Report of Geotechnical Investigation

Mohave 500kV Substation Series Capacitors Upgrade

Eldorado-Lugo-Mohave Series Capacitor Upgrade Project

Laughlin, Clark County, Nevada

Prepared for:

Beta Engineering

Pineville, Louisiana 71360

Project 4953-18-0131.03

July 27, 2018

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July 27, 2018
Wood Project 4953-18-0131.03

Mr. Nicholas Mulheim
Beta Engineering
4725 Highway 28 East
Pineville, Louisiana 71360

Subject: **Letter of Transmittal**
Report of Geotechnical Investigation
Mohave 500kV Substation Series Capacitors Upgrade
Eldorado Lugo-Mohave Series Capacitor Upgrade Project
Laughlin, Clark County, Nevada

Dear Mr. Mulheim:

We, Wood Environment & Infrastructure Solutions, Inc. (Wood – formerly Amec Foster Wheeler) are pleased to submit this report presenting the results of our geotechnical investigation for the Eldorado-Lugo-Mohave Capacitor Upgrade – Mohave 500kV Substation Series Capacitor Upgrade, in Laughlin, Clark County, Nevada.

The scope of our services was based on our agreement dated January 31, 2018 with revision 1 dated April 15, 2018, and our telecon of June 26, 2018.

The results of our investigation, including our prior subsurface explorations and laboratory testing, and design recommendations are presented in this report. Please note that you or your representative should submit copies of this report to the appropriate governmental agencies.

It has been a pleasure to be of professional service to you. Please contact us if you have any questions or if we can be of further assistance.

Sincerely,

Wood Environment & Infrastructure Solutions, Inc.

Eung Jin Jung, Ph.D.
Associate Engineer

Rosalind Munro
Principal Engineering Geologist

Reviewed by:

Marshall Lew, Ph.D.
Principal Engineer

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(Electronic copies submitted)

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Los Angeles, California

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Appendices

1.0 Scope

This report provides the results of our geotechnical investigation for the Eldorado-Lugo-Mohave Capacitor Upgrade – Mohave 500kV Substation Series Capacitors Upgrade, in Laughlin, Clark County, Nevada. The location of the site is illustrated on Figure 1, Site Vicinity Map.

We previously explored the site in 2016 and presented the boring logs and results of our laboratory testing in a data report for Southern California Edison dated June 24, 2016 (Wood predecessor company Amec Foster Wheeler Project No. 4953-16-0471) and addendum report dated July 13, 2016. We also prepared a geotechnical foundation design parameters report for the site dated May 22, 2018 (Wood Project No. 4953-18-0131.03). This report supersedes the May 22, 2018 report.

The recommendations presented in this report were developed using the geotechnical information from that investigation. We acknowledge that we have reviewed the field data and the results of the laboratory tests from the previous investigation and we concur with the data findings.

The scope of this investigation did not include the assessment of general site environmental conditions for the presence of contaminants in the soils and groundwater of the site.

Our recommendations are based on the results of our previous field exploration and laboratory tests. The results of our previous field explorations and laboratory tests, which form the basis of our recommendations, are presented in Appendices A and B.

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. No other warranty, express or implied, is made as to the professional advice included in this report. This report has been prepared for Beta Engineering and their design consultants to be used solely for the Mohave 500kV Substation Series Capacitors. This report has not been prepared for use by other parties, and may not contain sufficient information for purpose of other parties or other uses.

2.0 Site Conditions and Project Description

The existing Mohave Substation site is unpaved and covered with gravel.

It is currently planned to demolish the existing series capacitor racks and foundations and to construct new series capacitor platform structures, typical equipment supporting structures (bus supports, switch stands, etc.), deadend structures, circuit breakers, buildings, and other miscellaneous equipment at the existing Mohave substation shown on Figure 1. We understand that series capacitor platform structures are planned to be supported on mat foundations, typical equipment support structures are planned to be supported on drilled shafts, the deadend structures are planned to be supported on 5- to 6-foot diameter drilled shafts, and the circuit breakers, buildings and other miscellaneous equipment are planned to be supported on spread footings.

As indicated in your RFQ dated January 2, 2018, the series capacitor platform structures (Foundation Type 1) will be supported on mat (slab) foundations. The dead load bearing pressure at the bottom of the foundation is expected to be less than 500 pounds per square foot (psf). Under short term loading conditions, such as wind and seismic loads, the maximum bearing pressure is expected to be less than 2,000 psf.

Typical equipment support structures such as bus supports, switch stands, etc. (Foundation Type 2) will be supported on drilled shafts with diameters ranging from 2½ to 4 feet and lengths ranging from 8 to 15 feet. This foundation type will have very small applied axial dead loads (ranging from 2 to 4 kips). The lateral loads and moments applied to the top of the drilled shaft will be short term loads resulting from wind or seismic forces. Lateral loads will range from 1 to 5 kips. Moments will range from 20 to 60 ft-kips.

The circuit breakers, buildings, and other miscellaneous equipment (Foundation Type 4) may be supported on spread footings (slabs). The dead load bearing pressure at the bottom of the foundations are expected to be less than 500 psf. Under short term loading conditions such as wind or seismic loads, the maximum bearing pressures are expected to be less than 1,500 psf.

3.0 Field Explorations and Laboratory Tests

The geotechnical conditions at the site were explored by excavation of three hollow stem auger borings at the locations shown on Figure 2, Boring Location Map. The number, depths, and locations of the borings were provided by SCE. The explorations were performed on May 17, 2016 by our predecessor company Amec Foster Wheeler.

The hollow stem auger borings were drilled with a limited access hollow stem auger rig to a depth of 51½ feet. The borings were sampled with a standard penetration test (SPT) sampler and California Modified ring sampler at approximately 5-foot intervals, generally alternating between the sampler types. The number, depths, and locations of the borings were provided by SCE. A summary of the methodology of the exploratory borings drilled for the project and the logs of the borings are presented in Appendix A.

Soil samples collected from the borings were transported to the Amec Foster Wheeler laboratory, and were reviewed by Amec Foster Wheeler staff. The laboratory testing program was developed by SCE based on review of the field boring logs. Laboratory testing was performed by us and HDR. The types of tests performed are listed below:

- Moisture and density
- Direct shear
- Grain size distribution
- Consolidation
- Expansion index
- Atterberg Limit
- Compaction
- Corrosion (performed by HDR)

All testing was performed in general accordance with applicable ASTM specifications at the time of testing. Details of the laboratory testing program and the test results are presented in Appendix B.

4.0 Geology

4.1 Geologic Setting

The site is located in the Mohave Valley southeast of the Newberry Mountains in the Basin and Range (Nevada Bureau of Mines and Geology, 2018.)

4.2 Geologic Materials

The site is mapped as Quaternary alluvium (Nevada Bureau of Mines and Geology, 2018.) The alluvial deposits underlying the site consist predominantly of poorly graded sand with local variable amounts of gravel. Between 35 feet and 45 to 50 feet the soils consist of fat clay and sandy silt.

4.3 Groundwater

Groundwater was not encountered to the maximum depth drilled of 51½ feet below the existing grade.

4.4 Geologic-Seismic Hazards

Surface Fault Rupture

There are no known active faults with the potential for surface fault rupture located directly beneath or projecting toward the site (Nevada Bureau of Mines and Geology). Therefore, the potential for surface rupture due to fault plane displacement propagating to the surface at the site during the design life of the proposed development is considered low.

Seismicity

The site could be subjected to strong ground shaking in the event of an earthquake, this hazard is common in Nevada and the effects of ground shaking can be mitigated by proper engineering design and construction in conformance with current building codes and engineering practices.

Liquefaction and Seismically-Induced Settlement

Liquefaction potential is greatest where the groundwater level is shallow, and submerged loose, fine sands occur within a depth of about 50 feet or less. Liquefaction potential decreases as grain size and clay and gravel content increase. As ground acceleration and shaking duration increase during an earthquake, liquefaction potential increases. Groundwater was not encountered to the maximum depth drilled of 51½ feet below the existing grade. Therefore, the potential for liquefaction of the subsurface materials is considered to be low.

Seismically-induced settlement is often caused by loose to medium-dense granular soils densified during ground shaking. Dry and partially saturated soils as well as saturated granular soils are subject to seismically-induced settlement. The potential for seismically induced settlement is considered to be low.

Slope Stability

The relatively flat-lying topography at the site precludes both stability problems and the potential for lurching (earth movement at right angles to a cliff or steep slope during ground shaking).

Expansive and Corrosive Soils

The alluvial soils at the site are non-expansive.

The corrosion test results performed for us by HDR presented in our 2016 report (Amec Foster Wheeler, 2016a) indicate that the on-site soils range from mildly corrosive to ferrous metals at present moisture content, non-aggressive to copper, and that the potential for sulfate attack on portland cement concrete is considered severe.

Collapsible Soils

Conditions in arid and semi-arid climates favor the formation of collapsible soils. Collapsible soils are soils susceptible to large volumetric stains when they become saturated. The soils underneath the project site possess slight collapse potential based on the laboratory test results.

Tsunamis, Inundation, Seiches, and Flooding

The site is not located near the ocean. Therefore, tsunamis (seismic sea waves) are not considered a hazard at the site.

The site is not located within a potential inundation area for an earthquake-induced dam failure. The site is not located downslope of any large bodies of water that could adversely affect the site in the event of earthquake-induced seiches (wave oscillations in an enclosed or semi-enclosed body of water.)

The site is in the vicinity of active washes and there is the potential for flooding. The potential for flooding can be mitigated by proper civil engineering design.

Subsidence

The site is not within an area of known subsidence associated with fluid withdrawal (groundwater or petroleum), peat oxidation, or hydrocompaction. The potential for subsidence to adversely impact the site is considered low.

Oil Wells and Methane Gas

The site is not located within the limits of an oil field. There are no known oil wells on the site. Plugged and abandoned oil exploration holes are not known to be located near the site. Therefore, the potential for methane and other volatile gases to occur beneath the site is low.

5.0 Recommendations

5.1 Foundation Design Parameters

Foundation design parameters for the site are presented in the following table. The design parameters were estimated based on field data and laboratory test results.

Foundation Design Parameters

Depth	Soil Condition	Total Unit weight, pcf	Moisture Content (%)	Friction Angle, ϕ (degree)	Cohesion, c (psf)	Vertical Subgrade Modulus (pci)	Lateral Subgrade Modulus (pci)
0-3	Fill – Sandy Silt	105	-	-	-	-	-
3-35	Silty Sand, Sandy Silt, Poorly Graded Sand with variable amounts of Silt and Gravel	108	10	34	0	160	130
35-45	Lean Clay and Fat Clay	124	20	0	4,000	250	-
45+	Sandy Silt, Silty Sand, Poorly Graded Sand	104	6	36	0	350	225

By: GA 2/12/18
Checked by: EJJ 2/14/18

5.2 Drilled Cast-In-Place Concrete Piles

Axial Capacities

We have estimated the axial capacities of drilled cast-in-place concrete piles based on the strength characteristics of the on-site soils. The ultimate downward and upward friction capacities of 30-, 36-, and 48-inch diameter drilled piles for typical equipment support structures and 60- and 72-inch diameter drilled piles for the deadend structures are presented on Figure 2. We recommend the piles be designed for skin friction only.

The allowable capacities of the piles may be determined by dividing the ultimate capacities by a factor of 2. The allowable capacities are dead-plus-live load capacities; a one-third increase to the allowable values may be used when considering wind or seismic loads. It may be prudent to ignore capacities in the upper one foot of the piles.

Settlement

We estimate the static settlement of the proposed structure supported on conventional drilled cast-in-place concrete piles in the manner recommended to be less than ½ inch with a differential settlement of ¼ inch or less between adjacent supports.

Lateral Loads

Lateral loads may be resisted by the piles and by the passive resistance of the soils against pile caps. The resistance of the piles and the passive resistance of the soils against pile caps may be combined without reduction in determining the total lateral resistance.

We have computed the lateral capacities of the drilled piles using the computer program LPILE Plus by ENSOFT, Inc. Resistance of the soils adjacent to 30-, 36-, 48-, 60-, and 72-inch-diameter drilled piles are shown in the following tables for top of pile deflections of ¼, ½, ¾, and 1 inches. These resistances have been calculated assuming free-head pile conditions. The minimum pile length may be taken as the length required to reach the depth of zero moment given in the tables below. Lateral loads provided below are ultimate values.

Lateral Load Design Data
30-inch diameter Drilled Concrete Pile

	Pile Head Deflection (inches)			
	¼	**½**	**¾**	**1**
Pile Head Condition	**Free**			
Lateral Load (kips)	42	64	82	99
Maximum Moment (inch-kips)	2,491	4,153	5,655	7,080
Depth to Maximum Moment (ft)	8	8½	9½	9½
Depth to Zero Moment (ft)	22	23½	24½	25

Lateral Load Design Data
36-inch diameter Drilled Concrete Pile

	Pile Head Deflection (inches)			
	¼	**½**	**¾**	**1**
Pile Head Condition	**Free**			
Lateral Load (kips)	62	93	119	142
Maximum Moment (inch-kips)	4,120	6,806	9,215	11,500
Depth to Maximum Moment (ft)	9	9½	10½	11
Depth to Zero Moment (ft)	25	26½	27½	28

Lateral Load Design Data
48-inch diameter Drilled Concrete Pile

	Pile Head Deflection (inches)			
	¼	**½**	**¾**	**1**
Pile Head Condition	**Free**			
Lateral Load (kips)	114	171	216	256
Maximum Moment (inch-kips)	9,121	15,100	20,200	25,000
Depth to Maximum Moment (ft)	10½	11½	12½	13
Depth to Zero Moment (ft)	29	31½	32	32½

Lateral Load Design Data
60-inch diameter Drilled Concrete Pile

	Pile Head Deflection (inches)			
	¼	½	¾	1
Pile Head Condition	**Free**			
Lateral Load (kips)	176	271	342	404
Maximum Moment (inch-kips)	16,200	28,000	37,400	45,900
Depth to Maximum Moment (ft)	12	14	14½	15
Depth to Zero Moment (ft)	32½	34	36	37½

Lateral Load Design Data
72-inch diameter Drilled Concrete Pile

	Pile Head Deflection (inches)			
	¼	½	¾	1
Pile Head Condition	**Free**			
Lateral Load (kips)	250	396	498	587
Maximum Moment (inch-kips)	25,700	46,300	61,500	75,200
Depth to Maximum Moment (ft)	14	16	16½	17
Depth to Zero Moment (ft)	36½	38½	43	46

By: GA 2/13/2018
Checked by: EJJ 2/14/2018

Drilled Pile Installation

Observations of caving potential could not be made during our field explorations due to the hollow-stem auger drilling method used. However, due to the non-cohesive nature of the subsurface soils, caving should be anticipated during pile excavation. Therefore, provisions to reduce the potential for caving, such as the use of casing and/or drilling mud, may be necessary when drilling the piles and placing concrete.

Although it is not anticipated, piles spaced less than five diameters on center should be drilled and filled alternately, with the concrete permitted to set at least 8 hours before drilling an adjacent hole. The pile installation should be completed the same day that the drilling is performed. A collar should be placed around the mouth of the shaft after drilling to prevent soils from entering the excavation, and the pile shafts should be covered until concrete is placed.

Concrete should be pumped from the bottom up through a rigid pipe extending to the bottom of the drilled excavation, with the pipe being slowly withdrawn as the concrete level rises. The discharge end of the pipe should be at least 5 feet below the surface of the concrete at all times during placement. The concrete pump pressure should be at least 200 pounds per square inch. The discharge pipe should be kept full of concrete during the entire placement operation and should not be removed from the concrete until all of the concrete is placed and fresh concrete appears at the top of the pile. The volume of concrete pumped into the hole should be recorded and compared to design volume.

Only competent drilling contractors with experience in the installation of drilled cast-in-place piles in similar soil conditions should be considered for the pile construction. The drilling of the pile excavations and the placing of the concrete should be observed continuously by personnel of our firm to verify that the desired diameter and depth of piles are achieved.

5.3 Shallow Foundations

As indicated, the maximum loading on the mat to support series capacitor platform structures will be less than 2,000 pounds per square foot when considering wind or seismic loading. The maximum loading on the spread footing to support the circuit breakers, buildings and other miscellaneous equipment will be less than 1,500 pounds per square foot when considering wind or seismic loading. Mat foundations and spread footings may be established in undisturbed natural soils, estimated to be at a depth of 3 to 5 feet below the existing grade, or on properly compacted fill placed over the undisturbed natural soils. Accordingly, the mat foundations and spread footings, should be established at least 1½ feet below the lowest adjacent grade and may be designed to impose an allowable net dead-plus-live load bearing pressure of up to 2,500 pounds per square foot. Since this allowable bearing value is governed by settlement considerations, no increase in the above bearing value is allowed for additional mat/footing width or depth unless additional settlement can be tolerated.

The bearing value is a net value, and the weight of concrete in the foundation may be taken as 50 pounds per cubic foot. A one-third increase in the bearing value may be used when considering wind or seismic loads.

Lateral Loads

Lateral loads may be resisted by friction of the soil acting against the mat foundations and spread footings and by the passive resistance of the soils.

A coefficient of friction of 0.4 may be used between the mat foundation and the supporting soils. The passive resistance of soils can be assumed to be equal to the pressure developed by a fluid with a density of 250 pounds per cubic foot.

A one-third increase in the passive value may be used for wind or seismic loads. The frictional resistance and the passive resistance of the soils may be combined without reduction in determining the total lateral resistance.

Settlement

We estimate the static settlement of the proposed structure supported mat foundation and spread footings in the manner recommended to be less than 1½ and ¾ inches, respectively. Differential settlement is expected to be about 1/2 inch or less. Due to wetting of the upper 10 feet of soils, which is unlikely to happen, we estimate the additional settlement to be up to ¾ to 1 inch.

5.4 Ultimate Values

The allowable values in the preceding sections are for use with loadings determined by a conventional working stress design. When considering an ultimate design approach, the allowable values may be multiplied by the following factors:

Design Item	Ultimate Design Factor*
Bearing Value	3.0
Lateral Pile Capacity	1.0
Passive Pressure	1.5
Coefficient of Friction	1.5

*Ultimate axial pile capacities are presented in Figure 3.

In no event, however, should pile lengths be less than those required to support dead-plus-live loads when using the working stress design method.

5.5 Modulus of Subgrade Reaction

A modulus of subgrade reaction presented in Table 1 may be assumed for the onsite soils for both gravity and seismic analysis of the foundation. These values are a unit value for use with a 1-foot-square area. The modulus should be reduced in accordance with the following equation when used with larger mat foundations:

$$K_R = K\left[\frac{B+1}{2B}\right]^2$$

where:

K	=	unit subgrade modulus
K_R	=	reduced subgrade modulus
B	=	spread foundation/mat width

5.6 Seismic Design Parameters

We have determined the seismic design parameters in accordance with the provisions of the 2016 California Building Code and ASCE 7-10 Standard (ASCE, 2010) using the United States Geological Survey (USGS) Seismic Design Maps Web Application. The CBC Site Class was determined to be Site Class "D" based on the results of our explorations and a review of the local soil and geologic conditions. The mapped seismic parameters are presented in the following table:

Parameter	Mapped Value
S_S (0.2 second period, Site Class B)	0.263g
S_1 (1.0 second period, Site Class B)	0.109g
Site Class	D
F_a	1.589
F_v	2.365
$S_{MS} = F_aS_S$ (0.2 second period)	0.419g
$S_{M1} = F_vS_1$ (1.0 second period)	0.257g
$S_{DS} = 2/3 \times S_{MS}$ (0.2 second period)	0.279g
$S_{D1} = 2/3 \times S_{M1}$ (1.0 second period)	0.171g

By: GA 7/6/18 Checked: EJJ 7/9/18

5.7 Grading

Site Preparation/Removals

After demolition of the existing structures and after the site is cleared in fill areas and at design grade in cut areas, the exposed soils should be carefully observed for the removal of all loose and unsuitable deposits, including cobbles and rock fragments greater than 3 inches in diameter. Fill soils up to 3 feet in thickness were encountered in our prior borings at outside the substation footprint. Our prior borings were not drilled within the substation footprint so the location and thickness of existing fill is unknown. We do not have documentation of the placement of the existing fill. Any existing fill found to be unsuitable should be removed and recompacted. For both within and outside the substation, we estimate removals will be on the order of 0 to 3 feet varying based on depth of unsuitable fill soils observed. Cut areas exposing native materials should be over-excavated a minimum of 12 inches.

In foundation areas, after removal of unsuitable soils, over-excavation 12 inches below bottom of foundation should be performed. Removals/over-excavation should be performed laterally 2 feet beyond the limits of foundations.

After over-excavation, the exposed soils should be scarified to a depth of 6 inches, brought to near-optimum moisture content, and rolled with heavy compaction equipment. Fill should be compacted to at least 90% of the maximum dry density obtainable by the ASTM Designation D1557 method of compaction. In areas to support structures, the upper 12 inches should be compacted to a minimum of 95% relative compaction.

Good drainage of surface water should be provided by adequately sloping all surfaces. Such drainage will be important to minimize infiltration of water beneath foundations and pavement.

Excavation and Temporary Slopes

Where excavations are deeper than about 4 feet, the sides of the excavations should be sloped back at 1:1 (horizontal to vertical) or shored for safety. Unshored excavations should not extend below a plane drawn at 1½:1 (horizontal to vertical) extending downward from adjacent existing footings. We would be pleased to present data for design of shoring if required.

Excavations should be observed by personnel of our firm so that any necessary modifications based on variations in the soil conditions can be made. All applicable safety requirements and regulations, including OSHA regulations, should be met.

Compaction

Any required fill should be placed in loose lifts not more than 8-inches-thick and compacted. The fill should be compacted to at least 90% of the maximum density obtainable by the ASTM D1557-12 test method. In areas to support structures and areas for paved gravel and dirt road construction, the upper 12 inches should be compacted to a minimum of 95% relative compaction. The moisture content of the on-site soils at the time of compaction should vary no more than 2% below or above optimum moisture content.

Material for Fill

The on-site soils, less any debris or organic matter, can be used in required fills. Rock fragments and cobbles larger than 3 inches in diameter should not be used in the fill unless site specific criteria are developed and implemented.

5.8 Geotechnical Observation

The reworking of the upper soils and the compaction of all required fill should be observed and tested by the geotechnical consultant. The observation and testing should include:

- Observe the clearing and grubbing operations for proper removal of unsuitable materials.
- Observe pile excavations prior to placement of reinforcement.
- Observe the fill and backfill for uniformity during placement.
- Test backfill for field density and compaction to determine the percentage of compaction achieved during backfill placement.
- Observe and probe foundation materials to confirm that suitable bearing materials are present at the design foundation depths.

The governmental agencies having jurisdiction over the project should be notified prior to commencement of grading so that the necessary grading permits may be obtained and arrangements may be made for the required inspection(s).

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. No other warranty, express or implied, is made as to the professional advice included in this report.

The recommendations provided in this report are based upon our understanding of the described project information and on our interpretation of the data collected during our prior subsurface explorations. We have made our recommendations based upon experience with similar subsurface conditions under similar loading conditions. The recommendations apply to the specific project discussed in this report; therefore, any change in the structure configuration, loads, location, or the site grades should be provided to us so that we can review our conclusions and recommendations and make any necessary modifications.

The recommendations provided in this report are also based upon the assumption that the necessary geotechnical observations and testing during construction will be performed by representatives of our firm. The field observation services are considered a continuation of the geotechnical investigation and essential to verify that the actual soil conditions are as expected. This also provides for the procedure whereby the client can be advised of unexpected or changed conditions that would require modifications of our original recommendations. If another firm is retained for the geotechnical observation services, our professional responsibility and liability would be limited to the extent that we would not be the geotechnical engineer of record.

6.0 References

Amec Foster Wheeler, 2016a, Geotechnical Data Report, Proposed Mohave 500kV Substation Series Capacitors Upgrade, Part of Eldorado-Lugo-Mohave Series Capacitor Project, Laughlin, Clark County, Nevada, Project No. 4953-16-0471, dated June 24, 2016.

Amec Foster Wheeler, 2016b, Additional Consolidation Test Results, Proposed Mohave 500kV Substation Series Capacitors Upgrade, Part of Eldorado-Lugo-Mohave Series Capacitor Project, Laughlin, Clark County, Nevada, Project No. 4953-16-0471, dated July 13, 2016.

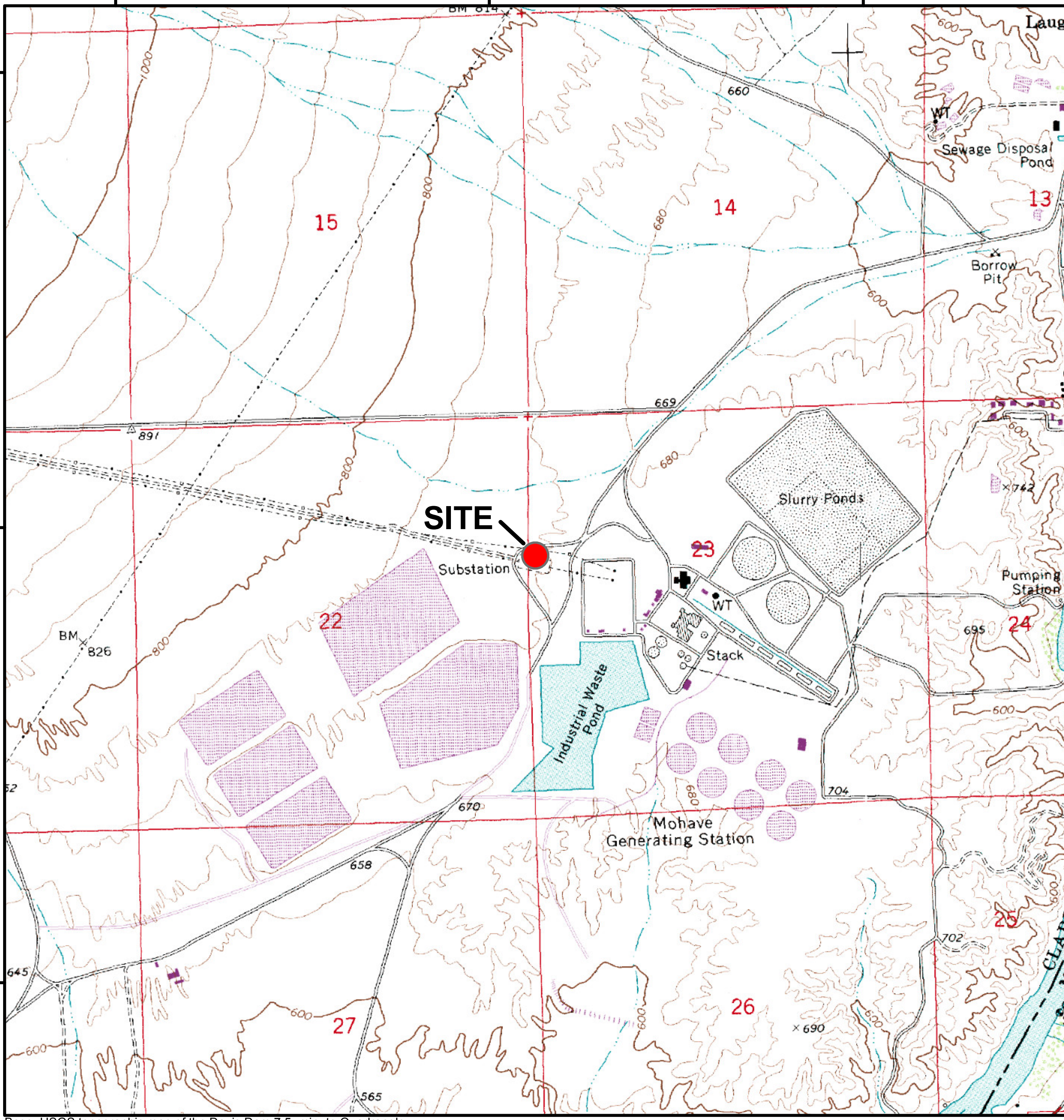
Nevada Bureau of Mines and Geology, Nevada Faults Map, Quaternary Faults in Nevada, https://gisweb.unr.edu/QuaternaryFaults/ accessed 5/18/2018.

Nevada Bureau of Mines and Geology, Stewart and Carlson's Geologic Map of Nevada, https://gisweb.unr.edu/NevadaGeology/ accessed 5/18/2018.

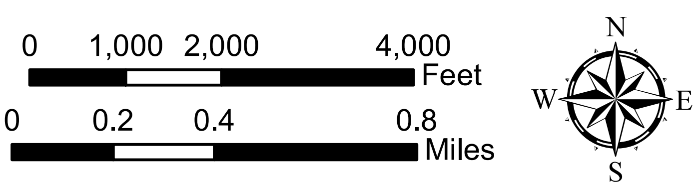
Wood, 2018, Geotechnical Foundation Design Parameters, Eldorado Lugo-Mohave Series Capacitor Upgrade Project, Mohave 500kV Substation Series Capacitors, Laughlin, Clark County, Nevada, Project No. 4953-18-0131.03.

Figure 1

Site Vicinity Map



Base: USGS topographic map of the Davis Dam 7.5 -minute Quadrangle.



wood.

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Mohave 500 kV Substation Series Capacitors Upgrade
Part of the Eldorado-Lugo-Mohave Series Capacitor Project
Laughlin, Clark County, Nevada

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LON:	-114.5986
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DATE:	7/6/2018

SITE VICINITY MAP

FIGURE: 1

PROJECT: 4953-18-0131

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Figure 2

Boring Location Map

Reference: Southern Nevada Water Authority Orthoimagery, 2014

LEGEND

3 ● PRIOR REPORT (4953-16-0471) BORING LOCATIONS

0 25' 50' 100'

SCALE: 1" = 50'

wood.

Wood
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Mohave 500 kV Substation Series Capacitors Upgrade
Part of the Eldorado-Lugo-Mohave Series Capacitor Project
Laughlin, Clark County, Nevada

LT,LNG:	
SCALE:	1" = 50'
DRAWN:	VMN
CHKD:	EJJ
DATE:	05/21/2018

Boring Location Map

FIGURE NO. 2

PROJECT NO. 4953-18-0131

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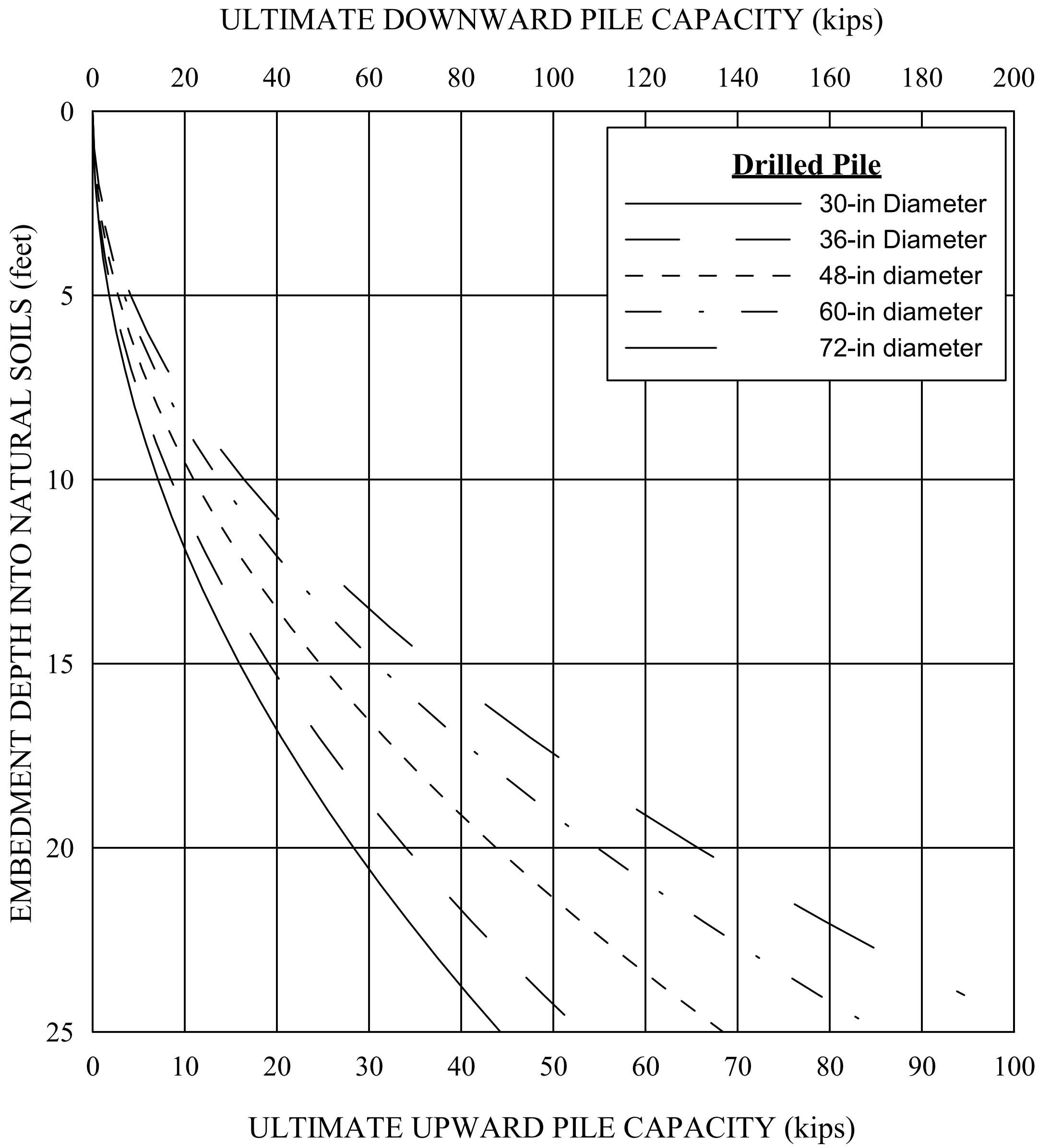
Date: May 22, 2018 - 11:15am By: vo.nguyen

Figure 3

Drilled Shaft Capacities



NOTES:

(1) The allowable capacities can be obtained by dividing the indicated value by 2.

(2) The indicated values refer to the total of dead plus live loads; a one-third increase may be used when considering wind or seismic loads analyses.

(3) The indicated values are based on the strength of the soils; the actual pile capacities may be limited to lesser values by the strength of the existing piles.

(4) The capacities shown are based on skin friction only.

(5) It may be prudent to neglect the upper one foot of pile embedment.

Prepared/Date: GA 2/12/2018
Checked/Date: EJJ 2/14/2018

SCE Capacitor Upgrade Project Mohave Site Laughlin, Clark County, Nevada	wood.	DRILLED PILE CAPACITIES Project No. 4953-18-0131 Figure 3

Appendix A

Boring Logs

APPENDIX A
FIELD EXPLORATIONS

Site conditions were explored by the excavation of three borings at the locations shown on Figure 2. The logs of the borings are presented in Figures A-1.1, A-1.2, and A-1.3. Prior to drilling, the boring locations were marked in the field and Underground Services Alert was notified to mark the location of known utilities. A geophysical survey of each of the proposed boring locations was performed by GEOVision to identify possible buried utilities in the vicinity. As an added precaution, the upper five feet of the borings was hand augered.

The three borings were drilled using limited access hollow-stem auger drilling equipment. The hollow stem borings were drilled to a depth of 51 feet below the existing grade. The diameter of the borings was 8 inches. Groundwater was not encountered to the maximum depth drilled of 51½ feet below the existing grade.

The soils encountered were logged by our geologist and relatively undisturbed and bulk samples were obtained for laboratory inspection and testing. The depths at which samples were obtained are indicated on the left side of the boring logs. Relatively undisturbed samples were obtained using California Modified ring samplers. The number of blows required to drive the samplers 12 inches using a 140 pound hammer falling 30 inches is indicated on the boring logs. In addition to obtaining undisturbed samples, standard penetration tests (SPT) were also performed. The soils are classified in the accordance with the Unified Soil Classification System described on Figure A-2.

BORING 1

DATE DRILLED: May 17, 2016
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: **

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	SAMPLE LOC.	USCS	DESCRIPTION
	0						SM	SILTY SAND - loose, moist, yellowish brown, few gravel up to 1/2 inch in diameter
	5		14	112	9/9/9		ML	SANDY SILT - loose, moist, fine to medium grained, (53% Passing No. 200 Sieve)
								Grading to sand
			12	90	5/13/18		SP-SM	POORLY GRADED SAND with SILT - medium dense, light yellowish brown, fine to medium grained, trace gravel up to 3/8 inch in diameter, (8% Passing No. 200 Sieve)
	10		1	111	7/16/25		SP	POORLY GRADED SAND - medium dense, fine grained, some medium, trace gravel up to 1/2 inch in diameter, subangular, friable
	15	7/12/17						Dry, fine grained, trace medium, trace gravel up to 3/8 inch in diameter, (4% Passing No. 200 Sieve)
	20		23	84	20/43/50			Fine grained
	25	11/21/30						(4% Passing No. 200 Sieve)
							SP	POORLY GRADED SAND with GRAVEL - very dense, dry, light yellowish brown, fine to coarse grained
	30				6/13/19			(Sample not recovered, added sand catcher to sampler), medium dense
								Fine to medium grained with gravelly zones, gravel up to 1/2 inch in diameter, friable
	35	17/14/16					CH	FAT CLAY - hard, moist, brown, few silt
	40							

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE; REFER TO PLOT PLAN FOR MORE ACCURATE LOCATION INFORMATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

(CONTINUED ON FOLLOWING FIGURE)

Field Tech: PER
Prepared By: JF
Checked By: EJJ

BORING 1 (Continued)

DATE DRILLED: 5/17/2016
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION (ft): **

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	SAMPLE LOC.	USCS	DESCRIPTION
		22.3	102	16/23/34			(LL=52, PI=33)
	45						
						SP	POORLY GRADED SAND - very dense, dry, light yellowish brown, layers of Silty Sand
	50			19/41/ 50/5¼"			Fine grained, friable
							END OF BORING AT 51 FEET
	55						
	60						
	65						
	70						
	75						
	80						

NOTES:
Hand augered upper 5 feet to avoid damage to utilities. Groundwater was not encountered. Boring was backfilled with soil cuttings and tamped.

* Number of blows required to drive the Modified California sampler 12 inches using a 140 pound automatic hammer falling 30 inches.

** Elevations are not available.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE; REFER TO PLOT PLAN FOR MORE ACCURATE LOCATION INFORMATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Field Tech: PER
Prepared By: JF
Checked By: EJJ

BORING 2

DATE DRILLED: May 17, 2016
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: **

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	SAMPLE LOC.	USCS	DESCRIPTION
	0						SM	SILTY SAND - moist, yellowish brown, fine to medium grained, few gravel up to 1 inch in diameter, subangular
	5		18	110	12/15/11		ML	SANDY SILT - very stiff, moist, light yellowish brown, fine to medium sand, trace gravel up to 3/8 inch in diameter, (58% Passing No. 200 Sieve)
			3	105	6/14/15			Change to friable sand
							SP	POORLY GRADED SAND - medium dense, dry, light yellowish brown, fine to medium grained, friable
	10		30	77	8/16/24			(2% Passing No. 200 Sieve)
	15	15/21/19						Dense
	20		3	104	20/36/40			Very dense, fine to medium grained, some coarse, trace gravel up to 3/8 inch in diameter, friable, (3% Passing No. 200 Sieve)
	25	9/19/22						Dense, moist, fine grained, friable
	30		3	101	12/29/38			Fine to medium grained, few gravel up to 1/2 inch in diameter, friable
	35							Rare gravel
		17/24/19					CL	LEAN CLAY - hard, moist, brown, alternating with layers of Silty Clay
	40							

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE; REFER TO PLOT PLAN FOR MORE ACCURATE LOCATION INFORMATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

(CONTINUED ON FOLLOWING FIGURE)

Field Tech: PER
Prepared By: JF
Checked By: EJJ

BORING 2 (Continued)

DATE DRILLED: May 17, 2016
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: **

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	SAMPLE LOC.	USCS	DESCRIPTION
			18	107	21/36/39			
								From 44 to 44.5 feet: Sand layer From 44.5 to 45 feet: Clay layer
	45	17/31/21					ML	SANDY SILT - hard, fine sand
	50				20/ 50/4½"		SM	SILTY SAND - very dense, brown, fine grained, trace gravel up to 1/2 inch in diameter END OF BORING AT 51 FEET
	55							
	60							
	65							
	70							
	75							
	80							

NOTES:
Hand augered upper 5 feet to avoid damage to utilities. Groundwater was not encountered. Boring was backfilled with soil cuttings and tamped.

* Number of blows required to drive the Modified California sampler 12 inches using a 140 pound automatic hammer falling 30 inches.

** Elevations are not available.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE; REFER TO PLOT PLAN FOR MORE ACCURATE LOCATION INFORMATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Field Tech: PER
Prepared By: JF
Checked By: EJJ

BORING 3

DATE DRILLED: May 17, 2016
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: **

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	SAMPLE LOC.	USCS	DESCRIPTION
	0						SM	SILTY SAND - yellowish brown, fine to medium grained, trace gravel up to 1/4 inch in diameter
	5		19	91	9/17/21			Medium dense, moist, fine grained
			4	102	6/9/13		SP-SM	POORLY GRADED SAND with SILT - medium dense, dry, fine grained, (11% Passing No. 200 Sieve)
	10		4	98	5/8/13			Trace coarse
	15	9/14/17					SP	POORLY GRADED SAND with GRAVEL - dense, dry, light yellowish brown, fine sand, little gravel up to 3/4 inch in diameter, (3% Passing No. 200 Sieve)
								At 18 feet: Rig chatter
	20		7	105	12/28/36			Gravel up to 1½ inches in diameter, subangular
								At 22 feet: Grading finer
	25	9/16/24					SP	POORLY GRADED SAND - dense, dry, light yellowish brown, fine grained, few medium to coarse
	30		3	99	27/47/ 50/4"			Very dense, fine grained, trace medium to coarse
								Fine to medium grained, some gravel up to 1/4 inch in diameter
	35	11/25/18					CL	LEAN CLAY - hard, brown, cohesive
	40							

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE; REFER TO PLOT PLAN FOR MORE ACCURATE LOCATION INFORMATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

(CONTINUED ON FOLLOWING FIGURE)

Field Tech: PER
Prepared By: JF
Checked By: EJJ

BORING 3 (Continued)

DATE DRILLED: May 17, 2016
EQUIPMENT USED: Hollow Stem Auger
HOLE DIAMETER (in.): 8
ELEVATION: **

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	SAMPLE LOC.	USCS	DESCRIPTION
			19	103	13/33/ 50/5"		SP	Grading sandier POORLY GRADED SAND - very dense, moist, fine grained
							ML	SILT - moist, brown
	45						CL	LEAN CLAY - hard, moist, brown
		13/13/22						Sand layer, fine grained, friable
							ML	SILT to SANDY SILT - hard, dry, pale brown, fine sand
	50				36/ 50/4½"			
								END OF BORING AT 51 FEET
	55							
	60							
	65							
	70							
	75							
	80							

NOTES:
Hand augered upper 5 feet to avoid damage to utilities. Groundwater was not encountered. Boring was backfilled with soil cuttings and tamped.

* Number of blows required to drive the Modified California sampler 12 inches using a 140 pound automatic hammer falling 30 inches.

** Elevations are not available.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE; REFER TO PLOT PLAN FOR MORE ACCURATE LOCATION INFORMATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Field Tech: PER
Prepared By: JF
Checked By: EJJ

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of material is LARGER than No. 200 sieve size)	GRAVELS (More than 50% of coarse fraction is LARGER than the No. 4 sieve size)	CLEAN GRAVELS (Little or no fines)	GW	Well graded gravels, gravel - sand mixtures, little or no fines.
			GP	Poorly graded gravels or grave - sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel - sand - silt mixtures.
			GC	Clayey gravels, gravel - sand - clay mixtures.
	SANDS (More than 50% of coarse fraction is SMALLER than the No. 4 Sieve Size)	CLEAN SANDS (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand - silt mixtures
			SC	Clayey sands, sand - clay mixtures.
FINE GRAINED SOILS (More than 50% of material is SMALLER than No. 200 sieve size)	SILTS AND CLAYS (Liquid limit LESS than 50)		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts and with slight plasticity.
			CL	Inorganic lays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (Liquid limit GREATER than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils.

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

SILT OR CLAY	SAND			GRAVEL		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

No.200 No.40 No.10 No.4 3/4" 3" 12"

U.S. STANDARD SIEVE SIZE

Reference: The Unified Soil Classification System, Corps of Engineers, U.S. Army Technical Memorandum No. 3-357, Vol. 1, March, 1953 (Revised April, 1960)

Undisturbed Sample	Auger Cuttings
Split Spoon Sample	Bulk Sample
Rock Core	Crandall Sampler
Dilatometer	Modified California Sampler
Packer	No Recovery
Water Table at time of drilling	Water Table after drilling

Correlation of Penetration Resistance with Relative Density and Consistency

SAND & GRAVEL		SILT & CLAY	
No. of Blows	Relative Density	No. of Blows	Consistency
0 - 4	Very Loose	0 - 1	Very Soft
5 - 10	Loose	2 - 4	Soft
11 - 30	Medium Dense	5 - 8	Medium Stiff
31 - 50	Dense	9 - 15	Stiff
Over 50	Very Dense	16 - 30	Very Stiff
		Over 30	Hard

KEY TO SYMBOLS AND DESCRIPTIONS

amec foster wheeler

Figure A-2

Appendix B

Laboratory Test Results

APPENDIX B
LABORATORY TEST RESULTS

Soil samples collected from the borings were transported to the Amec Foster Wheeler laboratory and were reviewed by our engineer. The laboratory testing program was developed by SCE based on review of the draft boring logs and our review comments. Laboratory testing was performed by us under the direction of SCE.

The field moisture content and dry density of the soils encountered were determined by performing tests on the undisturbed samples. The results of the tests are shown on the left side of the boring logs.

Direct shear tests were performed on selected undisturbed and remolded samples to determine the strength of the soils in accordance with ASTM D 3080 test method. The tests were performed after soaking the samples to near-saturated moisture content and at various surcharge pressures. The peak strength values obtained from the direct shear tests are presented on Figure B-1.1. The peak and ultimate strength values obtained from the direct shear tests, along with associated friction angles and cohesions are presented on Figure B-1.2 through B-1.10.

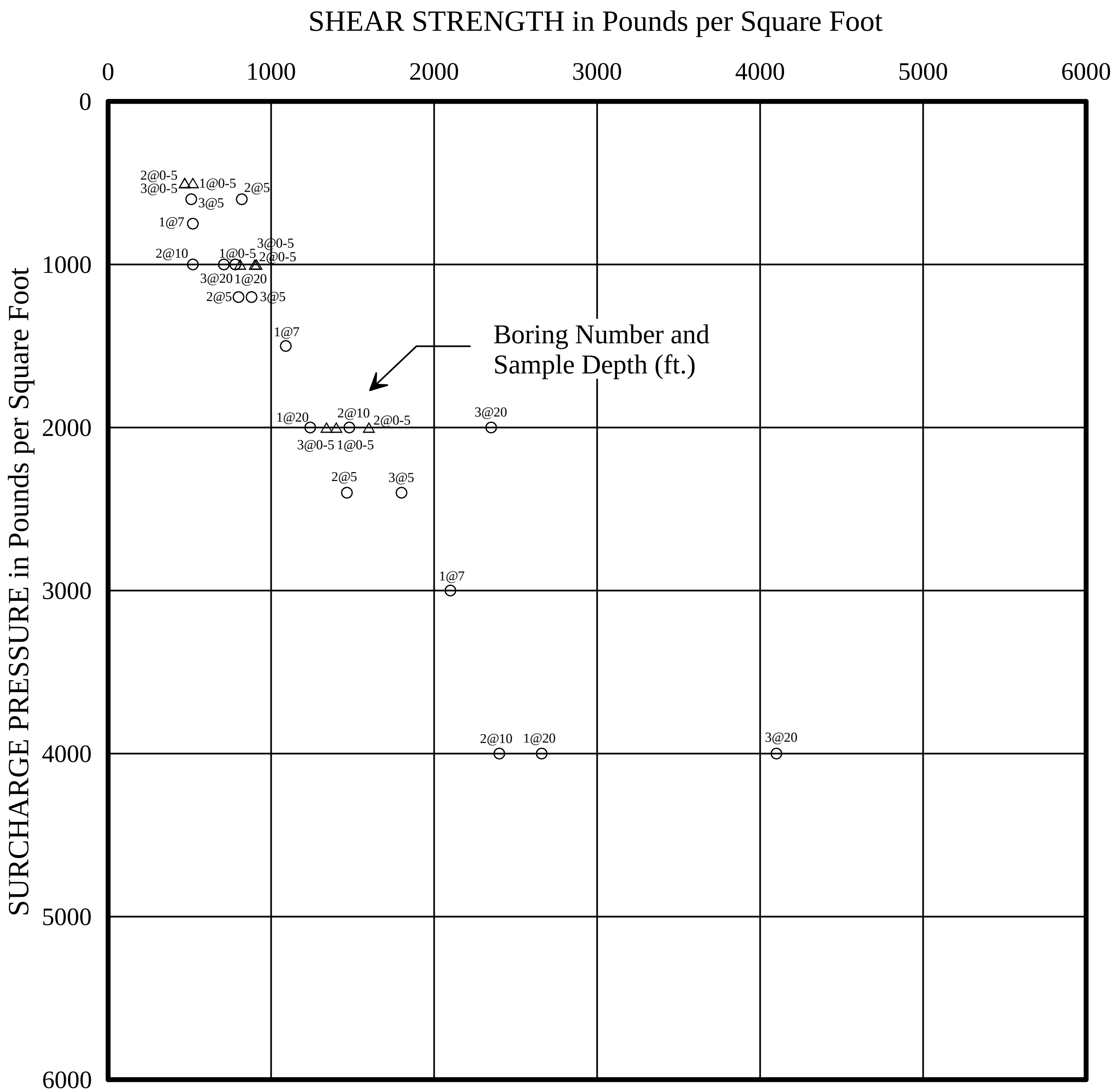
Consolidation testing was performed on seven selected samples in accordance with the ASTM D 2435 test method. The results of the tests are presented on Figures B-2.1 through B-2.7.

To determine the particle size distribution of the soils and to aid in classifying the soils, mechanical analyses were performed on nine selected samples in accordance with the ASTM D 6913 test method. The results of the mechanical analyses are presented on the boring logs and Figures B-3.1, B-3.2, and B-3.3.

Atterberg Limit tests were performed on one selected sample to determine the plasticity of the materials and to classify the soils in accordance with the ASTM D 4318 test method. The result of the test is presented on the boring logs and Figure B-4.

The optimum moisture content and maximum dry density of the near-surface soils were determined by performing compaction tests on three bulk samples obtained in the field. The tests were performed in accordance with the ASTM Designation D 1557 test method. The results of the tests are presented on Figure B-5.

Chemical testing was performed on selected samples to determine corrosivity of site soils by HDR. The results are presented on Figures B-6.1 and B-6.2.

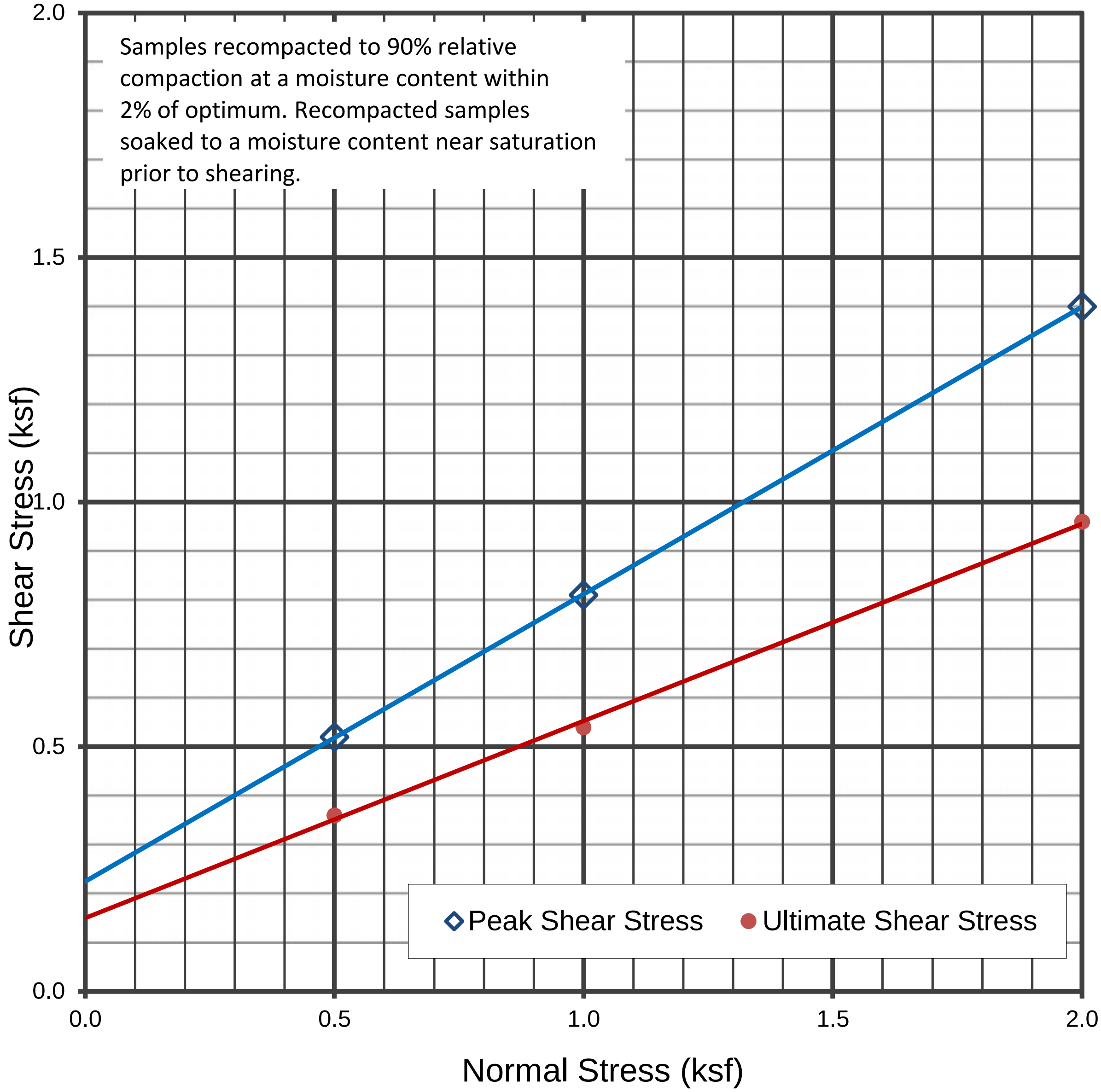


○ Samples tested after soaking to a moisture content near saturation

△ Samples were compacted to 90% and brought to within 2% of optimum moisture.

Prepared/Date: JF 6/7/2016
Checked/Date: EJJ 6/9/2016

Southern California Edison Mohave 500 kV Substation Laughlin, Clark County, Nevada	amec foster wheeler	DIRECT SHEAR TEST DATA Project No. 4953-16-0471 Figure B-1.1



Boring No.:	1
Sample No.:	n/a
Sample Depth (feet) :	0-5
Soil Type:	Silty Sand (SM)
Sample Conditions:	Recompacted; Soaked
In-Place Dry Density (PCF):	111
In-Place Moisture Content (%):	14.9

	◇	●
Cohesion (PSF):	225	150
Friction Angle (Degrees):	30	22

amec foster wheeler

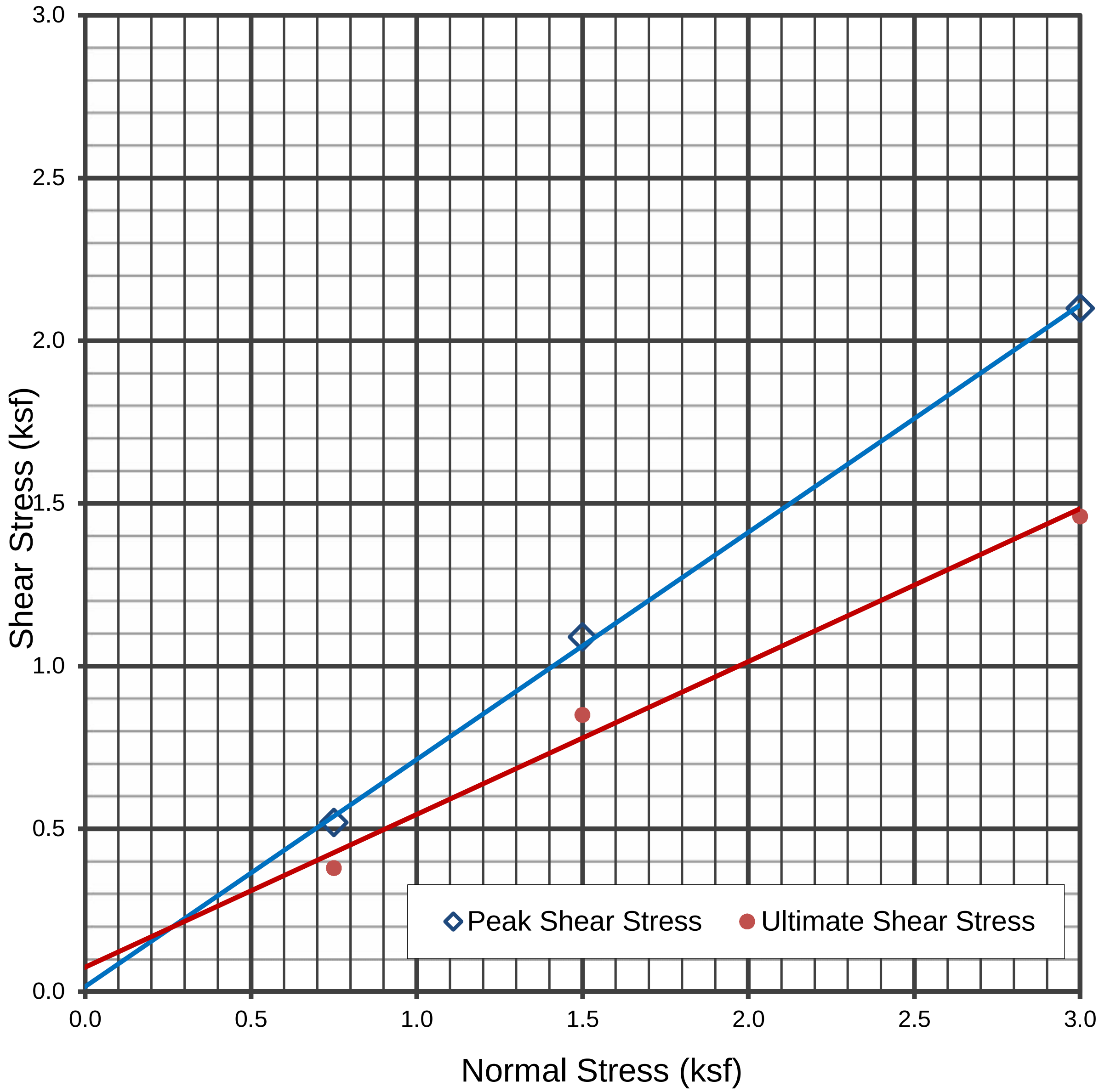
DIRECT SHEAR TEST

Southern California Edison
Mohave 500 kV Substation

Laughlin, Clark County, Nevada

Project No. 4953-16-0471

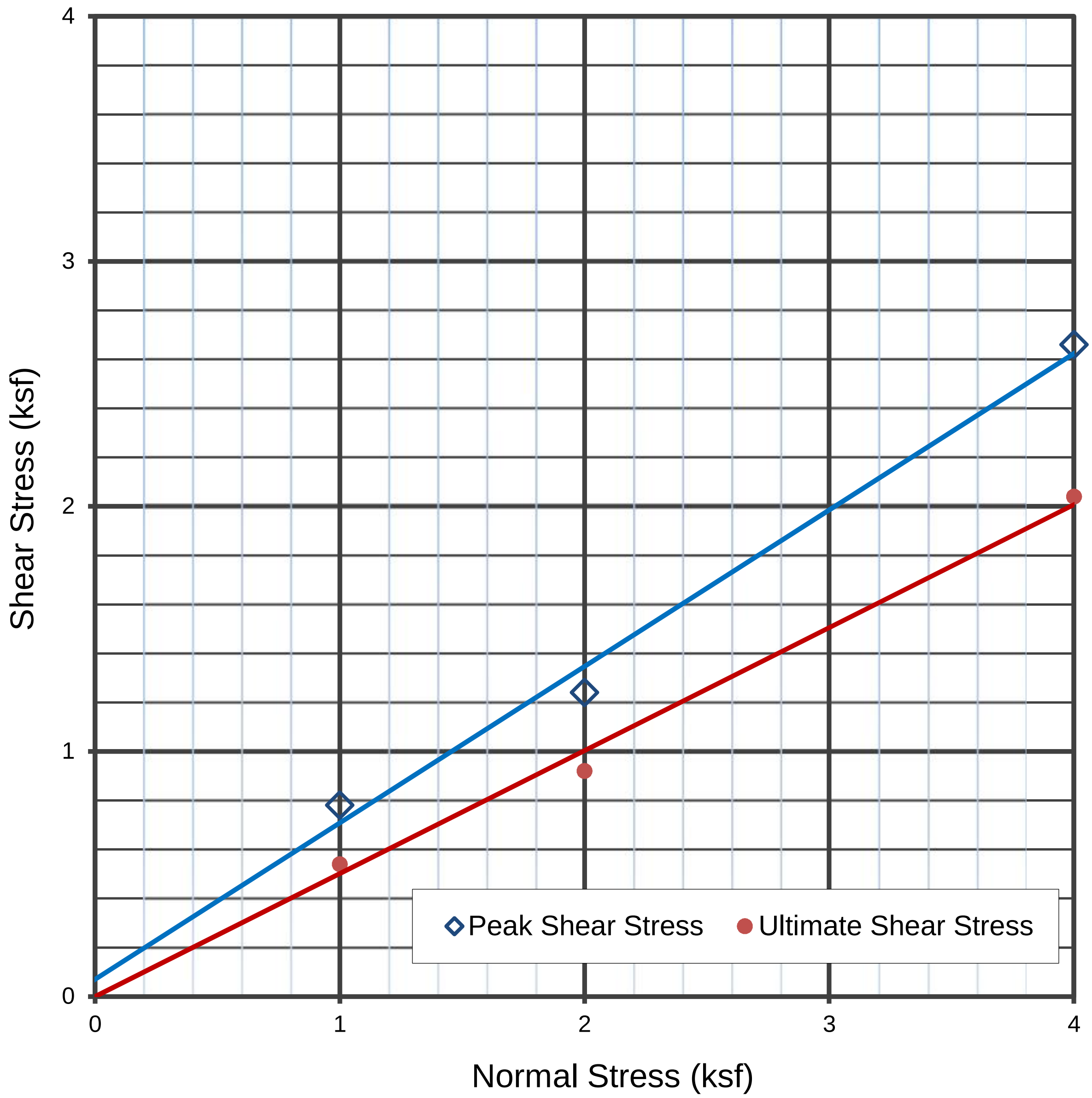
Figure B-1.2



Boring No.:	1
Sample No.:	n/a
Sample Depth (feet) :	7
Soil Type:	Poorly Graded Sand (SP)
Sample Conditions:	Intact; Soaked
In-Place Dry Density (PCF):	90
In-Place Moisture Content (%):	11.5

	◇	●
Cohesion (PSF):	15	75
Friction Angle (Degrees):	35	25

amec foster wheeler	DIRECT SHEAR TEST Southern California Edison Mohave 500 kV Substation Laughlin, Clark County, Nevada	Project No. 4953-16-0471 Figure B-1.3



Boring No.:	1
Sample No.:	n/a
Sample Depth (feet) :	20
Soil Type:	Poorly Graded Sand (SP)
Sample Conditions:	Intact; Soaked
In-Place Dry Density (PCF):	84
In-Place Moisture Content (%):	23.4

	◇	●
Cohesion (PSF):	70	0
Friction Angle (Degrees):	33	27

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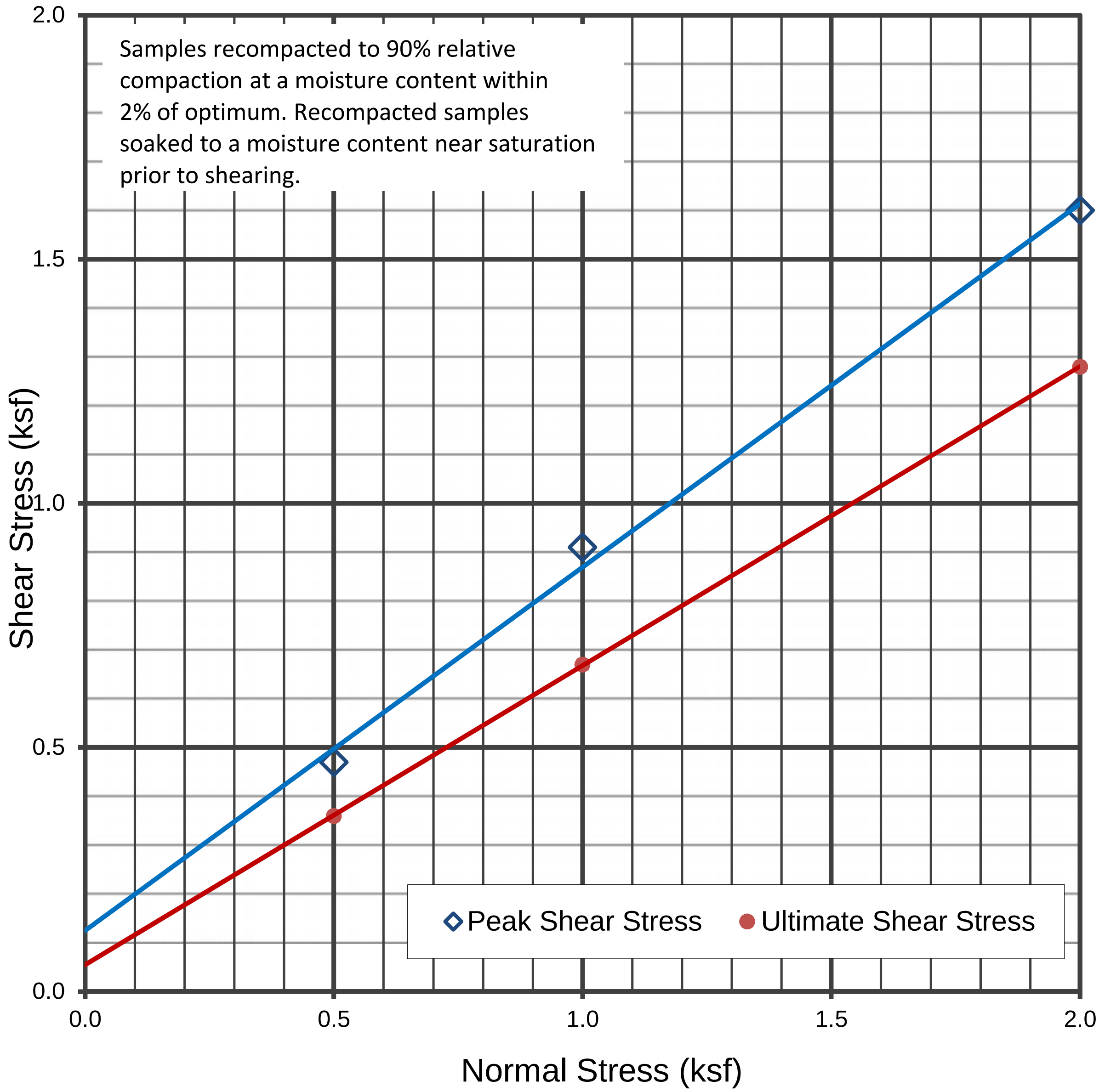
DIRECT SHEAR TEST

Southern California Edison
Mohave 500 kV Substation

Laughlin, Clark County, Nevada

Project No.
4953-16-0471

Figure
B-1.4



Boring No.:	2
Sample No.:	n/a
Sample Depth (feet) :	0-5
Soil Type:	Silty Sand (SM)
Sample Conditions:	Recompacted; Soaked
In-Place Dry Density (PCF):	116
In-Place Moisture Content (%):	10.5

	◇	●
Cohesion (PSF):	125	55
Friction Angle (Degrees):	37	32

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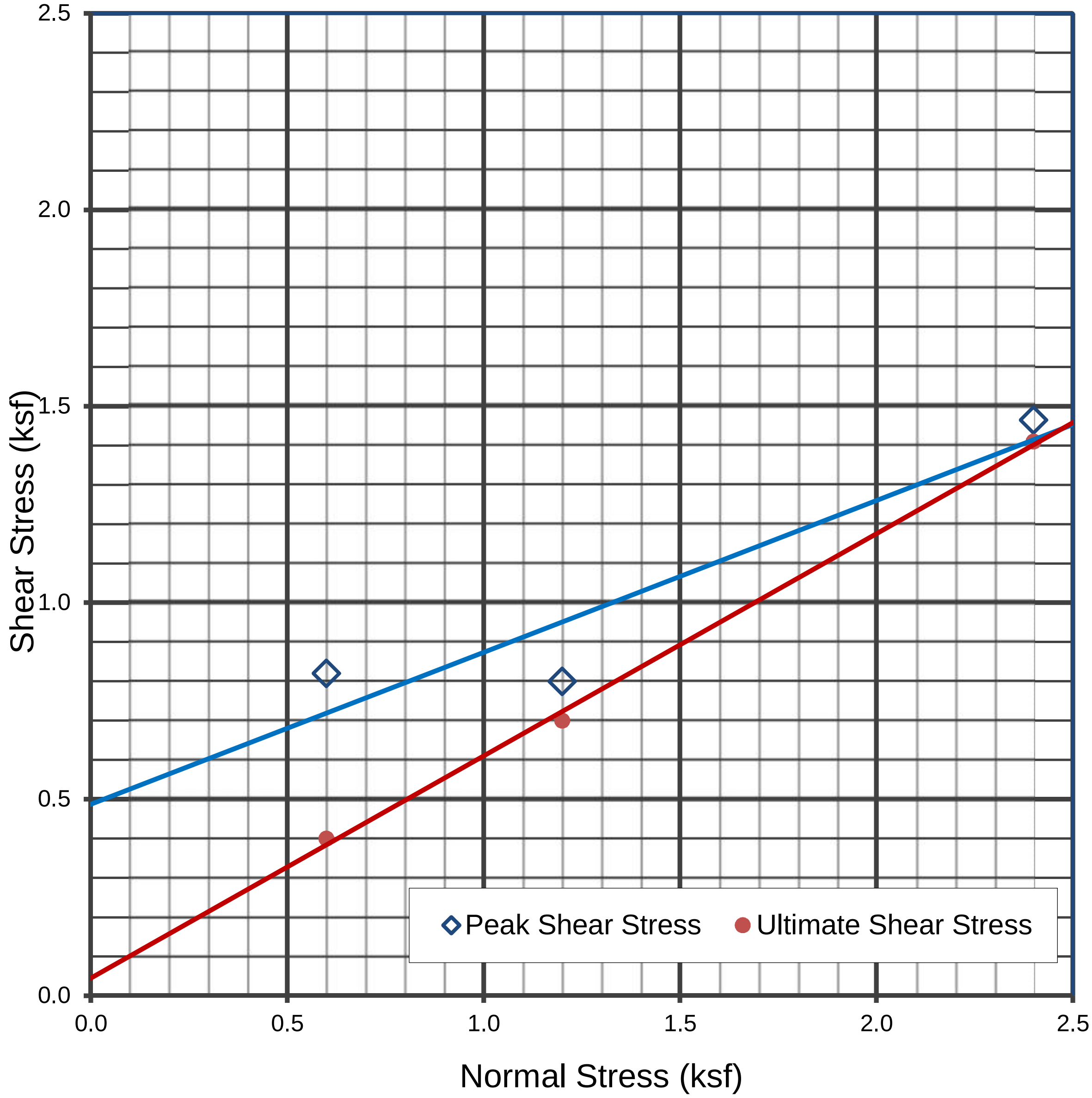
Mohave 500 kV Substation

Laughlin, Clark County, Nevada

Project No.
4953-16-0471

Figure
B-1.5



Boring No.:	2
Sample No.:	n/a
Sample Depth (feet) :	5
Soil Type:	Silty Sand (SM)
Sample Conditions:	Intact; Soaked
In-Place Dry Density (PCF):	110
In-Place Moisture Content (%):	17.5

	◇	●
Cohesion (PSF):	488	45
Friction Angle (Degrees):	21	29

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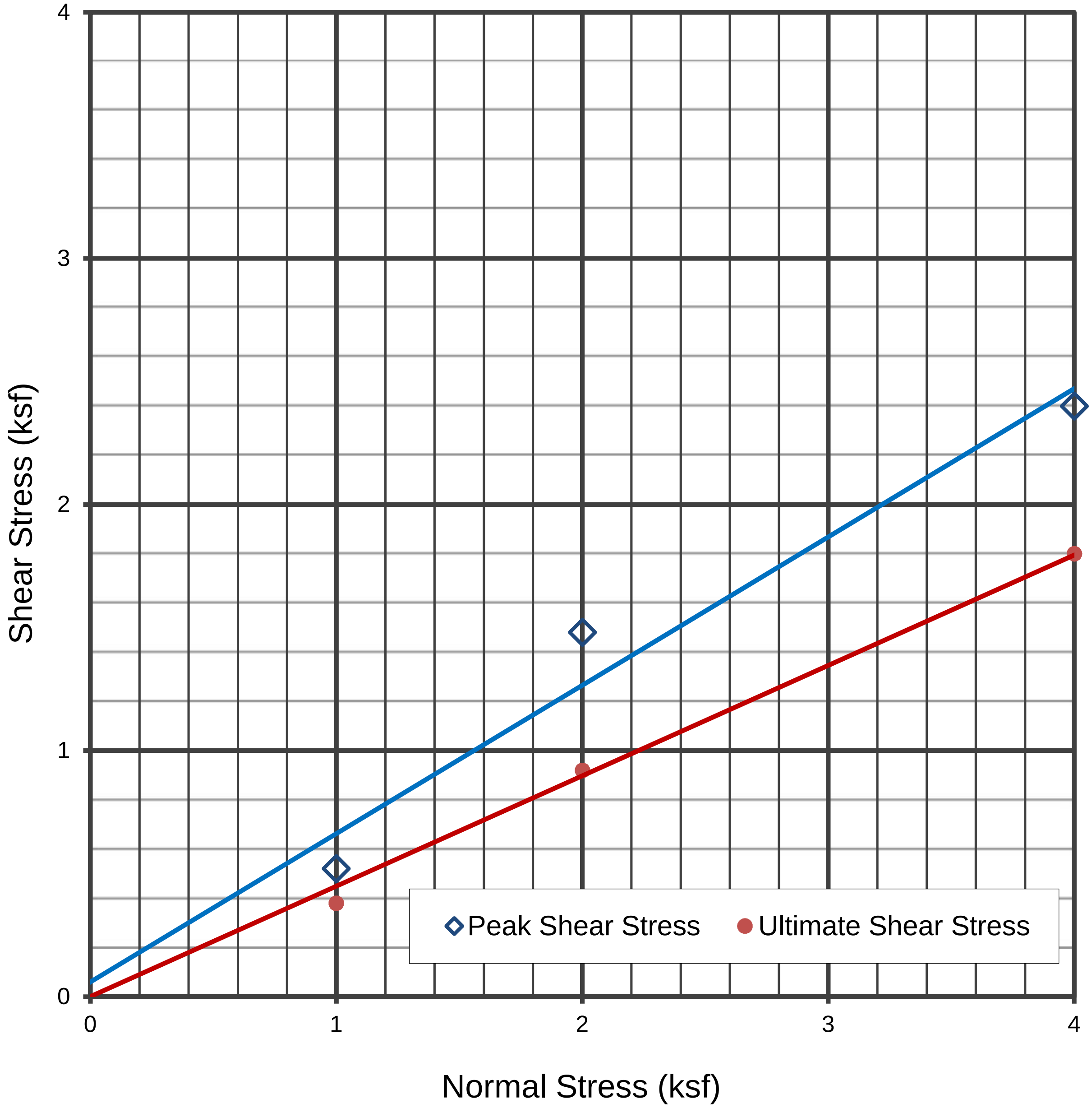
DIRECT SHEAR TEST

Southern California Edison
Mohave 500 kV Substation

Laughlin, Clark County, Nevada

Project No.
4953-16-0471

Figure
B-1.6



Boring No.:	2
Sample No.:	n/a
Sample Depth (feet) :	10
Soil Type:	Poorly Graded Sand (SP)
Sample Conditions:	Intact; Soaked
In-Place Dry Density (PCF):	77
In-Place Moisture Content (%):	29.6

	◇	●
Cohesion (PSF):	60	0
Friction Angle (Degrees):	31	24

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DIRECT SHEAR TEST

Southern California Edison

Mohave 500 kV Substation

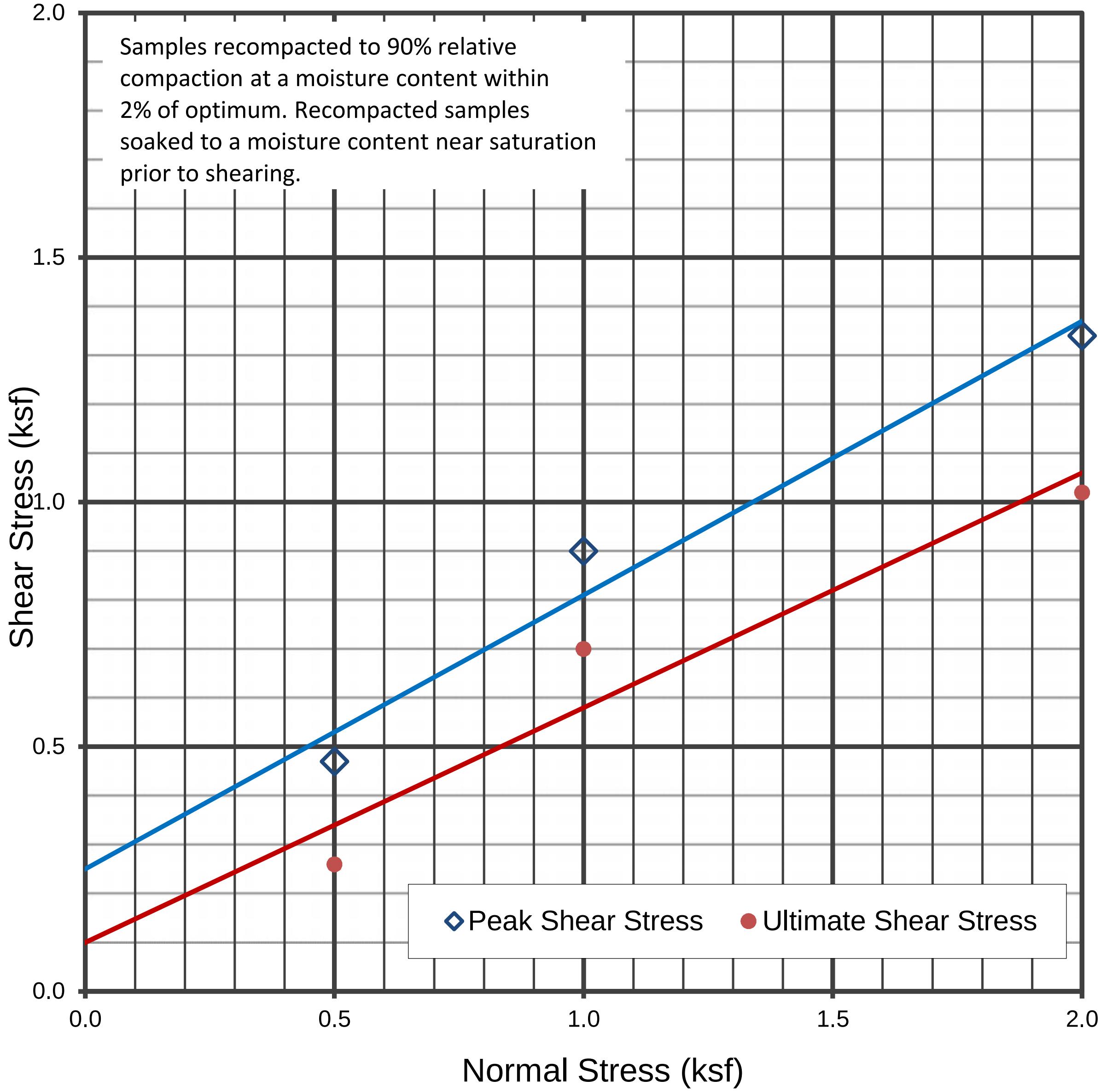
Laughlin, Clark County, Nevada

Project No.

4953-16-0471

Figure

B-1.7



Boring No.:	3
Sample No.:	n/a
Sample Depth (feet) :	0-5
Soil Type:	Silty Sand (SM)
Sample Conditions:	Recompacted; Soaked
In-Place Dry Density (PCF):	112
In-Place Moisture Content (%):	12.6

	◇	●
Cohesion (PSF):	250	100
Friction Angle (Degrees):	29	26

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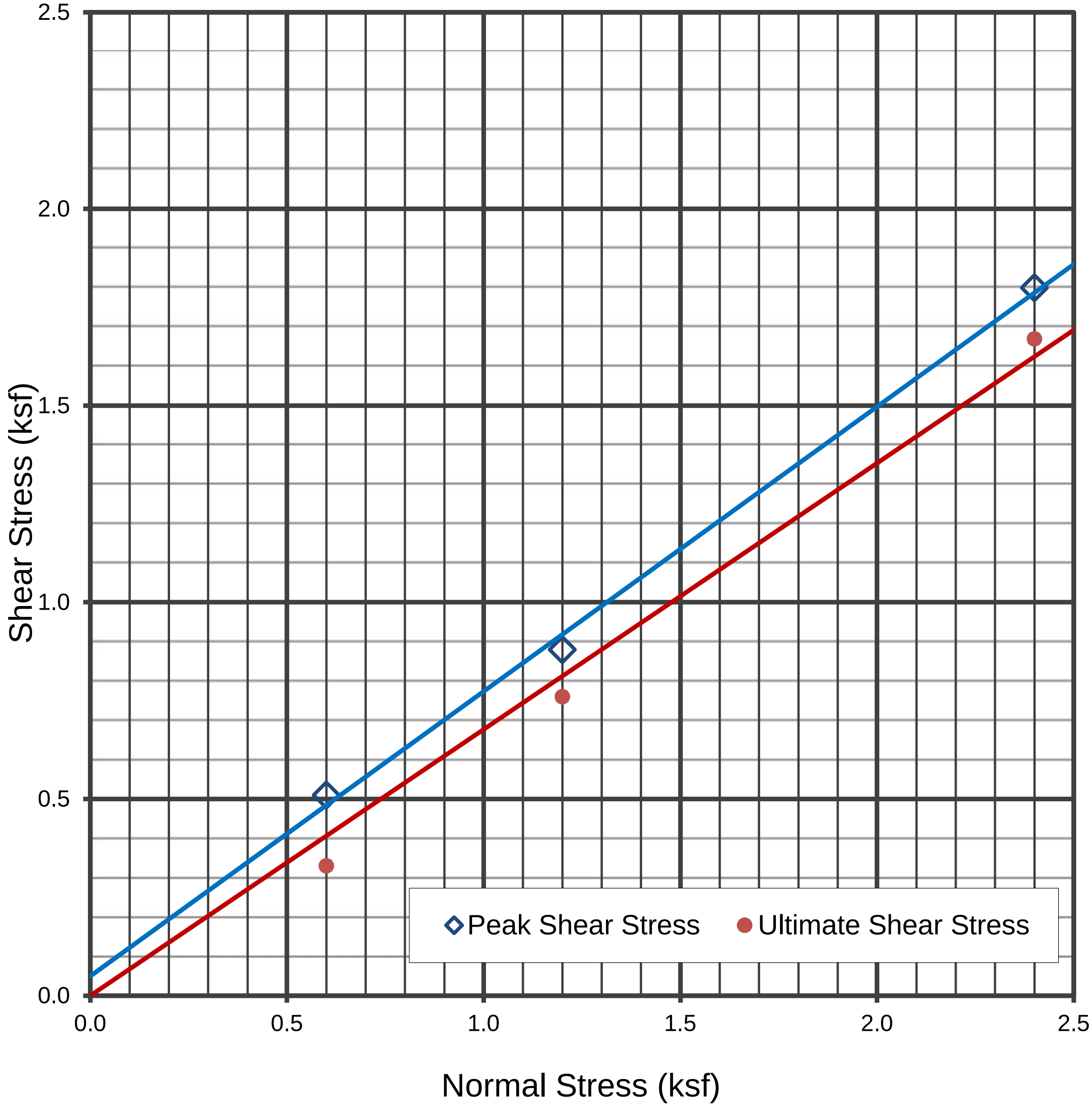
DIRECT SHEAR TEST

Southern California Edison
Mohave 500 kV Substation

Laughlin, Clark County, Nevada

Project No.
4953-16-0471

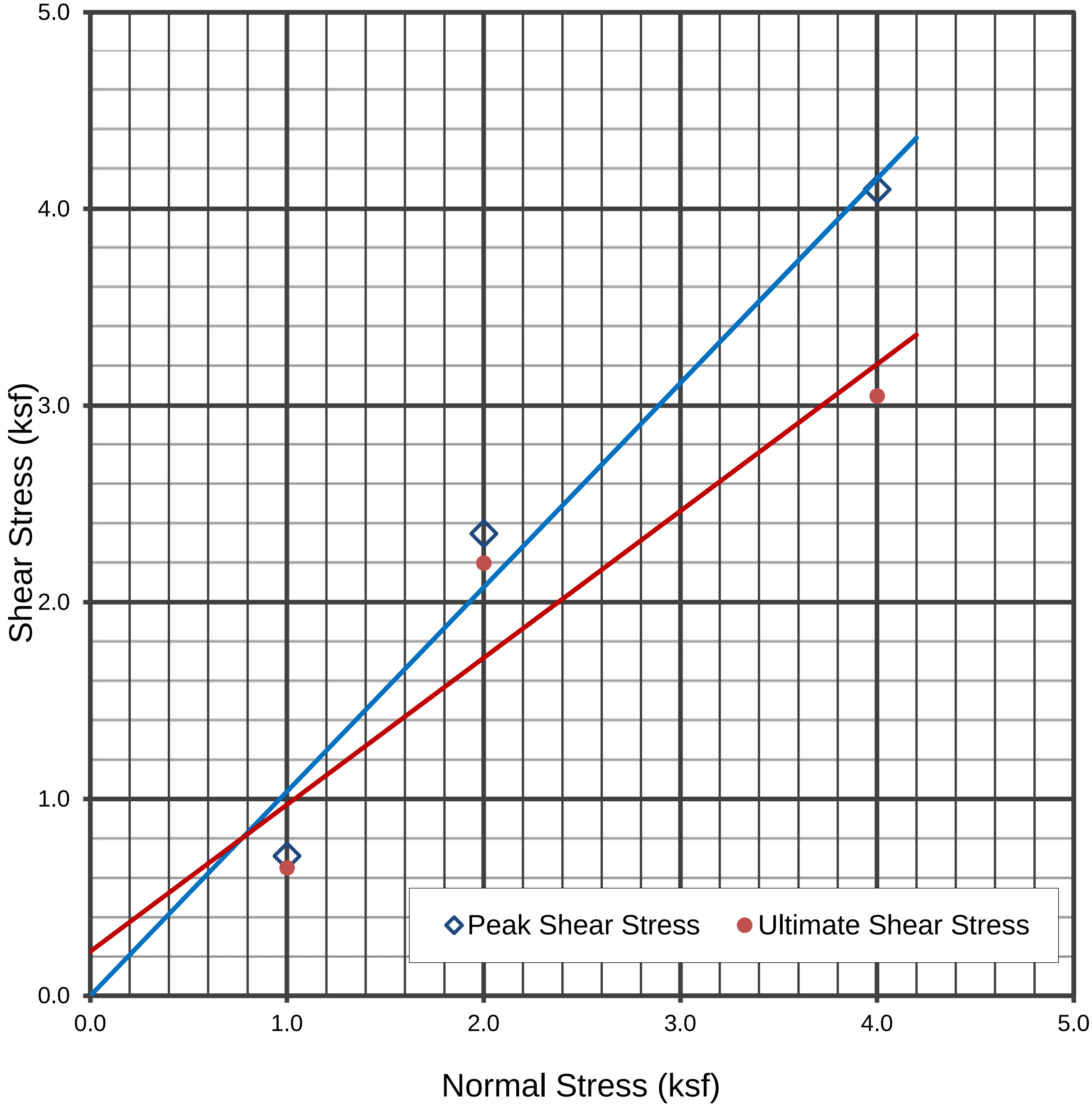
Figure
B-1.8



Boring No.:	3
Sample No.:	n/a
Sample Depth (feet) :	5
Soil Type:	Silty Sand (SM)
Sample Conditions:	Intact; Soaked
In-Place Dry Density (PCF):	91
In-Place Moisture Content (%):	18.9

	◇	●
Cohesion (PSF):	50	0
Friction Angle (Degrees):	36	34

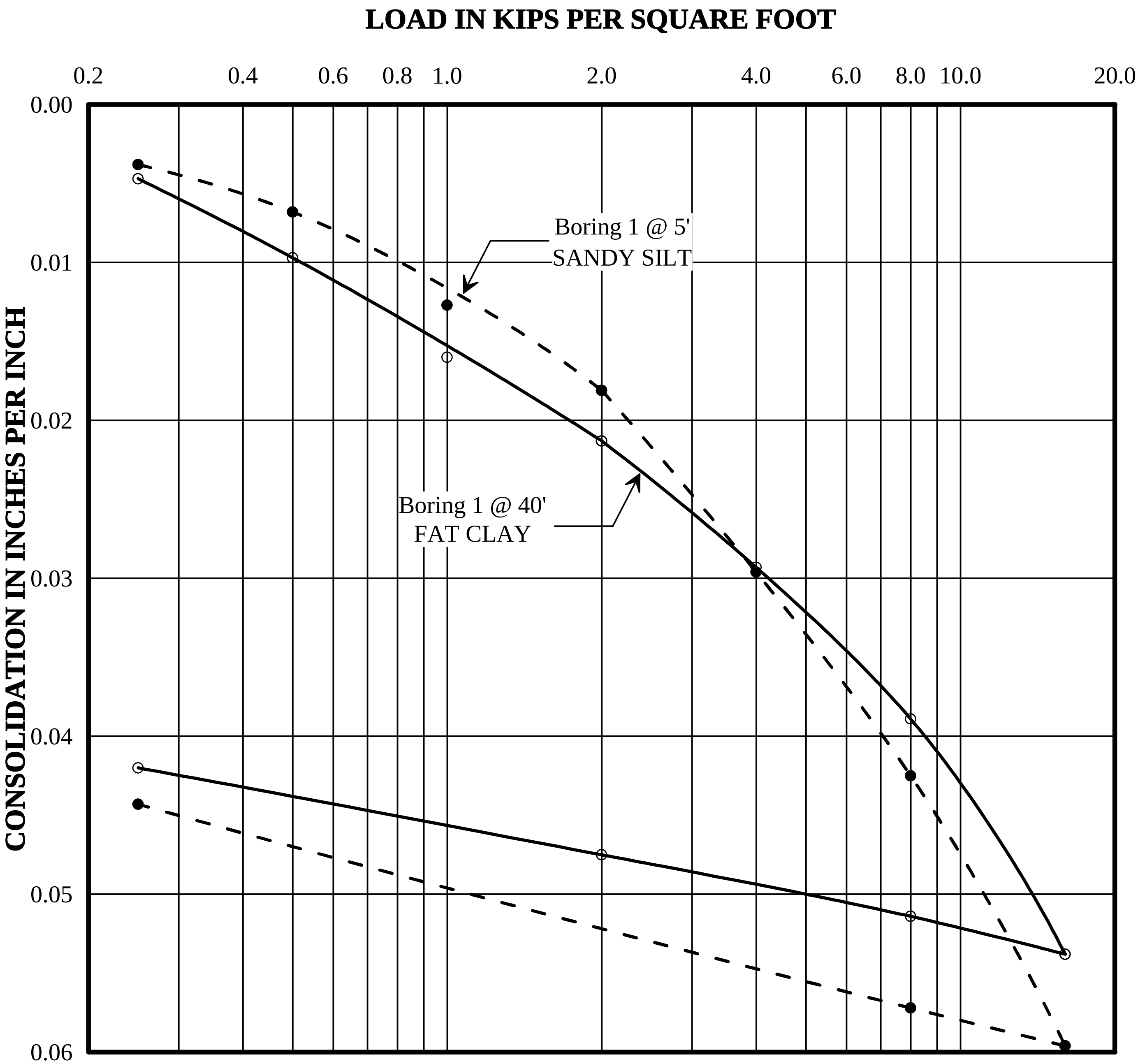
amec foster wheeler	DIRECT SHEAR TEST Southern California Edison Mohave 500 kV Substation Laughlin, Clark County, Nevada	Project No. 4953-16-0471
		Figure B-1.9



Boring No.:	3
Sample No.:	n/a
Sample Depth (feet) :	20
Soil Type:	Poorly Graded Sand w/ Gravel (SP)
Sample Conditions:	Intact; Soaked
In-Place Dry Density (PCF):	105
In-Place Moisture Content (%):	6.9

	◇	●
Cohesion (PSF):	0	225
Friction Angle (Degrees):	46	37

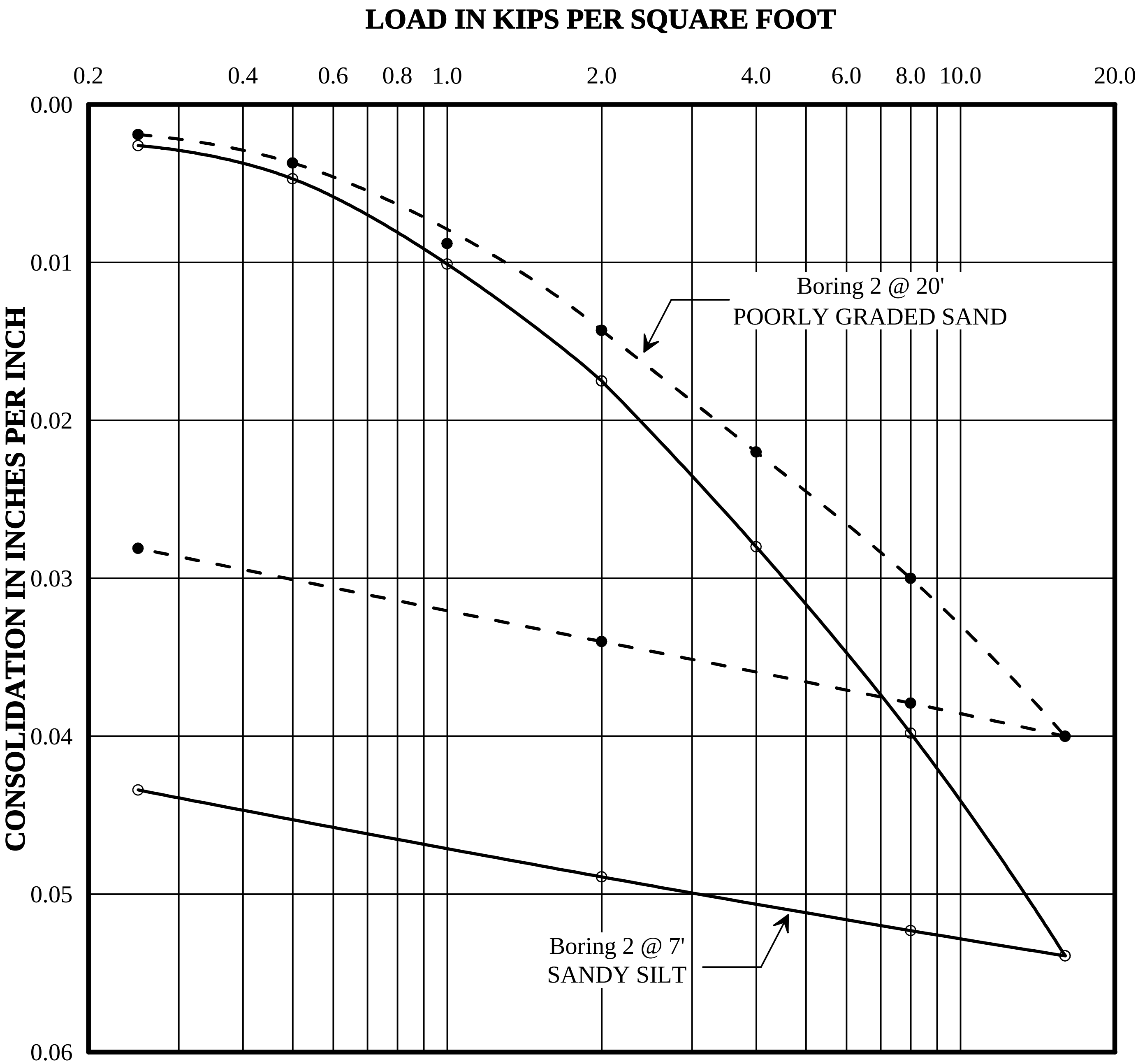
amec foster wheeler	DIRECT SHEAR TEST Southern California Edison Mohave 500 kV Substation Laughlin, Clark County, Nevada	Project No. 4953-16-0471 Figure B-1.10



Note: Samples tested at field moisture content.

Prepared/Date: JF 6/9/2016
Checked/Date: EJJ 6/9/2016

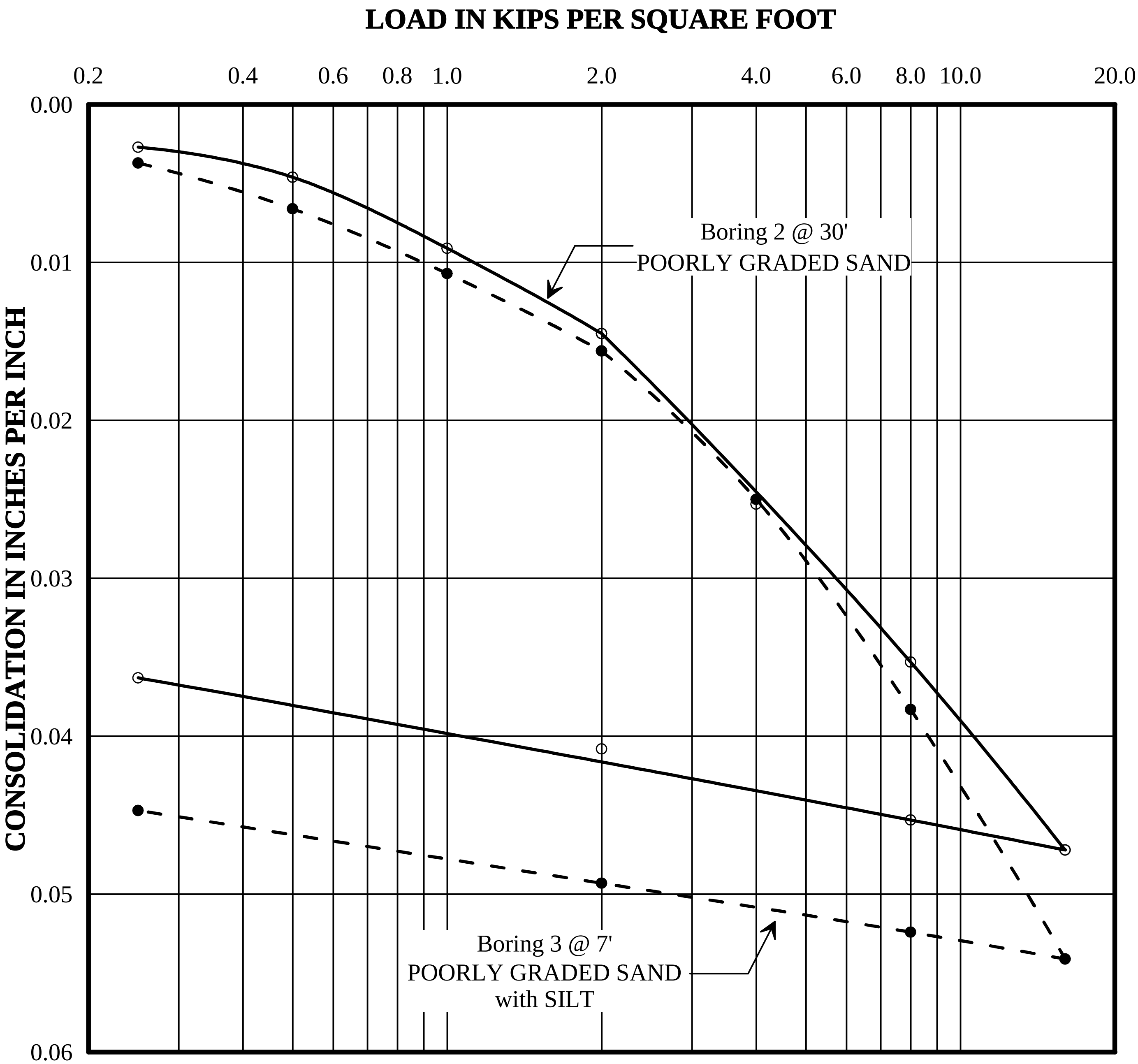
Southern California Edison Mohave 500 kV Substation Laughlin, Clark County, Nevada	amec foster wheeler	CONSOLIDATION TEST DATA Project No.: 4953-16-0471 Figure B-2.1



Note: Samples tested at field moisture content.

Prepared/Date: JF 6/9/2016
Checked/Date: EJJ 6/9/2016

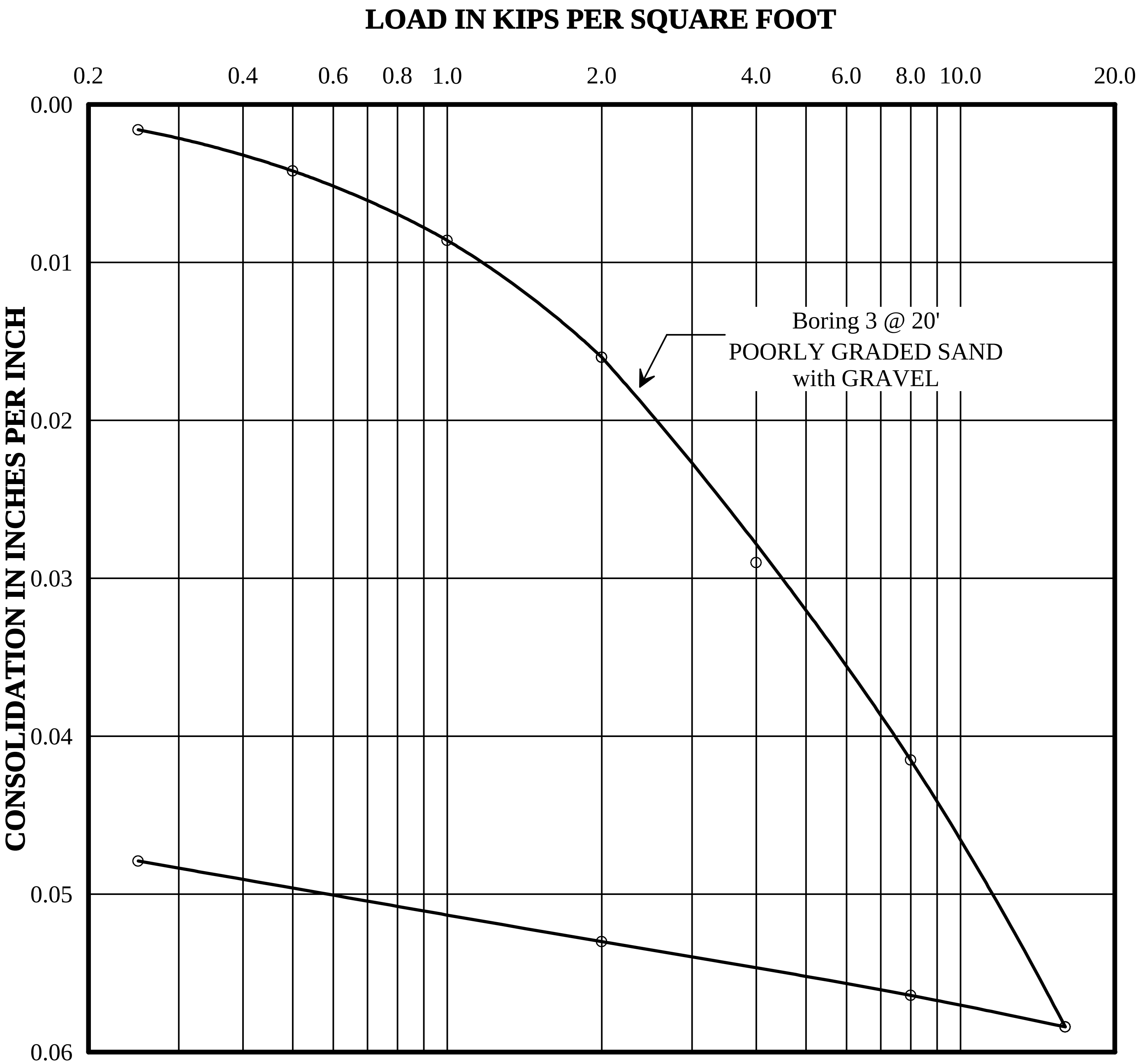
Southern California Edison Mohave 500 kV Substation Laughlin, Clark County, Nevada	amec foster wheeler	CONSOLIDATION TEST DATA Project No.: 4953-16-0471 Figure B-2.2



Note: Samples tested at field moisture content.

Prepared/Date: JF 6/9/2016
Checked/Date: EJJ 6/9/2016

Southern California Edison Mohave 500 kV Substation Laughlin, Clark County, Nevada	amec foster wheeler	CONSOLIDATION TEST DATA Project No.: 4953-16-0471 Figure B-2.3



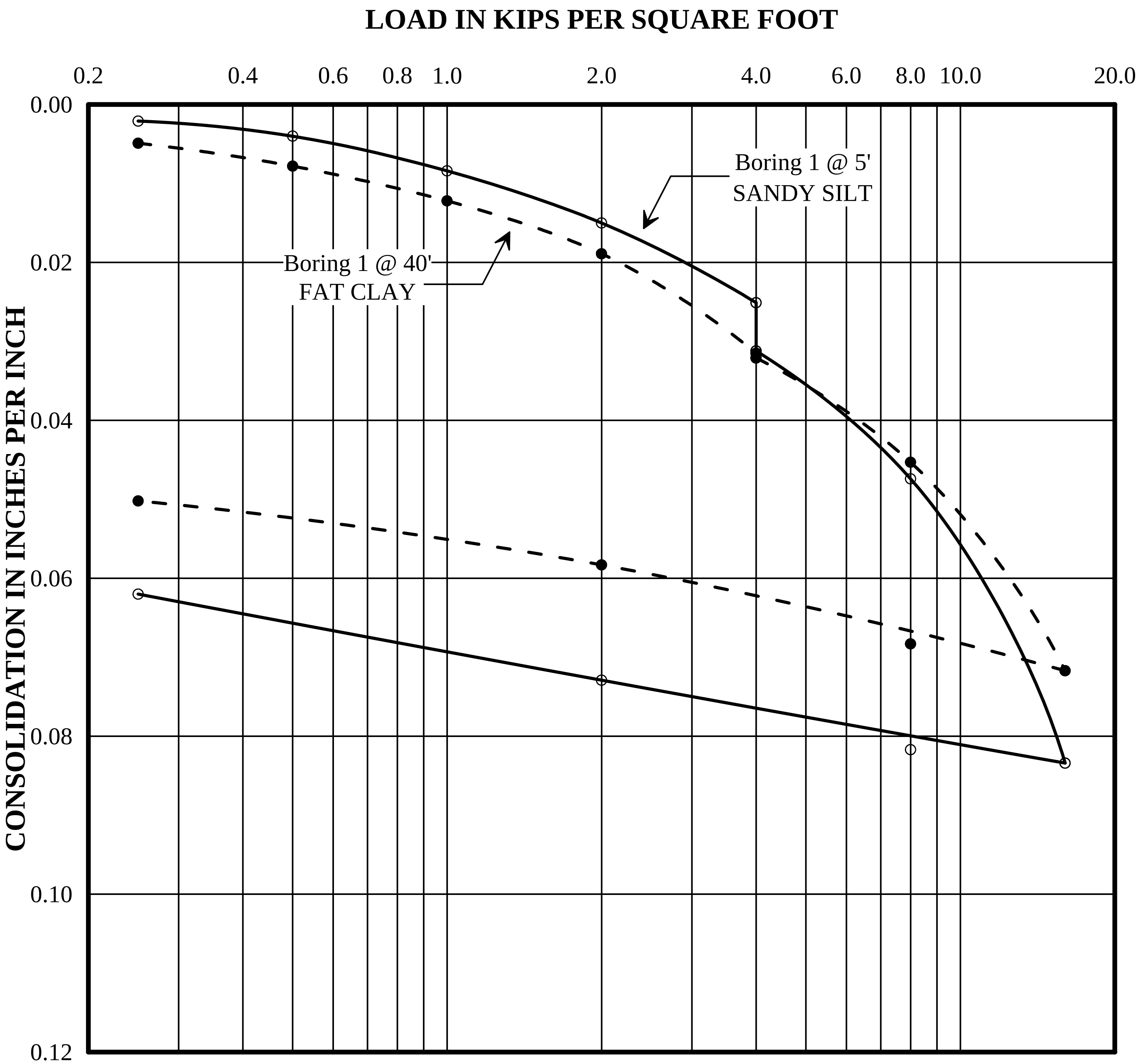
Note: Sample tested at field moisture content.

Prepared/Date: JF 6/9/2016
Checked/Date: EJJ 6/9/2016

Southern California Edison
Mohave 500 kV Substation
Laughlin, Clark County, Nevada

amec foster wheeler

CONSOLIDATION TEST DATA
Project No.: 4953-16-0471
Figure B-2.4



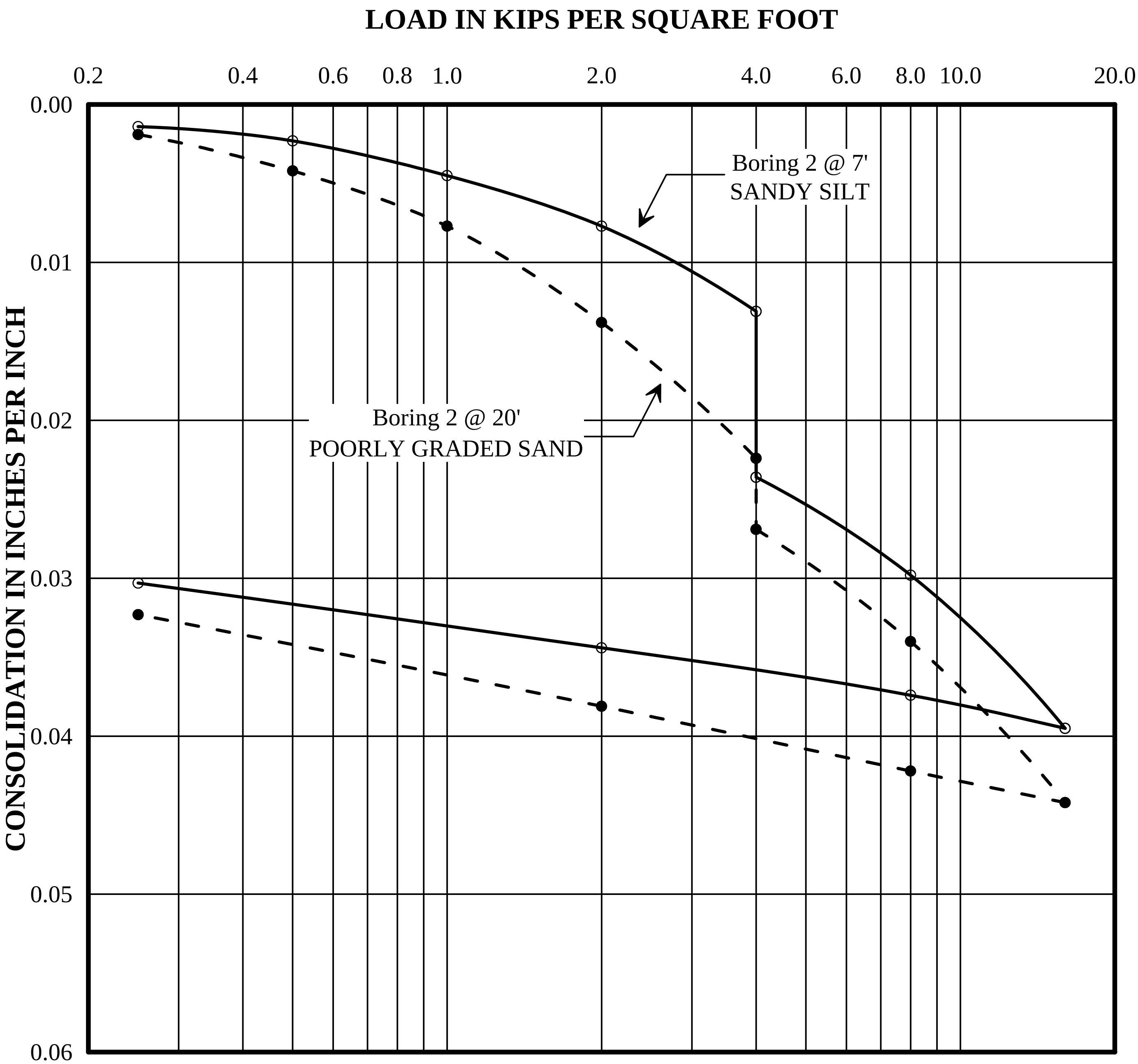
Note: Water added to samples after consolidation under a load of 4 kips per square foot.

Prepared/Date: CP 7/13/2016
Checked/Date: JF 7/13/2016

Southern California Edison
Mohave 500 kV Substation
Laughlin, Clark County, Nevada

amec foster wheeler

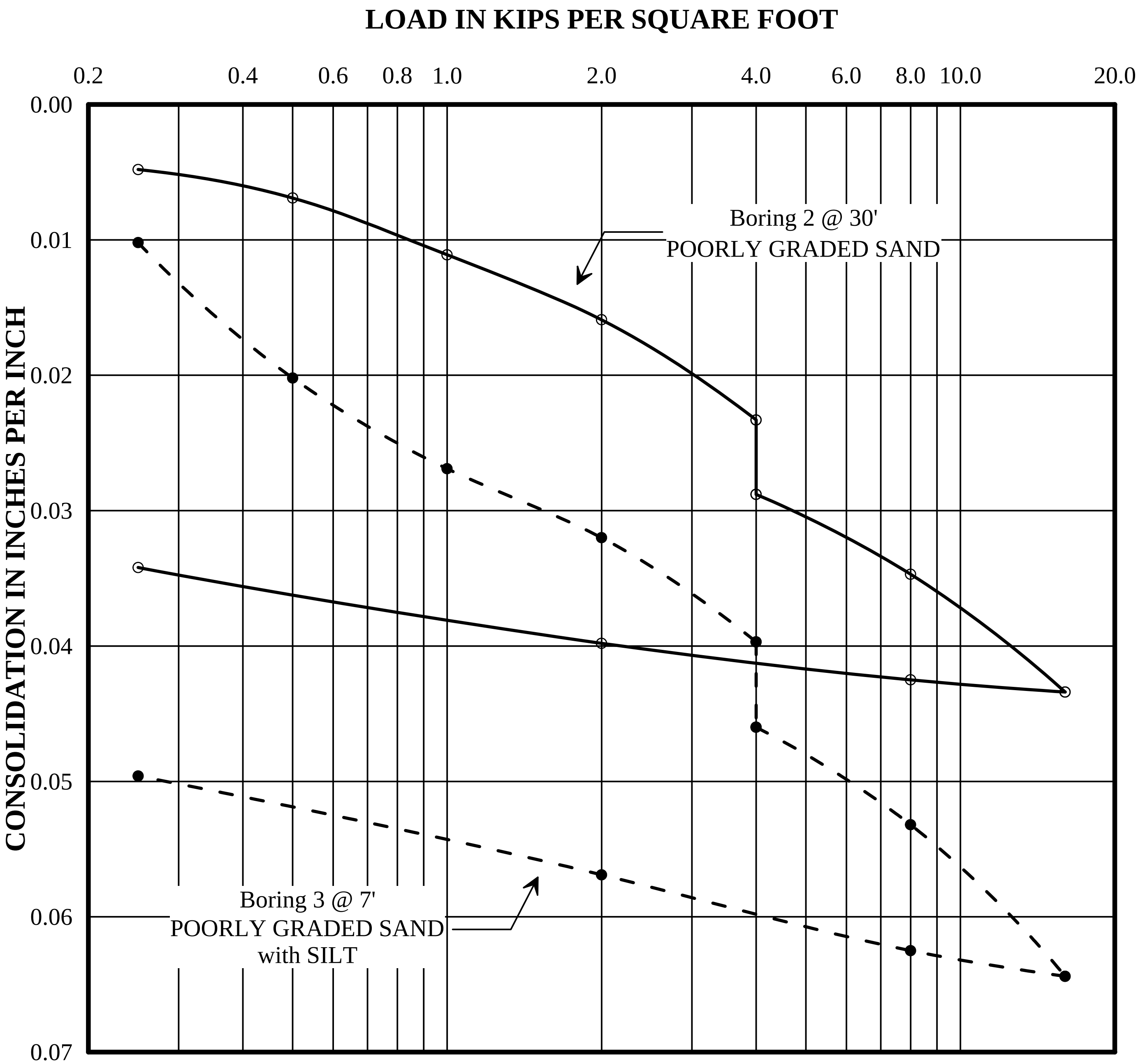
CONSOLIDATION TEST DATA
Project No.: 4953-16-0471
Figure B-2.5



Note: Water added to samples after consolidation under a load of 4 kips per square foot.

Prepared/Date: CP 7/13/2016
Checked/Date: JF 7/13/2016

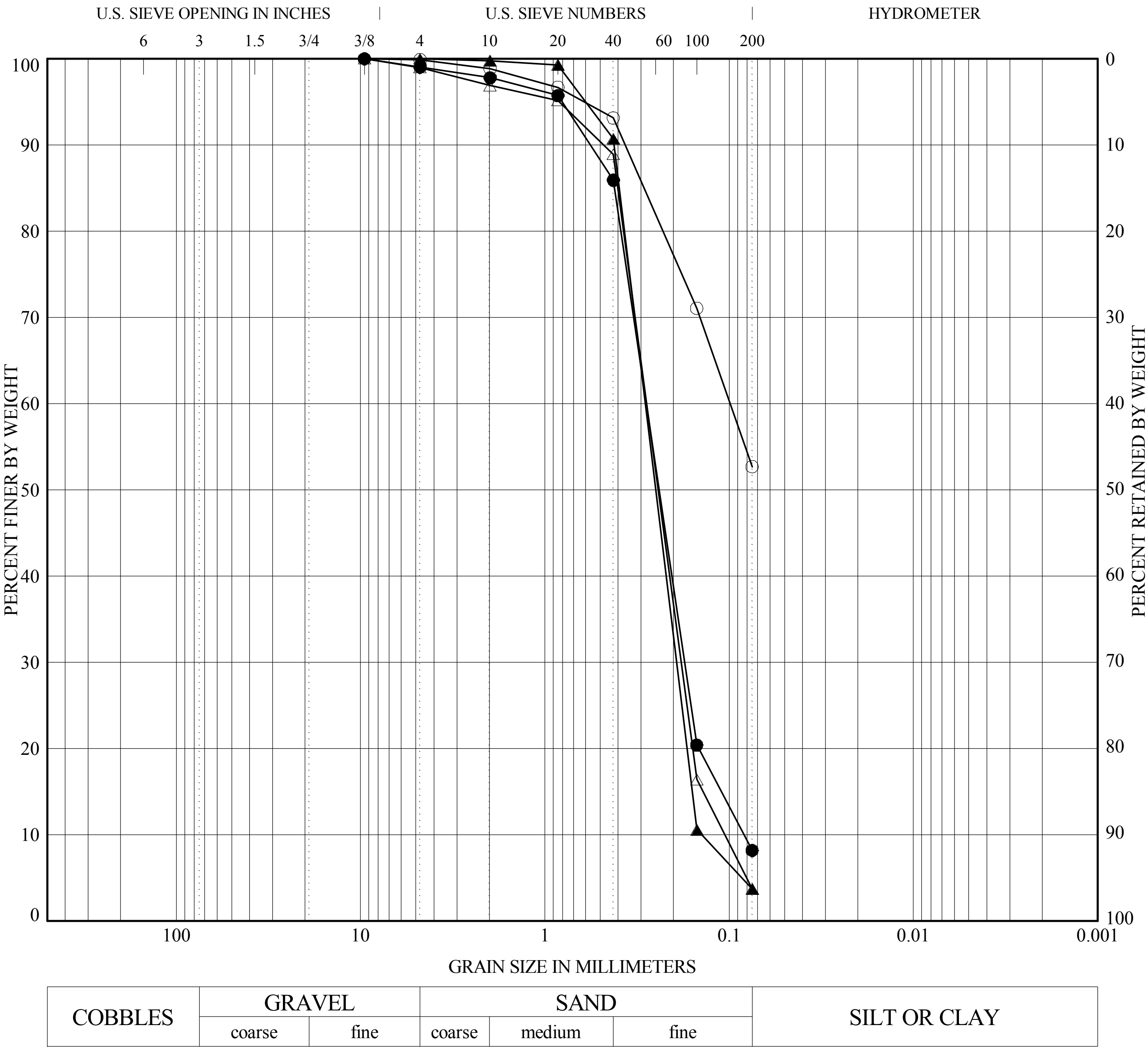
Southern California Edison Mohave 500 kV Substation Laughlin, Clark County, Nevada	amec foster wheeler	CONSOLIDATION TEST DATA Project No.: 4953-16-0471 Figure B-2.6



Note: Water added to samples after consolidation under a load of 4 kips per square foot.

Prepared/Date: CP 7/13/2016
Checked/Date: JF 7/13/2016

Southern California Edison Mohave 500 kV Substation Laughlin, Clark County, Nevada	amec foster wheeler	CONSOLIDATION TEST DATA Project No.: 4953-16-0471 Figure B-2.7



SYMBOL	BORING	DEPTH (ft)	CLASSIFICATION	LL (%)*	PL (%)*	PI (%)*	C_c	C_u
○	1	5.0	SANDY SILT (ML)	--	--	--	--	--
●	1	7.0	POORLY GRADED SAND with SILT (SP-SM)	--	--	--	1.3	3.4
△	1	15.0	POORLY GRADED SAND (SP)	--	--	--	1.1	2.7
▲	1	25.0	POORLY GRADED SAND (SP)	--	--	--	0.9	2.0

SYMBOL	BORING	DEPTH (ft)	D_{100} (mm)	D_{60} (mm)	D_{30} (mm)	D_{10} (mm)	% Gravel	% Sand	% Silt or % Clay
○	1	5.0	9.52	0.099	--	--	0.1	47.2	52.7
●	1	7.0	9.52	0.281	0.175	0.083	1.0	90.9	8.2
△	1	15.0	9.52	0.281	0.182	0.106	1.0	95.3	3.7
▲	1	25.0	4.75	0.285	0.193	0.142	0.0	96.3	3.7

Laboratory Test Method: ASTM D 422

*As determined by ASTM D 4318; see attached Atterberg Limits Test Results.

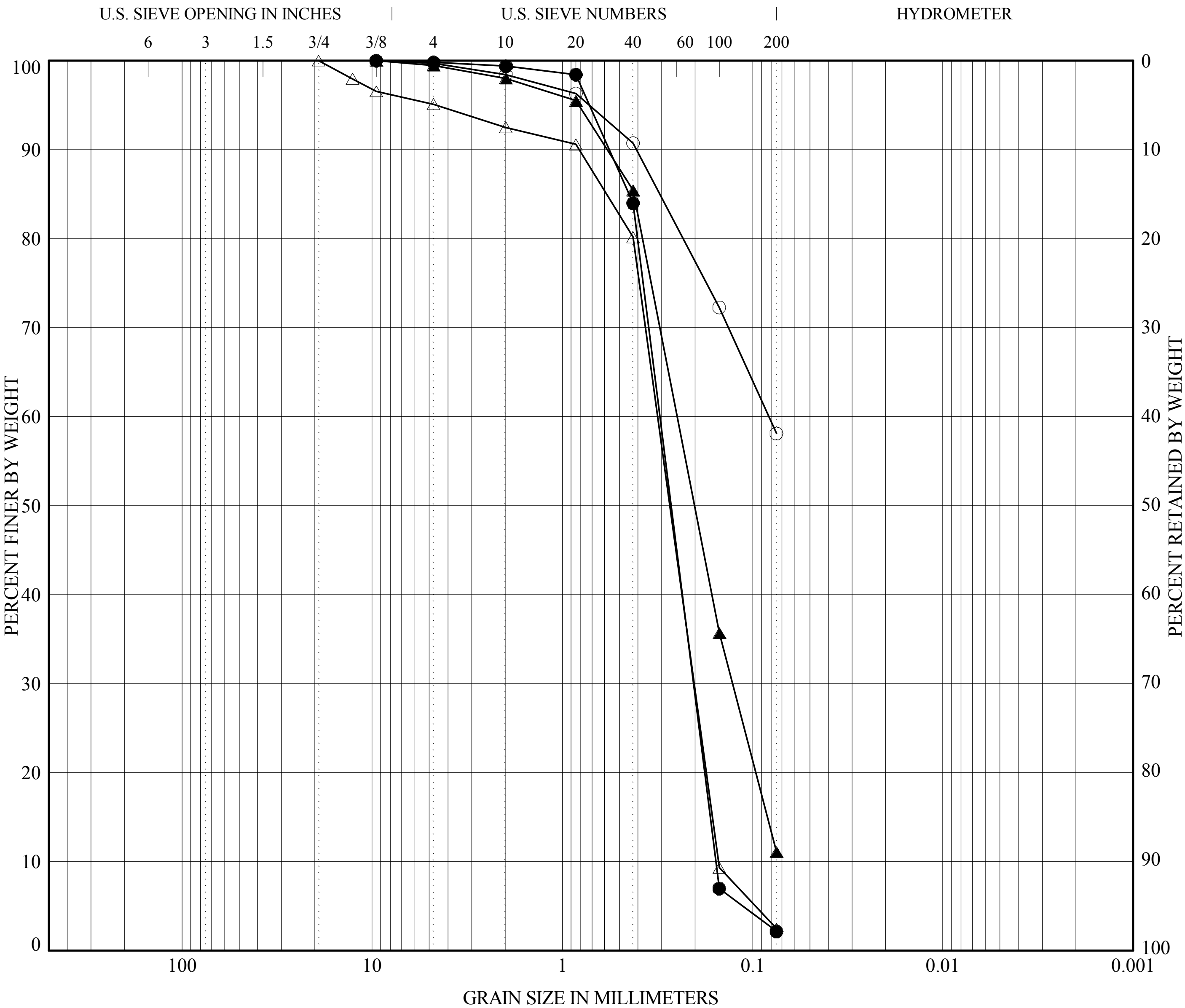
Prepared/Date: JF 6/8/2016
Checked/Date: EJJ 6/9/2016

Southern California Edison
Mohave 500 kV Substation
Laughlin, Clark County, Nevada

amec foster wheeler

PARTICLE SIZE DISTRIBUTION
Project No.: 4953-16-0471
Figure: B-3.1

AMEC FW_GRAIN SIZE L:\70131 GEOTECH\GINTW\LIBRARY AMEC JUNE2012.GLB P:\4953 GEOTECH\2016-PROJ\160471 SCE MOHAVE SUBSTATION UPGRADE\3.2 ALL FIELD NOTES\16-0471.GPJ 6/8/16



SYMBOL	BORING	DEPTH (ft)	CLASSIFICATION	LL (%)*	PL (%)*	PI (%)*	C_c	C_u
○	2	5.0	SANDY SILT (ML)	--	--	--	--	--
●	2	10.0	POORLY GRADED SAND (SP)	--	--	--	0.9	2.0
△	2	20.0	POORLY GRADED SAND (SP)	--	--	--	0.9	2.1
▲	3	7.0	POORLY GRADED SAND with SILT (SP-SM)	--	--	--	0.9	3.4

SYMBOL	BORING	DEPTH (ft)	D_{100} (mm)	D_{60} (mm)	D_{30} (mm)	D_{10} (mm)	% Gravel	% Sand	% Silt or % Clay
○	2	5.0	9.52	0.082	--	--	0.3	41.6	58.1
●	2	10.0	9.52	0.307	0.205	0.156	0.2	97.6	2.2
△	2	20.0	19.10	0.316	0.203	0.152	4.9	92.6	2.5
▲	3	7.0	9.52	0.249	0.128	--	0.5	88.4	11.1

Laboratory Test Method: ASTM D 422

*As determined by ASTM D 4318; see attached Atterberg Limits Test Results.

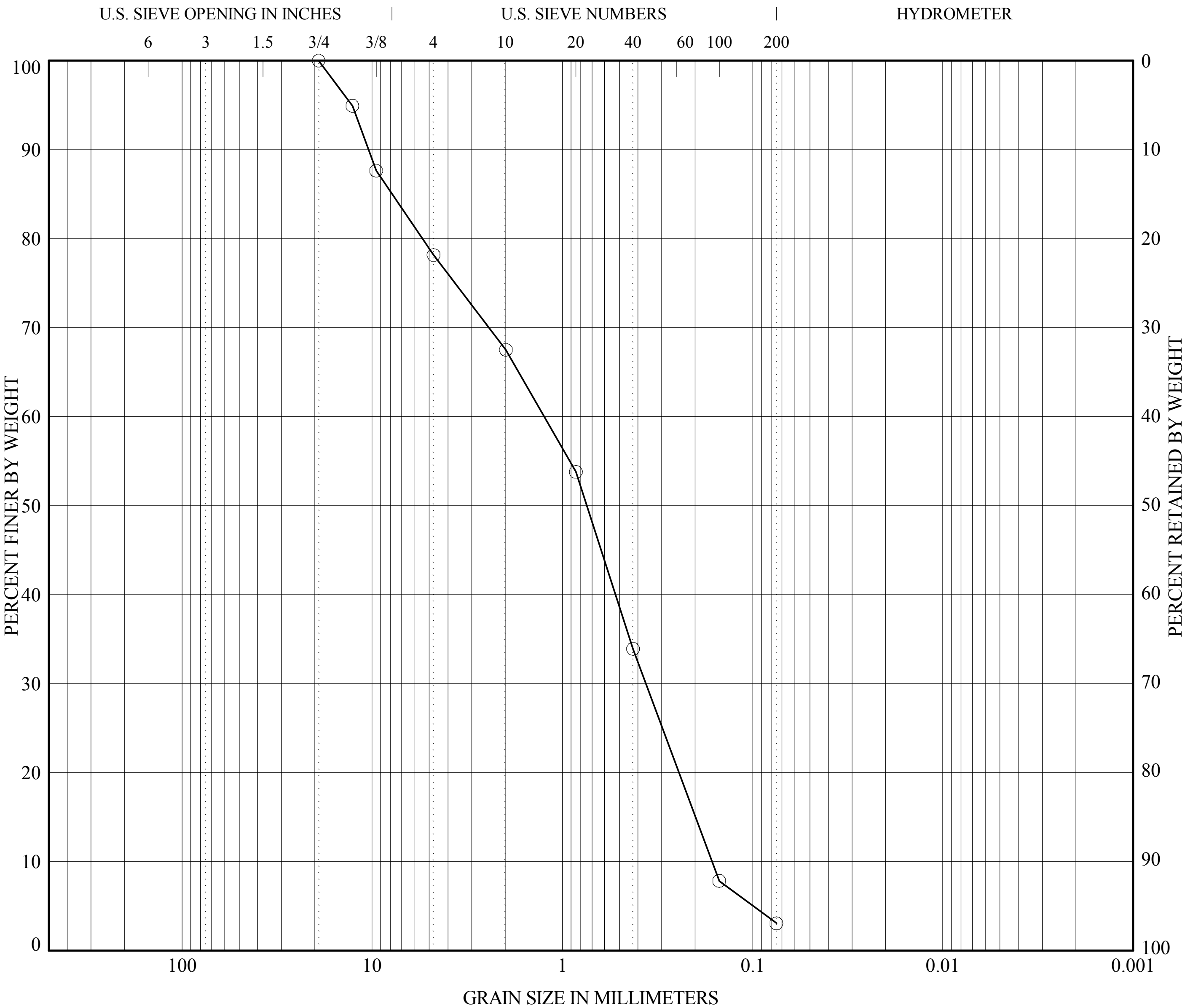
Prepared/Date: JF 6/8/2016
Checked/Date: EJJ 6/9/2016

Southern California Edison
Mohave 500 kV Substation
Laughlin, Clark County, Nevada

amec foster wheeler

PARTICLE SIZE DISTRIBUTION
Project No.: 4953-16-0471
Figure: B-3.2

AMEC FW_GRAIN SIZE L:\70131 GEOTECH\GINTW\LIBRARY AMEC JUNE2012.GLB
P:\4953 GEOTECH\2016-PROJ\160471 SCE MOHAVE SUBSTATION UPGRADE\3.2 ALL FIELD NOTES\16-0471.GPJ 6/8/16



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SYMBOL	BORING	DEPTH (ft)	CLASSIFICATION	LL (%)*	PL (%)*	PI (%)*	C_c	C_u
○	3	15.0	POORLY GRADED SAND with GRAVEL (SP)	--	--	--	0.6	7.6

SYMBOL	BORING	DEPTH (ft)	D_{100} (mm)	D_{60} (mm)	D_{30} (mm)	D_{10} (mm)	% Gravel	% Sand	% Silt or % Clay
○	3	15.0	19.10	1.247	0.364	0.163	21.8	75.1	3.1

Laboratory Test Method: ASTM D 422

*As determined by ASTM D 4318; see attached Atterberg Limits Test Results.

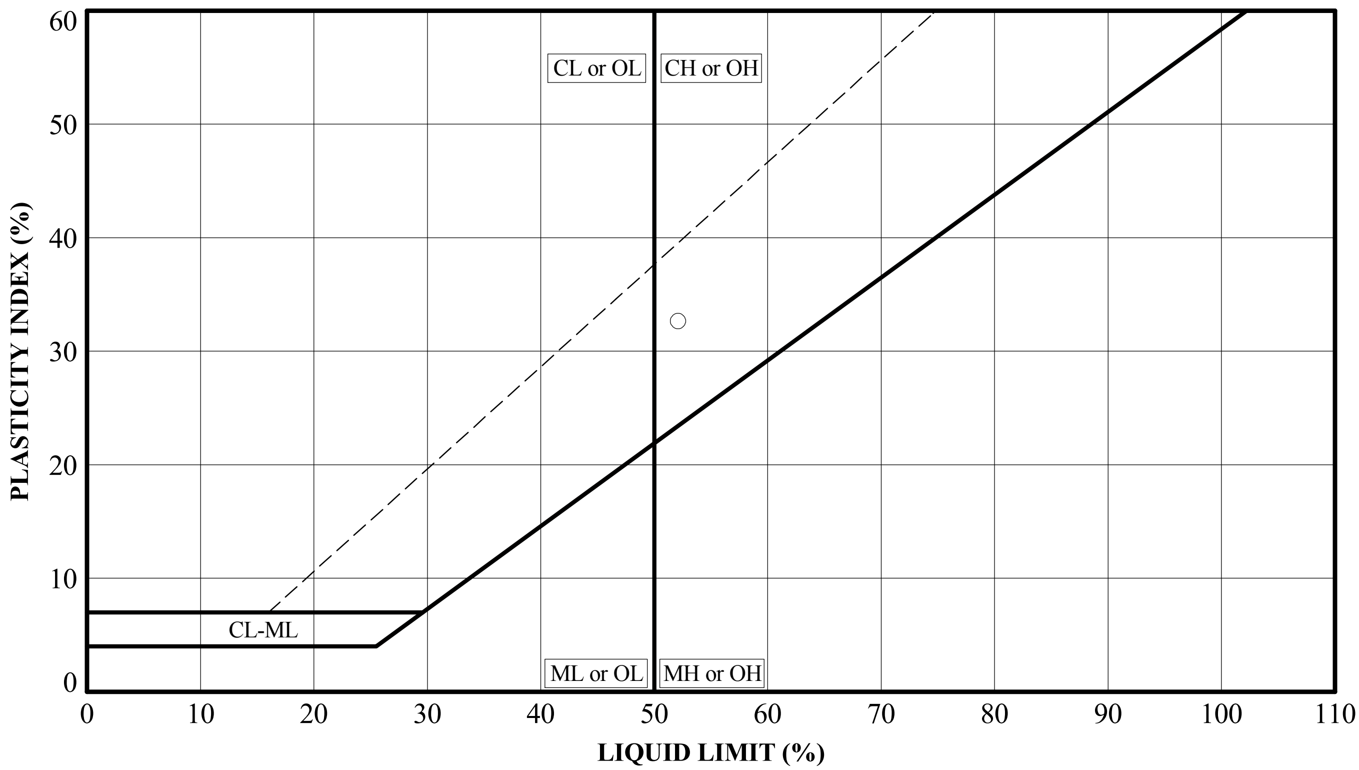
Prepared/Date: JF 6/8/2016
Checked/Date: EJJ 6/9/2016

Southern California Edison
Mohave 500 kV Substation
Laughlin, Clark County, Nevada

amec foster wheeler

PARTICLE SIZE DISTRIBUTION
Project No.: 4953-16-0471
Figure: B-3.3

AMEC FW_GRAIN SIZE L:\70131 GEOTECH\GINTW\LIBRARY AMEC JUNE2012.GLB
P:\4953 GEOTECH\2016-PROJ\160471 SCE MOHAVE SUBSTATION UPGRADE\3.2 ALL FIELD NOTES\16-0471.GPJ 6/8/16



SYMBOL	BORING	DEPTH (ft)	LL (%)	PL (%)	PI (%)	CLASSIFICATION
○	1	40.0	52	19	33	FAT CLAY (CH)

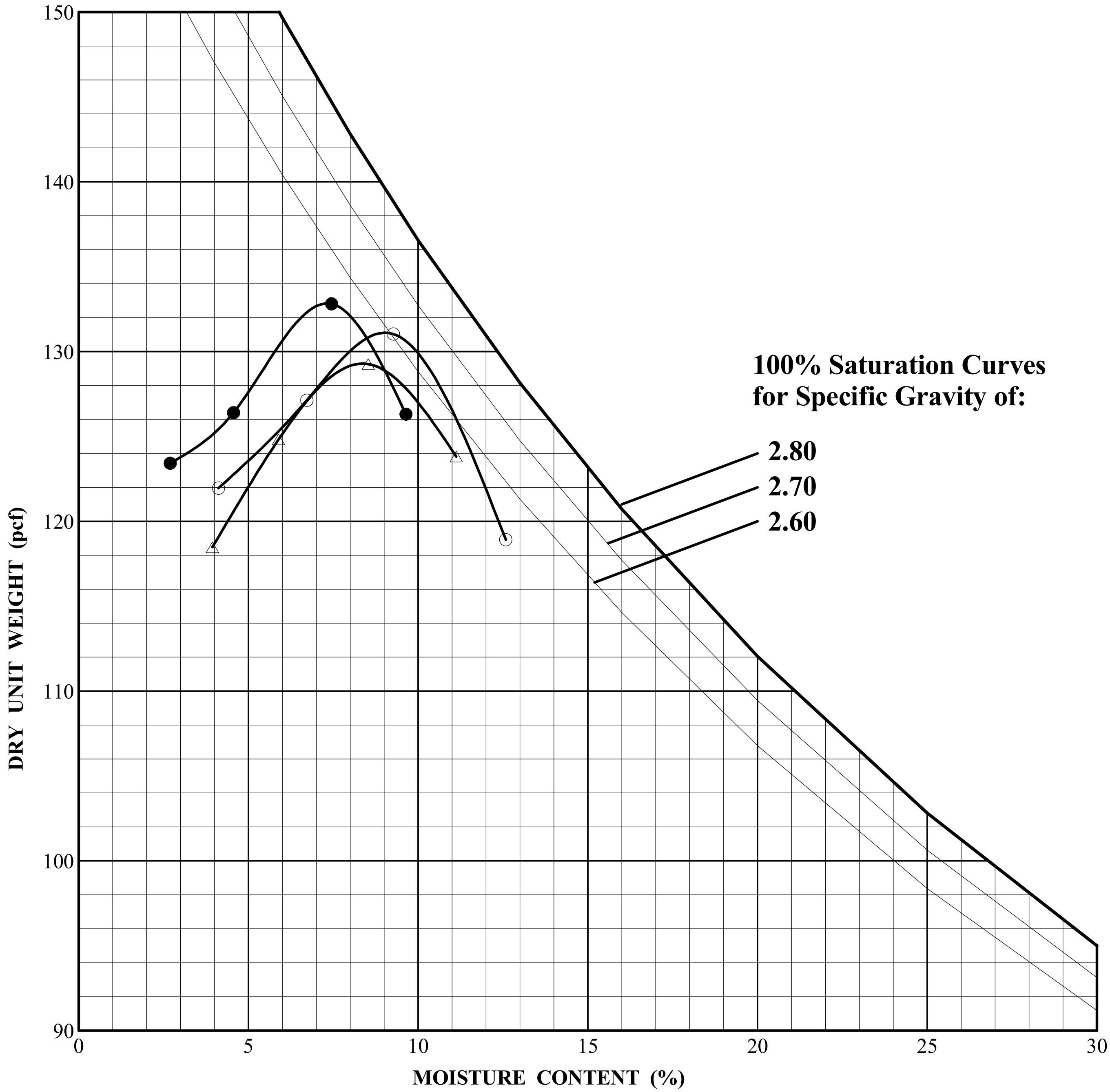
Laboratory Test Method: ASTM D 4318 "NP" indicates Non-Plastic

Prepared/Date: JF 6/8/2016
Checked/Date: EJJ 6/9/2016

Southern California Edison
Mohave 500 kV Substation
Laughlin, Clark County, Nevada

amec foster wheeler

ATTERBERG LIMITS TEST RESULTS
Project No.: 4953-16-0471
Figure: B-4



SYMBOL	BORING	DEPTH (ft)	CLASSIFICATION	OPTIMUM MOISTURE CONTENT (%)	MAXIMUM DRY UNIT WEIGHT (pcf)
○	1	0-5	SILTY SAND (SM)	9.3	131
●	2	0-5	SILTY SAND (SM)	7.5	133
△	3	0-5	SILTY SAND (SM)	8.5	129

Laboratory Test Method: ASTM D 1557, Method A

Prepared/Date: JF 6/7/2016
Checked/Date: EJJ 6/9/2016

Southern California Edison
Mohave 500 kV Substation
Laughlin, Clark County, Nevada

amec foster wheeler

COMPACTION TEST RESULTS
Project No.: 4953-16-0471
Figure: B-5

AMEC FW COMPACTION 3 TESTS L:\70131 GEOTECH\GINTW\LIBRARY AMEC JUNE2012.GLB
P:\4953 GEOTECH\2016-PROJ\160471 SCE MOHAVE SUBSTATION UPGRADE\3.2 ALL FIELD NOTES\16-0471.GPJ 6/8/16

TRANSMITTAL LETTER

DATE: June 2, 2016

ATTENTION: **Eung-Jin (EJ) Jeon**

TO: AMEC Foster Wheeler
6001 Rickenbacker Road
Los Angeles, CA 90040

SUBJECT: Laboratory Test Data
SCE-Mohave 500 kV Substation
Your #4953-16-0471, HDR Lab #16-0386LAB

COMMENTS: Enclosed are the results for the subject project.

James T. Keegan, MD
Laboratory Services Manager

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

Table 1 - Laboratory Tests on Soil Samples

AMEC Foster Wheeler
SCE-Mohave 500 kV Substation
Your #4953-16-0471, HDR Lab #16-0386LAB
25-May-16

Sample ID			B-1 @ 0-5' SM	B-1 @ 25' SP	B-2 @ 0-5' SP-SM	B-3 @ 0-5' SM
Resistivity		**Units**				
as-received		ohm-cm	10,000	30,000	60,000	3,920
saturated		ohm-cm	2,400	3,280	5,200	680
pH			7.6	8.3	8.2	8.2
Electrical Conductivity		mS/cm	0.46	0.29	0.12	1.00
Chemical Analyses						
Cations						
calcium	Ca^{2+}	mg/kg	16	42	38	12
magnesium	Mg^{2+}	mg/kg	4.4	6.0	5.3	4.4
sodium	Na^{1+}	mg/kg	337	161	72	743
potassium	K^{1+}	mg/kg	7.7	6.7	8.8	7.8
Anions						
carbonate	CO_3^{2-}	mg/kg	68	ND	32	156
bicarbonate	HCO_3^{1-}	mg/kg	116	192	204	37
fluoride	F^{1-}	mg/kg	13	0.6	2.8	8.0
chloride	Cl^{1-}	mg/kg	ND	54	ND	104
sulfate	SO_4^{2-}	mg/kg	530	324	24	1,190
phosphate	PO_4^{3-}	mg/kg	ND	ND	ND	ND
Other Tests						
ammonium	NH_4^{1+}	mg/kg	ND	ND	ND	ND
nitrate	NO_3^{1-}	mg/kg	5.7	8.3	27	9.7
sulfide	S^{2-}	qual	na	na	na	na
Redox		mV	na	na	na	na

Resistivity per ASTM G187, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B.
Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

Figure B-6.2

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316