESCRIPTION AND REMARKS	COLOR	CONSIST	SOIL TYPE	DEPTH (feet)	JARS	SACKS	SHEET STOCK	SHELBY TUBE	MOISTURE CONTENT %	PENETRATION RESISTANCE BLOWS/FT
GRAVELLY SAND, clayey	[illegible] brown	[illegible]	SC-SC	1	x				14	15
CLAY, gravelly and sandy with silt	[illegible] brown	[illegible]	CL-SC	2	x				17	13
				3						
				4	x				9	11
SHALE, [illegible], weathered and fractured with interbedded claystone	dark gray		[illegible]	5						
				6					▽	
				7						
				8						
SANDSTONE, highly weathered with interbedded claystone	yellowish brown			9						
				10	x				18	86/17"
				11						
				12						
				13						
CLAYSTONE	gray			14	x				10	76/9"
Note: (1) The stratification lines represent the approximate boundary between material types and the transition may be gradual. (2) Water level encountered 2 hours after drilling.				15						
				16						
				17	x				10	69/8"
				18						
Bottom of Boring = 17.5 Feet										

LOWNEY · KALDVEER ASSOCIATES

Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG

55,000-BARREL FUEL STORAGE TANK
Crockett, California

PROJECT NO	DATE	SHEET NO	BORING NO.
354-1	June, 1973	1 OF 1	EB-2

DRILL RIG Con[illegible] Auger	SURFACE ELEVATION ---	LOGGED BY [illegible]
DEPTH TO GROUNDWATER [illegible]	BORING DIAMETER [illegible]	DATE DRILLED 6/15/73

DESCRIPTION AND CLASSIFICATION				DEPTH (feet)	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT %	[illegible] RESISTANCE [illegible]
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE							
SANDY CLAY, gravelly	Brown	[illegible] dense	CL-SC	1	x				8	25
CLAY, gravelly and sandy with silt	Blue-green	stiff	CL-GC	2	x				12	11
SHALE, highly weathered and fractured with abundant interbedded clay	dark gray	BEDROCK		4	x				10	9
				5						
				6					▽	
				7						
				8						
				9	x				20	4
				10						
				11					13	Pushed (1,200 psi 50/4"
CLAYSTONE with interbedded sandstone	gray & brown			12	x					
				13						
				14						
				15						
				16	x					50/2"
				17						

Bottom of boring = 16.3 feet

Notes: (1) The stratification lines represent the approximate boundary between material types and the transition may be gradual.

(2) Water level recorded at the time of drilling.

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Foundation/Soil/Geological Engineers

EXPLORATORY BORING LOG

55,000-BARREL FUEL STORAGE TANK
Crockett, California

PROJECT NO	DATE	SHEET NO.	BORING NO.
354-1	June, 1973	1 OF 1	EB-3

APPENDIX B

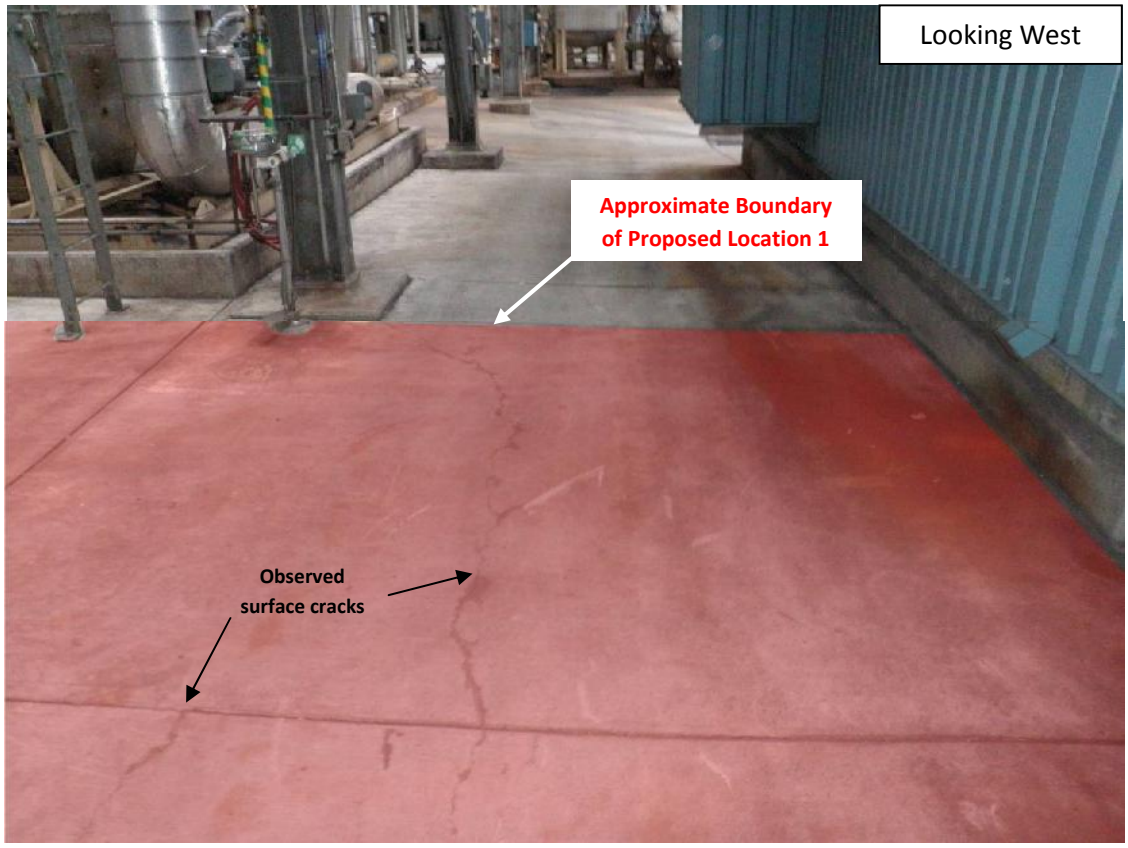
Photos of Proposed Locations taken October 19, 2011

Location 1

Looking South
Approximate Boundary
of Proposed Location 1

Looking East
Approximate Boundary
of Proposed Location 1
Observed
surface cracks

Location 1

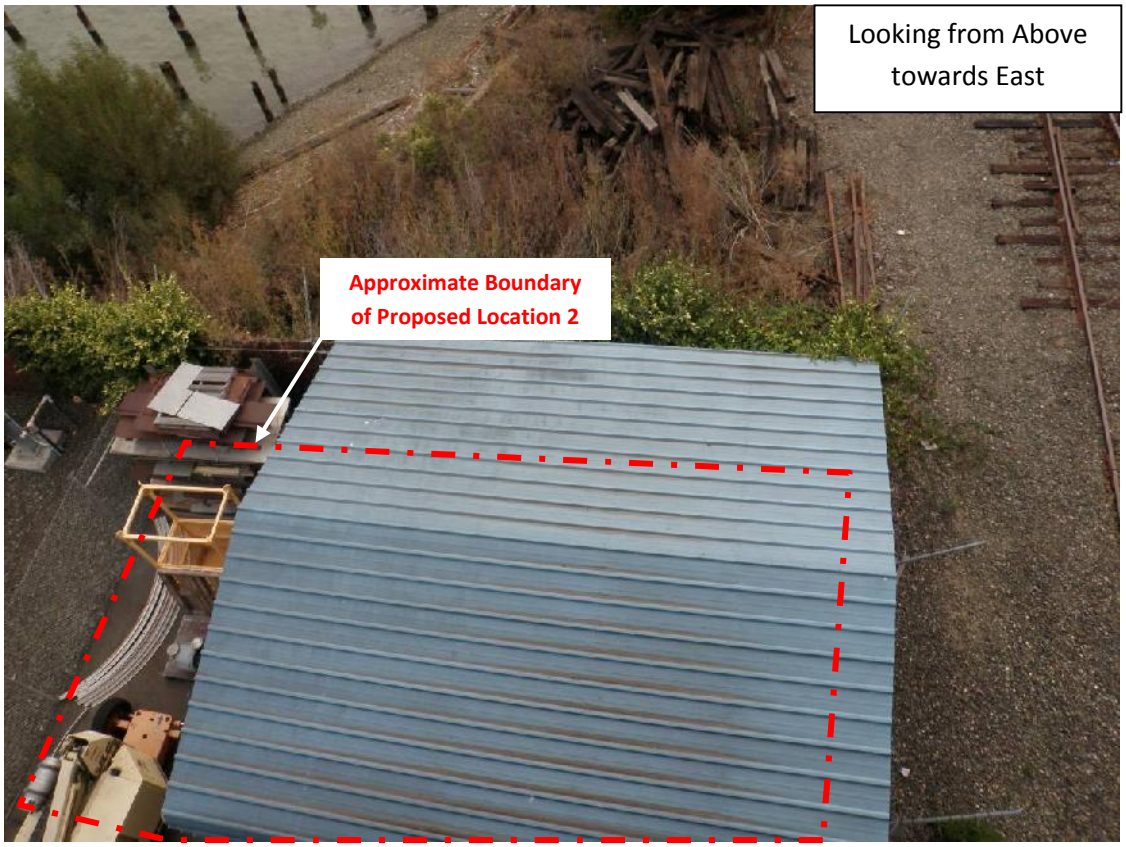

Looking West
Approximate Boundary of Proposed Location 1
Observed surface cracks

Location 2

Looking South
BECHTEL
Approximate Boundary
of Proposed Location 2

Looking Southwest
JLG
Approximate Boundary
of Proposed Location 2

Location 2


Looking from Above towards East
Approximate Boundary of Proposed Location 2

Looking East
Proposed Location 2 Just Outside of Photo