APPENDIX A

GEOTECHNICAL ENGINEERING INVESTIGATION PROPOSED UNDERGROUND SEWER PIPING SYSTEM

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MOORE TWINING ASSOCIATES, INC.

REVISED DRAFT
GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED UNDERGROUND SEWER PIPING SYSTEM
BIG SANDY RANCHERIA
FRESNO COUNTY, CALIFORNIA

Project Number: G56804.01

Mr. Henry Liang, P.E.
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February 27, 2020

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MOORE TWINING ASSOCIATES, INC.

February 27, 2020 G56804.01

Mr. Henry Liang, P.E.
Michael K. Nunley & Associates, Inc.
8405 North Fresno Street, Suite 120
Fresno, California 93720

Subject: **REVISED DRAFT: Geotechnical Engineering Investigation**
Proposed Underground Sewer Piping System
Big Sandy Rancheria
Fresno County, California

Dear Mr. Liang:

We are pleased to present this geotechnical engineering investigation report prepared for the proposed underground sewer piping system at Big Sandy Rancheria in Fresno County, California. The contents of this report include the purpose of the investigation, scope of services, background information, investigative procedures, our findings, conclusions, and recommendations.

We recommend that Moore Twining Associates, Inc. (Moore Twining) be retained to review those portions of the plans and specifications that pertain to earthwork 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.

We appreciate the opportunity to be of service to Michael K. Nunley & Associates, Inc. If you have any questions regarding this report, or if we can be of further assistance, please contact us at your convenience at (800) 268-7021.

Sincerely,

MOORE TWINING ASSOCIATES, INC.
Geotechnical Engineering Division

DRAFT

Kenneth J. Clark, CEG
Senior Engineering Geologist

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PROPOSED UNDERGROUND SEWER PIPING SYSTEM
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FRESNO COUNTY, CALIFORNIA

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1.0 INTRODUCTION

This report presents the results of a geotechnical engineering investigation prepared for the proposed underground sewer piping system at Big Sandy Rancheria in Fresno County, California. Moore Twining Associates, Inc. (Moore Twining) was authorized by Michael K. Nunley & Associates, Inc. (MKN) to conduct this geotechnical engineering investigation.

The contents of this report include the purpose of the investigation and the scope of services provided. The background information, a description of the investigative procedures used and the subsequent findings are presented. Finally, the report provides general conclusions, and related recommendations. The appendices contain the drawings (Appendix A), the logs of test borings and percolation test holes (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 a 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 The results of percolation tests;

2.1.3 Recommendations for temporary excavations, trench excavation, trench backfill, and excavation stability;

2.1.4 Recommendations for utility trench backfill, including discussion of the potential use of on-site soils as trench backfill; and,

2.1.5 Final test boring logs and laboratory test results.

This geotechnical engineering investigation report is provided specifically for the proposed project described in the Project Location and Description section of this report. This investigation did not include infiltration/percolation system design, foundation design (such as for lift stations and/or

treatment plant facilities), in-place density tests, an environmental investigation, or an environmental audit. This report does not include assessment of the feasibility of, nor design recommendations for the disposal field. In addition, this investigation did not include providing pavement section recommendations. It is anticipated that future geotechnical investigations will be required for the wastewater treatment plant and lift stations, once the locations of these improvements are known.

2.2 Scope: Our proposal, dated June 4, 2019, outlined the scope of our services. The actions undertaken during the investigation are summarized as follows:

2.2.1 The following documents provided by MKN were reviewed for general information purposes:

Report entitled: "Summary of Soil Profile Trenches and Effluent Loading Rate Estimation, Big Sandy Rancheria Effluent Disposal Project, Fresno County, California," prepared by Geocon, Inc., dated January 2013.

Figure 1-3, Big Sandy Rancheria, Wastewater Feasibility Study, Proposed Project Wastewater System, prepared by Hydroscience, undated.

2.2.2 The proposed test boring locations were premarked and coordinated with Mr. Kevin Norgaard (Michael K. Nunley & Associates), and Mr. Sal Terry (Big Sandy Rancheria).

2.2.3 Conducted a site reconnaissance and subsurface exploration, including test borings and percolation tests.

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

2.2.5 Mr. Henry Liang and Mr. Kevin Norgaard (MKN) were consulted during the investigation.

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

2.2.7 Prepared this report to present the purpose and scope, background information, field exploration procedures, findings, conclusions, and recommendations.

3.0 PROJECT DESCRIPTION

The project location and description, and previous studies, and the anticipated construction are summarized in the following subsections.

3.1 Project Location and Description: The project site area is located at Big Sandy Rancheria, within a broad southeast to northwest trending valley about 1 mile east of the town of Auberry, California. The site area is shown on Drawing No. 1 in Appendix A of this report. In general, the area of the proposed pipeline includes rural residential development and gently sloping terrain. Vegetation in areas adjacent to roadways and driveways typically comprises scattered oak trees and brush, with native grasses. A few granitic rock outcrops were noted near some of the borings and these outcrop locations are depicted on Drawing Nos. 3A and 3B in Appendix A.

Except for the southernmost portion of Auberry-Mission Road, the U.S.G.S. topographic map (Auberry Quadrangle, 2018) indicates the alignments of Mission-Auberry Road and Comstock Road are about 100 to 600 feet west of Backbone Creek, the topographic axis of the valley. Backbone Creek is located just west of the extreme southern portion of Auberry Road. The topographic map also shows that Backbone Creek continues north of Jose Basin Road, trending east of the north portion of the project site (area referred to as "Comstock parcel"). Although surface water was not noted during our field exploration, small seasonal creeks near the valley axis likely have surface flow during and after storm events.

It is our understanding that the proposed sewer piping system will serve approximately forty-five (45) residences, which are accessed along unimproved driveways from Auberry-Mission Road, Church Road, Rancheria Lane, Jose Basin Road, and Comstock Road. The schematic layout of the existing residences, roadways, driveways, and proposed pipeline is shown on Drawing No. 2 in Appendix A (based on the reference Figure 1-3). It is our understanding that the locations of the piping system improvements shown on Figure 1-3 are approximate, and will likely be revised somewhat during the project design process. It is also our understanding that SDR-35 PVC pipe will be used for sewer piping.

It is also our understanding that the main sewer line will extend about 3,200 feet under the western portion of Auberry-Mission Road, with laterals to residences extending to the east and west along Church Lane, Rancheria Road, and Jose Basin Road, and along driveways and open terrain. Where Auberry-Mission Road intersects Jose Basin Road, the main pipeline will turn east about 300 to 400 feet before turning north again about 1,250 feet to a proposed lift station. Figure 1-3 (provided by MKN) shows the proposed wastewater plant within the Comstock parcel, about 600 feet north of the proposed lift station. The referenced Figure 1-3 also indicates that the system will include a force main line.

The existing ground surface elevations within the proposed pipeline areas range from a high of about 2,785 feet above mean sea level (AMSL) at the extreme southeast extent of the gravity main, to about 2,445 feet AMSL at the proposed lift station.

The piping system is not expected to traverse significant/steep slopes. The majority of the pipeline is expected to be located in areas of native soils and rock. However, the pipeline will likely extend though fill soils in some areas, such as the south portion of Auberry-Mission Road.

The range of depths of the proposed piping was not known at the time of this report. For the purpose of this report, it is assumed most of the trenches would be shallower than about 6 feet. Cut and fill type grading is not expected as part of the pipeline project. Rather, it is understood that the pipeline trench will be backfilled to match the existing surface grades.

The referenced Figure 1-3 also shows the approximate locations of a proposed wastewater treatment plant and proposed disposal drain fields to be located in the "Comstock parcel" (north portion of the project area). The Comstock parcel has been investigated by others to be used for effluent disposal (see Section 3.2 of this report). The southeast portion of the Comstock parcel is a topographically low area where the wastewater treatment plant is proposed. A broad ridge line extends to the north of this low area and a north trending drainage gully is located at the base of the west facing slope of the ridge line. The gully is referred to by others as: "*unnamed tributary to Backbone Creek.*" The drain field area proposed for the current project is planned to be located on the upper portions of the west and north facing slopes of the ridge line, away from the gully (see Drawing No. 3 in Appendix A). Vegetation in the proposed drain field area comprises dense brush and scattered trees with native grasses. The slope gradients in the proposed drain field area appear to range from nearly flat to about 3½H to 1V.

Prior to our field investigations, underground utilities were located in the areas of the proposed test borings by representatives of Ponderosa Telephone and Pacific Gas & Electric, and a private utility locator (subcontracted to Moore Twining). In addition, private utilities serve the existing residences. The results of the utility locating and our site observations indicate that existing underground utilities are located near many of boring locations. The Big Sandy Rancheria potable water piping system, private well water systems and individual septic systems are also know to be located in the areas of the proposed sewer pipelines.

The conditions of the pavements on Auberry-Mission Road, Rancheria Lane, Jose Basin Road, and Comstock Road generally ranged from fair to poor, with pervasive block cracking throughout and numerous isolated areas of alligator cracking. The remainder of the roads and driveways were generally unpaved.

3.2 Previous Studies: General information from the referenced report entitled "*Summary of Soil Profile Trenches and Effluent Loading Rate Estimation, Big Sandy Rancheria Effluent Disposal Project, Fresno County, California*," prepared by Geocon, Inc., was reviewed as part of this investigation. The Geocon report summarizes the soil and rock conditions in the Comstock parcel, including the area proposed for disposal drain fields. The report also references field studies and a report prepared by Youngdahl Consulting Group, dated June 15 2001, entitled: "*Big Sandy Rancheria, Comstock Parcel, Onsite Wastewater Disposal Feasibility Study.*" Geocon's scope of work included observing and logging six (6) soil profile trenches, including three (3) trenches excavated in the area proposed for disposal drain fields. Testing and laboratory classification of soils was also conducted.

No other previous geotechnical engineering or geological studies conducted for this site were provided. If these documents are available they should be provided to Moore Twining for review and consideration.

4.0 INVESTIGATIVE PROCEDURES

The field exploration and laboratory testing program conducted for this investigation are summarized in the following subsections. The field exploration included a site reconnaissance, excavating and logging backhoe pits, drilling test borings and collecting soil samples.

4.1 Site Reconnaissance: The site reconnaissance consisted of visual observations of surface features. The reconnaissance was conducted by Mr. Ken Clark (Moore Twining engineering geologist) on December10th and 11th, 2019. The features noted are described in the "Background Information" section of this report.

4.2 Test Borings: Prior to the drilling, the approximate proposed pipeline boring locations were pre-marked and approved by Mr. Kevin Norgaard (Michael K. Nunley & Associates) and Mr. Sal Terry (Big Sandy Rancheria). The borings were generally located within, or near existing roads or driveways, in areas where underground sewer pipelines are anticipated. The approximate boring locations are shown on Drawing Nos. 3A and 3B in Appendix A.

Prior to drilling, the boring locations were marked in the field with white paint for Underground Service Alert (U.S.A), for public utility clearance. Also, a private utility locator cleared the boring locations on December 10, 2019, prior to commencement of drilling. Encroachment permit No. EP20-0040 was obtained from the Fresno County Road Maintenance and Operations Division prior to drilling borings B-2, B-8, B-9, and B-10, within the County right-of-way.

The test borings were drilled to target depths of about 15 feet below site grade (BSG), or until drilling refusal was encountered, whichever occurred first. It should be noted that practical drilling refusal and/or sampler refusal was encountered due to granitic rock in twelve (12) of the borings fifteen (15) borings. The depth of auger refusal is defined as the depth at which the drill auger

cannot be advanced downward at a rate exceeding roughly 6 inches per minute. The depth of sampler refusal is defined as the depth at which the standard penetration resistance sampler cannot be advanced at least 6 inches with 50 blows of the 140 pound hammer (see Section 4.2.1 of this report). Auger and/or sampler refusal occurred as shallow as 3.9 feet BSG (boring B-2) and between 5 and 10 feet BSG in six of the borings. Auger and/or sampler refusal occurred at depths of 13.8 to 15.9 feet BSG in the remaining 5 borings.

Test borings B-1, B-3, B-4, B-5, B-6, B-7, B-11, and B-12 were drilled on December 11, 2019, and test borings B-2, B-8, B-9, B-10, B-13, B-14 and B-15 were drilled on January 29, 2020 using a truck-mounted CME-75 drill rig equipped with 6⅝ inch diameter hollow-stem augers.

The soils and rock encountered in the borings 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. Rock was classified in accordance with the Caltrans Soil and Rock Logging, Classification, and Presentation Manual, 2010 Edition. Test boring logs are included in Appendix B of this report.

Soil and rock samples were collected and returned to our laboratory for classification and mechanics testing. The presence and elevation of free water, if any, in the test borings were noted and recorded during the drilling.

Boring locations were determined by field measurement with reference to existing site features. Elevations of the borings were not surveyed as a part of the investigation.

Borings B-2, B-8, B-9, and B-10, drilled within the County right-of-way ,were backfilled with neat cement and the upper foot of the boreholes were backfilled with rapid set concrete. The remainder of the borings were backfilled with soil cuttings, thus some settlement should be anticipated.

4.2.1 Soil Sampling: During drilling of the hollow-stem auger borings, 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 (SPT) 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 driving a California modified split barrel sampler into the soil. The soil was retained in brass 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.

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

4.3 Percolation Testing: On January 10th, 2020, borings P-1 through P-5 were drilled using a hand auger and/or post hole digger within the proposed drain field area in the northeast portion of the Comstock parcel. The site area was not accessible to a backhoe. The approximate locations of the percolation tests were designated by MKN and are shown on Drawing No. 4 in Appendix A.

The percolation borings were cylindrical with diameters of 5½ to 7½ inches. Percolation test holes were constructed in the hand excavated borings and included a 2-inch diameter perforated PVC pipe placed in the boreholes and used to transmit poured water to the bottom of the holes. Gravel packing was used to protect the sidewalls of the holes from collapse and washout during refilling. The logs of percolation test holes, with soil descriptions, are included in Appendix B of this report.

The percolation holes were presoaked overnight prior to the start of the percolation testing.

The percolation tests were conducted on January 20th and 21st, 2020. The testing included adding water to the test holes periodically and measuring the drop in water level over time. Measurements of water levels and the time of each reading were recorded on the field percolation test logs. The rates of water level decline near the end of the test period (when rates generally stabilized) were used to estimate the percolation rate. The percolation test logs are included in Appendix B of this report and the percolation rates are provided in Section 5.6 of this report.

After completion of testing, the PVC pipe used for percolation testing was removed from the test holes, and the test holes were backfilled with soil cuttings.

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

The results of laboratory tests conducted on samples are summarized on the figures in Appendix C. These data, along with the field observations, were used to prepare the final 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 Site Geologic Conditions: According to the Geologic Map of California -Fresno Sheet, the area of the proposed pipeline is mapped as "Mesozoic Granitic Rock." In the site area, the granitic rock is typically overlain by a relatively thin veneer of colluvial sediments.

5.2 **Existing Asphaltic Concrete Pavement Thickness**: The thicknesses of the existing asphaltic concrete pavements were measured where borings were drilled through pavements. The measurements are summarized below in Table No. 1.

Table No. 1
Thicknesses of Asphaltic Concrete Pavements Encountered

Boring	Location	Asphaltic Concrete Thickness (inches)	Aggregate Base (inches)
B-2	Auberry-Mission Road	3½	1
B-8	Rancheria Lane	3	1½
B-9	Rancheria Lane	2½	2
B-14	Comstock Road	2	3
P-15	Comstock Road	3½	1

Note: The pavement surface thickness was measured to the nearest tenth inch on four (4) sides and averaged to the nearest ½ inch. The aggregate base thickness was measured to the nearest ½ inch.

5.3 **Soil/Rock Profile:** In general, the upper soils encountered in the borings drilled in the pipeline areas predominantly comprised silty sands and clayey sands (colluvial soils) underlain by granitic rock. Only one of the fifteen borings drilled in the pipeline areas (B-11) did not encounter granitic rock, to the maximum depth explored of 16½ feet BSG. The colluvial soils ranged from 3½ to 10 feet in depth at most of the boring locations. Granitic rock was encountered below the colluvial soils at depths ranging from 3½ feet BSG to 10 feet BSG at most of the boring locations. Seven (7) of the fifteen (15) borings encountered granitic rock at a depth of about 5 feet or less.

The granitic rock encountered directly below the soils was typically intensely weathered and soft to very soft. The rock typically graded to moderately weathered and moderately soft within a few inches to a few feet below the soil interface. The weathered rock will require a significantly greater effort to excavate than the overlying soil (See Section 6.5 of this report).

The soils encountered in the proposed drain field area (northeast portion of the Comstock parcel) comprised silty sands with fines contents (passing the #200 sieve) ranging from 23 to 35 percent. The silty sands extended to the bottom of four of the five test holes, depths of 18 to 50 inches BSG. In boring P-2, silty sand was encountered to a depth of 48 inches, which was underlain by completely weathered granitic rock extending to a depth of 54 inches, the bottom of the boring.

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

5.4 Soil/Rock Engineering Properties: The following are descriptions of the soil and rock engineering properties as determined from our test borings and laboratory testing.

Silty Sands and Clayey Sands: The silty sands and clayey sands were predominantly described as loose to medium dense, as determined by standard penetration test (SPT), N-values, of 3 to 25 blows per foot. A few samples were described as dense, as determined by standard penetration test (SPT), N-values, of greater than 30 (see borings B-2, B-9 and B-14). The moisture contents of the silty sand and clayey sand samples tested ranged from about 3.7 to 11.0 percent. The results of testing of five (5) relatively undisturbed samples indicated dry densities of 101.1, 104.1, 110.0, 112.4, and 117.9 pounds per cubic foot. An expansion index test indicated a very low expansion index of 0.

Mesozoic Granitic Rock: The granitic rock was predominantly described as intensely weathered and very soft to moderately soft rock. Auger refusal was typically encountered in soft to moderately soft rock. The rock penetrated by the hollow-stem augers was friable. The standard penetration test (SPT), N-values, measured in the rock typically exceeded 50 blows per foot, with blows of roughly 20 to 50 blows per foot encountered in the upper few feet of the rock encountered in a few borings. The results of testing of a relatively undisturbed sample of weathered rock indicated a dry density of 115.9 pounds per cubic foot.

Sand Equivalent Test Results: The results of eight (8) sand equivalent tests conducted on samples of soil and rock collected from borings drilled in the pipeline area were 15, 15, 15, 16, 16, 19, 21, and 22.

Maximum Density/Optimum Moisture Tests: The results of a maximum density/optimum moisture determination test performed on a bulk sample of soils excavated boring B-4, B-10 and B-15 indicated maximum dry densities of 130.9 pounds per cubic foot (pcf), 133.4 pcf and 136.4 pcf, with optimum moisture contents of 7.5, 7.6, and 7.0 percent, respectively.

Chemical Tests: The results of chemical tests performed on three (3) near surface soil samples indicated pH values of 8.7, 7.4, and 6.3, minimum resistivity values of 20,010, 5,136, and 4,936 ohm-centimeter; soluble sulfate concentrations of “ND”, 0.0012, and “ND” (ND less than 0.00060 percent), and chloride concentrations of “ND”, “ND”, and “ND” (ND less than 0.00060 percent), respectively.

5.5 Surface and Groundwater Conditions: The project site area is located within a broad southeast to northwest trending valley. Although surface water was not noted during our field exploration, small seasonal creeks near the valley axis likely have surface flow during and after storms.

Groundwater was encountered in two (2) of the fifteen (15) borings drilled in the pipeline area, at depths of 10 and 3½ feet BSG in borings B-8 and B-13, respectively. These borings were drilled relatively close to the topographic axis of the valley. Considering that the depths where groundwater was encountered roughly correspond to the depths of the top of the granitic rock in those borings, the ground water is likely perched on the granitic rock.

Groundwater (free water) was not encountered in any of the five borings (P-1 through P-5) drilled in the proposed drain field area (northeast portion of the Comstock parcel).

The referenced report: "*Summary of Soil Profile Trenches and Effluent Loading Rate Estimation,"* prepared by Geocon, dated January 2013, prepared for the Comstock parcel area, states: "*We did not encounter groundwater or soil features indicative of seasonal groundwater in the six soil profile trenches excavated during this investigation. However, we observed surface seeps and YCG (2001) noted groundwater shallower than 8 feet in the central portion of the site near the unnamed tributary creek to Backbone Creek...Additionally, a BSR representative noted that seasonal ponding often occurs just west of the site roadway on the southern portion of the site."* Figure 3 of the aforementioned report shows the areas where shallow groundwater was encountered in March to April 2001, and surface water accumulation was noted on November 8, 2012 near the unnamed tributary creek to Backbone Creek. It should be noted that Figure 3 indicates: "seasonal ponding between road and slope" and groundwater depths of 3 to 4½ feet encountered in 2001 in three (3) test pits excavated in the vicinity of the proposed wastewater treatment plant (as reported by YCG). It should be noted that the Geocon report does not delineate surface water accumulation, seeps, or groundwater encountered in the proposed disposal field area.

Shallow perched groundwater commonly occurs above the granitic rock during and after wet seasons in the site region. It should be recognized, that water table elevations fluctuate with time, since they are dependent upon seasonal precipitation, irrigation, land use, and climatic conditions as well as other factors. Therefore, water level 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.

5.6 <u>Percolation Test Results:</u> The results of the percolation test measurements conducted on January 20th and 21st, 2020 are summarized in Table No. 2, below. The measurements obtained during the percolation tests are included on the percolation test logs in Appendix B. The test results are provided for informational purposes. This investigation did not include an assessment of the depth to rock, or seasonal high groundwater conditions in the disposal field area.

Table No. 2
Percolation Test Results

Test Location	Bottom of Test Hole Below Site Grade (inches)	Unfactored Percolation Rate[1] (Minutes/Inch)	Soil Type [2]
P-1	36	4	Silty Sand
P-2	54	4	Silty Sand and Weathered Rock
P-3	36	5	Silty Sand
P-4	18	10	Silty Sand
P-5	50	8	Silty Sand

1 - Includes no factor of safety (see discussion below). Results given include gravel correction factor and are rounded up to the nearest whole number.
2 - See percolation test boring logs in Appendix B of this report.

The unfactored percolation rates listed above do not take into account the long term effects of subgrade saturation, silt accumulation, etc. In general, the percolation rate of the soils will decrease when the soils are saturated and the reduction of the percolation rate increases the longer the soils are saturated. Published studies indicate field percolation rates can significantly overestimate the saturated permeability. In addition, soil bed consolidation and biomats can result in clogging of the pore spaces in the soil and reduce the long term percolation rate. Numerous other factors, such as variations in soil type and soil density across the entire area of the system can influence the percolation rate, both short and long term.

6.0 CONCLUSIONS

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

6.1 In general, the upper soils encountered in the borings drilled in the pipeline areas predominantly comprised silty sands and clayey sands (colluvial soils) underlain by granitic rock. Only one of the fifteen borings drilled in the pipeline areas (B-11) did not encounter granitic rock, to the maximum depth explored of 15 feet BSG. The colluvial soils ranged from 3½ to 10 feet in depth at most of the boring locations. Granitic rock was encountered below the colluvial soils at depths ranging from 3½ feet BSG to 10 feet BSG at most of the boring locations. Seven (7) of the fifteen (15) borings encountered granitic rock at a depth of about 5 feet or less. However, shallower rock than what was encountered in the borings were noted as outcrops near some of the borings (see Drawings 3A and 3B).

The granitic rock encountered directly below the soils was typically intensely weathered and soft to very soft and graded to moderately weathered and moderately soft within a few inches to a few feet below the soil interface.

6.2 The soils encountered in the percolation test holes drilled in the proposed drain field area (northeast portion of the Comstock parcel) comprised silty sands with fines contents (passing the #200 sieve) ranging from 23 to 35 percent. The silty sands extended to the bottom of four of the five test holes, extended to depths of 18 to 50 inches BSG. In boring P-2, silty sand was encountered to a depth of 48 inches and was underlain by completely weathered granitic rock was extending to a depth of 54 inches.

6.3 Based on the results of our investigation, the site soils are considered generally suitable for use as trench backfill after moisture conditioning (drying or wetting), and processing. However, due to the fines contents and sand equivalent values (less than 30), this report recommends a select, imported backfill material for the utility trench bedding, pipe zone backfill, and initial backfill. Considering the recommended geotechnical properties of the select-imported backfill materials, contractors should anticipate that the select imported soils will be easier to moisture condition and compact as trench bedding, pipe zone backfill, and initial backfill than the native soils. However, an alternate recommendation for use of on-site granular soils for trench bedding and pipe zone backfill is provided in Section 7.4.7 of this report if the piping can be designed for the lower strength bedding/pipe zone fill using onsite soils.

6.4 In order to use excavated rock materials as backfill processing should be anticipated (such as by crushing, screening and blending the excavated rock materials), in order to meet the particle size and fill placement recommendations of this report, and in order to allow determination of the relative compaction of fill soils based on ASTM D 1557. Gradation recommendations for on-site soils and mixtures of soil and rock particles to be used as trench backfill are included in Section 7.4-Trench Backfill Materials. As an alternative to processing hard rock for use as fill, imported fill soils meeting the requirements of Section 7.4-Trench Backfill Materials may be used.

6.5 The weathered rock will require a significantly greater effort to excavate than the overlying soil. Based on the hollow-stem auger drilling resistance and observation of rock samples, it should be anticipated that larger excavators and buckets with rock teeth will be required to effectively excavate into the granitic rock present in the pipeline area. The depth of rock encountered in the test borings is discussed in Section 5.3 of this report and the test boring logs should be consulted. Contractors should anticipate that hard granitic rock and corestones will also be encountered

during trenching for the pipeline that will require use of specialty rock excavation methods such as hydro-hammers in some areas to achieve the pipeline excavation.

6.6 Groundwater was encountered in two (2) of the fifteen (15) borings drilled in the pipeline area, at depths of 10 and 3½ feet BSG in borings B-8 and B-13, respectively. Considering that the depths where groundwater was encountered roughly correspond to the depths of the top of the granitic rock in those borings, the groundwater is likely perched on the granitic rock.

Groundwater (free water) was not encountered in any of the five borings (P-1 through P-5) drilled for percolation testing in the proposed drain field area (northeast portion of the Comstock parcel). Previous consultants have identified shallow groundwater and seeps in the areas of the proposed wastewater treatment plant and near the unnamed tributary to Backbone Creek. We are not aware of shallow groundwater or seeps having been identified in the proposed drain field area.

6.7 The results of five (5) percolation tests conducted in the proposed drain field area, in silty sand soils and weathered rock at depths of about 10 to 54 inches BSG, indicate unfactored percolation rates ranging from about 4 to 10 minutes per inch.

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, evaluation, and conclusions should be considered. The recommended design consultation and construction monitoring by Moore Twining or a qualified geotechnical engineer/geologist are integral to the proper application of the recommendations. The Contractor should be required to comply with the requirements and recommendations presented in this report. 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 This report was prepared for the proposed pipeline improvements described in the Project Location and Description section of this report. If foundations, slabs on grade, or other improvements not described in this report are planned, Moore Twining should be requested to prepare recommendations for these improvements.

7.1.2 Moore Twining should be requested to review the utility plans before the plans are released for bidding purposes so that any relevant recommendations can be presented. If proposed construction is different from that described in the Project Location and Description section of this report, the recommendations in this report may not be appropriate. Moore Twining should be notified and requested to provide supplemental recommendations for the proposed construction if changes are planned.

7.1.3 A preconstruction meeting including, as a minimum, the owner, general contractor, and underground subcontractors, civil engineer, and Moore Twining or a qualified geotechnical engineer/geologist should be scheduled by the general contractor at least one week prior to the start of work. The purpose of the meeting should be to discuss project requirements, concerns and scheduling.

7.1.4 Zones of wet, unstable soils and groundwater may be encountered within the pipeline alignment areas. Thus, dewatering and control of groundwater and stabilization of wet, unstable soil conditions should be anticipated. Soil stabilization may require aeration of the soils of placement of rock and geotextile fabric.

7.1.5 After review of the construction documents, the contractor(s) bidding on this project should determine if the data are sufficient for accurate bid purposes. If the data are not sufficient, the contractor should conduct, or retain a qualified geotechnical engineer to conduct, supplemental studies and collect more data as required to prepare accurate bids.

7.2 Temporary Excavations

Temporary excavations will be required to install the proposed pipeline.

7.2.1 The grades, classification and height recommendations presented in this report for temporary slopes are for consideration in preparing budget estimates and evaluating construction procedures. 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. This includes sloping or shoring to provide a safe environment for technicians to enter utility trenches and conduct compaction testing.

7.2.2 Temporary excavations should be constructed in accordance with OSHA requirements. In addition, temporary excavations 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.

7.2.3 Contractors should anticipate that sloping or shoring systems will be required to provide a safe environment for technicians to enter utility trenches in order to conduct compaction testing.

7.2.4 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.

7.2.5 Shoring should be designed by an engineer with experience in designing shoring systems and registered in the State of California.

7.2.6 Excavation stability should be monitored by the contractor. Slope gradient estimates provided in this report do not relieve the contractor of the responsibility for excavation safety. In the event that tension cracks or distress to the structure occurs, during or after excavation, the owners and Moore Twining, or a qualified geotechnical engineer/geologist should be notified immediately and the contractor should take appropriate actions to minimize further damage or injury.

7.3 Site Preparation

7.3.1 **General Stripping Recommendations:** All topsoil, vegetation, organics (trees and roots), and debris should be removed from the areas proposed for trenching and soil stockpiling. The general depth of stripping should be sufficiently deep to remove the root systems greater than ¼ inch in diameter and organic top soils (organic content greater than 3 percent). Soils with "abundant" roots and/or organic contents exceeding 3 percent by weight are not considered suitable for use as engineered fill. A minimum stripping depth of 6 inches is preliminarily estimated. The actual depth of stripping should be reviewed by our firm at the time of construction. Topsoil may be stockpiled and reused in landscape areas at the discretion of the owner.

7.3.2 All fills required to bring excavations to final grades should be placed as engineered fill on relatively flat prepared surfaces. In addition, all native soils over-excavated should be compacted as engineered fill.

7.3.3 The contractor is responsible for the disposal of concrete, asphaltic concrete, soil, rock, 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 is responsible for performing the tests, assessments, etc. to determine the appropriate method of disposal. In addition, the Contractor is responsible for all costs to dispose of these materials in a legal manner.

7.4 Pipeline Design and Construction

Trench Backfill Materials

7.4.1 The onsite soils encountered will be suitable for use as **final trench backfill** above 12 inches above the top of the pipe (above the pipe haunch fill, and initial backfill zone) provided they are free of organics, debris and oversize material greater than 2 inches in diameter, have at least 75 percent by weight passing the 3/4 inch sieve, and the moisture content of the soil is between optimum and three (3) percent over optimum moisture content at the time of placement. If soils other than those considered in this report are encountered, Moore Twining, or a qualified geotechnical engineer/geologist, should be notified to provide alternate recommendations. Some of the near surface soils encountered appeared to have moisture contents above the estimated optimum moisture contents. Thus, Contractors should anticipate that these soils will need to be processed to reduce moisture contents prior to using the soil as engineered fill backfill. If soft or unstable soils are encountered during excavation or compaction operations, our firm should be notified so the soils conditions can be examined and additional recommendations provided to address the pliant areas.

7.4.2 In order to use excavated granitic rock fragments as **final backfill**, processing would be required (such as by crushing, screening and blending the excavated materials), to meet the particle size recommendations of this report. Prior to reusing these rock materials as engineered fill, fragments of the granitic rock will need to be reduced to 2 inches in diameter or less and blended with sufficient soil materials to generate a well-graded material for use as engineered fill, or the rock fragments should be removed from soils to be used as engineered fill. Fragments of rock should not be nested together. The fragments should be mixed with the on-site soils to created a well-blended material to be used as engineered fill. As an alternative to processing the rock, imported fill soils meeting the requirements of this report (see Section 7.4.3) may be used. Acceptance criteria for select import trench backfill are provided for pipe bedding, haunches and initial backfill in Section 7.4.4 of this report.

7.4.3 If import fill soils are required for **final backfill** above the pipe haunch fill, and initial backfill zone, this material should be non-recycled, non-expansive and granular in nature with the following acceptance criteria recommended.

Percent Passing 3-Inch Sieve	100
Percent Passing No. 4 Sieve	85 - 100
Percent Passing No. 200 Sieve	15 - 50
Expansion Index (ASTM D4829)	Less than 30
Organics	Less than 3 percent by weight
Plasticity Index	15 or less

7.4.4 Prior to being transported to the site, 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, or a qualified geotechnical engineer/geologist, should be requested to sample and test the material to determine compliance with the above geotechnical criteria. Contractors should provide a minimum of 7 working days to complete the testing geotechnical testing.

7.4.5 **Pipe Bedding, Haunches and Initial Backfill:** The pipe bedding should consist of a minimum of 4 inches of compacted select sand with a minimum sand equivalent of 30 and meeting the following requirements: 100 percent passing the 1/4 inch sieve, a minimum of 90 percent passing the No. 4 sieve and not more than 10 percent passing the No. 200 sieve. The haunches and initial backfill (12 inches above the top of pipe) should consist of a select sand meeting these sand equivalent and gradation requirements that is placed in maximum 6-inch thick lifts and compacted to a minimum relative compaction of 92 percent using hand equipment. The project plans should identify the material requirements for bedding and initial backfill materials.

7.4.6 **Alternative Pipe Bedding, Haunches and Initial Backfill Using Onsite Soils:** The following alternate recommendations may be considered for pipe bedding, haunches and initial backfill if the following conditions are satisfied: 1) the pipeline designer determines the weaker pipe zone fill is sufficient for the conditions, and 2) the client accepts a higher potential for impacts due to increased difficulties obtaining compaction. The project plans should identify the requirements for bedding and initial backfill materials. Onsite backfill materials comprising granular soils with a fines content of not more than 50 percent, with a maximum particle diameter of 2 inches and a maximum plasticity index of 10 may be used if the aforementioned conditions are satisfied. The on-site silty sands and clayey sands would be

expected to meet these requirements. Any clay soils with fines content of more than 50 percent (if encountered) should not be used for pipe bedding, haunches or initial backfill. In the event that clayey soils are encountered, selective excavation and material handling, and/or some potential import should be anticipated.

7.4.7 Recycled materials should not be used as fill unless approved by the Owner and Moore Twining.

7.4.8 Unless specified otherwise, open graded gravel and rock material such as ¾-inch crushed rock should not be used as backfill including trench backfill. Crushed gravel and rock for backfill is prohibited. In the event an open graded rock is required as backfill by a governing agency, the rock section should be fully encapsulated in an engineering filter fabric, and Moore Twining should be contacted to provide additional recommendations.

Trenching

7.4.9 Utility trenches should not be constructed within a zone defined by a line that extends at an inclination of 1.5 horizontal to 1 vertical downward from the bottom of any building foundation.

7.4.10 The width of the trench should provide a minimum clearance of 8 inches between the sidewalls of the pipe and the trench, or as necessary to provide a trench width that is 12 inches greater than 1.25 times the outside diameter of the pipe, and a minimum width of 2 feet, whichever is greater.

7.4.11 The utility trench subgrade should be prepared by excavation of a neat trench without disturbance to the bottom of the trench. If sidewalls are unstable, the Contractor shall either slope the excavation to create a stable sidewall or shore the excavation. All trench subgrade soils disturbed during excavation, such as by accidental over-excavation of the trench bottom, or by excavation equipment with cutting teeth, should be compacted to a minimum of 92 percent relative compaction prior to placement of bedding material. The Contractor is responsible for notifying Moore Twining, or a qualified geotechnical engineer/geologist , when these conditions occur and arrange for their observation and testing of these areas prior to placement of pipe bedding. The Contractor shall use such equipment as necessary to achieve a smooth undisturbed native soil surface at the bottom of the trench with no loose material at the bottom of the trench. The Contractor shall either remove all loose soils or compact the loose soils as engineered fill prior to placement of bedding, pipe and backfill of the trench.

7.4.12 The trench width, type of pipe bedding, the type of initial backfill, and the compaction requirements of bedding and initial backfill material should be specified by the project Civil Engineer or applicable design professional in compliance with the manufacturer's requirements, governing agency requirements and this report, whichever is more stringent. For flexible polyvinylchloride (PVC) pipes, these requirements should be in accordance with the manufacturer's requirements or ASTM D-2321, whichever is more stringent.

Backfill and Compaction

7.4.13 The pipe bedding should be a minimum of 4 inches in thickness, moisture-conditioned to between optimum moisture content and three (3) percent above optimum moisture content, and compacted to a minimum of 92 percent relative compaction. The haunches and initial backfill (12 inches above the top of pipe) should be placed in maximum 6-inch thick lifts, moisture-conditioned to between optimum moisture content and three (3) percent above optimum moisture content, and compacted to a minimum relative compaction of 92 percent using hand equipment. Final backfill soil should be placed in loose lifts approximately 8 inches thick, moisture-conditioned to between optimum moisture content and three (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, with exception of the upper 12 inches of the pavement subgrade should be compacted to a dry density of at least 95 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.

7.4.14 The plans should note that all utility trenches should be compacted to a minimum relative compaction of 92 percent per ASTM D-1557, as required, with a minimum relative compaction of 95 percent per ASTM D-1557 in the upper 12 inches below pavement sections.

7.4.15 The compactability of the native soils is dependent upon the moisture contents, subgrade conditions, degree of mixing, type of equipment, as well as other factors. The evaluation of such factors was beyond the scope of this report; therefore, it is recommended that they be evaluated by the contractor during preparation of bids and construction of the project.

7.4.16 In-place density testing should be conducted in accordance with ASTM D 6938 (nuclear methods) at a frequency of at least:

Table No. 3
Minimum Testing Frequencies

Area	Minimum Test Frequency
Utility Lines	One (1) test per 150 lineal feet per lift

7.4.17 The project Civil Engineer should include slurry type cutoff collars along utility trenches to prevent the migration of surface water and potential associated piping/settlement. Moore Twining should be provided plans and requested to provide recommended cut-off collar locations based on utility plans/topographic maps to be provided prior to final design. Moore Twining should provide recommended cut-off collar locations based on utility plans/topographic maps to be provided prior to final design. Preliminarily, where the slope of the pipeline trench exceeds 4H to 1V, cut-off collars should be placed in the trench at a spacing of 200 feet.

7.4.18 The contractor should use appropriate equipment and methods to avoid damage to utilities and/or structures during placement and compaction of the backfill materials.

7.4.19 Jetting of trench backfill is not allowed to compact the backfill soils.

Drainage and Erosion Control

7.4.20 Site drainage should be designed to reduce concentration of surface water flows and reduce potential for erosion in the areas of the pipeline. After backfilling the pipeline in areas with slopes of steeper than 5H to1V, the pipeline areas and any adjacent areas where vegetation is disturbed should be planted with shallow rooted ground. The vegetation should be established and maintained to reduce the potential for erosion. The slopes would be subject to a higher erosion potential until vegetation is fully established.

Pipe Design Parameters

7.4.21 **Modulus of Soil Reaction:** Based on use of the select-imported backfill sand material and the minimum relative compaction recommendations under Section 7.4 of this report, a modulus of soil reaction of 1,200 pounds per

square inch may be used for pipe design. Based on use of the (alternative) on-site granular soils and the minimum relative compaction recommendations under Section 7.4 of this report, a modulus of soil reaction of 600 pounds per square inch may be used for pipe design.

7.4.22 **Thrust Blocks:** Thrust blocks may be designed using an allowable passive resistance of the native soils assumed to be equal to the pressure developed by a fluid with a density of 250 pounds per cubic foot, measured below the ground surface (final grade). Passive pressure in the upper 12 inches of subgrade should be neglected in determining the total passive resistance.

7.5 Corrosion Protection

7.5.1 Buried metal objects should be protected in accordance with the manufacturer's recommendations based on a National Association of Corrosion Engineers (NACE) corrosion severity rating of “corrosive” based on soil sample resistivity test values of 20,010, 5,136, and 4,936 ohm-cm). 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. If piping or concrete are placed in contact with deeper soils or engineered fill, these soils should be analyzed to evaluate the corrosion potential of these soils.

7.5.2 Corrosion of concrete due to sulfate attack is not anticipated based on soluble sulfate concentrations of “ND”, 0.0012, and “ND” (ND less than 0.00060 percent), for the near-surface soils tested. According to provisions of ACI 318, Section 4.3, the sulfate concentrations fall in the negligible classification (0.00 to 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 foundation and slabs due to the sulfate content.

7.5.3 These soil corrosion data should 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 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 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, pavements and foundations prior to finalization to determine whether they are consistent with our recommendations. This service is not part of this current contractual agreement.

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 the plan 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 conduct the necessary observation, field-testing services and provide results so that action necessary to remedy indicated deficiencies can be taken in accordance with the plans and specifications. Upon completion of the work, the geotechnical engineer should provide a written summary of the observations, field testing and conclusions regarding the conformance of the completed work to the intent of the plans and specifications. This service is not, however, part of this current contractual agreement.

9.2 The construction monitoring is an integral part of this investigation. This phase of the work provides Moore Twining the opportunity to verify the subsurface conditions interpolated from the soil borings and make alternative recommendations if the conditions differ from those anticipated.

9.3 If the Moore Twining is not afforded the opportunity to provide engineering observation and field testing services during construction activities related to earthwork, foundations, pavements and trenches; then, Moore Twining will not be responsible for compliance of any aspect of the construction with our recommendations or performance of the structures or improvements if the recommendations of this report are not followed. We recommend that if a firm other than Moore Twining is selected to conduct these services that they review this report and state that they understand the conclusions and recommendations of this report and they agree to conduct sufficient observations and testing to ensure the construction complies with this report's recommendations. Moore Twining should be notified, in writing, if another firm is selected to conduct observations and field-testing services prior to construction.

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 between boring and pit locations. The nature and extent of subsurface variations between borings and pits may not become evident until construction.

10.2 This investigation did not include an assessment of the depth to rock, or seasonal high groundwater conditions in the disposal field area, nor does it include a feasibility assessment, or recommendations for use in design of a disposal field.

10.3 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.

10.4 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 (over 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.

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

10.6 The conclusions and recommendations contained in this report are valid only for the project discussed in the Project Location and Description section of this report. The use of the information and recommendations contained in this report for improvements on this site not discussed herein, or for structures on other sites not discussed in this report, 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.

10.7 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.

10.8 This report presents the results of a geotechnical engineering investigation only and should not be construed as an environmental audit or study.

10.9 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.

10.10 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.

We appreciate the opportunity to be of service to Michael K. Nunley & Associates, Inc. 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

DRAFT

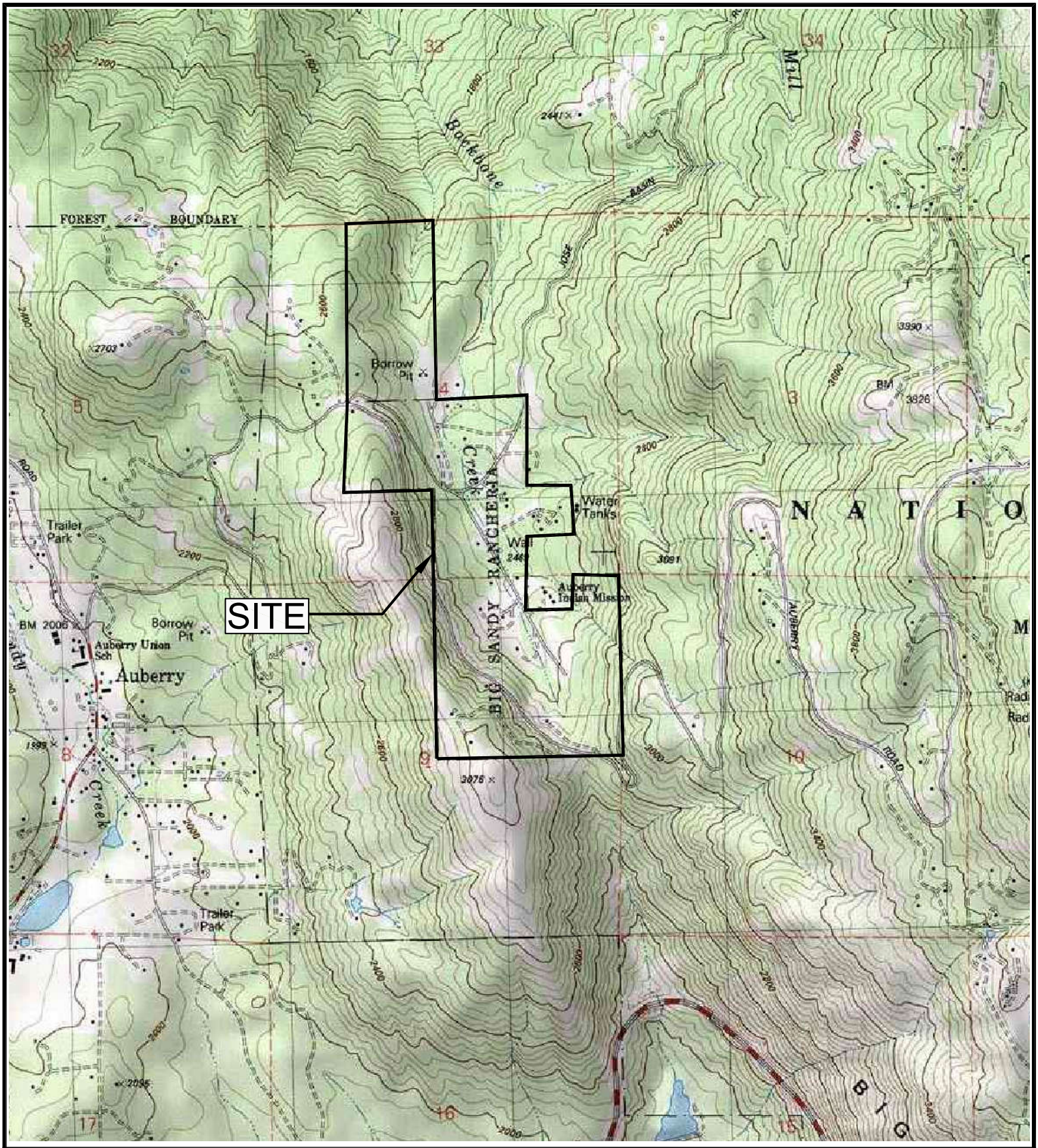
Kenneth J. Clark, CEG
Senior Engineering Geologist

DRAFT

Read L. Andersen, RGE
Manager

APPENDIX A
DRAWINGS

Drawing No. 1 -	Site Location Map
Drawing No. 2 -	Test Boring Locations and Approximate Pipeline Locations
Drawing No. 3A -	Test Boring Locations - South
Drawing No. 3B -	Test Boring Locations - North
Drawing No. 4 -	Percolation Test Locations



SOURCE: U.S.G.S. TOPOGRAPHIC MAP, 7 ½ MINUTE SERIES
AUBERRY, CALIFORNIA QUADRANGLE 1978, PHOTOREVISED 1983

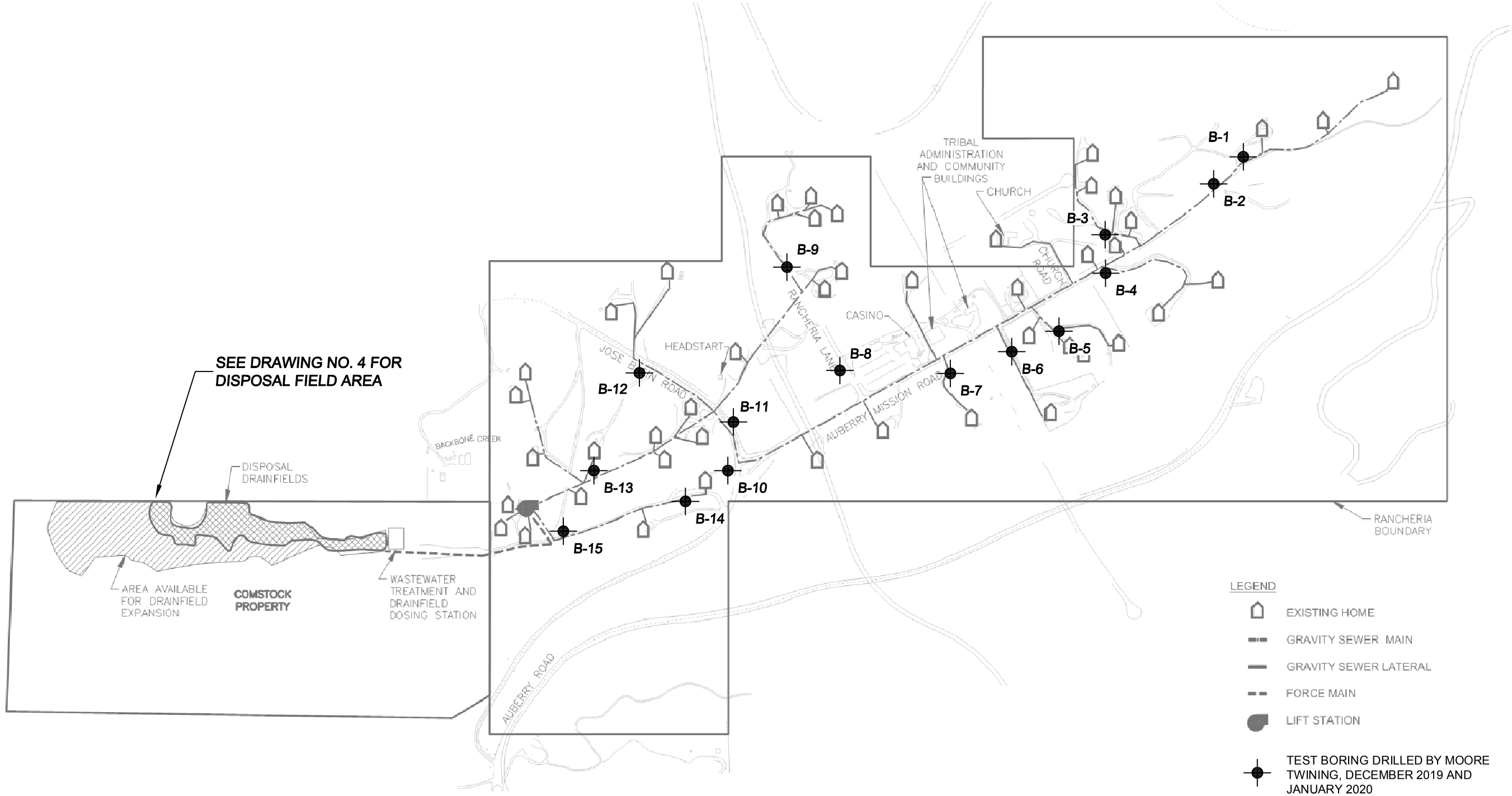
0 2000

APPROXIMATE SCALE
IN FEET

SITE LOCATION MAP
PROPOSED UNDERGROUND SEWER PIPING SYSTEM
BIG SANDY RANCHERIA
FRESNO COUNTY, CALIFORNIA

FILE NO.: 56804-01-01	DATE: 02/07/20
DRAWN BY: RM	APPROVED BY:
PROJECT NO. G56804.01	DRAWING NO. 1

MOORE TWINING ASSOCIATES, INC.



REFERENCE: HYDRO SCIENCE, FIGURE 1-3 BIG SANDY RANCHERIA WASTE WATER FEASIBILITY STUDY PROPOSED PROJECT WASTEWATER SYSTEM, DATED 06/03/13

N
0 600
APPROXIMATE SCALE IN FEET

MOORE TWINING ASSOCIATES, INC.

TEST BORING LOCATIONS AND APPROXIMATE PIPELINE LOCATIONS
PROPOSED UNDERGROUND SEWER PIPING SYSTEM
BIG SANDY RANCHERIA
FRESNO COUNTY, CALIFORNIA

FILE NO. 56804-01-02	DATE DRAWN: 02/07/20
DRAWN BY: RM	APPROVED BY:
PROJECT NO. G56804.01	DRAWING NO. 2

B-1 APPROXIMATE BORING LOCATION

APPROXIMATE AREA OF ROCK OUTCROP NOTED NEAR BORING

N

0 400

APPROXIMATE SCALE IN FEET

BORING LOCATION MAP - SOUTH
PROPOSED UNDERGROUND SEWER PIPING SYSTEM
BIG SANDY RANCHERIA
FRESNO COUNTY, CALIFORNIA

FILE NO. 56804-01-02	DATE DRAWN: 02/07/20
DRAWN BY: RM	APPROVED BY:
PROJECT NO. G56804.01	DRAWING NO. 3A

MOORE TWINING ASSOCIATES, INC.

B-1 APPROXIMATE BORING LOCATION

APPROXIMATE AREA OF ROCK OUTCROP NOTED NEAR BORING

N

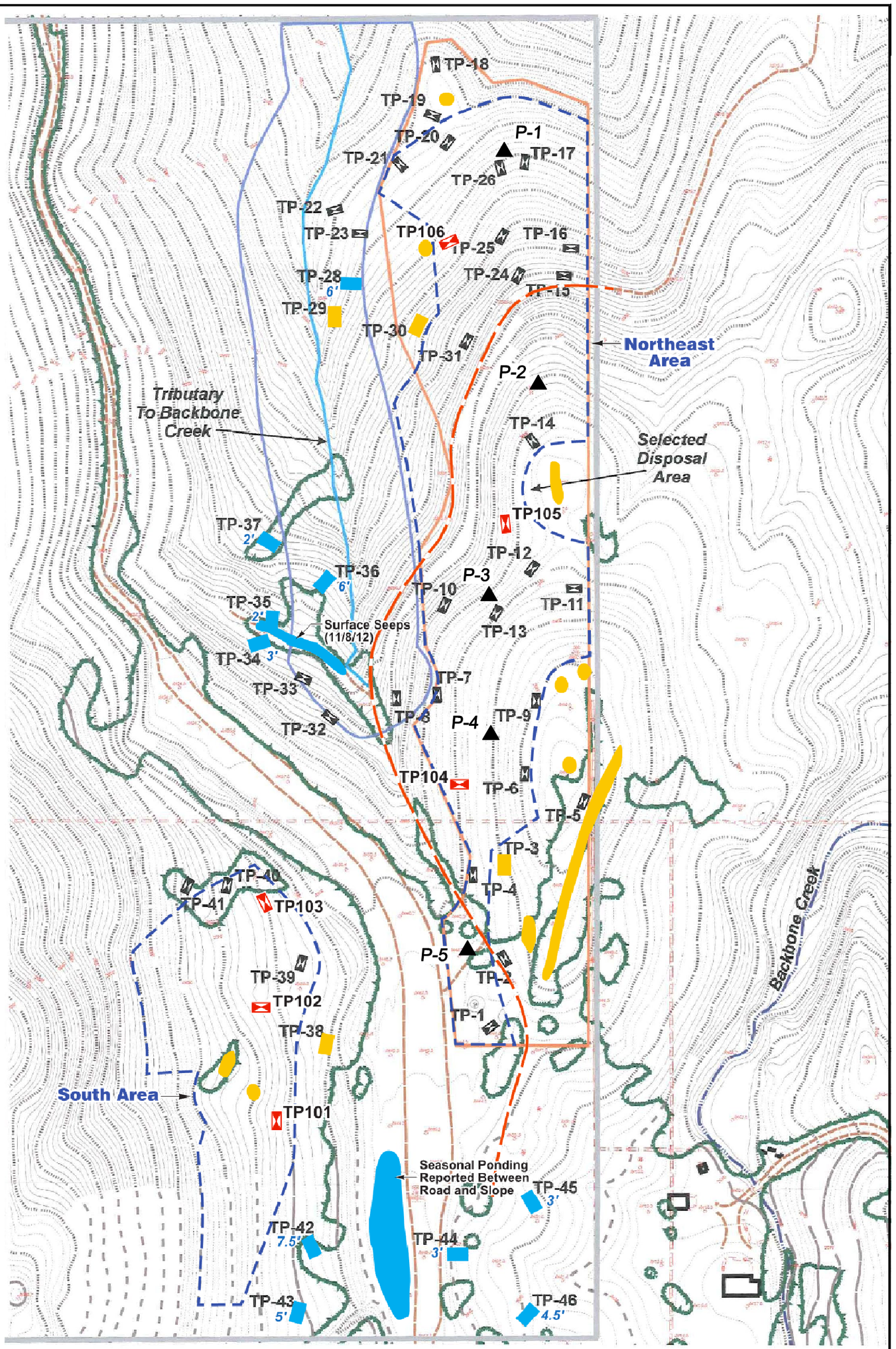
0 400

APPROXIMATE SCALE IN FEET

BORING LOCATION MAP - NORTH
PROPOSED UNDERGROUND SEWER PIPING SYSTEM
BIG SANDY RANCHERIA
FRESNO COUNTY, CALIFORNIA

FILE NO. 56804-01-02	DATE DRAWN: 02/07/20
DRAWN BY: RM	APPROVED BY:
PROJECT NO. G56804.01	DRAWING NO. 3B

MOORE TWINING ASSOCIATES, INC.



Ref: Youngdahl, June 2001

= Approximate 100' Stream Buffer

= Approximate Area with 10' Parcel Offset = 10.98 acres

= Approximate Parcel Boundary

= Approximate Soil Profile Trench Location (Youngdahl 2001)

= Approximate Soil Profile Trench Location (Geocon 2012)

= Bedrock Outcrop or Shallow Trench Refusal

= Approximate Location of Buried Ponderosa Telephone Fiber-Optic Cable

3' = Approximate Location and Depth of Shallow Groundwater (observed in soil profile trench, Mar.-Apr. 2001) or as noted

▲ = PERCOLATION TEST CONDUCTED BY MOORE TWINING, JANUARY 20th AND 21st, 2020

REFERENCE: BASE MAP TAKEN FROM FIGURE OF REPORT ENTITLED: "SUMMARY OF SOIL PROFILE TRENCHES AND EFFLUENT LOADING RATE ESTIMATION, BIG SANDY RANCHERIA EFFLUENT DISPOSAL PROJECT, FRESNO COUNTY, CALIFORNIA," PREPARED BY GEOCON, INC., JANUARY 2013.

0 200
APPROXIMATE SCALE IN FEET

N

MOORE TWINING ASSOCIATES, INC.

PERCOLATION TEST LOCATION MAP
PROPOSED UNDERGROUND SEWER PIPING SYSTEM
BIG SANDY RANCHERIA
FRESNO COUNTY, CALIFORNIA

FILE NO.	56804-01-02
DRAWN BY:	RM
DATE DRAWN:	02/07/20
PROJECT NO.	G56804.01
APPROVED BY:	
DRAWING NO.	4

APPENDIX B
LOGS OF TEST BORINGS AND PERCOLATION TEST HOLES AND PERCOLATION TEST DATA SHEETS

This appendix contains the logs of test borings and percolation test holes, and percolation test data sheets. The test boring and test hole logs represent our interpretation of the contents of the field logs 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 these pit and boring locations. Also, the passage of time may result in changes in the soil conditions at these test boring locations.

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.

Test Boring: B-1

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Logged By: K.C.

Date: December 11, 2019

Drill Type: CME 75

Elevation: N/A

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

Hammer Type: 140 LB Auto Trip Hammer

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	8/6 10/6 13/5	SM	SILTY SAND; moist, fine to coarse grained, dark-brown, with trace of clay medium dense light brown	-#200=35.3% SAND=64.7% SE=15	23	4.0
5	3/6 2/6 3/6		loose	-#200=20.5% SAND=77.0% +#4=2.5% SE=22	5	3.7
10	20/6 25/6 45/6	ROCK	GRANITIC ROCK; intensely weathered, friable, light-brown to light-gray, very soft		70	
15	18/6 32/6 40/6		soft to very soft		72	
20			Bottom of boring B-1 at 15 feet BSG			
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-2

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Logged By: J.C.

Date: January 29, 2020

Drill Type: CME 75

Elevation: N/A

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

Hammer Type: 140 LB Auto Trip Hammer

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 8/6 50/5	AC	ASPHALTIC CONCRETE = 3.4 INCHES	At 0.4-3 feet BSG: SR=4,936 ohm-cm SS=0.0012% Cl=<0.0006% pH=7.4 PI=9 LL=24 SE=16	>58	
		AB	AGGREGATE BASE = 1 INCH			
		SC	CLAYEY SAND; moist, fine to coarse grained, dark-brown, with rootlets Very dense Strong resistance to drilling		>50	
5	50/5	ROCK	GRANITIC ROCK; drilling refusal, intensely weathered, friable, light-brown to light-gray, soft			
			Auger and sampler refusal in boring B-2 at 3.9 feet BSG			
10						
15						
20						
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-3

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Logged By: K.C.

Date: December 11, 2019

Drill Type: CME 75

Elevation: N/A

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

Hammer Type: 140 LB Auto Trip Hammer

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	5/6 7/6 7/5	SM	SILTY SAND; moist, fine to coarse grained, light-brown medium dense		14	4.0
5	7/6 30/6 50/5				>80	
	50/1	ROCK	GRANITIC ROCK; intensely weathered, friable, light-brown to light-gray, estimated moderately soft		>50	
10			Auger and sampler refusal in boring B-3 at 7.1 feet BSG			
15						
20						
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-4

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Logged By: K.C.

Date: December 11, 2019

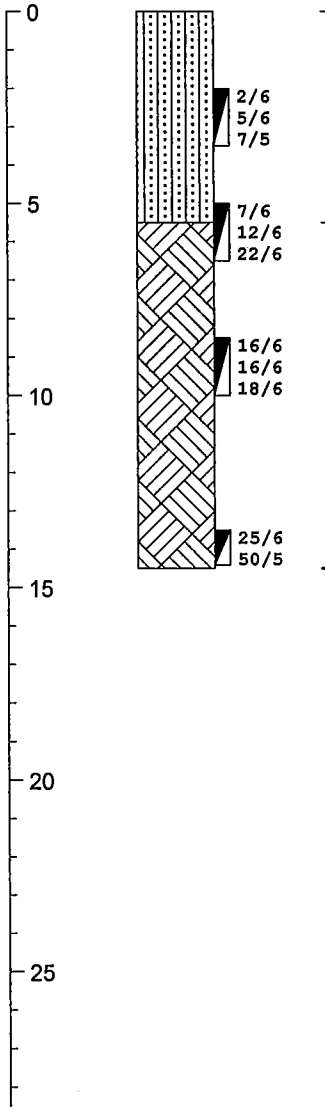
Drill Type: CME 75

Elevation: N/A

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

Hammer Type: 140 LB Auto Trip Hammer

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 %
		SM	SILTY SAND; moist, fine to coarse grained, dark-brown			
			medium dense		12	9.0
			light brown			
					34	6.2
		ROCK	GRANITIC ROCK; intensely weathered, friable, reddish-brown to light-gray, soft	at 5.5 to 14.5' BSG: pH=8.7 SS<0.00060 Cl<0.00060 SR=20,010 ohm-cm-	34	
			Moderately soft		>50	
			Sampler refusal in boring B-4 at 14.5 feet BSG			

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-5

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Drill Type: CME 75

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

Hammer Type: 140 LB Auto Trip Hammer

Logged By: K.C.

Date: December 11, 2019

Elevation: N/A

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	4/6 7/6 10/5	SM	SILTY SAND; moist, fine to medium with some coarse grains, dark-brown, with trace of clay medium dense, damp, light brown		17	5.2
5	37/6 50/5	ROCK	GRANITIC ROCK; intensely weathered, friable, reddish-brown to light-gray, very soft		>50	3.1
	50/1		Moderately soft Auger and sampler refusal in boring B-5 at 8.6 feet BSG		>50	
10						
15						
20						
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-6

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Drill Type: CME 75

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

Hammer Type: 140 LB Auto Trip Hammer

Logged By: K.C.

Date: December 11, 2019

Elevation: N/A

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	2/6 1/6 3/5	SM	SILTY SAND; moist, fine to coarse grained, grayish-brown loose		4	11.0
5	31/6 37/6 50/5	ROCK	GRANITIC ROCK; intensely weathered, friable, reddish-brown to light-gray, moderately soft		>87	2.6
	50/1		Practical sample and drilling refusal Sampler refusal in boring B-6 at 8.6 feet BSG		>50	
10						
15						
20						
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-7

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Drill Type: CME 75

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

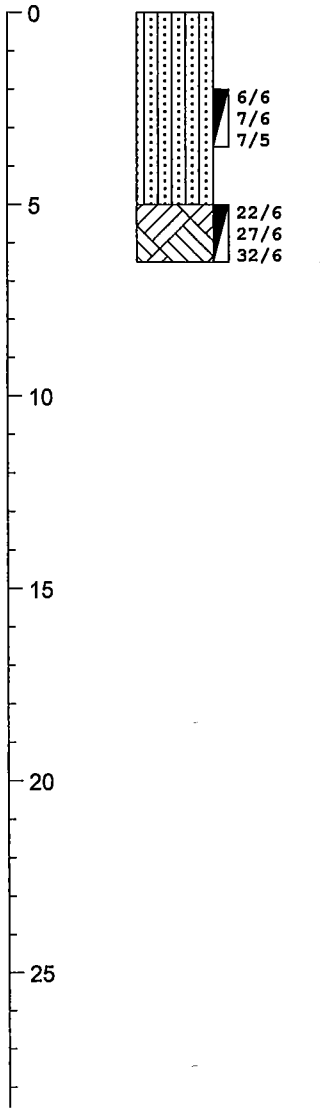
Hammer Type: 140 LB Auto Trip Hammer

Logged By: K.C.

Date: December 11, 2019

Elevation: N/A

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 %
		SM	SILTY SAND; moist, fine to medium grained with scattered coarse grains, brown medium dense at 2 feet BSG damp at 3 feet BSG		14	3.3
		ROCK	GRANITIC ROCK; intensely weathered, friable, reddish-brown to light-gray, moderately soft	-#200=24.2* SAND=68.3%* +#4=7.5%* SE=15	59	6.5
			Auger refusal in boring B-7 at 6.5 feet BSG			

Notes: * *Particle size distribution of weathered granitic rock fragments.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-8

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Drill Type: CME 75

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

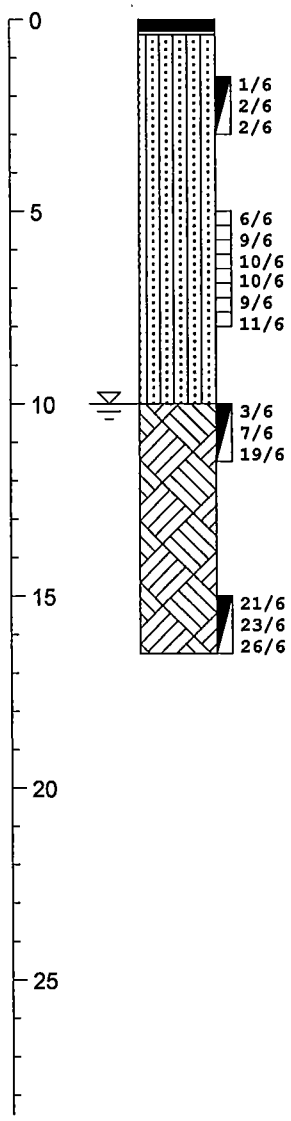
Hammer Type: 140 LB Auto Trip Hammer

Logged By: J.C.

Date: January 29, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: 10 Feet



ELEVATION/ DEPTH (feet)	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	AC	ASPHALTIC CONCRETE = 3 INCHES			
	AB	AGGREGATE BASE = 1.5 INCHES			
	SM	SILTY SAND; moist, fine to medium grained, dark-brown, with roots, trace clay		4	
5		Very loose		19	
		Medium dense	DD=112.4 pcf	20	12.4
10	ROCK	GRANITIC ROCK; intensely weathered, friable, grayish-brown, wet, very soft		26	
		Strong resistance to drilling at 11 feet BSG			
15		Light-brown		49	
		Bottom of boring B-8 at 16.5 feet BSG			
20					
25					

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-9

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Drill Type: CME 75

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

Hammer Type: 140 LB Auto Trip Hammer

Logged By: J.C.

Date: January 29, 2020

Elevation: N/A

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 9/6 9/6	AC AB	ASPHALTIC CONCRETE = 2.5 INCHES AGGREGATE BASE = 2 INCHES		18	
5	16/6 31/6 37/6	SM	SILTY SAND; medium dense, moist, fine to medium grained, dark-brown Medium dense Very dense, increase in fines content, brown	DD=110.0 pcf	68	5.1
10	25/6 50/3	ROCK	GRANITIC ROCK; intensely weathered, friable, light-brown to light-gray, very soft Strong resistance to drilling		>50	
15	50/3		soft, sample refusal Sampler refusal in boring B-9 at 13.8 feet BSG		>50	
20						
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-10

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Drill Type: CME 75

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

Hammer Type: 140 LB Auto Trip Hammer

Logged By: J.C.

Date: January 29, 2020

Elevation: N/A

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	2/6 1/6 2/6	SC	CLAYEY SAND; moist, fine to coarse grained, dark-brown, trace gravel Very loose	At 0-3 feet BSG: EI=0 SR=5,136 ohm-cm SS=<0.0006% Cl=<0.0006% pH=6.3 SE=16 DD=101.1 pcf ø=35° C=230 psf	3	
5	7/6 12/6 18/6	SM	SILTY SAND; medium dense, moist, fine to medium graineed, dark-brown		30	8.4
10	25/6 26/6 30/6	ROCK	GRANITIC ROCK; intensely weathered, friable, light-gray to light-brown, very soft		56	
15	50/5		Brown, soft, sample refusal Sampler refusal in boring B-10 at 15.4 feet BSG		>50	
20						
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-11

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Logged By: K.C.

Date: December 11, 2019

Drill Type: CME 75

Elevation: N/A

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

Hammer Type: 140 LB Auto Trip Hammer

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	2/6 3/6 5/5	SM	SILTY SAND; moist, fine to medium grained with scattered coarse grains and fine gravel, dark brown loose at 2 feet BSG	-#200=23.0% SAND=77.0% SE=21	8	4.0
5	8/6 8/6 8/6		At 2-1/2 feet BSG, damp, light brown medium dense		16	4.1
	4/6 6/6 8/6		decrease in fines		14	
10						
15	6/6 8/6 12/6		damp, fine to medium grained, light brown		20	
			Bottom of boring B-11 at 15 feet BSG			
20						
25						

Notes: * *Particle size distribution of weather granitic rock fragments.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-12

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Drill Type: CME 75

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

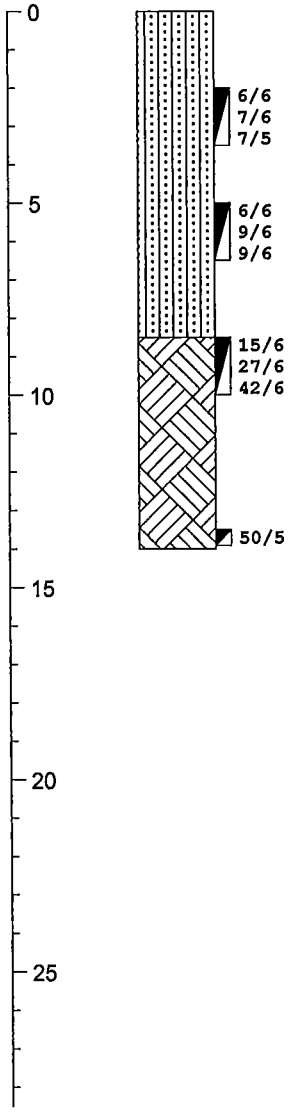
Hammer Type: 140 LB Auto Trip Hammer

Logged By: K.C.

Date: December 11, 2019

Elevation: N/A

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 %
		SM	SILTY SAND; moist, fine to medium grained with scattered coarse grains, brown		14	4.6
			medium dense at 2 feet BSG			
			damp and reddish brown at 2-1/2 feet BSG			
			yellowinsh brown		18	5.9
		ROCK	GRANITIC ROCK; intensely weathered, friable, reddish-brown to light-gray, soft		69	
				No Recovery	>50	
			Sampler refusal in boring B-12 at 14 feet BSG			

Notes: * *Particle size distribution of weather granitic rock fragments.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-13

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Drill Type: CME 75

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

Hammer Type: 140 LB Auto Trip Hammer

Logged By: J.C.

Date: January 29, 2020

Elevation: N/A

Depth to Groundwater
First Encountered During Drilling: 3.5 Feet

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0	2/6 2/6 2/6	ML	SILTY SAND; loose, moist, slight plasticity, black, with rootlets	SE=15	4	
	9/6 12/6 14/6	ROCK	GRANITIC ROCK; intensely weathered, friable, wet, brown, very soft	DD=115.9 pcf	26	14.0
5			Strong resistance to drilling			
	50/1		Drilling refusal, sample refusal, moderately hard		>50	
10			Auger and sampler refusal in boring B-13 at 7.1 feet BSG			
15						
20						
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-14

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Drill Type: CME 75

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

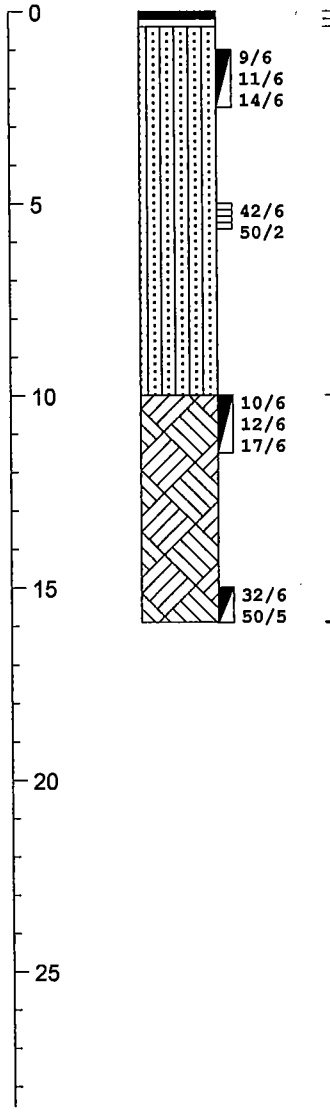
Hammer Type: 140 LB Auto Trip Hammer

Logged By: J.C.

Date: January 29, 2020

Elevation: N/A

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 %
		AC	ASPHALTIC CONCRETE = 2 INCHES			
		AB	AGGREGATE BASE = 3 INCHES			
		SM	SILTY SAND; medium dense, damp, fine to medium grained, brown, with trace clay	PI=NP LL=NV SE=19	25	
			Medium dense	DD=104.1 pcf	>50	5.9
			Very dense, moderate to strong cementation			
		ROCK	GRANITIC ROCK; intensely weathered, friable, light-brown, very soft		29	
			Moderate resistance to drilling			
					>50	
			Sampler refusal in boring B-14 at 15.9 feet BSG			

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: B-15

Project: Big Sandy Rancheria

Project Number: G56804.01

Drilled By: J.C.

Drill Type: CME 75

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

Hammer Type: 140 LB Auto Trip Hammer

Logged By: J.C.

Date: January 29, 2020

Elevation: N/A

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		AC	ASPHALTIC CONCRETE = 3.5 INCHES			
	2/6 2/6 2/6	AB	AGGREGATE BASE = 1 INCH		4	
		SM	SILTY SAND; moist, fine to medium grained, dark- brown, trace fine gravel	DD=117.9 pcf	17	7.9
5	6/6 7/6 10/6		Very loose Medium dense			
			Strong resistance to drilling			
	19/6 50/3	ROCK	GRANITIC ROCK; intensely weathered, friable, light-brown to light-gray, soft		>50	
10			Auger and sampler refusal in boring B-15 at 9.25 feet BSG			
15						
20						
25						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: P-1

Project:

Project Number:

Drilled By: KC

Drill Type: Hand Auger

Auger Type: 5.5 inch dia. bucket

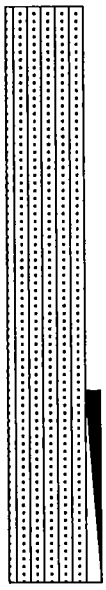
Hammer Type:

Logged By: KC

Date: January 10, 2020

Elevation: N/A

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		SM	Silty Sand, moist, brown, fine grained			
1						
2			damp, fine grained	-#200=26.4% SAND=73.6%		12.7
3			Bottom of boring at 36 inches.			
4						
5						

Notes: *A separate observation boring was drilled with a hand auger about 5 feet north and encountered the same profile with the exception that a yellowish brown silty sand was encountered at a depth of 4 feet and extended to a depth of 5.2 feet where hard drilling/ refusal was encountered.*

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: P-2

Project:

Project Number:

Drilled By: KC

Drill Type: Hand Auger

Auger Type: 5.5 inch dia. bucket

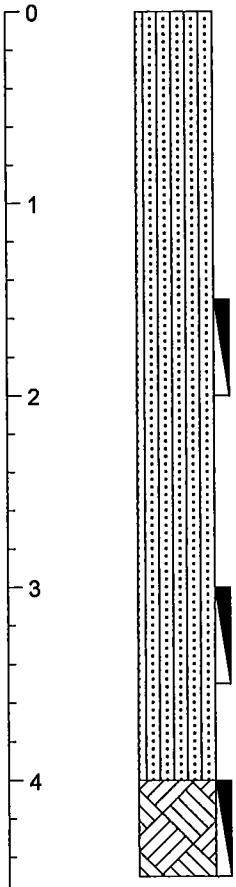
Hammer Type:

Logged By: KC

Date: January 10, 2020

Elevation: N/A

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		SM	Silty Sand, moist, brown, fine grained			
			damp, fine to medium grained			
1						
			trace of clay at 1.5 feet	-#200=32.2% SAND=67.8%		14.9
2						
3				-#200=29.4% SAMD=70.6%		4.3
4		ROCK	Completely Weathered Granitic Rock: Cuttings are damp, fine to coarse silty sand, yellowish brown	-#200=17.2% SAND=82.8%		5.4
			Bottom of boring at 54 inches			
5						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: P-3

Project:

Project Number:

Drilled By: KC

Drill Type: Hand Auger

Auger Type: 5.5 inch dia. bucket

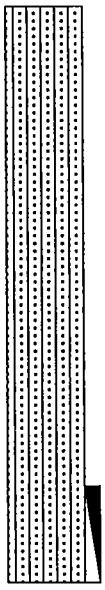
Hammer Type:

Logged By: KC

Date: January 10, 2020

Elevation: N/A

Depth to Groundwater First Encountered During Drilling: NE

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	N-Values blows/ft.	Moisture Content %
0		SM	Silty Sand: damp to moist, brown, fine grained with scattered coarse grains			
1						
2			damp, scattered coarse grains	-#200=23.0% SAND=77.0%		12.8
3			Bottom of boring at 36 inches			
4						
5						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: P-4

Project:

Project Number:

Drilled By: KC

Drill Type: Hand Auger

Auger Type: 5.5 inch dia. bucket

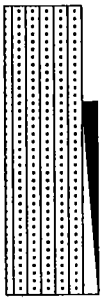
Hammer Type:

Logged By: KC

Date: January 10, 2020

Elevation: N/A

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		SM	Silty Sand: moist, brown, fine grained with scattered coarse grains, trace of clay	-#200=33.3% SAND=66.7%		15.7
1			Bottom of boring at 18 inches			
2						
3						
4						
5						

Notes:

Figure Number

MOORE TWINING ASSOCIATES, INC.

Test Boring: P-5

Project:

Project Number:

Drilled By: KC

Drill Type: Hand Auger

Auger Type: 5.5 inch dia. bucket

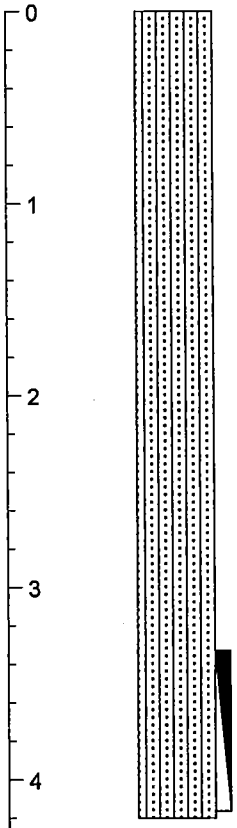
Hammer Type:

Logged By: KC

Date: January 10, 2020

Elevation: N/A

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		SM	Silty Sand, moist, dark brown, fine grained damp			
1						
2						
3			Yellowish-brown reduction in fines trace of clay	-#200=35.0% SAND=65.0%		5.5
4						
			Bottom of boring at 50 inches			
5						

Notes:

Figure Number

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
■	ASPHALTIC CONCRETE
□	Blank
▨	SC: Clayey sand
▨	Granitic Rock
▨	SM: Silty sand
▨	ML: Silt
Misc. Symbols	
▽	Water table during drilling

Notes:

1. Test borings were drilled on December 11, 2019, and January 29, 2020 using a CME-75 drill rig equipped with 6-5/8 inch outside diameter hollow-stem augers.

2. Groundwater was encountered during drilling in borings B-8 and B-13 (see logs).

3. Boring locations were located by pace and tape measure with reference to the existing site 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. Abbreviations used are:

AMSL =	Above mean sea level
O.D. =	Outside diameter
DD =	Dry density (pcf)
-#200 =	Percent passing #200 sieve (%)
N/A =	Not applicable
N/E =	None encountered
pcf =	pounds per cubic foot
psf =	pounds per square foot
BSG =	below site grade
LL =	Liquid Limit
PI =	Plasticity Index
C =	Cohesion
ø =	Angle of Internal Friction
NV =	No Value
NP =	Non Plastic

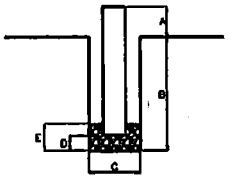
SE = Sand Equivalent

KEY TO SYMBOLS

Symbol	Description
Soil Samplers	
	Standard penetration test
	California Modified split barrel ring sampler

PERCOLATION TEST LOG
P-1

Project: Percolation Testing - Big Sandy Rancheria | **Project No. G56804.01**
Location: Auberry, CA | **Test Date: 1/21/2020**



	INCHES
A. Top of Pipe Above Ground	52
B. Depth of Hole	36
C. Diameter of Hole	6
D. Depth of Gravel Below Pipe	2
E. Total Gravel Layer Depth	24
F. Pipe Length	84
G. Pipe Diameter	2

Pre-saturated: Added 21 inches of water on 1/20/2020
Checked Hole noted to be dry 1/21/20 at about 9 am.

Gravel Correction Factor: 2.4

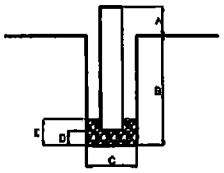
Trial	Date	Time	Depth To Water* (feet)	Time Interval (min)	Water Drop (inches)	Percolation Rate Corrected for Gravel (minutes per inch)
1	21-Jan-20	11:40:00	6.29			
	21-Jan-20	11:45:00	6.72	5.00	5.16	2.3
2	21-Jan-20	11:47:00	6.36			
	21-Jan-20	11:52:00	6.69	5.00	3.96	3.0
3	21-Jan-20	11:54:00	6.32			
	21-Jan-20	11:59:00	6.64	5.00	3.84	3.1
4	21-Jan-20	12:01:00	6.34			
	21-Jan-20	12:06:00	6.64	5.00	3.60	3.3
5	21-Jan-20	12:07:00	6.39			
	21-Jan-20	12:12:00 PM	6.67	5.00	3.36	3.5
6	21-Jan-20	12:14:00	6.36			
	21-Jan-20	12:19:00	6.65	5.00	3.48	3.4
7	21-Jan-20	12:21:00	6.39			
	21-Jan-20	12:26:00	6.66	5.00	3.24	3.7
8	21-Jan-20	12:28:00	6.35			
	21-Jan-20	12:33:00	6.64	5.00	3.48	3.4
9	21-Jan-20	12:34:00	6.35			
	21-Jan-20	12:39:00	6.64	5.00	3.48	3.4
10	21-Jan-20	12:41:00	6.35			
	21-Jan-20	12:46:00	6.63	5.00	3.36	3.5
11	21-Jan-20	12:51:00	6.39			
	21-Jan-20	12:56:00	6.65	5.00	3.12	3.8
12	21-Jan-20	12:58:00	6.34			
	21-Jan-20	13:03:00	6.62	5.00	3.36	3.5
13	21-Jan-20	13:05:00	6.38			
	21-Jan-20	13:10:00	6.65	5.00	3.24	3.7
14	21-Jan-20	13:12:00	6.39			
	21-Jan-20	13:17:00	6.65	5.00	3.12	3.8
15	21-Jan-20	13:19:00	6.36			
	21-Jan-20	13:24:00	6.63	5.00	3.24	3.7
16	21-Jan-20	13:25:00	6.31			
	21-Jan-20	13:30:00	6.6	5.00	3.48	3.4
17	21-Jan-20	13:31:00	6.34			
	21-Jan-20	13:36:00	6.6	5.00	3.12	3.8
18	21-Jan-20	13:38:00	6.34			
	21-Jan-20	13:43:00	6.6	5.00	3.12	3.8
19	21-Jan-20	13:44:00	6.29			
	21-Jan-20	13:49:00	6.54	5.00	3.00	3.9
20	21-Jan-20	13:53:00	6.34			
	21-Jan-20	13:58:00	6.6	5.00	3.12	3.8
21	21-Jan-20	13:59:00	6.24			
	21-Jan-20	14:04:00	6.49	5.00	3.00	3.9
22	21-Jan-20	14:06:00	6.31			
	21-Jan-20	14:11:00	6.56	5.00	3.00	3.9

* Depth to water measured from top of pipe

PERCOLATION TEST LOG
P-2

Project: Percolation Testing - Big Sandy Rancheria
Location: Auberry, CA

Project No. G56804.01
Test Date: 1/21/2020



	INCHES
A. Top of Pipe Above Ground	32
B. Depth of Hole	54
C. Diameter of Hole	5.5
D. Depth of Gravel Below Pipe	2
E. Total Gravel Layer Depth	31
F. Pipe Length	84
G. Pipe Diameter	2

Pre-saturated: Added 22 inches of water on 1/20/2020
Checked Hole noted to be dry 1/21/20 at about 9 am.

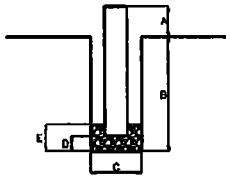
Gravel Correction Factor: 2.3

Trial	Date	Time	Depth To Water* (feet)	Time Interval (min)	Water Drop (inches)	Percolation Rate Corrected for Gravel (minutes per inch)
1	21-Jan-20	8:44:00	6.28			
	21-Jan-20	8:49:00	6.75	5.00	5.64	2.0
2	21-Jan-20	8:52:00	6.2			
	21-Jan-20	8:57:00	6.62	5.00	5.04	2.3
3	21-Jan-20	8:59:00	6.24			
	21-Jan-20	9:04:00	6.62	5.00	4.56	2.5
4	21-Jan-20	9:05:00	6.29			
	21-Jan-20	9:10:00	6.63	5.00	4.08	2.8
5	21-Jan-20	9:12:00	6.23			
	21-Jan-20	9:17:00 AM	6.58	5.00	4.20	2.7
6	21-Jan-20	9:18:00	6.26			
	21-Jan-20	9:23:00	6.58	5.00	3.84	3.0
7	21-Jan-20	9:25:00	6.25			
	21-Jan-20	9:30:00	6.58	5.00	3.96	2.9
8	21-Jan-20	9:31:00	6.22			
	21-Jan-20	9:36:00	6.55	5.00	3.96	2.9
9	21-Jan-20	9:37:00	6.24			
	21-Jan-20	9:42:00	6.56	5.00	3.84	3.0
10	21-Jan-20	9:44:00	6.22			
	21-Jan-20	9:49:00	6.55	5.00	3.96	2.9
11	21-Jan-20	9:51:00	6.2			
	21-Jan-20	9:56:00	6.53	5.00	3.96	2.9
12	21-Jan-20	9:57:00	6.17			
	21-Jan-20	10:02:00	6.52	5.00	4.20	2.7
13	21-Jan-20	10:03:00	6.23			
	21-Jan-20	10:08:00	6.55	5.00	3.84	3.0
14	21-Jan-20	10:09:00	6.23			
	21-Jan-20	10:14:00	6.55	5.00	3.84	3.0
15	21-Jan-20	10:16:00	6.22			
	21-Jan-20	10:21:00	6.55	5.00	3.96	2.9
16	21-Jan-20	10:22:00	6.12			
	21-Jan-20	10:27:00	6.48	5.00	4.32	2.7
17	21-Jan-20	10:29:00	6.11			
	21-Jan-20	10:34:00	6.45	5.00	4.08	2.8
18	21-Jan-20	10:36:00	6.14			
	21-Jan-20	10:41:00	6.48	5.00	4.08	2.8
19	21-Jan-20	10:42:00	6.23			
	21-Jan-20	10:47:00	6.53	5.00	3.60	3.2
20	21-Jan-20	10:48:00	6.28			
	21-Jan-20	10:53:00	6.55	5.00	3.24	3.5
21	21-Jan-20	10:56:00	6.26			
	21-Jan-20	11:01:00	6.53	5.00	3.24	3.5
22	21-Jan-20	11:02:07	6.28			
	21-Jan-20	11:07:00	6.55	4.88	3.24	3.5
23	21-Jan-20	11:08:00	6.23			
	21-Jan-20	11:13:00	6.5	5.00	3.24	3.5

* Depth to water measured from top of pipe

PERCOLATION TEST LOG
P-3

Project: Percolation Testing - Big Sandy Rancheria | **Project No. G56804.01**
Location: Auberry, CA | **Test Date: 1/20/2020**



	INCHES
A. Top of Pipe Above Ground	50
B. Depth of Hole	36
C. Diameter of Hole	6.5
D. Depth of Gravel Below Pipe	2
E. Total Gravel Layer Depth	24
F. Pipe Length	84
G. Pipe Diameter	2

Pre-saturated: Added 18 inches of water on 1/19/2020.
Checked Hole noted to be dry 1/20/20 at about 1 pm.

Gravel Correction Factor: 2.4

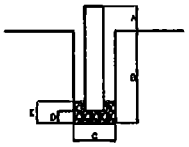
Trial	Date	Time	Depth To Water* (feet)	Time Interval (min)	Water Drop (inches)	Percolation Rate Corrected for Gravel (minutes per inch)
1	20-Jan-20	13:25:00	6.28			
	20-Jan-20	13:30:00	6.71	5.00	5.64	2.2
2	20-Jan-20	13:32:00	6.33			
	20-Jan-20	13:37:00	6.65	5.00	3.84	3.2
3	20-Jan-20	13:39:00	6.3			
	20-Jan-20	13:44:00	6.6	5.00	3.60	3.4
4	20-Jan-20	13:48:00	6.27			
	20-Jan-20	13:51:00	6.57	5.00	3.60	3.4
5	20-Jan-20	13:52:00	6.3			
	20-Jan-20	1:57:00 PM	6.59	5.00	3.48	3.5
6	20-Jan-20	13:59:00	6.2			
	20-Jan-20	14:04:00	6.55	5.00	4.20	2.9
7	20-Jan-20	14:06:00	6.32			
	20-Jan-20	14:11:00	6.59	5.00	3.24	3.7
8	20-Jan-20	14:12:00	6.24			
	20-Jan-20	14:17:00	6.52	5.00	3.36	3.6
9	20-Jan-20	14:19:00	6.35			
	20-Jan-20	14:24:00	6.6	5.00	3.00	4.0
10	20-Jan-20	14:25:00	6.26			
	20-Jan-20	14:30:00	6.54	5.00	3.36	3.6
11	20-Jan-20	14:32:00	6.26			
	20-Jan-20	14:37:00	6.52	5.00	3.12	3.9
12	20-Jan-20	14:39:00	6.2			
	20-Jan-20	14:44:00	6.5	5.00	3.60	3.4
13	20-Jan-20	14:45:00	6.18			
	20-Jan-20	14:50:00	6.46	5.00	3.36	3.6
14	20-Jan-20	14:51:00	6.3			
	20-Jan-20	14:56:00	6.56	5.00	3.12	3.9
15	20-Jan-20	14:59:00	6.3			
	20-Jan-20	15:04:00	6.56	5.00	3.12	3.9
16	20-Jan-20	15:06:00	6.3			
	20-Jan-20	15:11:00	6.56	5.00	3.12	3.9
17	20-Jan-20	15:13:00	6.31			
	20-Jan-20	15:18:00	6.55	5.00	2.88	4.2
18	20-Jan-20	15:20:00	6.3			
	20-Jan-20	15:25:00	6.55	5.00	3.00	4.0
19	20-Jan-20	15:27:00	6.31			
	20-Jan-20	15:32:00	6.56	5.00	3.00	4.0
20	20-Jan-20	15:35:00	6.28			
	20-Jan-20	15:40:00	6.53	5.00	3.00	4.0
21	20-Jan-20	15:41:00	6.3			
	20-Jan-20	15:46:00	6.54	5.00	2.88	4.2
22	20-Jan-20	15:48:00	6.31			
	20-Jan-20	15:53:00	6.55	5.00	2.88	4.2

* Depth to water measured from top of pipe

PERCOLATION TEST LOG
P-4

Project: Percolation Testing - Big Sandy Rancheria
Location: Auberry, CA

Project No. G58804.01
Test Date: 1/21/2020



	INCHES
A. Top of Pipe Above Ground	20
B. Depth of Hole	18
C. Diameter of Hole	7.5
D. Depth of Gravel Below Pipe	2
E. Total Gravel Layer Depth	18
F. Pipe Length	38
G. Pipe Diameter	2

Pre-saturated: Added 18 inches of water on January 19, 2020
Checked Hole noted to be dry 1/20/20 at about 9 am.

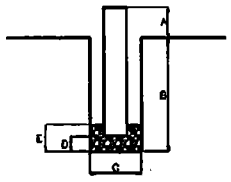
Gravel Correction Factor: 2.5

Trial	Date	Time	Depth To Water* (inches)	Time Interval (min)	Water Drop (inches)	Percolation Rate Corrected for Gravel (minutes per inch)
1	20-Jan-20	9:00:00	26.125			
	20-Jan-20	9:03:00	28.625	3.00	2.50	3.0
Refill-2	20-Jan-20	9:05:00	26.75			
	20-Jan-20	9:07:00	27.75	2.00	1.00	5.0
3	20-Jan-20	9:09:20	28.625	2.33	0.88	6.7
	20-Jan-20	9:11:10	29.5	1.83	0.88	5.3
Refill-4	20-Jan-20	9:12:20	25.5			
	20-Jan-20	9:14:45	27.125	2.42	1.63	3.8
5	20-Jan-20	9:16:45	28	2.00	0.88	5.8
	20-Jan-20	9:19:10 AM	28.875	2.42	0.88	7.0
6	20-Jan-20	9:21:10	29.375	2.00	0.50	10.1
Refill 7	20-Jan-20	9:22:10	26.5			
	20-Jan-20	9:27:10	28.5	5.00	2.00	6.3
Refill-8	20-Jan-20	9:28:50	27			
	20-Jan-20	9:33:50	28.5	5.00	1.50	8.4
Refill-9	20-Jan-20	9:35:15	27			
	20-Jan-20	9:40:15	28.75	5.00	1.75	7.2
Refill10	20-Jan-20	9:41:30	26.75			
	20-Jan-20	9:46:30	28.25	5.00	1.50	8.4
11	20-Jan-20	9:51:30	29.5	5.00	1.25	10.1
Refill	20-Jan-20	9:52:30	27.375			
12	20-Jan-20	9:57:30	28.875	5.00	1.50	8.4
Refill	20-Jan-20	9:58:30	27.375			
13	20-Jan-20	10:03:50	28.875	5.33	1.50	9.0
Refill	20-Jan-20	10:05:15	27.25			
14	20-Jan-20	10:10:15	28.625	5.00	1.38	9.2
Refill	20-Jan-20	10:12:05	27.625			
15	20-Jan-20	10:17:05	28.5	5.00	0.88	14.4
Refill	20-Jan-20	10:18:30	26.75			
16	20-Jan-20	10:23:30	28	5.00	1.25	10.1
Refill	20-Jan-20	10:25:50	26.5			
17	20-Jan-20	10:30:50	28.125	5.00	1.63	7.8
Refill	20-Jan-20	10:32:00	26.125			
18	20-Jan-20	10:37:00	27.625	5.00	1.50	8.4
	20-Jan-20	10:42:00	28.8125	5.00	1.19	10.6
Refill-19	20-Jan-20	10:43:10	27.125			
	20-Jan-20	10:48:40	28.5	5.50	1.38	10.1
Refill'20	20-Jan-20	10:49:25	26.75			
	20-Jan-20	10:54:25	28.125	5.00	1.38	9.2
Refill 21	20-Jan-20	10:55:50	26.8125			
	20-Jan-20	11:00:50	28.125	5.00	1.31	9.6
Refill22	20-Jan-20	11:02:45	26.125			
	20-Jan-20	11:07:45	27.375	5.00	1.25	10.1
Refill 23	20-Jan-20	11:09:10				
	20-Jan-20	11:14:10	27.875	5.00	1.25	10.1
Refill 24	20-Jan-20	11:15:05	26.6875			
	20-Jan-20	11:20:05	28.0625	5.00	1.375	9.2
Refill	20-Jan-20	11:22:00	26.625			
	20-Jan-20	11:27:00	28	5.00	1.375	9.2
Refill	20-Jan-20	11:28:30	26.5			
	20-Jan-20	11:33:30	28.625	5.00	2.125	5.9
Refill	20-Jan-20	11:34:30	26.5625			
	20-Jan-20	11:39:30	28.125	5.00	1.5625	8.1
Refill	20-Jan-20	11:40:35	26.4375			
	20-Jan-20	11:45:35	27.8125	5.00	1.375	9.2
Refill	20-Jan-20	11:46:30	26.5			
	20-Jan-20	11:51:30	27.9375	5.00	1.4375	8.8

* Depth to water measured from top of pipe

PERCOLATION TEST LOG
P-5

Project: Percolation Testing - Big Sandy Rancheria | **Project No. G56804.01**
Location: Auberry, CA | **Test Date: 1/20/2020**



	INCHES
A. Top of Pipe Above Ground	12.5
B. Depth of Hole	50
C. Diameter of Hole	5.5
D. Depth of Gravel Below Pipe	2
E. Total Gravel Layer Depth	35
F. Pipe Length	60
G. Pipe Diameter	2

Pre-saturated: Added 18 inches of water on January 19, 2020
Checked Hole noted to be dry 1/20/20 at about 9 am.

Gravel Correction Factor: 2.3

Trial	Date	Time	Depth To Water* (feet)	Time Interval (min)	Water Drop (inches)	Percolation Rate Corrected for Gravel (minutes per inch)
1	20-Jan-20	9:52:00	4.22			
	21-Jan-20	9:57:00	4.46	5.00	2.88	4.0
2	21-Jan-20	10:00:00	4.24			
	21-Jan-20	10:10:00	4.55	10.00	3.72	6.2
3	21-Jan-20	10:12:00	4.29			
	21-Jan-20	10:22:00	4.55	10.00	3.12	7.4
4	21-Jan-20	10:25:00	4.31			
	21-Jan-20	10:30:00	4.45	5.00	1.68	6.8
5	21-Jan-20	10:31:00	4.31			
	21-Jan-20	10:36:00 AM	4.44	5.00	1.56	7.4
6	21-Jan-20	10:37:00	4.3			
	21-Jan-20	10:42:00	4.43	5.00	1.56	7.4
7	21-Jan-20	10:44:00	4.25			
	21-Jan-20	10:49:00	4.4	5.00	1.80	6.4
8	21-Jan-20	10:50:00	4.25			
	21-Jan-20	10:55:00	4.4	5.00	1.80	6.4
9	21-Jan-20	10:57:00	4.32			
	21-Jan-20	11:02:00	4.45	5.00	1.56	7.4
10	21-Jan-20	11:04:00	4.28			
	21-Jan-20	11:09:00	4.41	5.00	1.56	7.4
11	21-Jan-20	11:11:00	4.26			
	21-Jan-20	11:16:00	4.4	5.00	1.68	6.8
12	21-Jan-20	11:17:00	4.31			
	21-Jan-20	11:22:00	4.43	5.00	1.44	8.0
13	21-Jan-20	11:23:00	4.3			
	21-Jan-20	11:28:00	4.43	5.00	1.56	7.4
14	21-Jan-20	11:30:00	4.31			
	21-Jan-20	11:35:00	4.43	5.00	1.44	8.0
15	21-Jan-20	11:37:00	4.26			
	21-Jan-20	11:42:00	4.39	5.00	1.56	7.4
16	21-Jan-20	11:43:00	4.24			
	21-Jan-20	11:48:00	4.37	5.00	1.56	7.4
17	21-Jan-20	11:50:00	4.29			
	21-Jan-20	11:55:00	4.41	5.00	1.44	8.0
18	21-Jan-20	11:56:00	4.3			
	21-Jan-20	12:01:00	4.42	5.00	1.44	8.0
19	21-Jan-20	12:02:00	4.31			
	21-Jan-20	12:07:00	4.43	5.00	1.44	8.0
20	21-Jan-20	12:10:00	4.32			
	21-Jan-20	12:15:00	4.43	5.00	1.32	8.7
21	21-Jan-20	12:16:00	4.24			
	21-Jan-20	12:21:00	4.36	5.00	1.44	8.0
22	21-Jan-20	12:23:00	4.24			
	21-Jan-20	12:28:00	4.36	5.00	1.44	8.0

* Depth to water measured from top of pipe

APPENDIX C

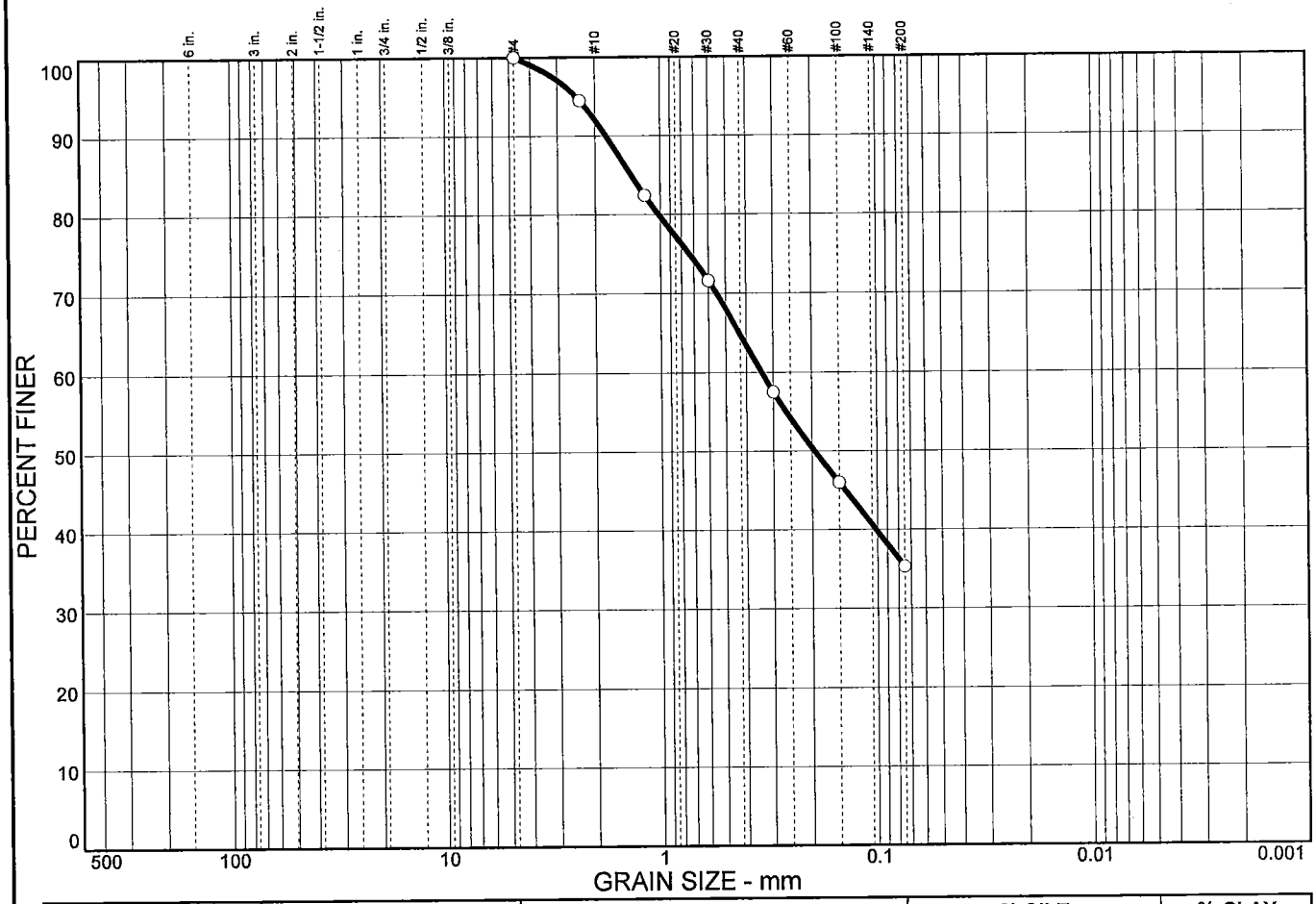
RESULTS OF LABORATORY TESTS

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

These Included:	**To Determine:**
Moisture Content (ASTM D2216)	Moisture contents representative of field conditions at the time the sample was taken.
Grain-Size Distribution (ASTM D422)	Size and distribution of soil particles, i.e., sand, gravel and fines (silt and clay)
Moisture-Density Relationship (ASTM D1557)	The optimum (best) moisture content for compacting soil and the maximum dry unit weight (density) for a given compactive effort.
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.
Moisture-Density Relationship (ASTM D1557)	The optimum (best) moisture content for compacting soil and the maximum dry unit weight (density) for a given compactive effort.
Resistivity (ASTM G187)	The potential of the soil to corrode metal.
Sand Equivalent (ASTM D2419)	Empirical value measure of relative amount, fineness, and character of claylike material in the sample.

These Included:	To Determine:
Sulfate Content (ASTM D4327)	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.
Chloride Content (ASTM D4327)	Percentage of soluble chloride in soil. Used to evaluate the potential attack on encased reinforcing steel.
pH (ASTM D4972)	The acidity or alkalinity of subgrade material.

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	64.7	35.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	94.5		
#16	82.4		
#30	71.6		
#50	57.5		
#100	46.0		
#200	35.3		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.36 D_{60}= 0.340 D_{50}= 0.194
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

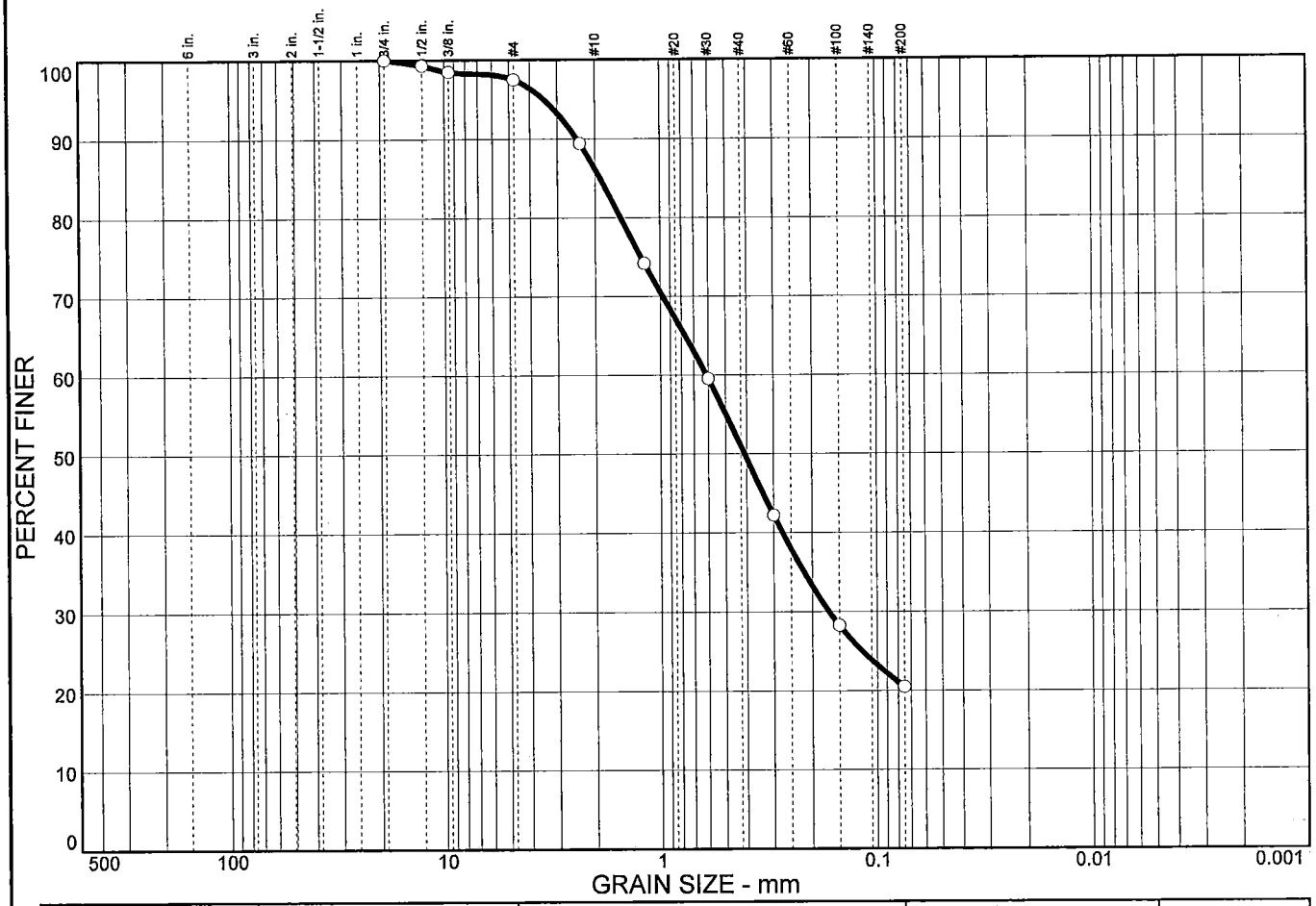
USCS= SM AASHTO=

Remarks

Sample No.: B-1 **Source of Sample:** **Date:** 12/11/19
Location: **Elev./Depth:** 2-3.5'

Moore Twining Associates, Inc. **Fresno, CA**	**Client:** **Project:** Big Sandy Rancheria Pipeline **Project No:** G56804.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	2.5	77.0	20.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	99.3		
3/8 in.	98.5		
#4	97.5		
#8	89.4		
#16	74.2		
#30	59.5		
#50	42.2		
#100	28.3		
#200	20.5		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.90 D_{60}= 0.613 D_{50}= 0.409
D_{30}= 0.167 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

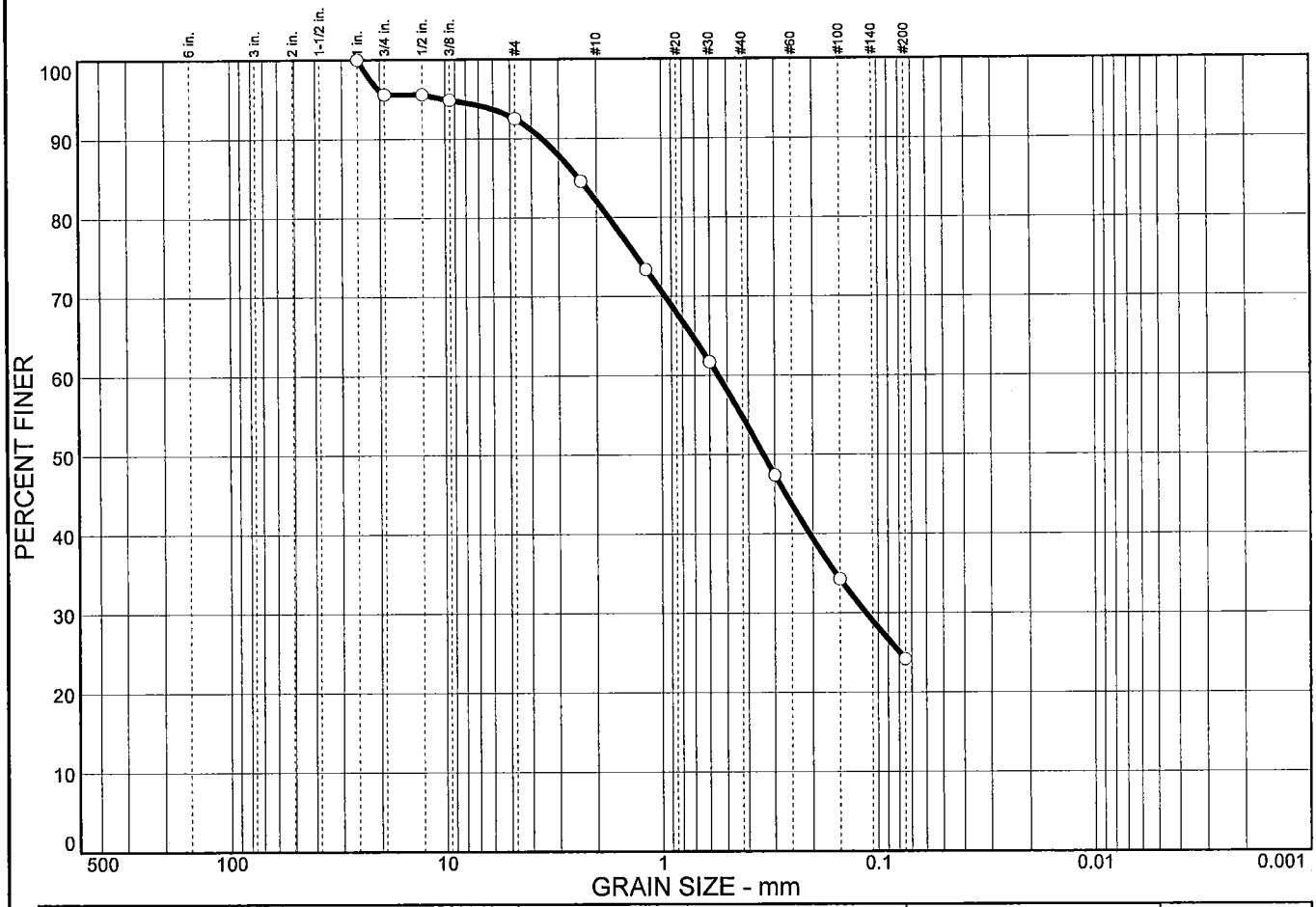
Remarks

Sample No.: B-1 **Source of Sample:** **Date:** 12/11/19
Location: **Elev./Depth:** 5-6.5'

Moore Twining Associates, Inc.
Fresno, CA

Client:
Project: Big Sandy Rancheria Pipeline
Project No: G56804.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	7.5	68.3	24.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	95.6		
1/2 in.	95.6		
3/8 in.	94.9		
#4	92.5		
#8	84.6		
#16	73.4		
#30	61.7		
#50	47.4		
#100	34.3		
#200	24.2		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 2.43 D_{60}= 0.550 D_{50}= 0.340
D_{30}= 0.114 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Sample No.: B-7 **Source of Sample:** **Date:** 12/11/19
Location: **Elev./Depth:** 5-6.5'

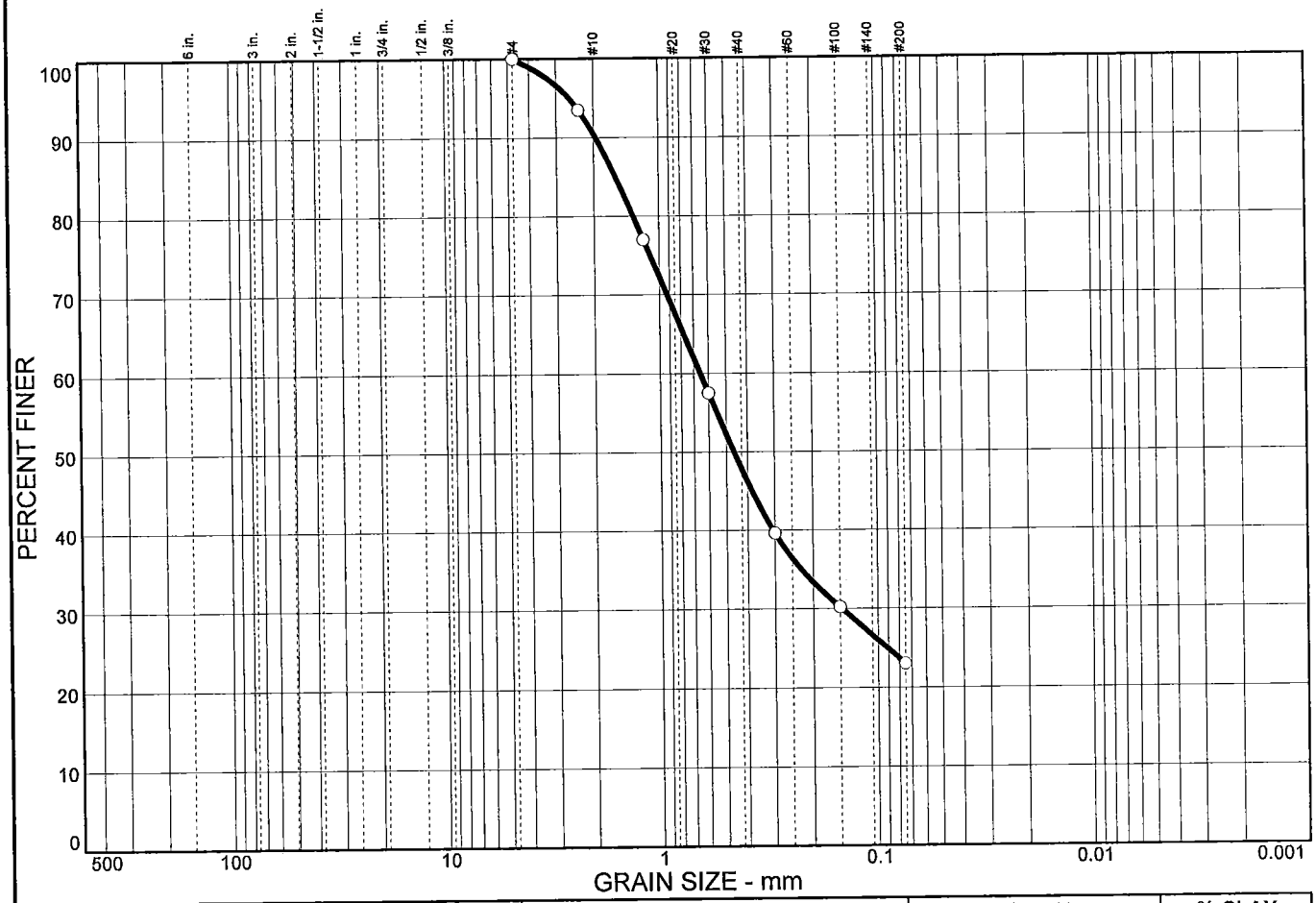
Moore Twining Associates, Inc.

Fresno, CA

Client:
Project: Big Sandy Rancheria Pipeline

Project No: G56804.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	77.0	23.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	93.5		
#16	77.0		
#30	57.5		
#50	39.6		
#100	30.2		
#200	23.0		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.59 D_{60}= 0.654 D_{50}= 0.461
D_{30}= 0.147 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

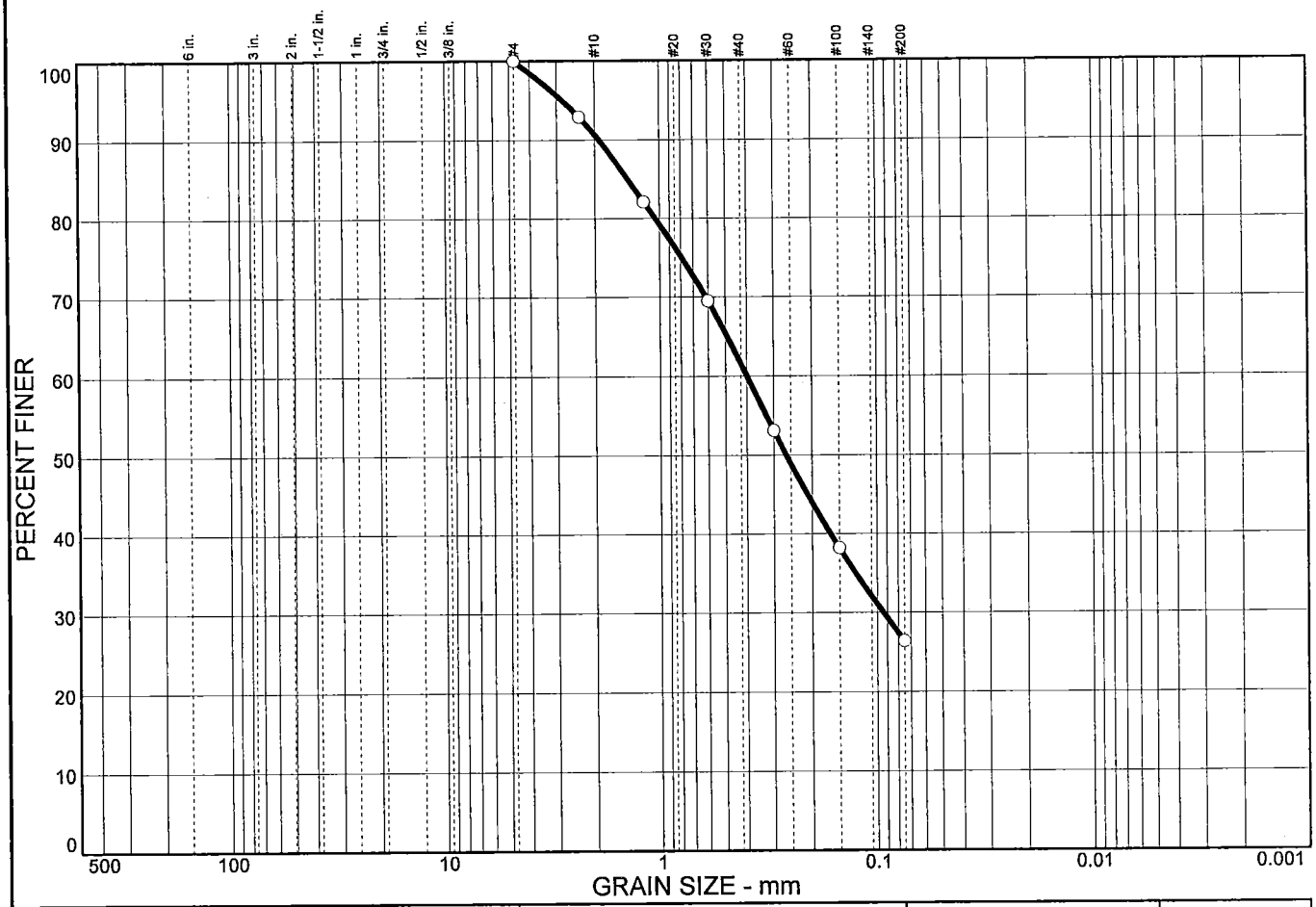
Remarks

Sample No.: B-11 **Source of Sample:** **Date:** 12/11/19
Location: **Elev./Depth:** 2-3.5'

Moore Twining Associates, Inc.
Fresno, CA

Client:
Project: Big Sandy Rancheria Pipeline
Project No: G56804.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	73.6	26.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	92.9		
#16	82.1		
#30	69.5		
#50	53.1		
#100	38.2		
#200	26.4		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.40 D_{60}= 0.399 D_{50}= 0.263
D_{30}= 0.0937 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

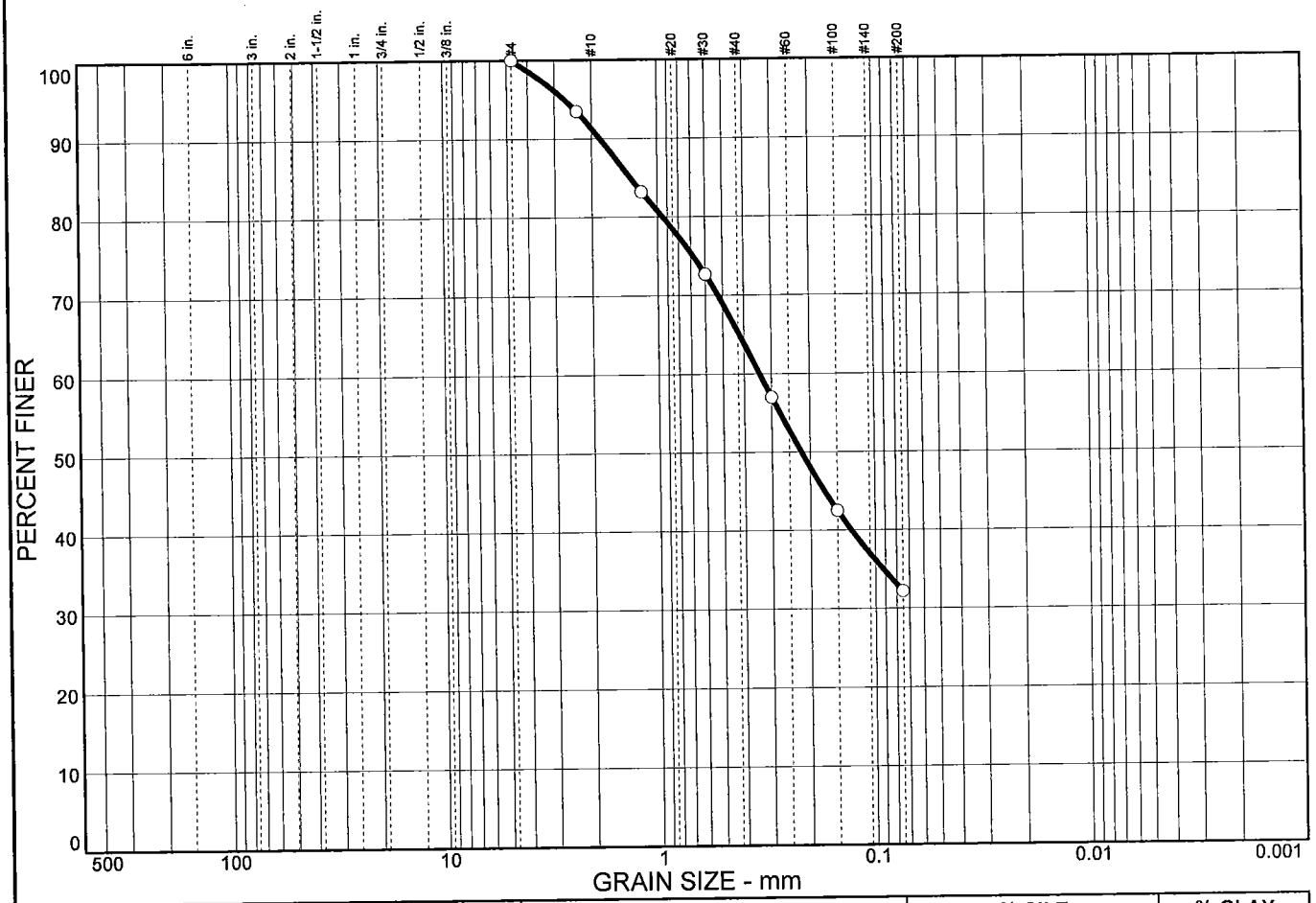
Remarks

Sample No.: P-1 **Source of Sample:** **Date:** 1/10/20
Location: **Elev./Depth:** 24-36"

Moore Twining Associates, Inc.
Fresno, CA

Client:
Project: Big Sandy Rancheria Pipeline
Project No: G56804.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	67.8	32.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	93.5		
#16	83.2		
#30	72.7		
#50	57.0		
#100	42.5		
#200	32.2		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.33 D_{60}= 0.340 D_{50}= 0.220
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

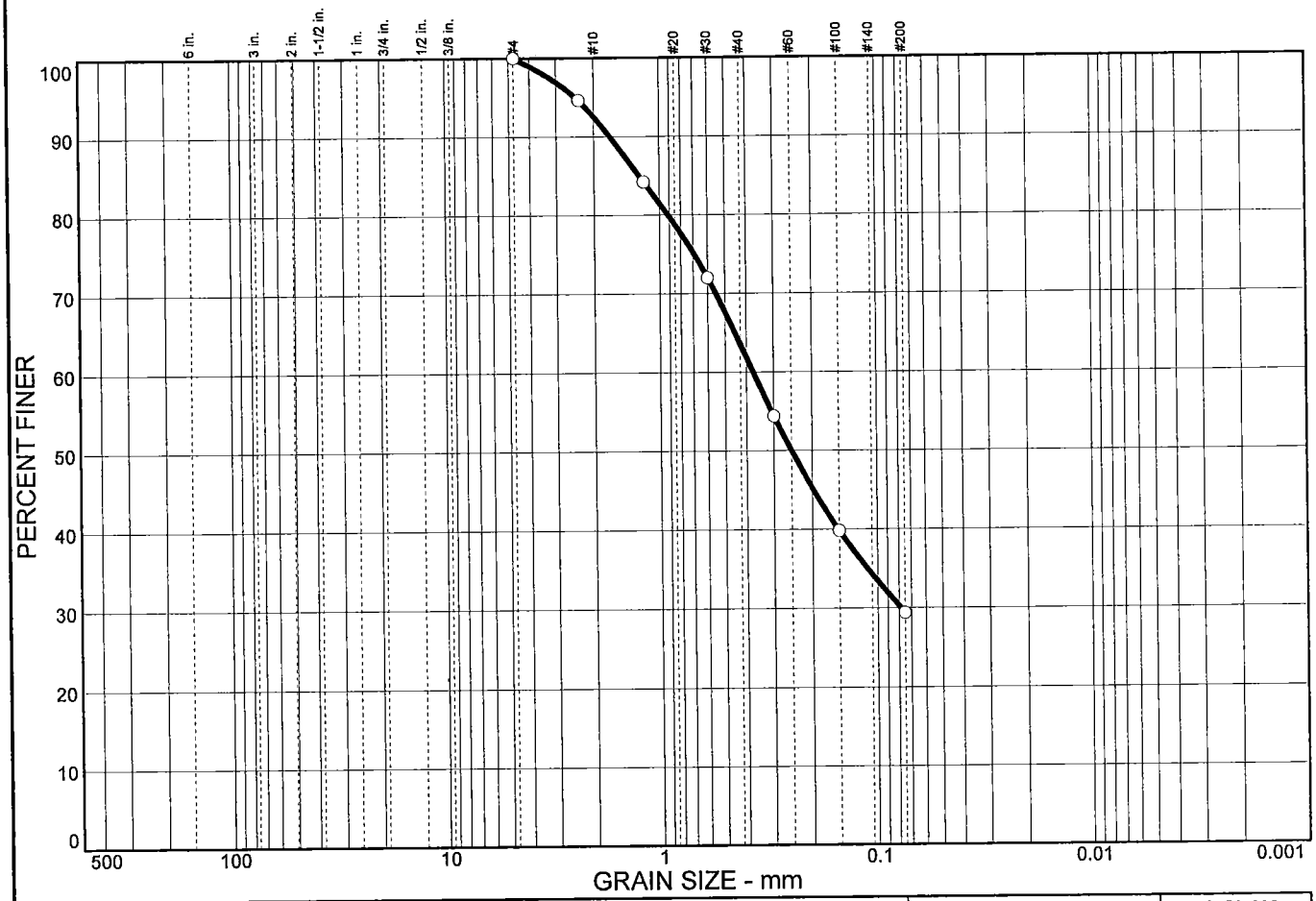
Remarks

Sample No.: P-2 **Source of Sample:** **Date:** 1/10/20
Location: **Elev./Depth:** 18-24"

Moore Twining Associates, Inc.
Fresno, CA

Client:
Project: Big Sandy Rancheria Pipeline
Project No: G56804.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	70.6	29.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	94.6		
#16	84.2		
#30	72.0		
#50	54.4		
#100	39.8		
#200	29.4		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.24 D_{60}= 0.373 D_{50}= 0.250
D_{30}= 0.0783 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

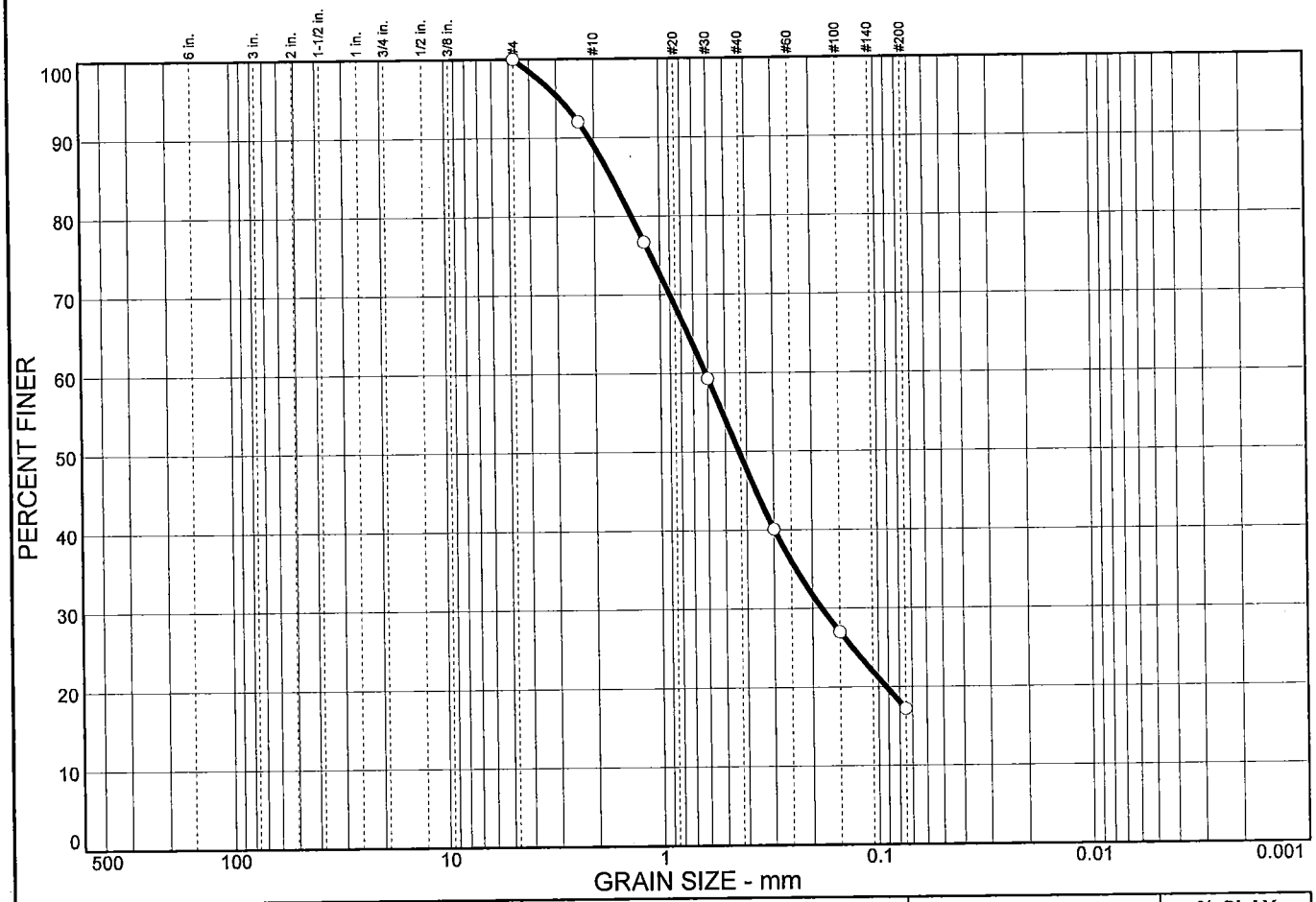
Remarks

Sample No.: P-2 **Source of Sample:** **Date:** 1/10/20
Location: **Elev./Depth:** 36-42"

Moore Twining Associates, Inc.
Fresno, CA

Client:
Project: Big Sandy Rancheria Pipeline
Project No: G56804.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	82.8	17.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	92.0		
#16	76.7		
#30	59.3		
#50	40.1		
#100	27.0		
#200	17.2		

* (no specification provided)

Material Description

Completely Weathered Granitic Rock

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.67 D_{60}= 0.615 D_{50}= 0.434
D_{30}= 0.181 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

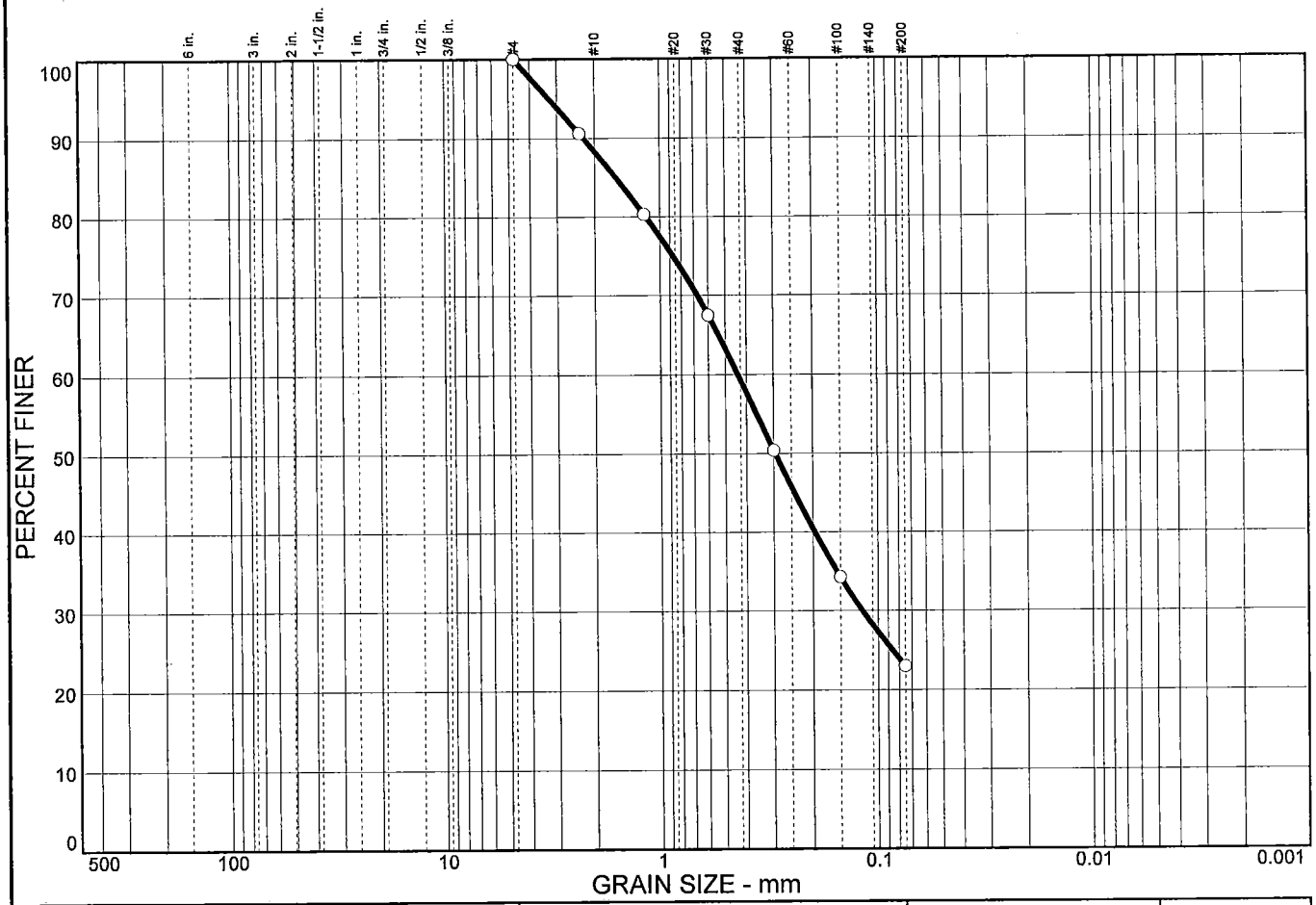
Remarks

Sample No.: P-2 **Source of Sample:** **Date:** 1/10/20
Location: **Elev./Depth:** 48-54"

Moore Twining Associates, Inc.
Fresno, CA

Client:
Project: Big Sandy Rancheria Pipeline
Project No: G56804.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	77.0	23.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	90.6		
#16	80.3		
#30	67.5		
#50	50.4		
#100	34.3		
#200	23.0		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.60 D_{60}= 0.438 D_{50}= 0.295
D_{30}= 0.118 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

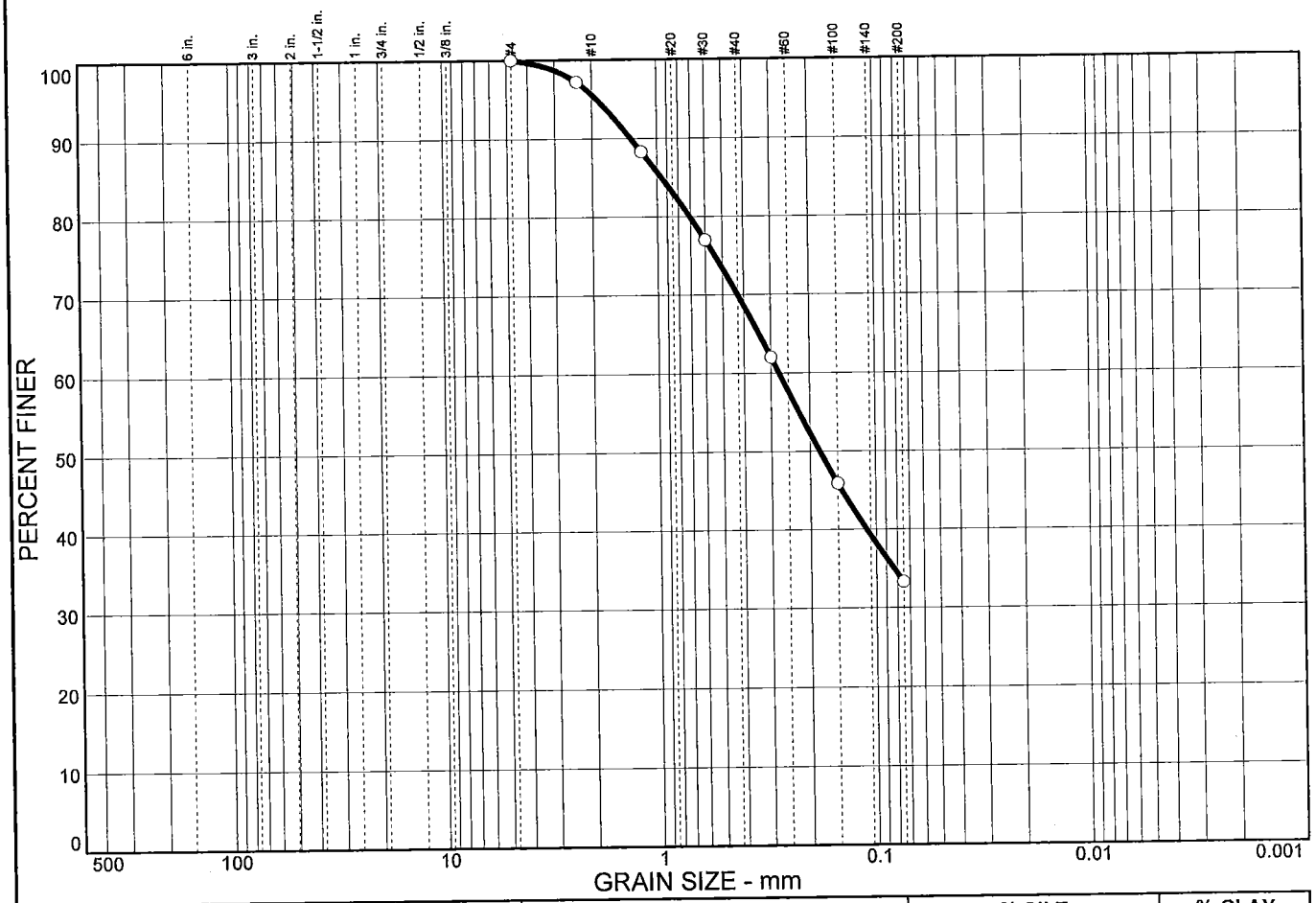
Sample No.: P-3 **Source of Sample:** **Date:** 1/10/20
Location: **Elev./Depth:** 30-36"

Moore Twining Associates, Inc.

Fresno, CA

Client:
Project: Big Sandy Rancheria Pipeline
Project No: G56804.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	66.7	33.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	97.2		
#16	88.3		
#30	77.0		
#50	62.0		
#100	45.9		
#200	33.3		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.955 D_{60}= 0.276 D_{50}= 0.181
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

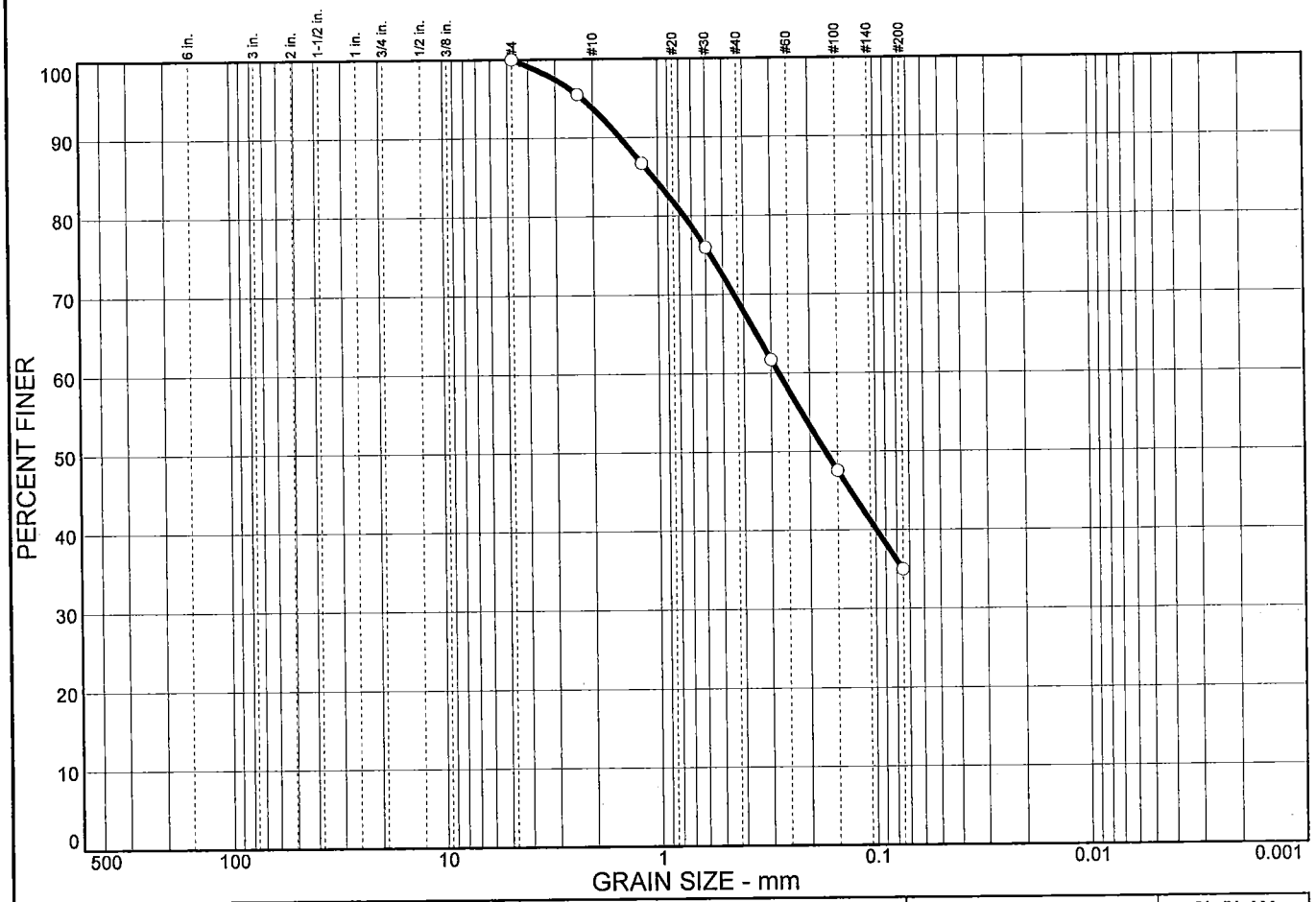
Remarks

Sample No.: P-4 **Source of Sample:** **Date:** 1/10/20
Location: **Elev./Depth:** 6-18"

Moore Twining Associates, Inc.
Fresno, CA

Client:
Project: Big Sandy Rancheria Pipeline
Project No: G56804.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	65.0	35.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	95.5		
#16	86.7		
#30	76.0		
#50	61.7		
#100	47.6		
#200	35.0		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 1.05 D_{60}= 0.277 D_{50}= 0.170
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

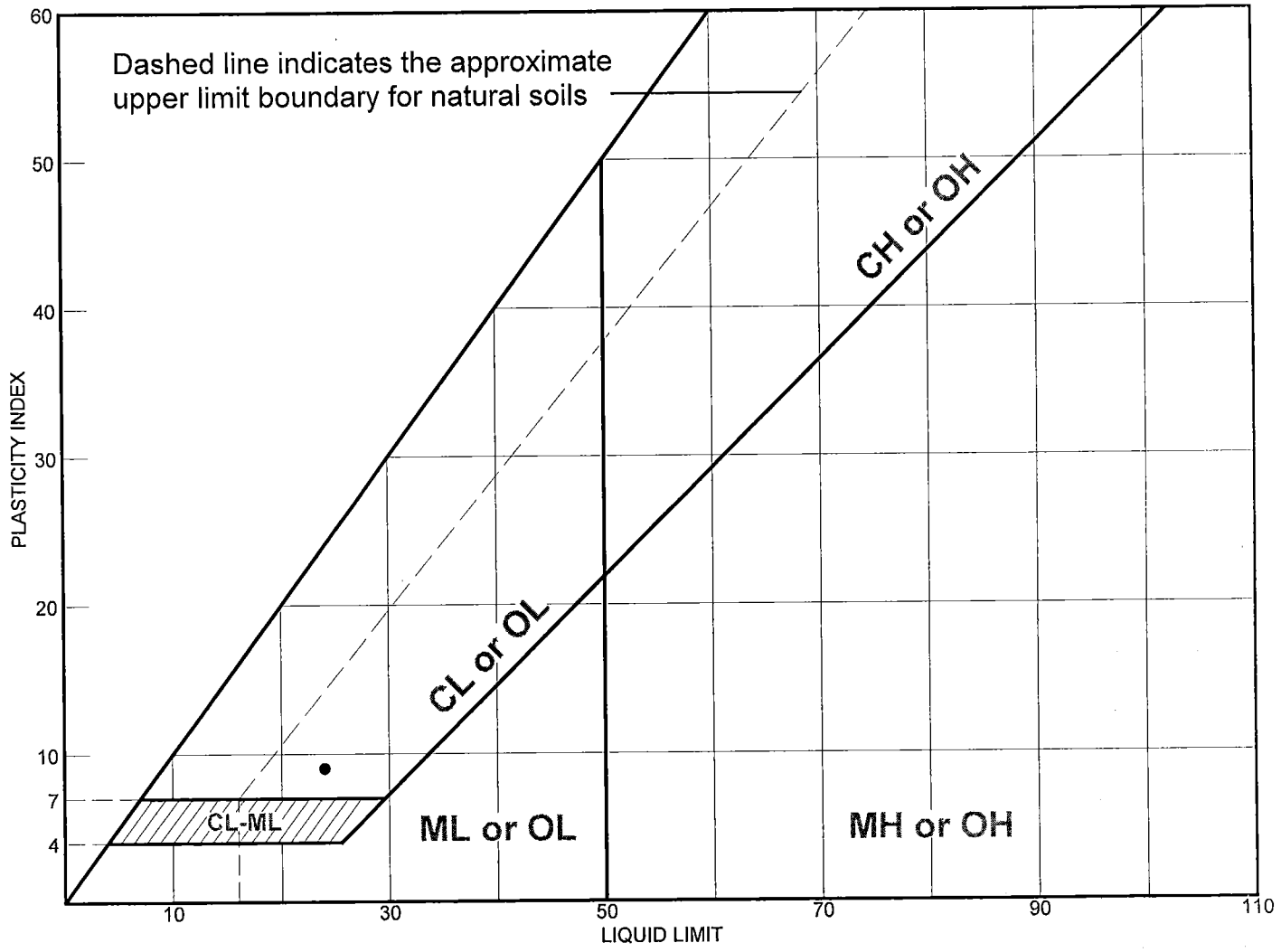
Sampled By: Ken Clark; Tested By: Miguel Alcaraz; Test Procedure: AS

Sample No.: P-5 **Source of Sample:** **Date:** 1/10/20
Location: **Elev./Depth:** 40-50"

Moore Twining Associates, Inc.
Fresno, CA

Client:
Project: Big Sandy Rancheria Pipeline
Project No: G56804.01 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Clayey sand	24	15	9			SC

Project No. G56804.01 **Client:**

Project: Big Sandy Rancheria Pipeline

● **Source:** **Sample No.:** B-2 **Elev./Depth:** 1-2.5'

Remarks:

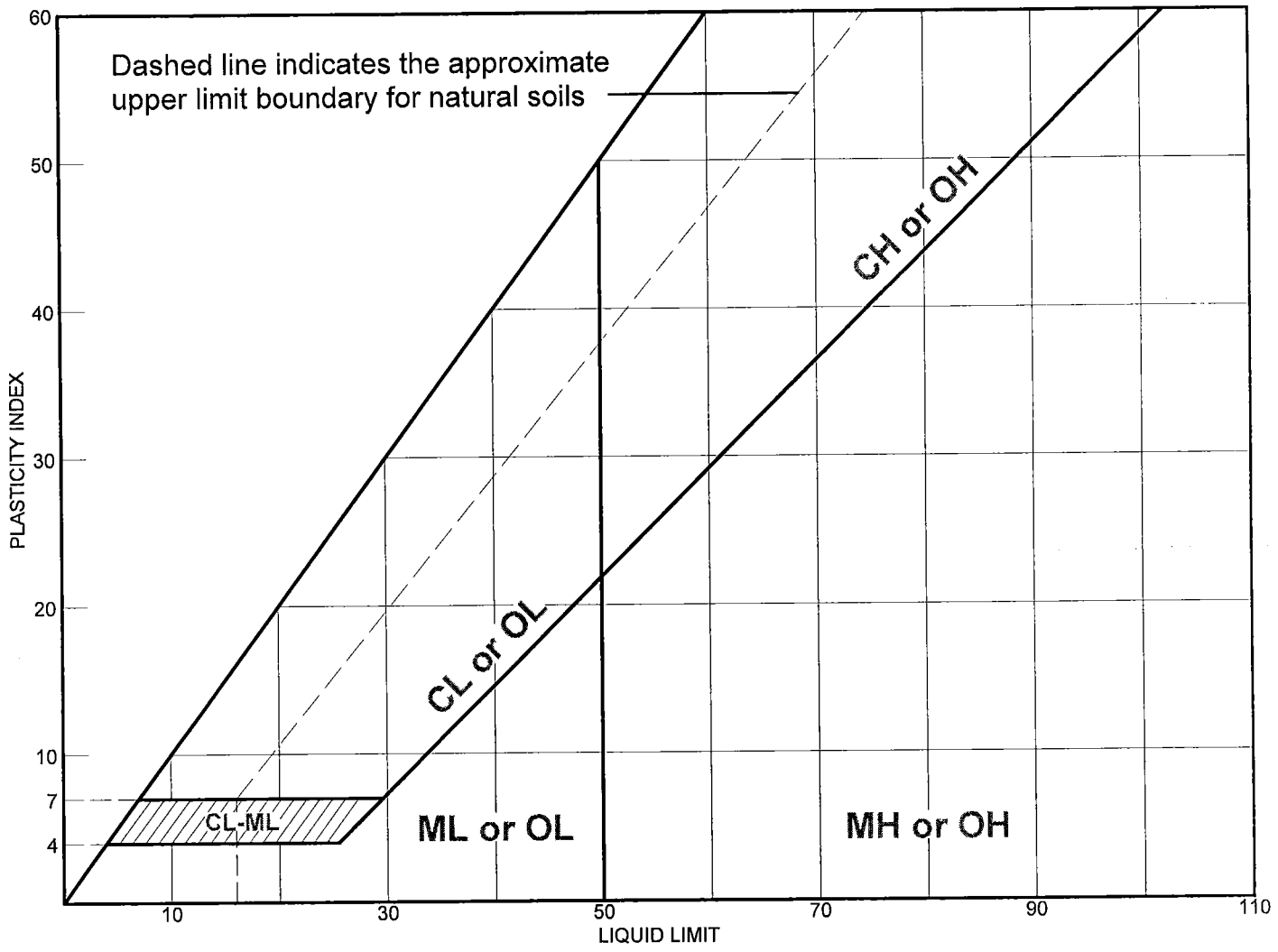
●

Moore Twining Associates, Inc.

Fresno, CA

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Silty sand	NV	NP	NP			SM

Project No. G56804.01 **Client:**

Project: Big Sandy Rancheria Pipeline

● **Source:** **Sample No.:** B-14 **Elev./Depth:** 1-2.5'

Remarks:

●

Moore Twining Associates, Inc.

Fresno, CA

Figure

MOORE TWINING ASSOCIATES, INC.

EXPANSION INDEX TEST, ASTM D4829

MTA PROJECT NAME:	Big Sandy Rancheria Pipeline	REPORT DATE:	2/21/2020
		TEST DATE:	2/12/2020
MTA PROJECT NO.:	G56804.01		
SAMPLE I.D.:	B-10 @ 0-3'		
SAMPLED BY:	JC		
SAMPLE DATE:	1/29/2020	TESTED BY:	MA
MATERIALS DESCRIPTION:	Clayey sand		
% PASSING # 4 SIEVE	100		

Initial Moisture Determination:

Pan + Wet Soil Wt., gm	250.0
Pan + Dry Soil Wt., gm	229.0
Pan Wt., gm	0.0
Initial % Moisture Content	9.2

Final Moisture Determination:

Wet Soil Wt., lbs	0.9666
Dry Soil Wt., lbs	0.8231
Final % Moisture Content	17.4

Initial Expansion Data:

Ring + Sample Wt., lbs	0.8986
Ring Wt., lbs	0.0000
Remolded Wt., lbs	0.8986
Remolded Wet Density, pcf	123.6
Remolded Dry Density, pcf	113.2

Final Expansion Data:

Ring + Sample Wt., lbs	0.9666
Ring Wt., lbs	0.0000
Remolded Wt., lbs	0.9666
Remolded Wet Density, pcf	134.9
Remolded Dry Density, pcf	114.8

Initial Volume	Final Volume
0.00727222	0.007168

Expansion Data:

Initial Gage Reading, in:	0.0500
Final Gage Reading, in:	0.0356
Expansion, in:	-0.0144
Expansion Index	0

Comments: **Very Low Expansion Potential**

Classification of Expansive Soils. (Table No.1 From ASTM D4829)

Expansion Index	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High

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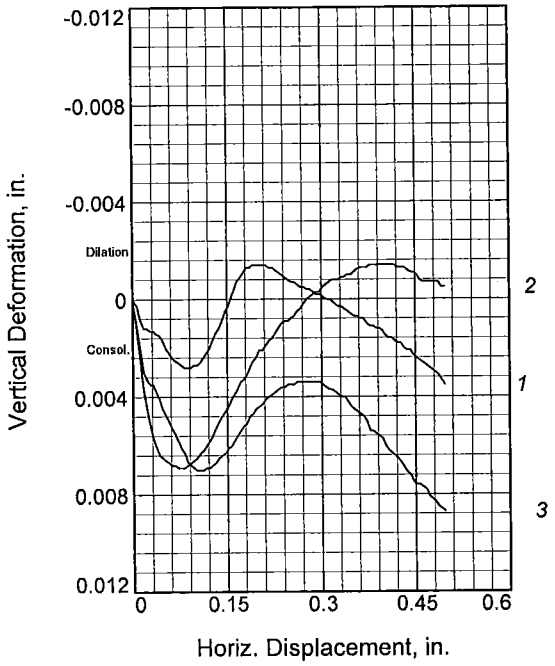

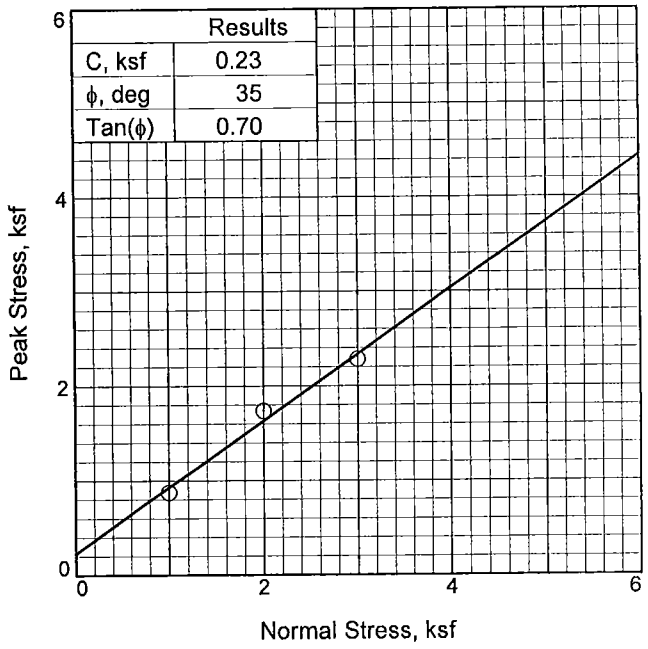

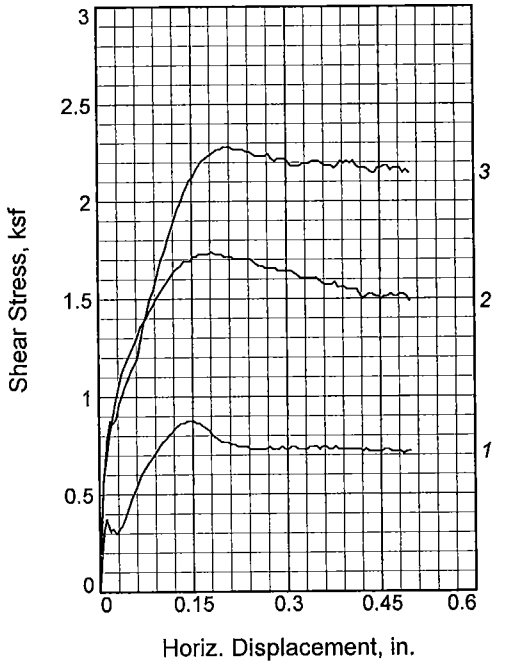

Sample No.		1	2	3
Initial	Water Content, %	9.4	11.2	9.6
	Dry Density, pcf	90.6	97.0	95.9
	Saturation, %	30.3	42.1	35.2
	Void Ratio	0.8264	0.7059	0.7251
	Diameter, in.	2.42	2.42	2.42
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	29.1	24.1	24.4
	Dry Density, pcf	92.2	99.3	99.2
	Saturation, %	97.0	95.9	97.1
	Void Ratio	0.7948	0.6653	0.6672
	Diameter, in.	2.42	2.42	2.42
	Height, in.	0.98	0.98	0.97
Normal Stress, ksf		1.00	2.00	3.00
Peak Stress, ksf		0.88	1.74	2.28
Displacement, in.		0.14	0.18	0.20
Ultimate Stress, ksf				
Displacement, in.				
Strain at peak, %		5.9	7.5	8.4

Sample Type:
Description: Silty sand

Specific Gravity= 2.65
Remarks:

Figure _____

Client:

Project: Big Sandy Rancheria Pipeline

Sample Number: B-10 **Depth:** 5-6.5'

Proj. No.: G56804.01 **Date Sampled:** 1/29/20

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

MOORE TWINING ASSOCIATES, INC.

Project Name:	Big Sandy Rancheria Pipeline	Report Date:	1/9/2020
		Sample Date:	12/11/2019
Project Number:	G56804.01		
		Sampled By:	KC
Subject:	Sand Equivalent , ASTM D2419	Tested By:	MA
Material Description:	Silty sand	Test Date:	12/23/2019
Location:	Varies		

Laboratory Test Results, Sand Equivalent, ASTM D2419

Sample I.D.:	Sand Reading	Clay Reading	Sand Equivalent
B-1 @ 2-3.5	1.9	12.9	15
B-11 @ 2-3.5'	2.6	12.4	21
B-7 @ 5-6.5'	1.9	12.9	15
B-1 @ 5-6.5'	2.6	12.2	22

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MOORE TWINING ASSOCIATES, INC.

Project Name:	Big Sandy Rancheria Pipeline	Report Date:	2/21/2020
		Sample Date:	1/29/2020
Project Number:	G56804.01		
		Sampled By:	JC
Subject:	Sand Equivalent ASTM D2419	Tested By:	MA
		Test Date:	1/31/2020

Laboratory Test Results, Sand Equivalent, ASTM D2419

Sample I.D.:	Sand Reading	Clay Reading	Sand Equivalent
B-2 @ 1-2.5'	1.9	12.6	16
B-10 @ 1-2.5'	2.1	13.7	16
B-13 @ 1-2.5'	1.7	11.4	15
B-14 @ 1-2.5'	2.4	13.1	19

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Fresno, CA 93721

COMPACTION TEST REPORT

Test specification: ASTM D 1557-12 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
5.5-14.5'	SM							

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 130.9 pcf Optimum moisture = 7.5 %	Silty sand

Project No. G56804.01 **Client:**

Project: Big Sandy Rancheria Pipeline

● **Source:** **Sample No.:** B-4 **Elev./Depth:** 5.5-14.5'

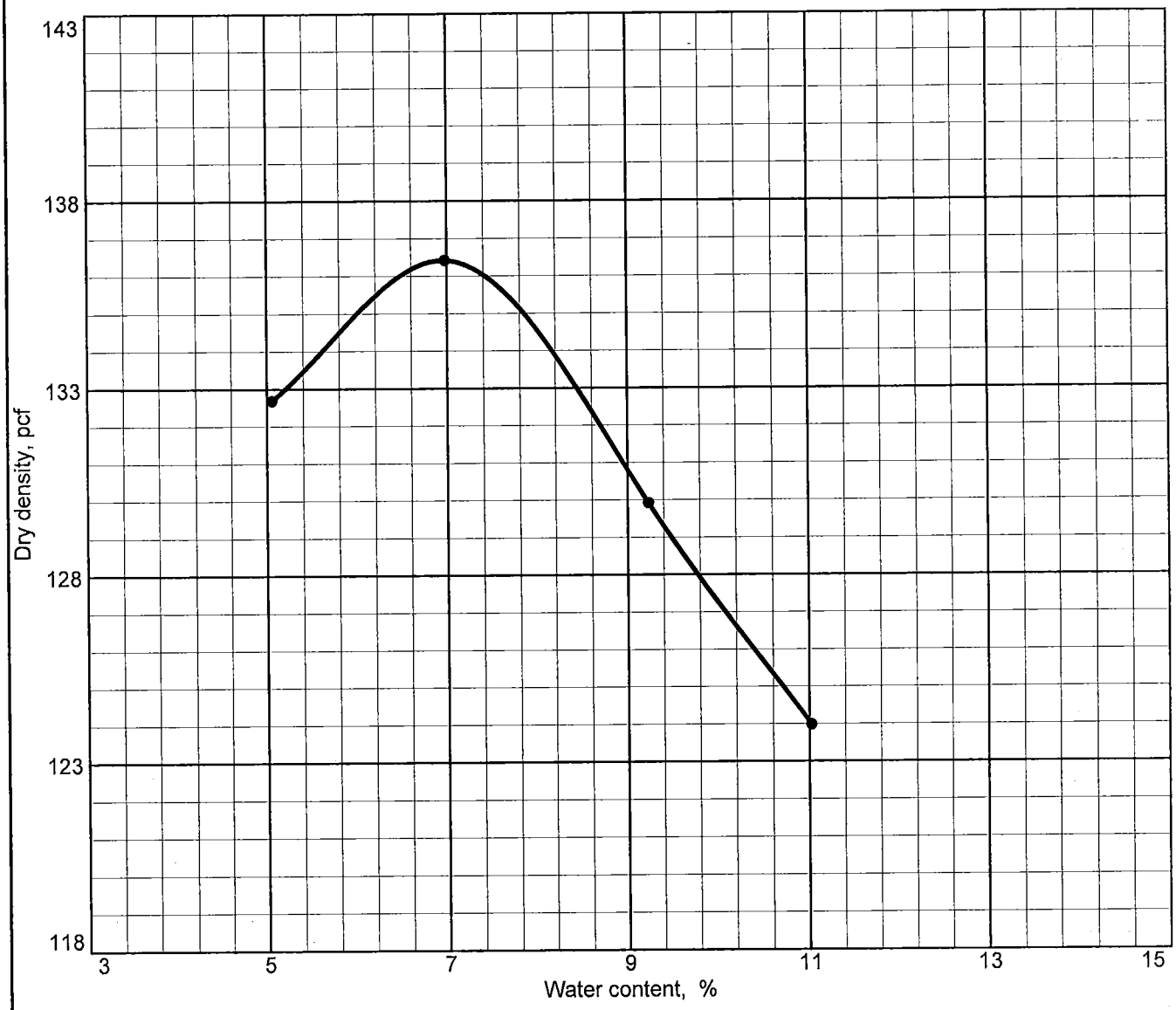
Moore Twining Associates, Inc.

Fresno, CA

Remarks:

Figure

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
0.4-3'	SM							

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 136.4 pcf Optimum moisture = 7.0 %	Silty sand

Project No. G56804.01 **Client:**

Project: Big Sandy Rancheria Pipeline

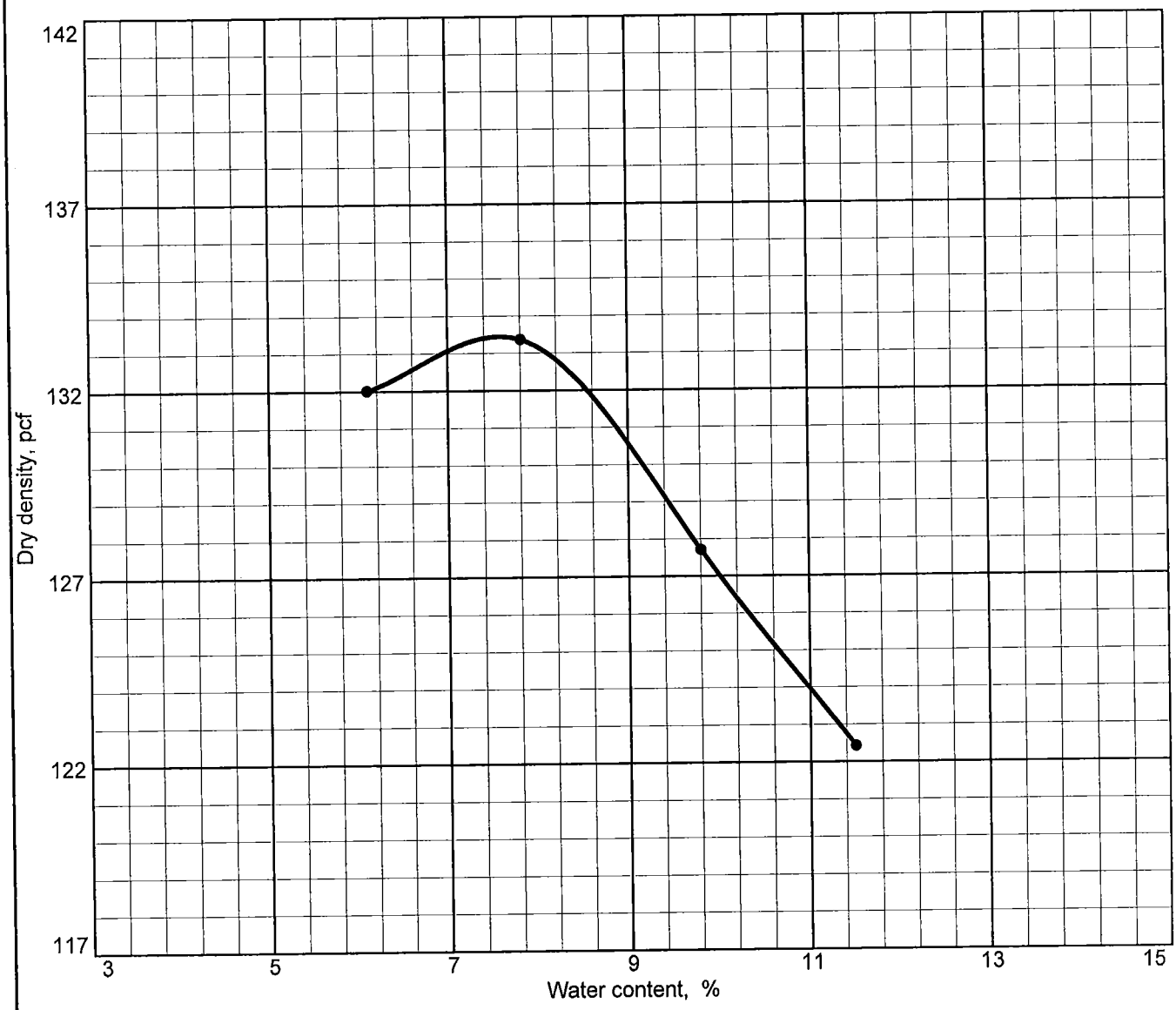
● **Source:** **Sample No.:** B-15 **Elev./Depth:** 0.4-3'

Remarks:

Moore Twining Associates, Inc.

Fresno, CA

Figure



Test specification: ASTM D 1557-12 Method A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
0-3'	SC							

TEST RESULTS

Maximum dry density = 133.4 pcf

Optimum moisture = 7.6 %

MATERIAL DESCRIPTION

Clayey sand

Project No. G56804.01 **Client:**

Project: Big Sandy Rancheria Pipeline

● **Source:** **Sample No.:** B-10 **Elev./Depth:** 0-3'

Remarks:

Moore Twining Associates, Inc.

Fresno, CA

Figure

MOORE TWINING ASSOCIATES, INC.

Project Name:	Big Sandy Rancheria Pipeline	Report Date:	2/21/2020
		Sample Date:	1/29/2020
Project Number:	G56804.01		
		Sampled By:	JC
Subject:	Minimum Resistivity, ASTM G187	Tested By:	MA
Material Description:	Clayey sand	Test Date:	1/28/2020
Location:	B-2 @ 0.4-3'		

Laboratory Test Results, Minimum Resistivity - ASTM G187

Total Water Added, mls	Resistivity, Ohm-cm
50 mls	160,080
100 mls	56,695
150 mls	30,015
200 mls	22,011
250 mls	16,675
300 mls	12,006
350 mls	5,336
400 mls	4,936
450 mls	5,269

Remarks: Min. Resistivity is 4,936 Ohm-cm

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FX: 559.268.7126
2527 Fresno Street
Fresno, CA 93721

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Project Name:	Big Sandy Rancheria Pipeline	Report Date:	1/9/2020
		Sample Date:	12/11/2019
Project Number:	G56804.01		
		Sampled By:	KC
Subject:	Minimum Resistivity, ASTM G187	Tested By:	MA
Material Description:	Silty sand	Test Date:	12/23/2019
Location:	B-4 @ 5.5-14.5'		

Laboratory Test Results, Minimum Resistivity - ASTM G187

Total Water Added, mls	Resistivity, Ohm-cm
50 mls	37,352
100 mls	32,016
150 mls	20,010
200 mls	31,349

Remarks: Min. Resistivity is 20,010 Ohm-cm

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MOORE TWINING ASSOCIATES, INC.

Project Name:	Big Sandy Rancheria Pipeline	Report Date:	2/21/2020
		Sample Date:	1/29/2020
Project Number:	G56804.01		
		Sampled By:	JC
Subject:	Minimum Resistivity, ASTM G187	Tested By:	MA
Material Description:	Clayey sand	Test Date:	1/28/2020
Location:	B-10 @ 0-3'		

Laboratory Test Results, Minimum Resistivity - ASTM G187

Total Water Added, mls	Resistivity, Ohm-cm
50 mls	86,710
100 mls	24,679
150 mls	18,676
200 mls	12,673
250 mls	8,004
300 mls	5,803
350 mls	5,536
400 mls	5,136
450 mls	5,269

Remarks: Min. Resistivity is 5,136 Ohm-cm

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California ELAP Certificate #1371

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December 27, 2019

Work Order #: **FL23021**

Ken Clark
MTA Geotechnical Division
2527 Fresno Street
Fresno, CA 93721

RE: Big Sandy Rancheria Pipeline

Enclosed are the analytical results for samples received by our laboratory on **12/23/19** . For your reference, these analyses have been assigned laboratory work order number **FL23021.**

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.

Susan Federico
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 2527 Fresno Street Fresno CA, 93721	**Project:** Big Sandy Rancheria Pipeline **Project Number:** G56804.01 **Project Manager:** Ken Clark	**Reported:** 12/27/2019

Analytical Report for the Following Samples

Sample ID	Notes	Laboratory ID	Matrix	Date Sampled	Date Received
B-4 @ 5 1/2 - 14 1/2		FL23021-01	Soil	12/11/19 00:00	12/23/19 12:30

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MTA Geotechnical Division 2527 Fresno Street Fresno CA, 93721	**Project:** Big Sandy Rancheria Pipeline **Project Number:** G56804.01 **Project Manager:** Ken Clark	**Reported:** 12/27/2019

B-4 @ 5 1/2 - 14 1/2

FL23021-01 (Soil) Sampled: 12/11/19 00:00

Analyte	Flag	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method
Inorganics									
Chloride		ND	6.0	mg/kg	3	B9L2604	12/26/19	12/26/19	ASTM D4327
Chloride		ND	0.00060	% by Weight	3	[CALC]	12/26/19	12/26/19	ASTM D4327
Sulfate as SO4		ND	0.00060	% by Weight	3	[CALC]	12/26/19	12/26/19	ASTM D4327
pH		**8.7**	0.10	pH Units	1	B9L2604	12/26/19	12/27/19	ASTM D4972 Mod
Sulfate as SO4		ND	6.0	mg/kg	3	B9L2604	12/26/19	12/26/19	ASTM D4327

Notes and Definitions

µg/L	micrograms per liter (parts per billion concentration units)
mg/L	milligrams per liter (parts per million concentration units)
mg/kg	milligrams per kilogram (parts per million concentration units)
ND	Analyte NOT DETECTED at or above the reporting limit
RPD	Relative Percent Difference

Analysis of pH, filtration, and residual chlorine is to take place immediately after sampling in the field. If the test was performed in the laboratory, the hold time was exceeded. **(for aqueous matrices only)**

MOORE TWINING
ASSOCIATES, INC.
California ELAP Certificate #1371

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February 11, 2020

Work Order #: **GA31005**

Ken Clark
MTA Geotechnical Division
2527 Fresno Street
Fresno, CA 93721

RE: Big Sandy Rancheria Pipeline

Enclosed are the analytical results for samples received by our laboratory on **01/31/20** . For your reference, these analyses have been assigned laboratory work order number **GA31005.**

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.

Julio Morales
Client Services Supervisor

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ASSOCIATES, INC.
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(559) 268-0740 Fax

MTA Geotechnical Division 2527 Fresno Street Fresno CA, 93721	**Project:** Big Sandy Rancheria Pipeline **Project Number:** G56804.01 **Project Manager:** Ken Clark	**Reported:** 02/11/2020

Analytical Report for the Following Samples

Sample ID	Notes	Laboratory ID	Matrix	Date Sampled	Date Received
B2 @ 0.4-3		GA31005-01	Soil	01/29/20 00:00	01/31/20 10:55
B10 @ 0-3		GA31005-02	Soil	01/29/20 00:00	01/31/20 10:55

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

MTA Geotechnical Division 2527 Fresno Street Fresno CA, 93721	**Project:** Big Sandy Rancheria Pipeline **Project Number:** G56804.01 **Project Manager:** Ken Clark	**Reported:** 02/11/2020

B2 @ 0.4-3

GA31005-01 (Soil) Sampled: 01/29/20 00:00

Analyte	Flag	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method
Inorganics									
Chloride		ND	6.0	mg/kg	3	B0B1013	02/10/20	02/10/20	ASTM D4327
Chloride		ND	0.00060	% by Weight	3	[CALC]	02/10/20	02/10/20	ASTM D4327
Sulfate as SO4		**0.0012**	0.00060	% by Weight	3	[CALC]	02/10/20	02/10/20	ASTM D4327
pH		**7.4**	0.10	pH Units	1	B0B1013	02/10/20	02/11/20	ASTM D4972 Mod
Sulfate as SO4		**12**	6.0	mg/kg	3	B0B1013	02/10/20	02/10/20	ASTM D4327

B10 @ 0-3

GA31005-02 (Soil) Sampled: 01/29/20 00:00

Analyte	Flag	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method
Inorganics									
Chloride		ND	6.0	mg/kg	3	B0B1013	02/10/20	02/11/20	ASTM D4327
Chloride		ND	0.00060	% by Weight	3	[CALC]	02/11/20	02/11/20	ASTM D4327
Sulfate as SO4		ND	0.00060	% by Weight	3	[CALC]	02/11/20	02/11/20	ASTM D4327
pH		**6.3**	0.10	pH Units	1	B0B1013	02/10/20	02/11/20	ASTM D4972 Mod
Sulfate as SO4		ND	6.0	mg/kg	3	B0B1013	02/10/20	02/11/20	ASTM D4327

Notes and Definitions

µg/L	micrograms per liter (parts per billion concentration units)
mg/L	milligrams per liter (parts per million concentration units)
mg/kg	milligrams per kilogram (parts per million concentration units)
ND	Analyte NOT DETECTED at or above the reporting limit
RPD	Relative Percent Difference

Analysis of pH, filtration, and residual chlorine is to take place immediately after sampling in the field. If the test was performed in the laboratory, the hold time was exceeded. **(for aqueous matrices only)**

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