GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED RADIO TOWER AND EQUIPMENT SHELTER
NORTH OF THE INTERSECTION (PWP23-046)
OF MANNING AVENUE AND SOUTH RIO VISTA AVENUE
REEDLEY, FRESNO COUNTY CALIFORNIA

PROJECT NUMBER: A26360.01

For:

County of Fresno
Public Works and Planning Division
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September 6, 2023

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MOORE TWINING ASSOCIATES, INC.

Since 1898

September 6, 2023 A26360.01

Mr. Roger Davidson
County of Fresno
Public Works and Planning Division
2220 Tulare Street, Seventh Floor
Fresno, CA 93721

Subject: Geotechnical Engineering Investigation
Proposed Radio Tower and Equipment Shelter (PWP23-046)
North of the Intersection of Manning Avenue and South Rio Vista Avenue
Reedley, Fresno County, California

Dear Mr. Davidson:

We are pleased to submit this geotechnical engineering investigation report prepared for the proposed radio tower and equipment shelter to be located north of the intersection of Manning Avenue and South Rio Vista Avenue in Reedley, Fresno County, California.

The contents of this report include the purpose of the investigation, scope of services, background information, investigative procedures, our findings, evaluation, conclusions, and recommendations. It is recommended that those portions of the plans and specifications that pertain to earthwork, pavements, and foundations be reviewed by Moore Twining Associates, Inc. (Moore Twining) to determine if they are consistent with our recommendations. This service is not a part of this current contractual agreement; however, the client should provide these documents for our review prior to their issuance for construction bidding purposes.

In addition, it is recommended that Moore Twining be retained to provide inspection and testing services for the excavation, earthwork, pavement, and foundation phases of construction. These services are necessary to determine if the subsurface conditions are consistent with those used in the analyses and formulation of recommendations for this investigation, and if the construction complies with our recommendations. These services are not, however, part of this current contractual agreement. A representative with our firm will contact you in the near future regarding these services.

Sincerely,
MOORE TWINING ASSOCIATES, INC.

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1.0 INTRODUCTION

We are pleased to submit this report of a geotechnical engineering investigation conducted for the proposed radio tower and equipment shelter to be located north of the intersection of Manning Avenue and South Rio Vista Avenue in Reedley, Fresno County, California. Moore Twining Associates, Inc. (Moore Twining) was authorized to conduct this investigation by Fresno County Public Works and Planning Division.

The contents of this report include the purpose of the investigation and the scope of services provided. The existing site features and anticipated construction are discussed. In addition, a description of the investigative procedures used and the subsequent findings obtained are presented. Finally, this report provides general conclusions and related recommendations. The report appendices contain the drawings (Appendix A), the logs of borings (Appendix B), and the results of laboratory tests (Appendix C).

The Geotechnical Engineering Division of Moore Twining, headquartered in Fresno, California, performed the investigation.

2.0 PURPOSE AND SCOPE OF INVESTIGATION

2.1 Purpose: The purpose of the investigation was to conduct a field exploration and laboratory testing program, evaluate the data collected during the field and laboratory portions of the investigation, and provide the following:

2.1.1 A description of general subsurface soil and groundwater conditions encountered;

2.1.2 Recommendations for earthwork construction, including site preparation and engineered fill;

2.1.3 Recommendations for temporary excavations and trench backfill;

2.1.4 Foundation design parameters;

2.1.5 Recommendations for 2022 California Building Code seismic coefficients and earthquake spectral response acceleration values;

2.1.6 An evaluation of liquefaction and seismic settlement potential;

2.1.7 Evaluation of soil corrosivity; and

2.1.8 Final test boring logs and laboratory test results.

This report is provided specifically for the proposed radio tower and equipment shelter planned at the subject site. This investigation did not include a geologic/seismic hazards evaluation, percolation tests, flood plain investigation, environmental investigation, or environmental audit. In addition, since no pavements appear to be planned for this project, this report did not include any Resistance-value laboratory tests and does not provide any pavement recommendations.

2.2 Scope: Our proposal, dated July 5, 2023, outlined the scope of our services. The actions undertaken during the investigation are summarized as follows:

2.2.1 A site plan, prepared by the County of Fresno, dated May 2, 2023, was reviewed.

2.2.2 Boring permit WELL10085013 was obtained from the County of Fresno Department of Public Health - Environmental Health Division.

2.2.3 Satellite images of the site between the years 1998 and 2023 from online sources, were reviewed.

2.2.4 A site reconnaissance and subsurface exploration were conducted.

2.2.5 Laboratory tests were conducted to determine selected physical and engineering properties of the subsurface soils.

2.2.6 The data obtained from the investigation were evaluated to develop an understanding of the subsurface soil conditions and engineering properties of the subsurface soils.

2.2.7 This report was prepared to present the purpose and scope, background information, field exploration procedures, findings, conclusions, and recommendations.

3.0 BACKGROUND INFORMATION

The site description, site history and the anticipated construction are summarized in the following subsections.

3.1 Site Location and Description: The project site is located at the County of Fresno's work yard, about 200 feet north-northwest of the intersection of Manning Avenue and South Rio Vista Avenue in Reedley, Fresno County, California. A site location map is included as Drawing No. 1 in Appendix A of this report. The project area is generally lower in elevation than most of the adjacent grades.

The site is bounded to the north by an asphalt concrete paved driveway (descending from South Rio Vista Avenue), vacant land with a stockpile of soil, and a developed commercial property beyond;

to the east by vacant land with stockpiles of soil, and a Fresno County Public Works yard beyond; to the south by northeast descending slopes and South Rio Vista Avenue beyond; and to the west by a wood retaining wall and southeast descending slope, an asphalt concrete paved driveway, vacant land and South Rio Vista Avenue beyond.

The proposed equipment shelter is to be located within an area covered by asphalt concrete pavement and by aggregate base where the radio tower is planned. At the time of our field investigation, the ground surface in the area of the proposed tower and equipment shelter site sloped gently down to the northeast. The area of the proposed equipment shelter is bordered by cut slopes on the northwest, southwest and southeast sides that surround the area of the proposed equipment shelter in a U-shape. These slopes appeared to range in maximum height from about 3 feet to 8 feet with inclinations ranging from about 1H:1V to about 2¾H:1V. The cut slopes were covered by green and dry grasses, weeds and other low-lying vegetation. An approximate 6-foot tall wood retaining wall was noted at the toe of the southeast-facing slope on the northwest side of the proposed equipment shelter. Beyond the retaining wall and adjacent southeast-descending slope is an asphalt concrete paved driveway that slopes down to the northeast from South Rio Vista Avenue.

The area of the proposed tower is to be located in more of an open area to the northeast of the proposed equipment shelter and is not surrounded by any slopes.

Four large stockpiles of soil were noted during our site observations. Some of these stockpiles of soil are identified on Drawing No. 2 in Appendix A.

The locations of existing and proposed improvements are shown on Drawing No. 2 in Appendix A of this report.

3.2 <u>Site History</u>: Satellite images of the site were reviewed for various years between 1998 and 2023 for general site history information. The August 1998 image shows the Fresno County Public Works yard with a driveway on the west side of the proposed improvements that sloped down to the northeast from South Rio Vista Avenue. It appears there is an earthen slope that slopes down to the southeast from the driveway and another earthen slope (directly south of the proposed improvements) that slopes down to the northeast from South Rio Vista Avenue. Some stockpiles of soil vaguely appear in various areas beyond the proposed radio tower and equipment shelter area. These stockpiles are clearer in the 2005 and 2009 images of the site.

Sometime between 2006 and 2009, the east-descending slope appears to have also been graded on the east side of the proposed equipment shelter area, and the slopes appear to make a U-shape around the proposed equipment shelter area. In addition, the driveway and area where the equipment shelter is planned appears to be paved with asphalt concrete in the 2009 image of the site. The 2011 image of the site appears similar in the project area, except a wooden wall appears to have been constructed at the base of the slope on the west side of the proposed equipment shelter area, and a storage bin appears adjacent to the wall. Some stored materials also appear at the base of the slope in the southeastern portion of the U-shaped slopes that surround the proposed equipment shelter area.

The 2013 image shows that the storage bin has been removed, and the wooden wall remains. Many of the stockpiles of soil near the area of the improvements have also been removed in the 2013 image of the site. Sometime between 2015 and 2017, several stockpiles of soil were added within the Fresno County Public Works yard outside the area of the proposed improvements. The project area appears relatively unchanged between 2017 and 2023.

3.3 Anticipated Construction: It is understood that the proposed construction will consist of a new radio tower and an equipment shelter. According to the site plan, the radio tower will be a three-legged, 250-foot-tall lattice microwave (radio) tower. It is assumed that the loads for the radio tower will be supported on either drilled shaft foundations or a mat foundation. The site plan shows that the tower will be surrounded by a 6-foot-tall chainlink fence.

The equipment shelter is proposed to be located about 22 feet west of the tower, with plan dimensions of approximately 61 feet by 16 feet (~980 square feet). A maximum continuous footing load of 1 kip per foot was assumed for equipment shelter. Equipment loads are assumed to apply a soil pressure of less than 1 kip per square foot. In the event that the actual structural loads are higher than those loads assumed for this report, Moore Twining should be contacted to evaluate the anticipated settlements and provide alternate recommendations, if warranted.

Grading plans were not provided for our review. It is anticipated that only minor cuts and fills will be required to construct level pads for the equipment shelter and radio tower.

4.0 INVESTIGATIVE PROCEDURES

The field exploration and laboratory testing program conducted for this investigation are summarized in the following subsections.

4.1 Field Exploration: The field exploration included a site reconnaissance, drilling test borings, and soil sampling.

4.1.1 Site Reconnaissance: The site reconnaissance consisted of walking the site and noting visible surface features. The site reconnaissance was conducted by a Moore Twining staff engineer on August 1, 2023. The features noted are described in the "Background Information" section of this report.

4.1.2 Drilling Test Borings: Prior to drilling, the site was marked for Underground Service Alert (U.S.A.) for member utility clearance. In addition, prior to drilling, boring permit WELL10085013 was obtained from the County of Fresno Department of Public Health - Environmental Health Division. During the geotechnical field exploration, two (2) test borings were drilled on August 1, 2023. The boring for the equipment shelter was drilled to a depth of about 20 feet below site grade (BSG), and the boring for the radio tower was drilled to a depth of about 51½ feet BSG using a CME-75 truck mounted drill rig equipped with 6-⅝ inch outside diameter hollow stem augers.

The approximate test boring locations are shown on Drawing No. 2 in Appendix A. The soils encountered in the test boring were logged during drilling by a representative of Moore Twining. The field soil classification was in accordance with the Unified Soil Classification System and consisted of particle size, color, and other distinguishing features. Soil samples were collected and returned to our laboratory for classification and soil mechanics testing. The presence and elevation of free water, if any, in the test boring were noted and recorded during the drilling.

The test boring location was determined by tape measure with reference to existing site features. The elevation of the boring was not surveyed as a part of the investigation. In accordance with the requirements of the boring permit, the borings were backfilled with neat cement, topped with some soil cuttings and patched with asphalt concrete cold patch where drilled in a pavement area. Some settlement of the backfill should be anticipated.

4.1.3 Soil Sampling: Standard penetration tests were conducted, and both disturbed and relatively undisturbed soil samples were obtained.

The standard penetration resistance, N-value, is defined as the number of blows required to drive a standard split barrel sampler into the soil. The standard split barrel sampler has a 2 inch O.D. and a 1-⅜ inch inside diameter (I.D.). The sampler is driven by a 140 pound weight free falling 30 inches. The sampler is lowered to the bottom of the bore hole and set by driving it an initial 6 inches. It is then driven an additional 12 inches and the number of blows required to advance the sampler the additional 12 inches is recorded as the N-value.

Relatively undisturbed soil samples for laboratory tests were obtained by pushing or driving a California modified split barrel sampler into the soil. The soil was retained in stainless steel rings, 2.5 inches O.D. and 1 inch in height. The lower 6 inch portion of the samples were placed in close-fitting, plastic, air-tight containers which, in turn, were placed in cushioned boxes for transport to the laboratory. In addition, bulk samples of soil were obtained for laboratory testing.

Soil samples obtained were taken to Moore Twining's laboratory for classification and testing.

4.2 Laboratory Testing: The laboratory testing was programmed to determine selected physical and engineering properties of the soils tested. The tests were conducted on disturbed and relatively undisturbed samples representative of the subsurface material.

The results of laboratory tests are summarized in Appendix C. These data, along with the field observations, were used to prepare the final test boring logs in Appendix B.

5.0 FINDINGS AND RESULTS

The findings and results of the field exploration and laboratory testing are summarized in the following subsections.

5.1 Soil Profile: The near surface soils consisted of fill soils extending to a depth of about 2 feet BSG in both borings B-1 and B-2. Below the 5-inch thick asphalt concrete layer, the fill soils encountered in boring B-1 were underlain by silty sand fill soils over an apparent buried 2½ inch layer of asphalt concrete. The fill soils encountered in boring B-2 consisted of 6 inches of aggregate base over silty sand soils. The native soils encountered below a depth of 2 feet BSG in both borings consisted of interbedded layers of poorly graded sands, silty sands, and poorly graded sands with silt that extended to depths of about 15 to 18 ½ feet BSG. These layers were underlain by interbedded layers of sandy silts, clayey sands, poorly graded sands, sandy lean clays, and silty sands extending to the maximum depth explored, about 51 ½ feet BSG.

The foregoing is a general summary of the soil conditions encountered in the test borings drilled for this investigation. Detailed descriptions of the soils encountered are presented on the logs of test borings in Appendix B. The stratification lines shown on the boring logs represent the approximate boundary between soil types; the actual in-situ transition may be gradual.

5.2 <u>Soil Engineering Properties</u>: The engineering properties of the subsurface soils encountered during this investigation are summarized below.

Silty Sand Fill Soils: The silty sand fill soils were generally described as medium dense to dense, as determined by standard penetration resistance (SPT), N-values, of 30 and 43 blows per foot. The moisture content of the fill samples tested were about 6 percent.

Native Poorly Graded Sands and Poorly Graded Sands with Silt: The native poorly graded sands and poorly graded sands with silt were described as loose to dense, as determined by standard penetration resistance (SPT), N-values, and SPT equivalent N-values (estimated by driving a California Modified split barrel sampler) ranging from 6 to 39 blows per foot. The moisture contents of the samples tested ranged from 1 to 6 percent. One (1) relatively undisturbed sample revealed a dry density of 104.6 pounds per cubic foot. A direct shear test conducted on a sample collected from depths of about 2 to 3½ feet BSG from boring B-1 indicated an internal angle of friction of 31 degrees and 180 pounds per square foot of cohesion.

Native Silty Sands: The native silty sands were generally described as loose to medium dense, as determined by standard penetration resistance (SPT), N-values, ranging from 10 and 30 blows per foot. The moisture content of the samples tested ranged from about 8 to 12 percent.

Native Sandy Silts: The native sandy silts encountered were described as very stiff to hard, as indicated by standard penetration resistance (SPT), N-values, and SPT equivalent N-values (estimated by driving a California Modified split barrel sampler) ranging from 27 to 40 blows per foot. The moisture content of samples tested were about 5 and 13 percent. One (1) relative undisturbed sample revealed a dry density of 97.7 pounds per cubic foot. A consolidation test conducted on a sample collected from depths of about 15 to 16½ feet BSG from boring B-2 indicated about 3.9 percent consolidation under a load of 16 kips per square foot.

Native Clayey Sands: The native clayey sands encountered were described as dense, as indicated by standard penetration resistance (SPT), N-values, ranging from 31 to 46 blows per foot. The moisture content of one sample tested was about 10 percent.

Native Sandy Lean Clays: The native sandy lean clays encountered were described as hard, as indicated by a standard penetration resistance (SPT), N-value, of 37 blows per foot.

Maximum Density/Optimum Moisture Determination: A maximum density/optimum moisture determination conducted on a near surface bulk sample containing a mixture of silty sand fill and native poorly graded sand soils collected from depths of about ½ to 5 feet BSG from boring B-1 indicated a maximum dry density of 127.2 pounds per cubic foot at an optimum moisture content of 8.7 percent.

Chemical Tests: Chemical tests performed on a near surface sample containing a mixture of silty sand fill and native poorly graded sand soils collected from depths of about ½ to 5 feet BSG from boring B-1 indicated a pH value of 8.6; a minimum resistivity value of 2,700 ohm-centimeters; 0.01 percent by weight concentration of sulfate; and 0.0053 percent by weight concentration of chloride.

The risk of corrosion of construction materials relates to the potential for soil-induced chemical reaction. Corrosion is a naturally occurring process whereby the surface of a metallic structure is oxidized or reduced to a corrosion product such as iron oxide (i.e., rust). The metallic surface is attacked through the migration of ions and loses its original strength by the thinning of the member.

Soils make up a complex environment for potential metallic corrosion. The corrosion potential of a soil depends on numerous factors including soil resistivity, texture, acidity, field moisture and chemical concentrations. In order to evaluate the potential for corrosion of metallic objects in contact with the onsite soils, chemical testing of soil samples was performed by Moore Twining as part of this report. The test results are included in Appendix C of this report. Conclusions regarding the corrosion potential of the soils tested are included in the Conclusions section of this report based on the National Association of Corrosion Engineers (NACE) corrosion severity ratings listed in the Table No. 1, below.

Table No. 1

Soil Resistivity (ohm cm)	Corrosion Potential Rating
>20,000	Essentially non-corrosive
10,000 - 20,000	Mildly corrosive
5,000 - 10,000	Moderately corrosive
3,000 - 5,000	Corrosive
1,000 - 3,000	Highly corrosive
<1,000	Extremely corrosive

The results of soil sample analyses indicate that the near-surface soils exhibit a "highly corrosive" potential to buried metal objects. Appropriate corrosion protection should be provided for buried improvements based in the "highly corrosive" corrosion potential. If piping or concrete are placed in contact with imported soils, these soils should be analyzed to evaluate the corrosion potential of these soils.

If the manufacturers or suppliers cannot determine if materials are compatible with the soil corrosion conditions, a professional consultant, i.e., a corrosion engineer, with experience in corrosion protection should be consulted to provide design parameters. Moore Twining does not provide corrosion engineering services.

5.3 **<u>Groundwater Conditions</u>:** Groundwater was encountered in test boring B-2 at a depth of about 50 feet BSG during drilling. After drilling, groundwater was measured in boring B-2 at a depth of about 47 feet BSG.

Historical groundwater data reviewed from the Department of Water Resources indicates that a well located about ⅓ mile southeast of the site had a groundwater depth of about 32 feet BSG in 2019 to about 65½ feet BSG in 1960 for a data collected between 1946 and 2019. Based on our review of recent groundwater data from the Department of Water Resources Sustainable Groundwater Management Act (SGMA) Data Viewer website, the groundwater depth at the site was estimated to be about 68 feet BSG in the Spring 2022.

It should be recognized, however, that groundwater is dependent upon seasonal precipitation, irrigation, land use, and climatic conditions as well as other factors. Therefore, observations at the time of the field investigation may vary from those encountered both during the construction phase and the design life of the project. The evaluation of such factors was beyond the scope of this investigation and report.

6.0 CONCLUSIONS

Based on the data collected during the field and laboratory investigations, our geotechnical experience in the vicinity of the project site, and our understanding of the anticipated construction, the following conclusions are presented.

6.1 The site is considered suitable for the proposed construction with regard to support of the proposed radio tower and equipment shelter, provided the recommendations contained in this report are followed. It should be noted that the recommended design consultation and observation of clearing, and earthwork activities by Moore Twining are integral to this conclusion.

6.2 The near surface soils encountered in the soil borings consisted of fill soils extending to a depth of about 2 feet BSG. Below the 5-inch asphalt concrete layer, a silty sand fill soils was encountered in boring B-1 over a buried 2½ inch layer of asphalt concrete. The fill soils encountered in boring B-2 consisted of 6 inches of aggregate base over medium dense silty sand soils. The native soils encountered below a depth of 2 feet BSG in both borings consisted of interbedded layers of loose to dense poorly graded sands and poorly graded sands with silt, loose to medium dense silty sands, very stiff to hard sandy silts, dense clayey sands, and hard sandy lean clays extending to the maximum depth explored.

6.3 Based on the findings of this investigation, the radio tower may be supported on a drilled shaft foundation, or a mat foundation supported over compacted engineered fill. The equipment shelter may be supported on shallow spread foundations over compacted engineered fill. In addition, as part of the site preparation, all existing fill soils and pavement materials should be excavated from below areas of shallow foundations. The existing fill materials should not be relied upon to support the proposed foundations.

6.4 Groundwater was encountered in test boring B-2 at a depth of about 50 feet BSG during drilling. After drilling, groundwater was measured in boring B-2 at a depth of about 47 feet BSG.

6.5 The site includes some areas of oversteepened slopes, steeper than 2 Horizontal to 1 Vertical. In general, the slopes steeper than 2H:1V would be subject to impacts such as sloughing and instability.

6.6 The project site is not located in an Alquist-Priolo Earthquake Fault Zone. Based on our review of the 2010 Fault Activity Map of California, the nearest known active or potentially active fault is the potentially active Nunez Fault located about 60 miles southwest of the site, and the Kern Canyon Fault located about 60 miles east of the site. Accordingly, the potential for ground rupture at the site is considered low.

6.7 The horizontal ground acceleration defined by the 2022 California Building Code for liquefaction and seismic settlement analyses is estimated to be 0.31g, and the maximum considered earthquake from hazard deaggregation analysis was determined to be a 5.5 magnitude earthquake. A groundwater depth of 32 feet BSG was considered for the liquefaction analysis based on the historical water well data reviewed as part of this investigation. The liquefaction analysis indicates that the potential for liquefaction to occur is low. In addition, seismic settlements were determined to be negligible.

6.8 According to the NACE corrosion severity ratings, the testing classified the soils as having a "highly corrosive" corrosion condition. Metallic materials planned in contact with the soils should be protected based on the "highly corrosive" corrosion conditions.

6.9 Based on Table 19.3.1.1 - Exposure categories and classes from Chapter 19 of ACI 318, the sulfate concentration from chemical testing of soil samples falls in the S0 classification (less than 0.10 percent by weight) for concrete.

7.0 RECOMMENDATIONS

Based on the evaluation of the field and laboratory data and our geotechnical experience in the vicinity of the project, we present the following recommendations for use in the project design and construction. However, this report should be considered in its entirety. When applying the recommendations for design, the background information, procedures used, findings and conclusions should be considered. The recommended design consultation and construction monitoring by Moore Twining are integral to the proper application of the recommendations.

Where the requirements of a governing agency or utility agency differ from the recommendations of this report, the more stringent recommendations should be applied to the project.

7.1 General

7.1.1 A preconstruction meeting including, as a minimum, the owner, foundation contractor, earthwork contractor and Moore Twining, should be scheduled by the general contractor at least one week prior to the start of construction. The purpose of the meeting should be to discuss critical project issues and the recommendations of this report.

7.1.2 If unstable soil conditions are experienced, methods such as aeration, mixing wet soils with drier soils, chemical (i.e., lime) treatment of the soil, or use of a bridge lift with aggregate base and a geotextile stabilization fabric such as Mirafi 600X or equivalent, may be required to achieve a stable condition.

7.1.3 If the data in this report are not sufficient for bidding purposes, the contractor should conduct, or retain a qualified geotechnical engineer to conduct, supplemental studies and collect more data as required to prepare accurate bids.

7.1.4 Slopes ascend from the area of the proposed foundations. In some cases, the slopes are steeper than 2H:1V. In order to reduce issues with slope instability, sloughing, etc., a maximum slope gradient of 2H:1V would be recommended for earthen slopes. In addition, foundations should be setback from the toe of adjacent slopes a minimum horizontal distance of 5 feet, as necessary to achieve proper site drainage, and to achieve the requirements of the California Building Code. To reduce erosion potential, vegetation should be established and maintained on all slopes.

7.2 Site Grading and Drainage

7.2.1 Develop and maintain site grades which will drain surface runoff away from foundations, both during and after construction. Exterior finished grades should be sloped a minimum of two percent for a distance of at least five feet away from foundations/structures or as necessary to preclude ponding of water and/or erosion adjacent to foundations, whichever is more stringent.

7.2.2 Landscaping after construction (if any) should direct rainfall away from foundations and prevent ponding of water and erosion.

7.2.3 It is not recommended to place landscape or planted areas directly adjacent to the improvements. Trees should be setback from the proposed structure at least 10 feet or a distance equal to the anticipated drip line radius of the mature tree. For example, if a tree has an anticipated drip line diameter of 30 feet, the tree should be at least 15 feet away (radius) from the proposed foundations.

7.3 Site Preparation

7.3.1 All vegetation, topsoil, organics, root structures, utility lines, irrigation piping, etc. should be removed from areas to be graded. The general depth of stripping should be sufficiently deep to remove any root systems, and/or organic top soils. The actual depth of stripping should be reviewed by Moore Twining at the time of construction. All roots larger than ¼ inch in diameter or any accumulation of organic matter that will result in an organic content more than 3 percent should be removed and not used as engineered fill.

7.3.2 After stripping and removal of the existing pavement, the equipment shelter building area should be over-excavated to a minimum depth of 24 inches below existing site grades, to the depth required to remove all fill and pavement materials to expose undisturbed native soils, or to the bottom of the proposed foundations, whichever is greater. The over-excavation should extend at least 5 feet horizontally beyond all foundations, and 3 feet beyond any attached sidewalks or stoops, whichever is further. Upon approval of the bottom of the excavation, the bottom of the excavation should be scarified to a depth of 8 inches, moisture-conditioned and compacted as engineered fill.

7.3.3 Recommendations for support of the proposed radio tower using drilled shaft foundations are provided in sections 7.8 and 7.9 of this report. If the radio tower is to be supported on a mat foundation, then after stripping and removal of asphalt concrete pavements (if any), the mat slab area should be over-excavated to a minimum depth of 24 inches below existing site grades, to at least 12 inches below the bottom of the mat slab, and to the depth required to remove all existing fill and pavement materials to expose undisturbed native soils, whichever is greater. The over-excavation should be relatively uniform across the entire concrete slab-on-grade area and extend horizontally a minimum of 3 feet beyond the edges of the slab. Upon approval of the bottom of the excavation, the bottom of the excavation should be scarified to a depth of 8 inches, moisture-conditioned and compacted as engineered fill.

7.3.4 After stripping and removal of root systems, asphalt concrete, etc., areas to receive fill outside the equipment building area and tower area should be scarified a minimum of 8 inches in depth, moisture conditioned to sightly above the optimum moisture content and compacted as engineered fill. All fill required to bring the site to final grade should be placed as engineered fill. In addition, all native soils over-excavated should be compacted as engineered fill.

7.3.5 The Contractor should be responsible for the disposal of concrete, asphaltic concrete, soil, spoils, etc. (if any) that must be exported from the site. Individuals, facilities, agencies, etc. may require analytical testing and other assessments of these materials to determine if these materials are acceptable. The Contractor should be responsible to perform the tests, assessments, etc. to determine the appropriate method of disposal.

7.4 Engineered Fill

7.4.1 The near surface soils encountered are silty sands and poorly graded sands. These soils will be suitable for use as engineered fill material provided they are free of organics, debris, particles 3 inches in dimension and larger, and root systems are removed. If soils other than those considered in this report are encountered, Moore Twining should be notified to provide alternate recommendations.

7.4.2 Import fill soil (if required) should be non-expansive and granular in nature with the following acceptance criteria recommended.

Percent Passing 3-Inch Sieve	100
Percent Passing No. 4 Sieve	75 - 100
Percent Passing No. 200 Sieve	15 - 40
Expansion Index (ASTM D4829)	Less than 20
Organics	Less than 3 percent by weight

Prior to being transported to the site, the import material shall be certified by the Contractor and the supplier (to the satisfaction of the Owner) that the soils do not contain any environmental contaminates regulated by local, state or federal agencies having jurisdiction. In addition, Moore Twining should be requested to sample and test the material to determine compliance with the above geotechnical criteria. The contractors should provide a minimum of 7 working days to complete the testing.

7.4.3 Imported and native on-site soils placed as engineered fill should be placed in loose lifts approximately 8 inches thick, moisture-conditioned to between optimum and 3 percent above optimum moisture content, and compacted to a dry density of at least 92 percent of the maximum dry density as determined by ASTM Test Method D1557. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable.

7.4.4 Utility trench backfill should be placed in 8 inch lifts, moisture conditioned to sightly above optimum and compacted to a minimum of 92 percent relative compaction (ASTM D1557). Lift thickness can be increased if the contractor can demonstrate the minimum compaction requirements can be achieved.

7.4.5 Open graded gravel and rock material such as ¾-inch crushed rock or ½-inch crushed rock should not be used as backfill including trench backfill. In the event gravel or rock is required by a pipe manufacturer or design engineer, all open graded materials shall be fully encased in a geotextile filter fabric, such as Mirafi 140N, to prevent migration of fine grained soils into the porous material. Crushed rock should be placed in thin (less than 8 inch) lifts and densified with a minimum of three (3) passes using a vibratory compactor.

7.4.6 Aggregate base should comply with State of California Department of Transportation requirements for Class 2 aggregate base and should be non-recycled. Aggregate base should be compacted to a minimum relative compaction of 95 percent and to a stable, non-yielding condition.

7.5 Foundations - General Recommendations

This section include general recommendations for both shallow and deep foundations. This report provides recommendations for conventional shallow spread foundations for the proposed equipment shelter building (refer to section 7.6). Recommendations for support of the radio tower on a mat foundation are provided in section 7.7 of this report, and recommendations for use of drilled shaft foundations for the radio tower are provided in sections 7.8 and 7.9 of this report.

7.5.1 The foundations should be designed and reinforced for the anticipated static settlements. A professional engineer experienced in foundation design should recommend the thickness, design details and concrete specifications for the foundations based on: 1) a total static settlement of 1 inch; and 2) a differential static settlement of ½ inch.

7.5.2 The following seismic factors were developed using online data obtained from the Ground Motion Parameter Calculator provided by the Structural Engineers Association of California website (https://seismicmaps.org/) based upon a latitude of 36.605164 degrees and a longitude of -119.472267 degrees and a Site Class D. The data provided in Table No. 2 are based upon the procedures of the 2022 California Building Code and were not determined based upon a ground motion hazard analysis. The structural engineer should review the values in Table No. 2 and determine whether a ground motion hazard analysis is required for the project considering the seismic design category, structural details, and requirements of ASCE 7-16 (Section 11.4.8 and other applicable sections). If required, Moore Twining should be notified and requested to conduct the additional analysis, develop updated seismic factors for the project, and update the following values.

Table No. 2

Seismic Factor	2022 CBC Value
Site Class	D
Maximum Considered Earthquake (geometric mean) peak ground acceleration adjusted for site effects (PGA_M)	0.310g
Mapped Maximum Considered Earthquake (geometric mean) peak ground acceleration (PGA)	0.225g
Spectral Response At Short Period (0.2 Second), S_s	0.521
Spectral Response At 1-Second Period, S_1	0.211
Site Coefficient (based on Spectral Response At Short Period), F_a	1.383

Seismic Factor	2022 CBC Value
Site Coefficient (based on spectral response at 1-second period) F_v	See Note
Maximum considered earthquake spectral response acceleration for short period, S_{MS}	0.721
Maximum considered earthquake spectral response acceleration at 1 second, S_{M1}	See Note
Five percent damped design spectral response accelerations for short period, S_{DS}	0.480
Five percent damped design spectral response accelerations at 1-second period, S_{D1}	See Note

Note: Requires ground motion hazard analysis per ASCE Section 21.2 (ASCE 7-16, Section 11.4.8), unless an Exception of Section 11.4.8 of ASCE 7-16 is applicable for the project design.

7.5.3 Foundation excavations or exposed soils should not be left uncovered and allowed to dry such that the moisture content of the soil is less than optimum moisture content, or drying produces cracks in the soils and sloughing. The moisture and density should be maintained until concrete is placed. It should be noted that the contractor should take precautions not to allow the exposed soils to dry, including on weekends and holidays. If dry soils are noted, the contractor should request written recommendations from our firm to properly moisture condition the foundation excavations. In addition, if soft or unstable soils are encountered during excavation operations, our firm should be notified so the soil conditions can be evaluated and additional recommendations provided to address the pliant areas.

7.5.4 The moisture content of the subgrade soils should be tested and verified for proper moisture by Moore Twining within 48 hours of placement of the vapor retarding membrane or the concrete for the slab-on-grade if a vapor retarding membrane is not used. If necessary to achieve the recommended moisture content, the native subgrade could be over-excavated, moisture conditioned as necessary and compacted as engineered fill.

7.5.5 The bottom surface area of concrete footings or concrete slabs in direct contact with engineered fill can be used to resist lateral loads. An allowable coefficient of friction of 0.30 can be used for design.

7.5.6 For the shallow foundations, the allowable passive resistance of the native soils and engineered fill may be assumed to be equal to the pressure developed by a fluid with a density of 275 pounds per cubic foot. The upper 12 inches of subgrade in landscaped areas should be neglected in determining the total passive resistance.

7.6 Shallow Conventional Foundations for Equipment Shelter Building

7.6.1 Conventional foundations for the equipment shelter building supported on subgrade soils prepared as recommended in the "Site Preparation" section of this report may be designed for a maximum net allowable soil bearing pressure of 2,500 pounds per square foot for dead-plus-live loads. This value may be increased by one-third for short duration wind or seismic loads. If a structural slab system is used, the slab may be designed for an allowable bearing pressure of 1,000 pounds per square foot.

7.6.2 All shallow footings/thickened edges for the proposed new equipment building should have a minimum depth of 12 inches below the lowest adjacent finished grade.

7.6.3 The foundations should be continuous around the perimeter of the equipment shelter building to reduce moisture migration beneath the structure. Continuous perimeter foundations should be extended through doorways and/or openings that are not needed for support of loads.

7.6.4 A structural engineer experienced in foundation design should recommend the thickness, design details and concrete specifications for the foundations based on the estimated settlements. Foundation designs for the equipment shelter building should consider a static settlement of 1 inch and a differential static settlement of ½ inch over the shortest length of the structure.

7.6.5 Shallow foundation excavations should be observed by Moore Twining prior to the placement of steel reinforcement and concrete to verify conformance with the intent of the recommendations of this report. The Contractor is responsible for proper notification to Moore Twining and receipt of written confirmation of this observation prior to placement of steel reinforcement.

7.6.6 Foundation excavations or exposed soils should not be left uncovered and allowed to dry such that the moisture content of the soils is less than optimum moisture content or drying produces cracks in the soils. The exposed soils, such as sidewalls, excavation bottoms, etc. should be continuously moistened to maintain the moisture content at least optimum until concrete is placed.

7.7 Mat Foundation for Radio Tower

Recommendations are provided below for use in design of a mat foundation for the proposed radio tower. In the event a drilled shaft foundation is desired for support of the proposed radio tower, recommendations for design and construction of drilled shafts are provided in sections 7.8 and 7.9 of this report.

7.7.1 Mat foundations (if used for support of the radio tower) should be supported on engineered fill soils prepared as recommend in section 7.3.3 of this report.

7.7.2 The mat foundation may be designed for an allowable soil bearing pressure of 1,500 pounds per square foot. The soil bearing pressure may be increased by 150 percent for temporary loading. On a preliminary basis, the mat foundation may be designed using a modulus of subgrade reaction of 175 pounds per cubic inch when based on a 1 foot square plate. This value does not account for the size effects of the foundation. Thus, in design, the modulus of subgrade reaction value should be adjusted for the actual footing geometry. If additional information is required, when the approximate foundation size and load distribution (applied soil pressure) for the mat foundation is known, Moore Twining can provide a more detailed recommendation for the modulus of subgrade reaction value based on the size effects of the foundation, if needed.

7.7.3 A structural engineer experienced in foundation design should recommend the thickness, design details and concrete specifications for the foundations based on the estimated settlements. Foundation designs for the radio tower mat foundation should consider a static settlement of 1.5 inch and a differential static settlement of ¾ inch over 30 feet, or over the least distance of the mat foundation, whichever is less.

7.7.4 Mat foundations should include be embedded a minimum of 24 inches below the lowest adjacent finished grade, or should include a thickened edge with an embedment of at least 24 inches below the lowest finished adjacent grade. Deeper embedment is anticipated to be required for structural design.

7.8 Drilled Shafts for Proposed Radio Tower

In the event that drilled shaft foundations are planned for the radio tower instead of a mat foundation, recommendations are provided below in sections 7.8 and 7.9 for drilled shafts.

7.8.1 A structural engineer registered in the state of California should prepare structural details for the drilled shafts to resist shear, moment, and axial (tension and compression) loads.

7.8.2 Skin friction in the upper portion of drilled shaft, to a depth of 1 shaft diameter should be neglected for design. The allowable vertical downward load capacity of the drilled shaft foundations below a depth of 1 shaft diameter below site grade may be designed based on an allowable skin friction value of 250 pounds per square foot to a depth of 15 feet below the existing ground surface, and an allowable skin friction value of 500 pounds per square foot below a depth of 15 feet below the existing ground surface. These values may be increased ⅓ for short duration loading.

7.8.3 The allowable uplift resistance of the shaft foundations may be assumed to be one-half of the vertical downward load capacity plus the weight of the concrete.

7.8.4 Drilled shafts should be placed no closer to each other than three shaft diameters, center-to-center. For alternate spacing, the capacity of drilled shafts in groups should be reduced using appropriate group reduction formulas.

7.8.5 Passive resistance in the upper portion of the drilled shaft, to a depth of 1 shaft diameter should be neglected for design. The allowable passive resistance of the soils below a depth of 1 shaft diameter below site grade may be assumed to be equal to the pressure developed by a fluid with a density of 275 pounds per cubic foot to a maximum of 2,750 pounds per square foot. These values may be increased by one-third for short duration wind or seismic loads. The passive pressure for drilled shaft foundations spaced at least three (3) shaft diameters apart may be applied over a width equal to 2 shaft diameters.

7.8.6 Based on the soils encountered in Boring B-2 during our field investigation for the proposed radio tower location, the following soil parameters have been prepared for lateral analysis of pile foundations using the software program LPILE by Ensoft, Inc.:

Table No. 3

Soil Consistency	Depth BSG (feet)	Unit Weight (pcf)	Angle of Internal Friction (degrees)	Soil Modulus, K (pci)	Undrained Shear Strength (psf)	Strain (E_{50})
Medium Dense Silty Sands and Poorly Graded Sand with interbedded silt	1'-15'	105	31	90	N/A	N/A
Very Stiff Silts	15'-20'	100	N/A	1,000	2,000	0.005
Medium Dense to Dense Clayey Sands and Silty Sands	20'-30'	105	30	90	N/A	N/A
Dense Clayey Sand	30'-40'	105	30	225	N/A	N/A
Medium Dense to Dense Clayey Sands and Silty Sands	40'-45'	105	30	90	N/A	N/A
Hard Silts and Clays	45'-51.5'	105	N/A	2,000	4,000	0.005

The upper 12 inches should be neglected in determining the lateral resistance
pcf = Pounds per cubic foot
psf = pounds per square foot
pci = pounds per cubic inch

7.9 Drilled Shaft Construction

7.9.1 It is assumed the foundation design engineer will prepare a specification for the construction of the drilled shaft foundations as part of the construction documents. The specifications should be consistent with the recommendations included in this report.

7.9.2 Concrete should be placed in the drilled shaft as soon as possible following drilling.

7.9.3 Granular soils were encountered in the test boring drilled during this investigation. These soils may collapse into the borehole during drilling for the piles. Temporary casing should be used for temporary support of the drilled shaft excavations during construction. The casing should be slowly removed from the shaft excavation during placement of concrete to ensure the casing is not raised above the level of the concrete during shaft construction, to prevent sidewall soils from sloughing into the shaft excavation. As an alternative, it may be possible to utilize a drilling slurry for temporary support of the foundation excavations. The Contractor will be required to provide temporary excavation support of the drilled shaft excavations as necessary to construct the foundations.

7.9.4 Casing (if used) should be able to withstand the external pressures of the caving soils. The outside diameter of the casing should not be less than the diameter of the drilled shaft.

7.9.5 Drilled holes for drilled shaft foundations should be drilled within 2 degrees of vertical. The rebar cage should be suspended within 2 degrees of vertical in the center of the excavation. This condition should be verified and documented during construction. Minimum concrete cover, as specified by the project design engineer, should be maintained throughout the length of the excavation.

7.9.6 Casing should be lifted slowly as the concrete is deposited, while the bottom of the casing is kept at least two feet below the top of the concrete.

7.9.7 Moore Twining should inspect the drilling of the shafts to verify that the materials encountered are consistent with those evaluated during our geotechnical engineering investigation. This inspection should be conducted during drilling and prior to placement of reinforcing steel and concrete.

7.9.8 Loose soils should be removed from the drilled shaft excavation prior to placement of reinforcing steel and concrete.

7.10 Equipment Shelter Slab on Grade and Vapor Barrier

This section provides general recommendations that may be applied to the slab-on-grade at the equipment shelter.

7.10.1 Slabs-on-grade should be constructed over a minimum of 4 inches of non-recycled, Class 2 aggregate base (AB) over the depth of engineered fill recommended in the "Site Preparation" section of this report.

7.10.2 The slabs and underlying subgrade soils should be constructed in accordance with current American Concrete Institute (ACI) standards.

7.10.3 A vapor retarder should be placed below interior building slabs where moisture could permeate into the interior and create problems. Refer to the American Concrete Institute's Guide to Concrete Floor and Slab Construction (ACI 302.1R) for selection and installation of moisture vapor retarders. It is recommended that a Stegowrap 15 vapor retarder be used where moisture could permeate into the interior and create problems, such as where flooring or floor slab applications will contain moisture sensitive materials (or other slab applications or uses). The vapor retarder should overlay the compacted 4 inch layer of aggregate base. It should be noted that placing the PCC slab directly on the vapor retarder may increase the potential for cracking and curling; however, ACI recommends the placement of the vapor retarding membrane directly below the slab unless a watertight roofing system is in place prior to slab construction to reduce the amount vapor emission through the slab-on-grade. It is recommended that the slab be moist cured for a minimum of 7 days to reduce the potential for excessive cracking.

The underslab membrane should have a high puncture resistance (minimum of approximately 2,400 grams of puncture resistance), high abrasion resistance, rot resistant, and mildew resistant. It is recommended that the membrane be selected in accordance with the current ASTM C 755, Standard Practice For Selection of Vapor Retarder For Thermal Insulation and conform to the current ASTM E 1745 Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs and ASTM E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Waters, or as Ground Cover. It is recommended that the vapor barrier installation conform to the current ACI Manual of Concrete Practice, Guide for Concrete Floor and Slab Construction (302.1R), Addendum, Vapor Retarder Location and current ASTM E 1643, Standard Practice for Installation of Water Vapor Retarders Used In Contact with Earth or Granular Fill Under Concrete Slabs. In addition, it is recommended that the manufacturer of floor covering, floor covering adhesive or other slab material applications be consulted to determine if the manufacturers have additional recommendations regarding the design and construction of the slab-on-grade, testing of the slab-on-grade, slab preparation, application of the adhesive, installation of the floor covering and maintenance requirements. It should be noted that the recommendations presented in this report are not intended to achieve a specific vapor emission rate.

7.10.4 The membrane should be installed so that there are no holes or uncovered areas. All seams should be overlapped and sealed with the manufacturer approved tape continuous at the laps so they are vapor tight. All perimeter edges of the membrane, such as pipe penetrations, interior and exterior footings, joints, etc., should be caulked per manufacturer's recommendations.

7.10.5 Tears or punctures that may occur in the membrane should be repaired prior to placement of concrete per manufacturer's recommendations. Once repaired, the membrane should be inspected by the contractor and the owner to verify adequate compliance with manufacture's recommendations.

7.10.6 The moisture retarding membrane is not required beneath exposed concrete floors, provided that moisture intrusion into the structure are permissible for the design life of the structure.

7.10.7 Additional measures to reduce moisture migration should be implemented for floors that will receive moisture sensitive coverings. These include: 1) constructing a less pervious concrete floor slab by maintaining a water-cement ratio of 0.52 lb./lb. or less in the concrete for slabs-on-grade, 2) ensuring that all seams and utility protrusions are sealed with tape to create a "water tight" moisture barrier, 3) placing concrete walkways or pavements adjacent to the structure, 4) providing adequate drainage away from the structure, 5) moist cure the slabs for at least 7 days, and 6) locating lawns, irrigated landscape areas, and flower beds away from the structure.

7.10.8 The Contractor shall test the moisture vapor transmission through the slab, the pH, internal relative humidity, etc., at a frequency and method as specified by the flooring manufacturer or as required by the plans and specifications, whichever is most stringent. The results of vapor transmission tests, pH tests, internal relative humidity tests, ambient building conditions, etc. should be within floor manufacturer's and adhesive manufacturer's specifications at the time the floor is placed. It is recommended that the floor manufacturer and subcontractor review and approve the test data prior to floor covering installation.

7.11 Temporary Excavations

7.11.1 It is the responsibility of the contractor to provide safe working conditions with respect to excavation slope stability. The contractor is responsible for site slope safety, classification of materials for excavation purposes, and maintaining slopes in a safe manner during construction. The grades, classification and height recommendations presented for temporary slopes are for consideration in preparing budget estimates and evaluating construction procedures.

7.11.2 Temporary excavations should be constructed in accordance with OSHA requirements. Temporary cut slopes should not be steeper than 1.5:1, horizontal to vertical, and flatter if possible. If excavations cannot meet these criteria, the temporary excavations should be shored.

7.11.3 In no case should excavations extend below a 1.5H to 1V zone below utilities, foundations and/or floor slabs which are to remain after construction. Excavations which are required to be advanced below the 1.5H to 1V envelope should be shored to support the soils, foundations, and slabs.

7.12 Corrosion Protection

7.12.1 Based on the National Association of Corrosion Engineers corrosion severity rating listed in Section 5.2 of this report and the analytical results of two (2) soil samples tested, the soils have a "highly corrosive" corrosion potential to ferrous alloy pipes, as indicated by a resistivity value of 2,700 ohms-centimeter, and a pH values of 8.6. Buried metal objects should be protected in accordance with the manufacturer's recommendations based on the "highly corrosive" corrosion potential of the soil. The evaluation was limited to the effects of soils to metal objects; corrosion due to other potential sources, such as stray currents and groundwater, was not evaluated.

7.12.2 Based on Table 19.3.1.1 - Exposure categories and classes from Chapter 19 of ACI 318, the sulfate concentration from chemical testing of soil samples falls in the S0 classification (less than 0.10 percent by weight) for concrete. Therefore, no restrictions are required regarding the type, water-to-cement ratio, or strength of the concrete used for foundations and slabs due to the sulfate content.

7.12.3 We recommend that these soil corrosion data be provided to the manufacturers or suppliers of materials that will be in contact with soils (pipes or ferrous metal objects, etc.) to provide assistance in selecting the protection and materials for the proposed products or materials. If the manufacturer's or supplier's cannot determine if materials are compatible with the soil corrosion conditions, a professional consultant, i.e., a corrosion engineer, with experience in corrosion protection should be consulted to design parameters. Moore Twining is not a corrosion engineer; thus, cannot provide recommendations for mitigation of corrosive soil conditions. It is recommended that a corrosion engineer be consulted for the site specific conditions.

8.0 DESIGN CONSULTATION

8.1 Moore Twining should be retained to review those portions of the contract drawings and specifications that pertain to earthwork operations and foundations prior to finalization to determine whether they are consistent with our recommendations.

8.2 It is the client's responsibility to provide plans and specification documents for our review prior to their issuance for construction bidding purposes.

8.3 If Moore Twining is not retained for review, we assume no liability for the misinterpretation of our conclusions and recommendations. This review is documented by a formal plan/specification review report provided by Moore Twining.

9.0 CONSTRUCTION MONITORING

9.1 It is recommended that Moore Twining be retained to observe the excavation, earthwork, and foundation phases of work to determine that the subsurface conditions are compatible with those used in the analysis and design. This service is not, however, part of this current contractual agreement.

10.0 NOTIFICATION AND LIMITATIONS

10.1 The conclusions and recommendations presented in this report are based on the information provided regarding the proposed construction, and the results of the field and laboratory investigation, combined with interpolation of the subsurface conditions.

10.2 If variations or undesirable conditions are encountered during construction, Moore Twining should be notified promptly so that these conditions can be reviewed and our recommendations reconsidered where necessary. It should be noted that unexpected conditions frequently require additional expenditures for proper construction of the project.

10.3 If the proposed construction is relocated or redesigned, or if there is a substantial lapse of time between the submission of our report and the start of work (more than 12 months) at the site, or if conditions have changed due to natural cause or construction operations at or adjacent to the site, the conclusions and recommendations contained in this report should be considered invalid unless the changes are reviewed and our conclusions and recommendations modified or approved in writing.

10.4 Changed site conditions, or relocation of proposed structure(s), may require additional field and laboratory investigations to determine if our conclusions and recommendations are applicable considering the changed conditions or time lapse.

10.5 The conclusions and recommendations contained in this report are valid only for the project discussed in the Anticipated Construction section of this report. The use of the information and recommendations contained in this report for structure on this site not discussed herein is not recommended. The entity or entities that use or cause to use this report or any portion thereof for another structure or site not covered by this report shall hold Moore Twining, its officers and employees harmless from any and all claims and provide Moore Twining's defense in the event of a claim.

10.6 This report is issued with the understanding that it is the responsibility of the client to transmit the information and recommendations of this report to developers, owners, buyers, architects, engineers, designers, contractors, subcontractors, and other parties having interest in the project so that the steps necessary to carry out these recommendations in the design, construction and maintenance of the project are taken by the appropriate party.

10.7 Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally-accepted engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied.

10.8 Reliance on this report by a third party (i.e., that is not a party to our written agreement) is at the party's sole risk. If the project and/or site are purchased by another party, the purchaser must obtain written authorization and sign an agreement with Moore Twining in order to rely upon the information provided in this report for design or construction of the project.

11.0 CLOSING

We appreciate the opportunity to be of service to the County of Fresno. If you have any questions regarding this report, or if we can be of further assistance, please contact us at your convenience.

Sincerely,

MOORE TWINING ASSOCIATES, INC.
Geotechnical Engineering Division

Allen H. Harker, CEG
Certified Engineering Geologist

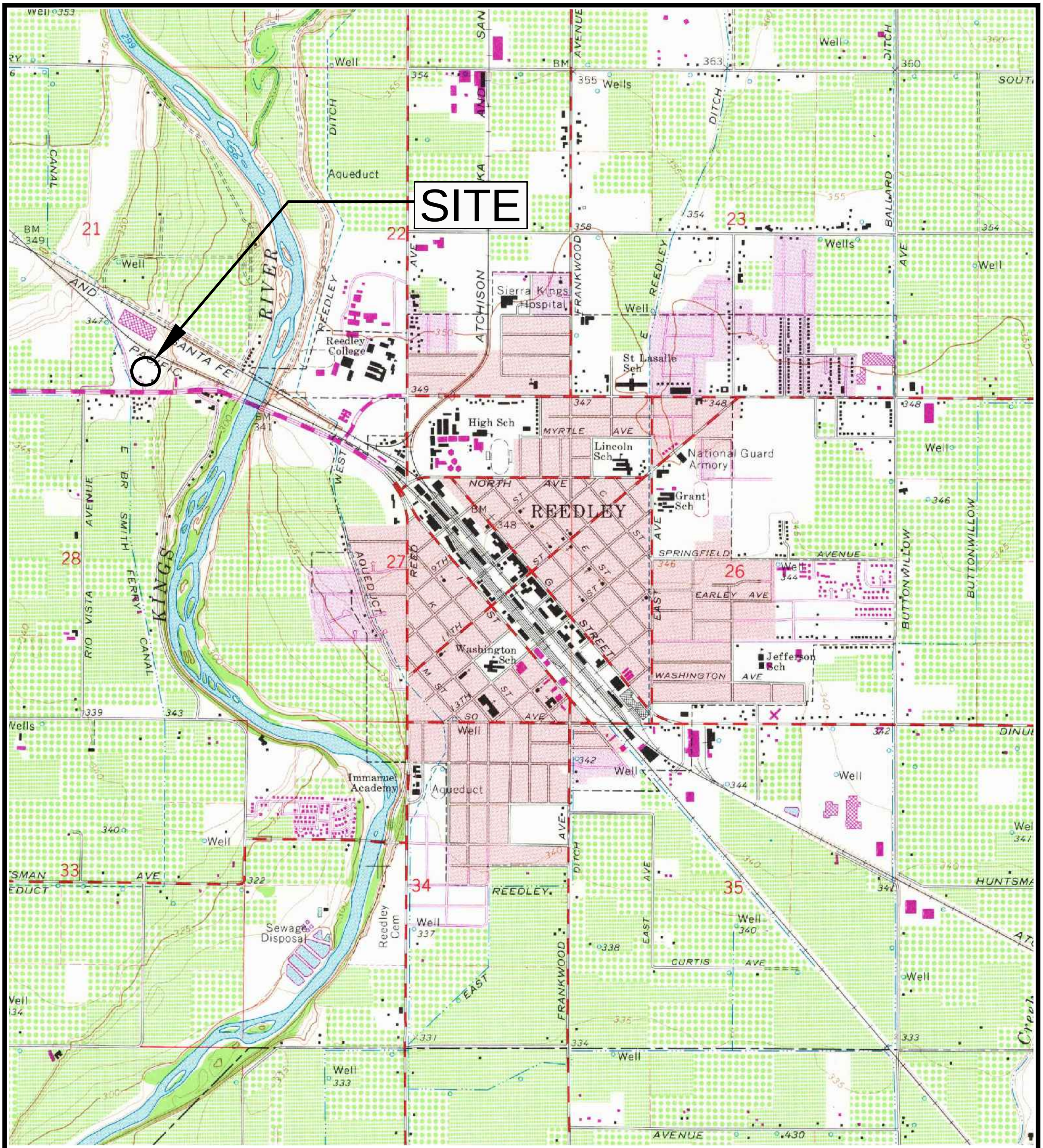
Read L. Andersen, RGE
Manager

APPENDIX A

DRAWINGS

Drawing No. 1 - Site Location Map

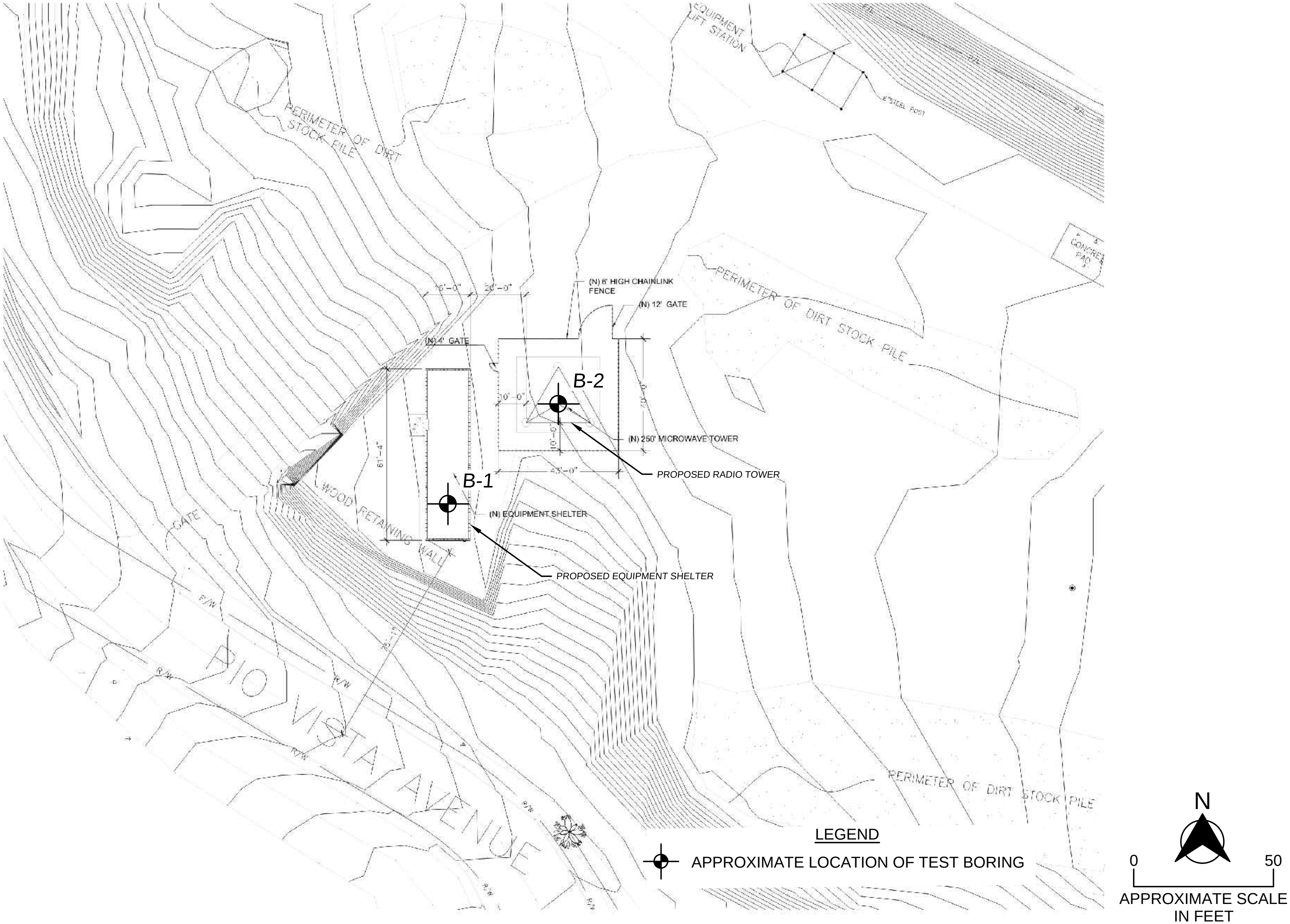
Drawing No. 2 - Test Boring Location Map



SOURCE: U.S.G.S. TOPOGRAPHIC MAP, 7 ½ MINUTE SERIES
REEDLEY, CALIFORNIA QUADRANGLE 1966, PHOTOREVISED 1981

0 2000
APPROXIMATE SCALE
IN FEET

SITE LOCATION MAP PROPOSED RADIO TOWER AND EQUIPMENT SHELTER NORTH OF THE INTERSECTION OF MANNING AVENUE AND SOUTH RIO VISTA AVENUE REEDLEY, CALIFORNIA	FILE NO.: 26360-01-01	DATE: 08/08/2023	MOORE TWINING ASSOCIATES, INC.
	DRAWN BY: JE	APPROVED BY:	
	PROJECT NO. A26360.01	DRAWING NO. 1	



TEST BORING LOCATION MAP PROPOSED RADIO TOWER AND EQUIPMENT SHELTER NORTH OF THE INTERSECTION OF MANNING AVENUE AND SOUTH RIO VISTA AVENUE REEDLEY, CALIFORNIA	FILE NO. 26360-01-02	DATE DRAWN: 08/08/2023	MOORE TWINING ASSOCIATES, INC.
	DRAWN BY: JE	APPROVED BY:	
	PROJECT NO. A26360.01	DRAWING NO. 2	

APPENDIX B

LOG OF TEST BORING

This appendix contains the final boring log. The log represents our interpretation of the contents of the field log and the results of the field and laboratory tests.

The logs and related information depict subsurface conditions only at these locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at the test boring locations. Also, the passage of time may result in changes in the soil conditions.

In addition, an explanation of the abbreviations used in the preparation of the logs and a description of the Unified Soil Classification System are provided at the end of Appendix B.

MOORE TWINING ASSOCIATES, INC.

Since 1898

Test Boring: B-1

Project: Proposed Radio Tower and Equipment Shelter in Reedley, California

Project Number: A26360.01

Logged By: A.V.

Drilled By: J.S.

Date: August 1, 2023

Drill Type: CME 75

Elevation: N/A

Auger Type: 6-5/8" O.D. Hollow Stem Augers

Hammer Type: 140 Pound Auto Trip

Depth to Groundwater First Encountered During Drilling: N/E

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	7/6, 13/6, 30/6	AC	Asphalt Concrete = 5 inches	From 0.5-5': pH = 8.6, SR = 2,700 ohm-cm, Cl = 0.0053%, SS = 0.01%	43	6.0
		FILL	FILL - SILTY SAND; dense, moist, fine to coarse grained, brown, with some gravel			
	6/6, 30/6, 30/6	AC	At 1.8 feet - Asphalt Concrete layer, 2.5 inches in thickness		60	1.1
		SP	At 2 feet - NATIVE - POORLY GRADED SAND; dense, damp, fine to coarse grained, light brown			
5	3/6, 3/6, 3/6		Loose	From 2-3.5': DD = 104.6 pcf, Sand = 96.3%, -200 = 3.7%, ø = 31°, c = 180 psf	6	1.5
	3/6, 4/6, 6/6	SM	SILTY SAND; loose, moist, fine to medium grained, brown, with increasing sand content with depth		10	11.6
10						
	7/6, 9/6, 11/6		Medium dense, fine to coarse grained		20	
15		SP	POORLY GRADED SAND; medium dense, fine to coarse grained, light brown			
	9/6, 20/6, 26/6	SC	CLAYEY SAND; dense, moist, fine to medium grained, reddish brown		46	
20			Bottom of Boring B-1 at 20 feet			
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-2

Project: Proposed Radio Tower and Equipment Shelter in Reedley, California

Project Number: A26360.01

Drilled By: J.S.

Drill Type: CME 75

Auger Type: 6-5/8" O.D. Hollow Stem Augers

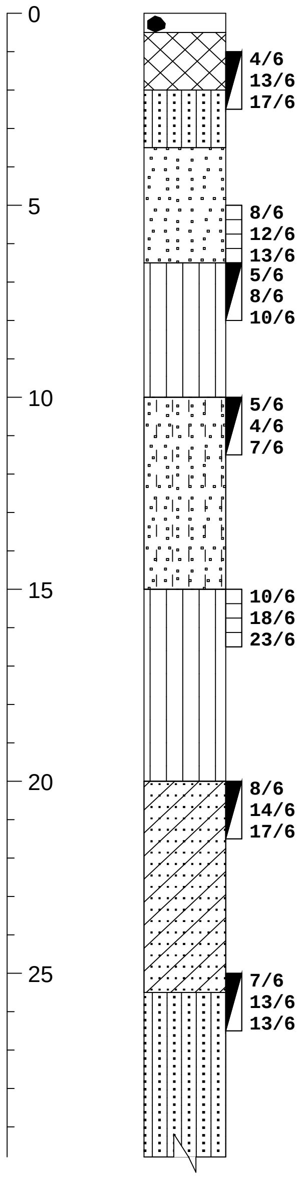
Hammer Type: 140 Pound Auto Trip

Logged By: A.V.

Date: August 1, 2023

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 50 feet*



USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
AB	Aggregate Base = 6 inches			
FILL	FILL - SILTY SAND; medium dense, moist, fine to medium grained, brown, some gravel		30	6.4
SM	At 2 feet - NATIVE - SILTY SAND; medium dense, moist, fine to coarse grained, brown, with increasing sand content with depth	Sample disturbed	25	1.2
SP	POORLY GRADED SAND; damp, fine to coarse grained, light brown Medium dense	Sand = 41.6% -200 = 58.4%	18	12.5
ML	SANDY SILT; very stiff, moist, slight plasticity, brown, trace			
SP-SM	POORLY GRADED SAND WITH SILT; medium dense, moist, fine to coarse grained, brown, with 2-inch interbedded seam of silt		11	6.3
ML	SANDY SILT; very stiff, damp, non-plastic, light brown, with seams of sand, with iron-oxide staining	DD = 97.7 pcf	41	5.1
SC	CLAYEY SAND; dense, moist, fine to medium grained, reddish brown		31	9.5
	Medium dense	Sand = 77.8% -200 = 22.2%	26	7.7
SM	SILTY SAND; medium dense, moist, fine to medium grained, reddish brown			

Notes: ** Groundwater encountered at 50 feet below site grade during drilling. Groundwater measured at 47 feet below site grade after drilling.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-2

Project: Proposed Radio Tower and Equipment Shelter in Reedley, California

Project Number: A26360.01

Drilled By: J.S.

Drill Type: CME 75

Auger Type: 6-5/8" O.D. Hollow Stem Augers

Hammer Type: 140 Pound Auto Trip

Logged By: A.V.

Date: August 1, 2023

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 50 feet*

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
30	8/6 18/6 24/6	SC	CLAYEY SAND; dense, moist, fine grained, reddish brown, with interbedded 2-inch seam of poorly graded sand		42	
		CL	SANDY LEAN CLAY; moist, low plasticity, reddish brown			
35	9/6 13/6 20/6	SC	CLAYEY SAND; dense, moist, fine to coarse grained, reddish brown		33	
40	5/6 8/6 14/6	SM	SILTY SAND; medium dense, very moist, fine to medium grained, brown		22	
45	5/6 18/6 22/6	ML	SANDY SILT; hard, very moist, non-plastic, light brown, with iron-oxide staining		40	
50	5/6 17/6 20/6	SC	CLAYEY SAND; dense, wet, fine to medium grained, reddish brown		37	
		CL	SANDY LEAN CLAY; hard, very moist, low plasticity, brown			
			Bottom of Boring B-2 at 51.5 feet			
55						

Notes: ** Groundwater encountered at 50 feet below site grade during drilling. Groundwater measured at 47 feet below site grade after drilling.*

Figure Number

KEY TO SYMBOLS

Symbol	Description
	Strata symbols
	Asphalt concrete
	Fill
	Poorly Graded Sand
	Silty Sand
	Clayey Sand
	Aggregate base
	Silt
	Poorly Graded Sand with Silt
	Lean Clay
	Misc. Symbols
	Boring continues
	Water table during drilling
	Soil Samplers
	Standard penetration test
	California Modified split barrel ring sampler

Notes:

1. Exploratory borings were drilled on 8/1/23 using a CME 75 drill rig equipped with 6-5/8" outside diameter hollow stem augers.

2. Groundwater was encountered in one of the borings, see log for boring B-2.

3. Boring locations were measured or paced from existing features.

4. These logs are subject to the limitations, conclusions, and recommendations in this report.

5. The "N-value" reported for the California Modified Split Barrel Sampler is the uncorrected field blow count. This value should not be interpreted as an SPT equivalent N-value.

6. Results of tests conducted on samples recovered are reported on the logs.

DD	= Natural dry density (pcf)	LL	= Liquid Limit (%)
+4	= Percent retained on the No. 4 sieve(%)	PI	= Plasticity Index (%)
-200	= Percent passing the No. 200 sieve (%)	EI	= Expansion Index
Sand	= Percent passing the No. 4 sieve and retained on No. 200 sieve (%)	Gravel	= Percent passing 3-inch & retained on No. 4 sieves(%)
pH	= Soil pH	SR	= Soil resistivity (ohms-cm)
SS	= Soluble sulfates (%)	Cl	= Soluble chlorides (%)
ø	= Internal Angle of Friction (degrees)	c	= Cohesion (psf)
pcf	= Pounds per cubic foot	psf	= Pounds per square foot
O.D.	= Outside diameter	AMSL	= Above mean sea level
N/A	= Not applicable	N/E	= Not encountered

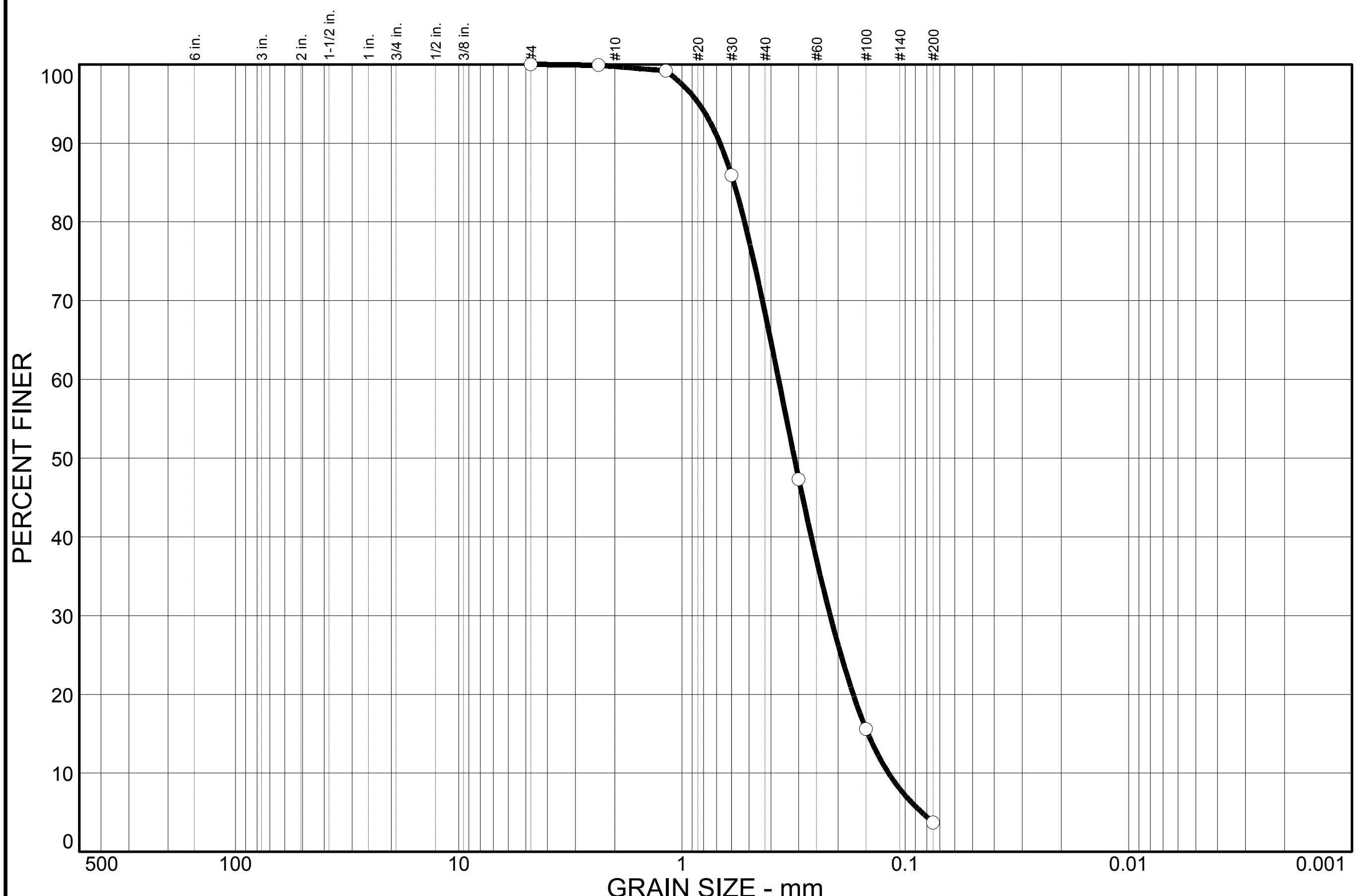
APPENDIX C

RESULTS OF LABORATORY TESTS

This appendix contains the individual results of the following tests. The results of the moisture content and dry density tests are included on the boring log in Appendix B. These data, along with the field observations, were used to prepare the final test boring log in Appendix B.

These Included:	To Determine:
Moisture Content (ASTM D2216)	Moisture contents representative of field conditions at the time the sample was taken.
Dry Density (ASTM D2937)	Dry unit weight of sample representative of in-situ or in-place undisturbed condition.
Grain-Size Distribution (ASTM D422)	Size and distribution of soil particles, i.e., sand, gravel and fines (silt and clay).
Atterberg Limits (ASTM D4318)	Determines the moisture content where the soil behaves as a viscous material (liquid limit) and the moisture content at which the soil reaches a plastic state
Consolidation (ASTM 2435)	The amount and rate at which a soil sample compresses when loaded, and the influence of saturation on its behavior.
Direct Shear (ASTM D3080)	Soil shearing strength under varying loads and/or moisture conditions.
Moisture-Density Relationship (D1557)	The optimum (best) moisture content for compacting soil and the maximum dry unit weight (density) for a given compactive effort.
pH (Cal Test 643)	The acidity or alkalinity of subgrade material.
Resistivity (G187)	The potential of the soil to corrode metal.
Chloride Content (Cal Test 422)	Percentage of soluble chloride in soil. Used to evaluate the potential attack on encased reinforcing steel.
Sulfate Content (Cal Test 417)	Percentage of water-soluble sulfate as (SO4) in soil samples. Used as an indication of the relative degree of sulfate attack on concrete and for selecting the cement type.

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.3	31.3	64.7	3.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.2		
#30	85.9		
#50	47.3		
#100	15.6		
#200	3.7		

* (no specification provided)

Material Description

Poorly graded sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.587 D_{60}= 0.370 D_{50}= 0.314
D_{30}= 0.217 D_{15}= 0.147 D_{10}= 0.119
C_u= 3.11 C_c= 1.07

Classification

USCS= SP AASHTO=

Remarks

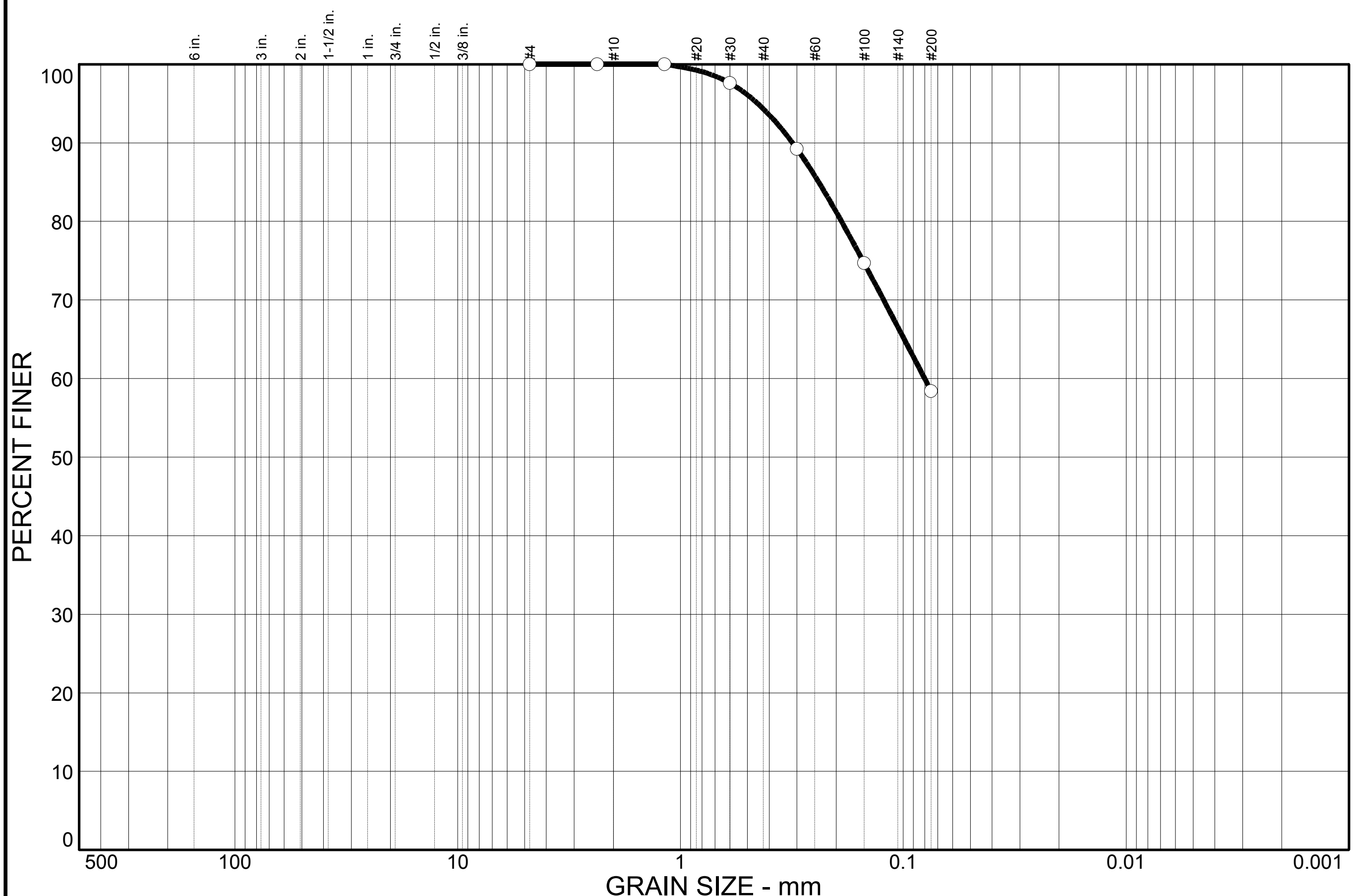
Sample No.: B-1 **Source of Sample:** **Date:** 8/1/23
Location: **Elev./Depth:** 2-3.5'

Moore Twining Associates, Inc.

Fresno, CA

Client:
Project: Proposed Radio Tower
Project No: A26360.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	5.7	35.9	58.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	100.0		
#30	97.6		
#50	89.2		
#100	74.7		
#200	58.4		

* (no specification provided)

Material Description

Sandy silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.240 D_{60}= 0.0802 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

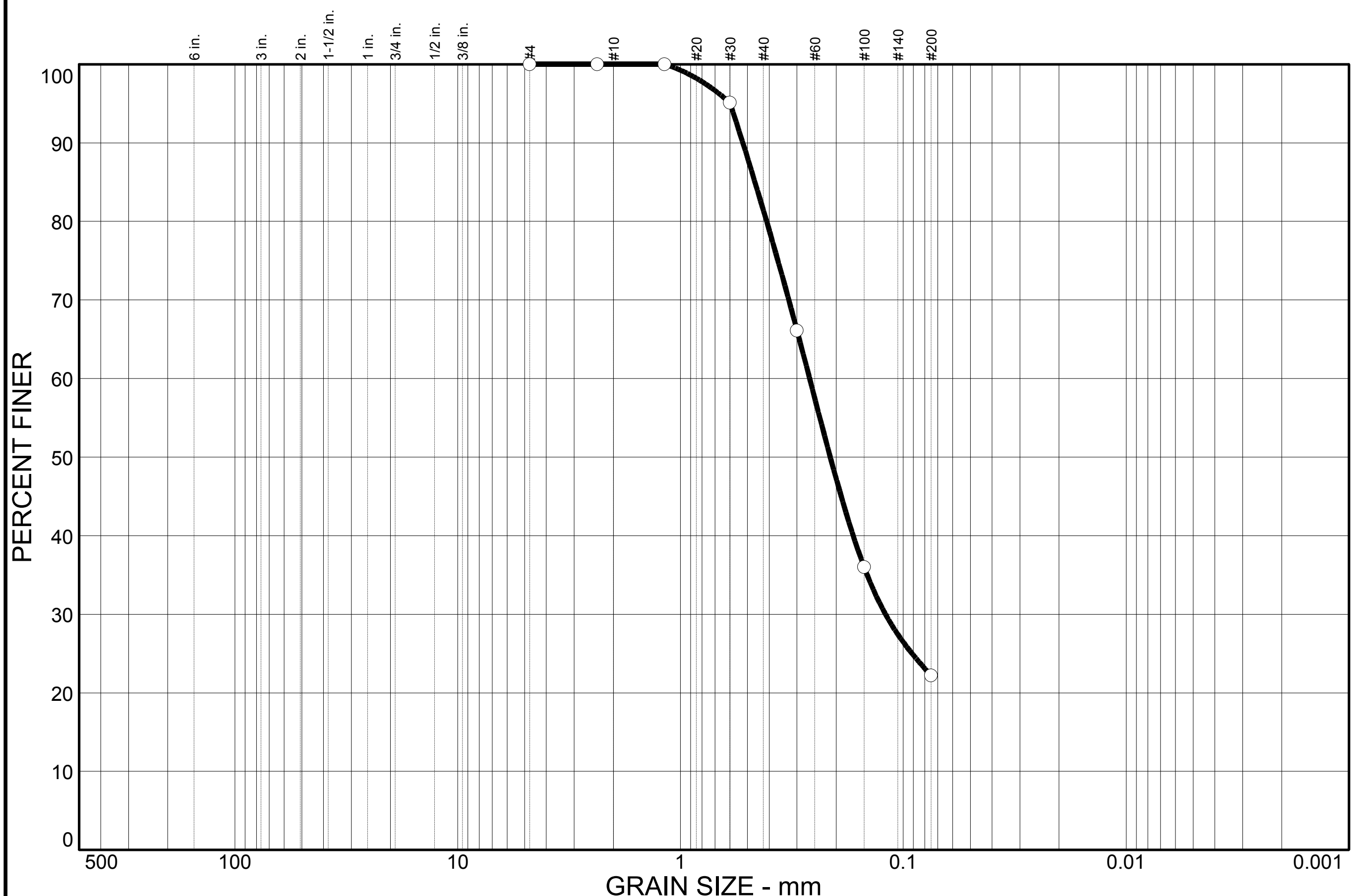
Sample No.: B-2 **Source of Sample:** **Date:** 8/1/23
Location: **Elev./Depth:** 7.5-8'

Moore Twining Associates, Inc.

Fresno, CA

Client:
Project: Proposed Radio Tower
Project No: A26360.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	18.6	59.2	22.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	100.0		
#30	95.1		
#50	66.1		
#100	36.0		
#200	22.2		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.464 D_{60}= 0.264 D_{50}= 0.213
D_{30}= 0.120 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Sample No.: B-2 **Source of Sample:** **Date:** 8/1/23
Location: **Elev./Depth:** 25-26.5'

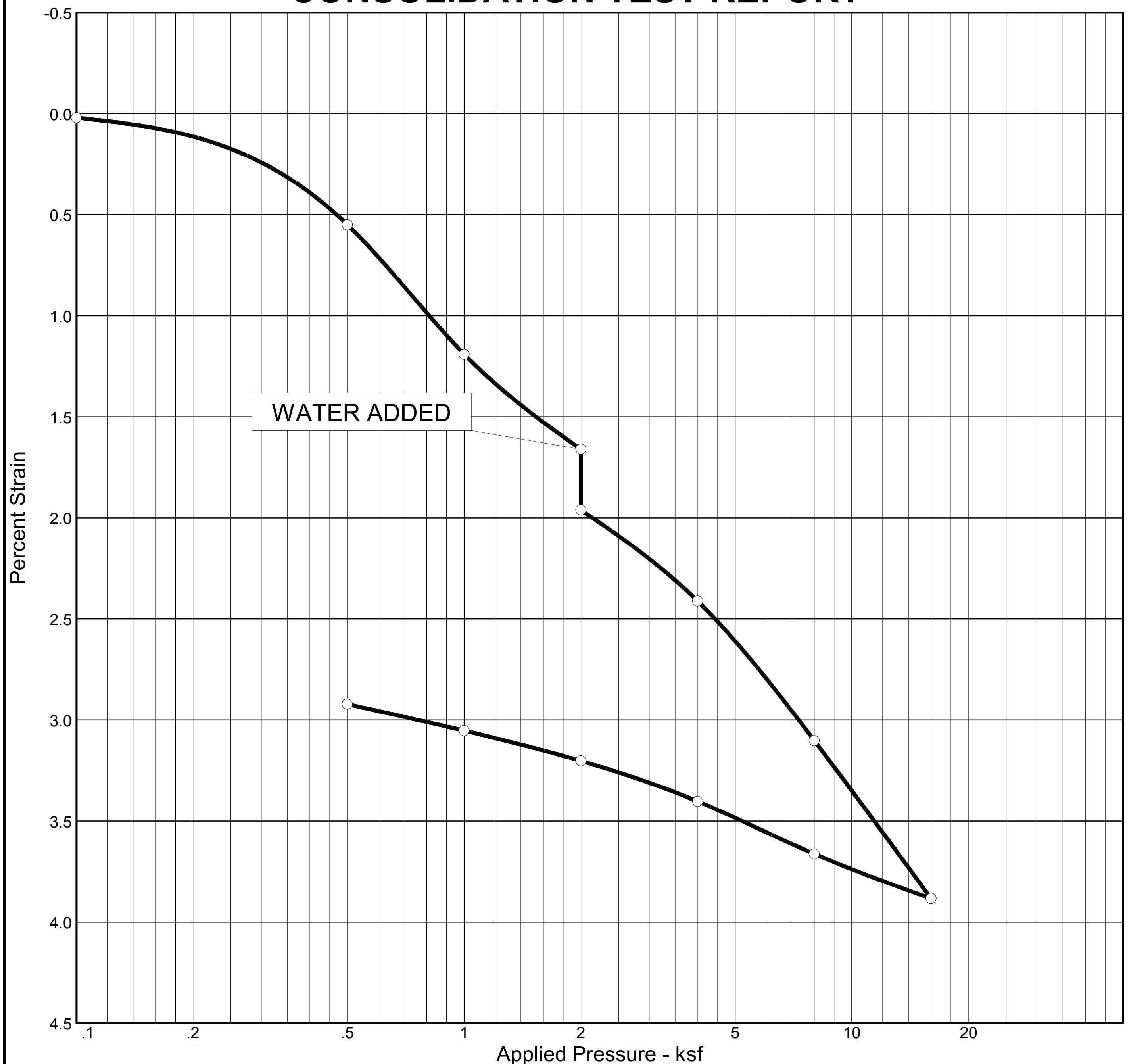
Moore Twining Associates, Inc.

Fresno, CA

Client:
Project: Proposed Radio Tower

Project No: A26360.01 **Figure**

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_s	Swell Press. (ksf)	Clpse. %	e_o
Sat.	Moist.											
19.4 %	5.0 %	98.3			2.65		1.12	0.04	0.01		0.3	0.683

MATERIAL DESCRIPTION	USCS	AASHTO
Sandy Silt	ML	

Project No. A26360.01 **Client:**

Project: Proposed Radio Tower

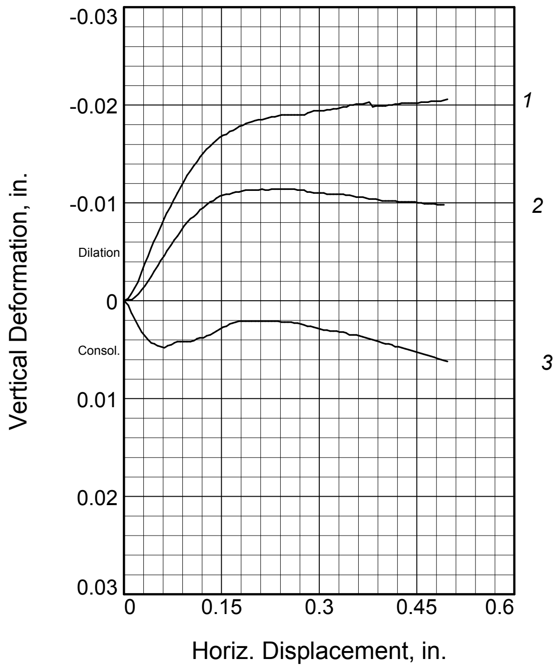
Source: **Sample No.:** B-2 **Elev./Depth:** 15-16.5'

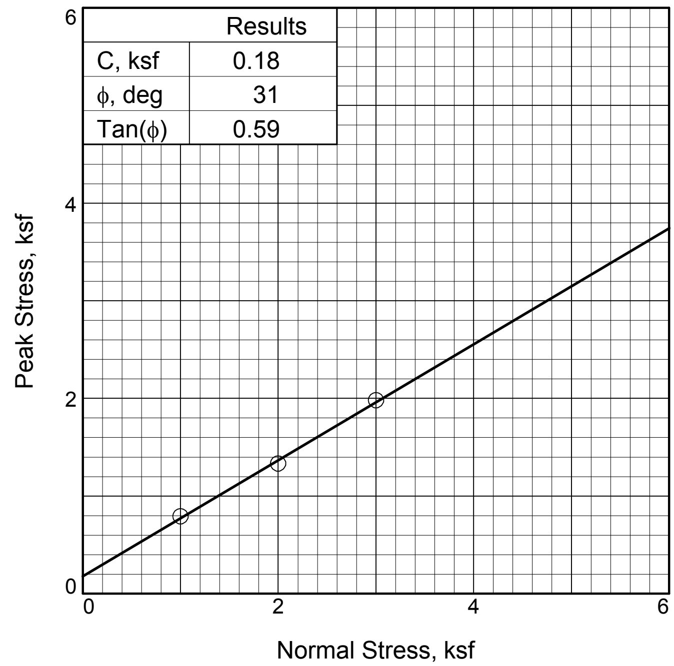
Moore Twining Associates, Inc.

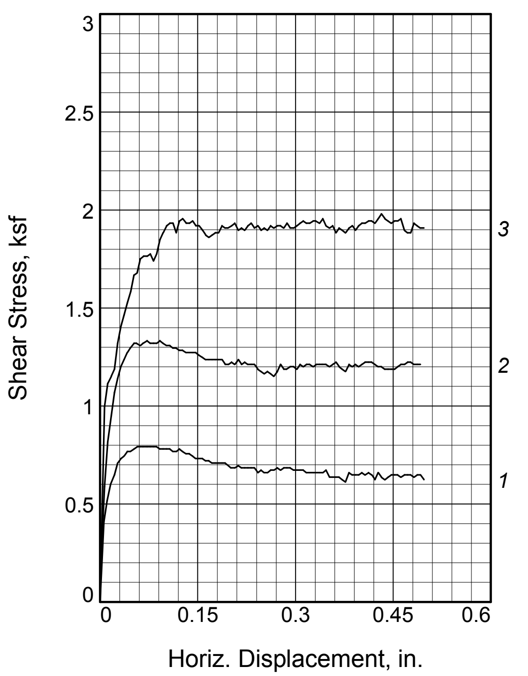
Fresno, CA

Remarks:

Figure







	Sample No.	1	2	3
Initial	Water Content, %	18.6	10.9	14.4
	Dry Density, pcf	89.6	92.3	93.4
	Saturation, %	58.4	36.4	49.5
	Void Ratio	0.8468	0.7919	0.7712
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	30.5	27.8	27.1
	Dry Density, pcf	90.9	93.9	95.2
	Saturation, %	98.7	96.8	97.5
	Void Ratio	0.8191	0.7614	0.7375
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.98	0.98	0.98
	Normal Stress, ksf	1.00	2.00	3.00
	Peak Stress, ksf	0.79	1.33	1.98
	Displacement, in.	0.06	0.07	0.43
	Ultimate Stress, ksf			
	Displacement, in.			
	Strain at peak, %	2.4	3.0	17.9

Sample Type:
Description: Poorly graded sand

Specific Gravity= 2.65
Remarks:

Figure ________

Client:

Project: Proposed Radio Tower

Sample Number: B-1 **Depth:** 2-3.5'

Proj. No.: A26360.01 **Date Sampled:** 8/1/23

DIRECT SHEAR TEST REPORT
Moore Twining Associates, Inc.
Fresno, CA

COMPACTION TEST REPORT

Test specification: ASTM D 1557-12 Method B Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
0.5-5'	SM							

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 127.2 pcf Optimum moisture = 8.7 %	Mix of Silty Sand and Poorly Graded Sand

Project No. A26360.01 **Client:**

Project: Proposed Radio Tower

● **Source:** **Sample No.:** B-1 **Elev./Depth:** 0.5-5'

Remarks:

Moore Twining Associates, Inc.

Fresno, CA

Figure

MOORE TWINING ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

August 15, 2023

Work Order #: **JH10017**

Alan Villegas
MTA Geotechnical Division
2527 Fresno Street
Fresno, CA 93721

RE: Proposed Radio Tower

Enclosed are the analytical results for samples received by our laboratory on **08/10/23** . For your reference, these analyses have been assigned laboratory work order number **JH10017**.

All analyses have been performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, Moore Twining Associates, Inc. (MTA) is not responsible for use of less than complete reports. Results apply only to samples analyzed.

If you have any questions, please feel free to contact us at the number listed above.

Sincerely,

Moore Twining Associates, Inc.

Lauren Cox
Client Services Representative

MOORE TWINING ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

MTA Geotechnical Division	**Project:**	Proposed Radio Tower	**Reported:**
2527 Fresno Street	**Project Number:**	A26360.01	08/15/2023
Fresno CA, 93721	**Project Manager:**	Alan Villegas	

Analytical Report for the Following Samples

Sample ID	Notes	Laboratory ID	Matrix	Date Sampled	Date Received
B-1 @ 0.5'-5'		JH10017-01	Soil	08/01/23 00:00	08/10/23 12:21

MOORE TWINING ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

MTA Geotechnical Division 2527 Fresno Street Fresno CA, 93721	**Project:** Proposed Radio Tower **Project Number:** A26360.01 **Project Manager:** Alan Villegas	**Reported:** 08/15/2023

B-1 @ 0.5'-5'

JH10017-01 (Soil)

Analyte	Result	Reporting Limit	Units	Batch	Prepared	Analyzed	Method	Flag
Inorganics								
Chloride	**0.0053**	0.0040	% by Weight	[CALC]	08/15/23	08/15/23	[CALC]	
Chloride	**53**	40	mg/kg	B3H1110	08/11/23	08/15/23	Cal Test 422	
pH	**8.6**	0.10	pH Units	B3H1110	08/11/23	08/14/23	Cal Test 643	
Sulfate as SO4	**0.01**	0.0040	% by Weight	[CALC]	08/15/23	08/15/23	[CALC]	
Sulfate as SO4	**100**	40	mg/kg	B3H1110	08/11/23	08/15/23	Cal Test 417	

Notes and Definitions

PREP	Modified preparation by pulverizing sample to pass #40 sieve and soaked for a minimum of 12 hours using a minimum dilution ratio of 1:10
ND	Analyte NOT DETECTED at or above the reporting limit
mg/kg	milligrams per kilogram (parts per million concentration units)

MOORE TWINING ASSOCIATES, INC.
Since 1898

Project Name:	Proposed Radio Tower	Report Date:	8/18/2023
		Sample Date:	8/1/2023
Project Number:	A26360.01		
		Sampled By:	AV
Subject:	Minimum Resistivity, ASTM G187	Tested By:	RS
Material Description:	Mix of Silty Sand and Poorly Graded Sand	Test Date:	8/11/2023
Location:	B-1 @ 0.5-5'		

Laboratory Test Results, Minimum Resistivity - ASTM G187

Total Water Added, mls	Resistivity, Ohm-cm
50 mls	6,100
75 mls	4,400
100 mls	3,700
125 mls	3,000
150 mls	2,800
175 mls	2,700
200 mls	2,700
225 mls	2,700
250 mls	2,700

Remarks: Min. Resistivity is 2,700 Ohm-cm

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