SECTION H

GEOTECHNICAL REPORT

CSA 70 D-1 LAKE ARROWHEAD
MacKay PARK
PICKLEBALL COURTS PROJECT

FOR

COUNTY SERVICE AREA 70 D-1 MacKay PARK
LAKE ARROWHEAD, CALIFORNIA

GEOTECHNICAL INVESTIGATION

LAKE ARROWHEAD MACKAY PARK
PICKLEBALL COURT PROJECT
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

GEOCON
WEST, INC.

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

SAN BERNARDINO COUTNY
DEPARTMENT OF PUBLIC WORKS
SAN BERNARDINO, CALIFORNIA

PROJECT NO. W1661-99-03

NOVEMBER 27, 2023

Project No. W1661-99-03
November 27, 2023

Ellie Hargrove
San Bernardino County Department of Public Works
222 W. Hospitality Lane, 2nd Floor
San Bernardino, California 92415-0450

Subject: GEOTECHNICAL INVESTIGATION
LAKE ARROWHEAD MACKAY PARK PICKLEBALL COURT PROJECT
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

Dear Ms. Hargrove:

In accordance with your authorization of our proposal dated September 14, 2023, we have performed a geotechnical investigation for the proposed pickleball courts and associated improvements located at Mackay Park in the City of Lake Arrowhead, California. The accompanying report presents the findings of our investigation and our conclusions and recommendations pertaining to the geotechnical aspects of proposed design and construction. Based on the results of our investigation, it is our opinion that the proposed improvements can be constructed as proposed, provided the recommendations of this report are followed and implemented during design and construction.

If you have any questions regarding this report, or if we may be of further service, please contact the undersigned.

Very truly yours,

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GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a geotechnical investigation for the proposed pickleball courts and associated improvements located at Mackay Park in the City of Lake Arrowhead, California (see Vicinity Map, Figure 1). The purpose of the investigation was to evaluate subsurface soil and geologic conditions underlying the areas of proposed construction and, based on conditions encountered, to provide conclusions and recommendations pertaining to the geotechnical aspects of the proposed design and construction.

The scope of this investigation included site reconnaissance, field exploration, laboratory testing, engineering analysis, and the preparation of this report. The site was explored October 19 and 20, 2023, by excavating ten test pits using hand auger equipment and manual digging tools. The test pits were excavated to a maximum depth of approximately 4 feet below the existing ground surface. The approximate locations of the exploratory test pits are depicted on the Site Plan (see Figure 2). A detailed discussion of the field investigation, including boring logs, is presented in Appendix A.

Laboratory tests were performed on selected soil samples obtained during the investigation to determine pertinent physical and chemical soil properties. Appendix B presents a summary of the laboratory test results.

The recommendations presented herein are based on analysis of the data obtained during the investigation and our experience with similar soil and geologic conditions. References reviewed to prepare this report are provided in the *List of References* section.

If project details vary significantly from those described herein, Geocon should be contacted to determine the necessity for review and possible revision of this report.

2. SITE AND PROJECT DESCRIPTION

The subject property is located at Mackay Park in the City of Lake Arrowhead, California. The site is occupied by an asphalt paved parking lot, basketball courts, a volleyball court, exercise equipment, pickleball courts, and restrooms. The site is bounded by Mackay Park Road to the north and east, by a descending graded slope, Torrey Road, and Rouse Ranch Road to the south, and by a vacant parcel to the west. Surface water drainage at the site appears to be by sheet flow along the existing ground contours. The site is located on relatively flat graded pad with no highs or lows. South of the site, the topography slopes down to the south, towards Papoose Lake, with 235 feet of elevation change.

Based on the information provided by the Client, it is our understanding that the proposed improvements will consist of the addition of five pickleball courts; two adjacent to existing pickleball play courts and three in replacement of the existing volleyball court (see Site Plan, Figure 2). Ancillary improvements include the removal of existing exercise equipment and reinstalling at other locations throughout the site (generally near existing walkways), as well as the realignment of walkways to accommodate the new pickleball courts.

Any changes in the design, location or elevation of any structure, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

3. GEOLOCIG SETTING

The site is in the eastern part of the Transverse Ranges Geomorphic Province which is characterized as a complex series of east-west trending valleys and steep mountains which is bisected by the San Andreas fault. Due to north-south compression of the San Bernardino and San Gabriel Mountains (the Transverse Ranges), rapid uplift is occurring. This has resulted in uplifted valleys such as the Lake Arrowhead area, in the central portion of the San Bernardino Mountains. The San Bernardino Mountains are geologically complex and comprised of Miocene-age sedimentary rocks, Cretaceous-age granitic rocks, and Cambrian-age sedimentary rock that are complexly deformed by normal, reverse, and thrust faults and are tightly folded. Locally, the site is located at the top of a graded slope on the north side of Papoose Lake and underlain by Quaternary age undifferentiated surficial deposits derived from the local upslope areas.

4. SOIL AND GEOLOGIC CONDITIONS

Based on our field investigation and published geologic maps, the soils underlying the site consist of undocumented artificial fill material over Quaternary age undifferentiated surficial deposits consisting of cobbles, gravel, sand and silt. At depth, the site is underlain by Mesozoic age quartz monzonite bedrock (Dibblee, 1971). Detailed stratigraphic profiles are provided in the boring logs in Appendix A.

4.1 Artificial Fill

Artificial fill was encountered in our field explorations to a maximum depth of approximately 4 feet below the existing ground surface and consists primarily of brown to olive brown or grayish brown silty sand, with various amounts of fine to coarse gravel and cobbles. The artificial fill can be characterized as fine- to coarse-grained, medium dense to dense and slightly moist. The artificial fill is likely the result of past grading or construction activities at the site. Deeper fill may exist between excavations and in other portions of the site that were not directly explored.

4.2 Surficial Deposits

The surficial deposits were encountered in all test pits except TP2 and TP7. The surficial deposits generally consist of olive brown to grayish brown silty sand and well-graded sand with various amounts of silt, fine to coarse gravel and cobbles. The surficial deposits can be characterized as medium dense to dense and slightly moist.

5. GROUNDWATER

The site is located on an elevated topographic surface and is not located in a designated groundwater basin. The site and the local area is underlain by shallow quartz monzonite bedrock that is not considered water-bearing.

Groundwater was not encountered in our test pits, excavated to a maximum depth of 4 feet below the existing ground surface. Based on the shallow bedrock condition, the absence of groundwater in our test pits, and the depth of proposed construction, static groundwater is neither expected to be encountered during construction, nor have a detrimental effect on the project However, it is not uncommon for groundwater levels to vary seasonally or for groundwater seepage conditions to develop where none previously existed, especially in impermeable fine-grained soils which are heavily irrigated or after seasonal rainfall. In addition, recent requirements for stormwater infiltration could result in shallower seepage conditions in the immediate site vicinity. Proper surface drainage of irrigation and precipitation will be critical for future performance of the project. Recommendations for drainage are provided in the S*urface Drainage* section of this report (see Section 7.10.

6. GEOLOGIC HAZARDS

6.1 Surface Fault Rupture

The numerous faults in Southern California include Holocene-active, pre-Holocene, and inactive faults. The criteria for these major groups are based on criteria developed by the California Geological Survey (CGS, formerly known as CDMG) for the Alquist-Priolo Earthquake Fault Zone Program (CGS, 2018). By definition, a Holocene-active fault is one that has had surface displacement within Holocene time (about the last 11,700 years). A pre-Holocene fault has demonstrated surface displacement during Quaternary time (approximately the last 1.6 million years) but has had no known Holocene movement. Faults that have not moved in the last 1.6 million years are considered inactive.

The site is not within a state-designated Alquist-Priolo Earthquake Fault Zone (CGS, 2023b) for surface fault rupture hazards. No Holocene-active or pre-Holocene faults with the potential for surface fault rupture are known to pass directly beneath the site. Therefore, the potential for surface rupture due to faulting occurring beneath the site during the design life of the proposed development is considered low. However, the site is located in the seismically active Southern California region and could be subjected to moderate to strong ground shaking in the event of an earthquake on one of the many active Southern California faults. The faults in the vicinity of the site are shown in Figure 3, Regional Fault Map.

The closest active fault to the site is the North Frontal Thrust System located approximately 8.1 miles to the northwest-northeast (Ziony and Jones, 1989). Other nearby active faults are the San Andreas Fault Zone, the San Jacinto Fault Zone, and the Helendale-South Lockhart Fault Zone located approximately 8.5 miles southwest, 13.2 miles southwest, and 17½ miles northeast of the site, respectively (USGS, 2006).

Several buried thrust faults, commonly referred to as blind thrusts, underlie the Southern California area at depth. These faults are not exposed at the ground surface and are typically identified at depths greater than 3.0 kilometers. The October 1, 1987 M_w 5.9 Whittier Narrows earthquake and the January 17, 1994 M_w 6.7 Northridge earthquake were a result of movement on the Puente Hills Blind Thrust and the Northridge Thrust, respectively. These thrust faults and others in the Southern California area are not exposed at the surface and do not present a potential surface fault rupture hazard at the site; however, these deep thrust faults are considered active features capable of generating future earthquakes that could result in moderate to significant ground shaking at the site.

6.2 Seismicity

As with all of Southern California, the site has experienced historic earthquakes from various regional faults. The seismicity of the region surrounding the site was formulated based on research of an electronic database of earthquake data. The epicenters of recorded earthquakes with magnitudes equal to or greater than 5.0 in the site vicinity are depicted on Figure 4, Regional Seismicity Map. A partial list of moderate to major magnitude earthquakes that have occurred in the Southern California area within the last 100 years is included in the table on the following page.

LIST OF HISTORIC EARTHQUAKES

Earthquake (Oldest to Youngest)	Date of Earthquake	Magnitude	Distance to Epicenter (Miles)	Direction to Epicenter
Near Redlands	July 23, 1923	6.3	19	SSW
Long Beach	March 10, 1933	6.4	64	SW
Tehachapi	July 21, 1952	7.5	117	WNW
San Fernando	February 9, 1971	6.6	71	W
Whittier Narrows	October 1, 1987	5.9	54	WSW
Sierra Madre	June 28, 1991	5.8	48	W
Landers	June 28, 1992	7.3	42	E
Big Bear	June 28, 1992	6.4	20	ESE
Northridge	January 17, 1994	6.7	78	W
Hector Mine	October 16, 1999	7.1	56	ENE
Ridgecrest	July 5, 2019	7.1	107	NNW

The site could be subjected to strong ground shaking in the event of an earthquake. However, this hazard is common in Southern California and the effects of ground shaking can be minimized if the proposed structures are designed and constructed in conformance with current building codes and engineering practices.

6.3 Seismic Design Criteria

The following table summarizes the site-specific design criteria obtained from the 2022 California Building Code (CBC; Based on the 2021 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The data was calculated using the online application *U.S. Seismic Design Maps*, provided by the Structural Engineers Association of California (SEAOC). The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2022 CBC and Table 20.3-1 of ASCE 7-16. The values presented below are for the risk-targeted maximum considered earthquake (MCE_R).

2022 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2022 CBC Reference
Site Class	D	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	1.813g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.684g	Figure 1613.2.1(3)
Site Coefficient, F_A	1.0	Table 1613.2.3(1)
Site Coefficient, F_V	1.7	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.813g	Section 1613.2.3 (Eqn 16-20)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	1.163g*	Section 1613.2.3 (Eqn 16-21)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	1.208g	Section 1613.2.4 (Eqn 16-22)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.775g*	Section 1613.2.4 (Eqn 16-23)

*Per Supplement 3 of ASCE 7-16, a ground motion hazard analysis (GMHA) shall be performed for projects on Site Class "D" sites with 1-second spectral acceleration (S_1) greater than or equal to 0.2g, which is true for this site. However, Supplement 3 of ASCE 7-16 provides an exception stating that that the GMHA may be waived provided that the parameter S_{M1} is increased by 50% for all applications of S_{M1}. The values for parameters S_{M1} and S_{D1} presented above have **not** been increased in accordance with Supplement 3 of ASCE 7-16.

The table below presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.77g	Figure 22-9
Site Coefficient, F_{PGA}	1.1	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.847g	Section 11.8.3 (Eqn 11.8-1)

Deaggregation of the MCE peak ground acceleration was performed using the USGS online Unified Hazard Tool, 2014 Conterminous U.S. Dynamic edition (v4.2.0). The result of the deaggregation analysis indicates that the predominant earthquake contributing to the MCE peak ground acceleration is characterized as a 7.13 magnitude event occurring at a hypocentral distance of 12.84 kilometers from the site.

Deaggregation was also performed for the Design Earthquake (DE) peak ground acceleration, corresponding to two-thirds of the MCE peak ground acceleration. The result of the analysis indicates that the predominant earthquake contributing to the DE peak ground acceleration is characterized as a 6.96 magnitude occurring at a hypocentral distance of 14.57 kilometers from the site.

Conformance to the criteria in the above tables for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

6.4 Liquefaction Potential

Liquefaction is a phenomenon in which loose, saturated, relatively cohesionless soil deposits lose shear strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground motion, gradation characteristics of the subsurface soils, in-situ stress conditions, and the depth to groundwater. Liquefaction is typified by a loss of shear strength in the liquefied layers due to rapid increases in pore water pressure generated by earthquake accelerations.

The current standard of practice, as outlined in the "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California" and "Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California" requires liquefaction analysis to a depth of 50 feet below the lowest portion of the proposed structure. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine- to medium-grained, primarily sandy soil. In addition to the requisite soil conditions, the ground acceleration and duration of the earthquake must also be of a sufficient level to induce liquefaction.

The site is within an area identified by the San Bernardino County Land Use Plan (2010) to have a low potential for liquefaction. The site is underlain by a thin veneer of surficial deposits that is underlain by shallow quartz monzonite bedrock. Groundwater was not encountered in our test pits excavated to a maximum depth of 4 feet below the ground surface. Based on these considerations, it is our opinion that the potential for liquefaction and associated ground deformations to occur at the site is very low.

6.5 Slope Stability

The site is located on relatively flat graded pad with no highs or lows. South of the site, the topography slopes down to the south, towards Papoose Lake, with approximately 235 feet of elevation change. According to the San Bernardino County Land Use Plan (2010), the site is located within an area identified as having a low to moderate potential for slope instability. There are no known landslides near the site, nor is the site in the path of any known or potential landslides (USGS, 2023a). Therefore, the potential for slope stability hazards to adversely affect the proposed development is considered low.

6.6 Earthquake-Induced Flooding

Earthquake-induced flooding is inundation caused by failure of dams or other water-retaining structures due to earthquakes. A review of the San Bernardino County Land Use Plan (2010) indicates that the site is not located within a potential inundation area for an earthquake-induced dam failure. Therefore, the probability of earthquake-induced flooding is considered very low.

6.7 Tsunamis, Seiches, and Flooding

The site is not located within a coastal area. Therefore, tsunamis, seismic sea waves, are not considered a significant hazard at the site.

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures are located immediately up gradient from the project site. Flooding from a seismically induced seiche is considered unlikely.

The site is not within a 100-Year Flood Zone or a 500-Year Flood Zone (San Bernardino Countywide Plan, 2022).

6.8 Oil Fields & Methane Potential

Based on a review of the California Geologic Energy Management Division (CalGEM) Well Finder website, the site is not located within the boundaries of a known oil field and no oil or gas wells are located within ¼-mile of the site (CalGEM, 2023). However, due to the voluntary nature of record reporting by the oil well drilling companies, wells may be improperly located or not shown on the location map and undocumented wells could be encountered during construction. Any wells encountered during construction will need to be properly abandoned in accordance with the current requirements of the CalGEM.

Since the site is not located within the boundaries of a known oil field, the potential for the presence of methane or other volatile gases occurring at the site is considered low. However, should it be determined that a methane study is required for the proposed development it is recommended that a qualified methane consultant be retained to perform the study and provide mitigation measures as necessary.

6.9 Subsidence

Subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of groundwater, oil, or natural gas. Soils that are particularly subject to subsidence include those with high silt or clay content. The site is not located within an area of known ground subsidence (USGS, 2023b). No known large-scale extraction of groundwater, gas, oil, or geothermal energy is occurring or planned at the site or in the general site vicinity. There appears to be little or no potential for ground subsidence due to withdrawal of fluids or gases at the site.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 General

7.1.1 It is our opinion that neither soil nor geologic conditions were encountered during the investigation that would preclude the construction of the proposed improvements provided the recommendations presented herein are followed and implemented during design and construction.

7.1.2 In general, up to 2½ feet of existing artificial fill was encountered during the site investigation. Test pits TP2 and TP7 encountered refusal on large boulders and the depth of artificial fill was not established. The existing fill encountered is believed to be the result of past grading and construction activities at the site. Deeper fill may exist in other areas of the site that were not directly explored. It is our opinion that the existing fill in its present condition is not suitable for direct support of proposed play courts and improvements. The existing fill and site soils are suitable for re-use as engineered fill, provided the recommendations in the *Grading* section of this report are followed (see Section 7.4).

7.1.3 Where exterior slabs-on-grade for the pickleball court improvements are to be constructed, it is recommended that all existing artificial fill be excavated, screened of rocks and delirious debris, and be properly compacted. Recommendations for earthwork are provided in the *Grading* section of this report (see Section 5.4). Recommendations for *Exterior Concrete Slabs-on-Grade* are provided in section 7.5 of this report.

7.1.4 Where new paving is to be placed, it is recommended that all existing fill be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing fill in the area of new paving is not required; however, paving constructed over existing uncertified fill may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of subgrade soil should be scarified, moistened, and properly compacted for paving support. Paving recommendations are provided in the *Preliminary Pavement Recommendations* section of this report (see Section 7.8).

7.1.5 Based on our observations onsite and our knowledge of the geologic setting, cobbles and boulders should be anticipated during earthwork at the subject site. The contractor should be prepared for difficult excavation conditions. The presence of these materials and their impact on construction methods and equipment selection should be considered by contractor prior to bidding and construction.

7.1.6 Screening of the earth materials will likely be required to remove deleterious debris (wood chips) and oversize (greater than 6 inches) rock, to generate suitable fill soils prior to placement and compaction. Generation of oversized material (greater than 6 inches) should be anticipated.

7.1.7 All excavation bottoms, including trenches, must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing bedding materials, fill, steel, gravel or concrete.

7.1.8 Area drainage systems are likely proposed for the pickleball playfields. The playfields should be fine graded so that ponding is not allowed to occur, and all drainage is directed away from foundations into proper collection outlets/channels. Recommendations for site drainage are provided in the *Surface Drainage* section of this report (Section 7.10).

7.1.9 Any changes in the design, location or elevation of improvements, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

7.2 Soil and Excavation Characteristics

7.2.1 The in-situ soils can be excavated with moderate effort using conventional excavation equipment. Due to the granular nature of the soils, excessive caving is anticipated in unshored excavations. Screening of the earth materials will be required to remove deleterious debris (wood chips) and oversize (greater than 6 inches) rock, to generate suitable fill soils prior to placement and compaction. Generation of oversized material (greater than 6 inches) should be anticipated.

7.2.2 It is the responsibility of the contractor to ensure that all excavations and trenches are properly shored and maintained in accordance with applicable OSHA rules and regulations to maintain safety and maintain the stability of existing adjacent improvements.

7.2.3 All onsite excavations must be conducted in such a manner that potential surcharges from existing structures, construction equipment, and vehicle loads are resisted. The surcharge area may be defined by a 1:1 projection down and away from the bottom of an existing foundation or vehicle load. Penetrations below this 1:1 projection will require special excavation measures such as sloping or shoring. Excavation recommendations are provided in the *Temporary Excavations* section of this report (see Section 7.9).

7.2.4 Based on the predominantly granular nature of the soils encountered during site exploration, the upper site soils are considered to be “non-expansive”. The recommendations in this report assume that foundations and slabs will derive support in these materials.

7.3 Minimum Resistivity, pH, and Water-Soluble Sulfate

7.3.1 Potential of Hydrogen (pH) and resistivity testing as well as chloride content testing were performed on representative samples of soil to generally evaluate the corrosion potential to surface utilities. The tests were performed in accordance with California Test Method Nos. 643 and 422 and indicate that the soils are considered "moderately" corrosive with respect to corrosion of buried ferrous metals on site. The results are presented in Appendix B (Figure B13) and should be considered for design of underground structures. Due to the corrosive potential of the soils, it is recommended that PVC, ABS or other approved plastic piping be utilized in lieu of cast-iron when in direct contact with the site soils.

7.3.2 Laboratory tests were performed on representative samples of the site materials to measure the percentage of water-soluble sulfate content. Results from the laboratory water-soluble sulfate tests are presented in Appendix B (Figure B13) and indicate that the on-site materials possess a sulfate exposure class of "S0" to concrete structures as defined by 2022 CBC Section 1904 and ACI 318-19 Chapter 19.

7.3.3 Geocon West, Inc. does not practice in the field of corrosion engineering and mitigation. If corrosion sensitive improvements are planned, it is recommended that a corrosion engineer be retained to evaluate corrosion test results and incorporate the necessary precautions to avoid premature corrosion of buried metal pipes and concrete structures in direct contact with the soils.

7.4 Grading

7.4.1 Grading is anticipated to include the preparation of the subgrade for courts, utility trench backfill, miscellaneous foundation excavations, and the preparation of the subgrade for walkways and paving.

7.4.2 A preconstruction conference should be held at the site prior to the beginning of grading operations with the owner, contractor, civil engineer, geotechnical engineer, and building official in attendance. Special soil handling requirements can be discussed at that time.

7.4.3 Grading should commence with the removal of all existing vegetation, wood chips, and existing improvements from the area to be graded. Deleterious debris such as wood and root structures should be exported from the site and should not be mixed with the soils intended for re-use as engineered fill. Asphalt and concrete should not be mixed with the fill soils unless approved by the Geotechnical Engineer. All existing underground improvements planned for removal should be completely excavated and the resulting depressions properly backfilled in accordance with the procedures described herein. Once a clean excavation bottom has been established it must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.).

7.4.4 **Screening of the earth materials will be required to remove oversize (greater than 6 inches) rock, prior to placement and compaction**. Cobbles and boulders should be expected. The contractor should be prepared for difficult excavation conditions. The presence of these materials and their impact on construction methods and equipment selection should be considered by contractor prior to bidding and construction.

7.4.5 Prior to construction of exterior slabs-on-grade for the proposed pickleball courts, it is recommended that all existing fill be excavated, screened, and properly compacted for slab support.

7.4.6 All fill and backfill soils should be placed in horizontal loose layers approximately 6 to 8 inches thick, moisture conditioned to near optimum moisture content, and properly compacted to a minimum of 90 percent of the laboratory maximum dry density in accordance with ASTM D 1557 (latest edition). The upper 12 inches of the subgrade for courts, slabs, and paving should be compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D1557 (latest edition). Paving recommendations are provided in the *Preliminary Pavement Recommendations* section of this report (see Section 7.8).

7.4.7 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures, which will not be tied to the proposed structure, may be supported on conventional foundations bearing on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and proper compaction cannot be performed or is undesirable, foundations may derive support directly in the undisturbed alluvial soils and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials. If the soils exposed in the excavation bottom are soft or loose, compaction of the soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved in writing by a Geocon representative.

7.4.8 Although not anticipated for this project, all imported fill shall be observed, tested, and approved by Geocon West, Inc. prior to bringing soil to the site. Rocks larger than 6 inches in diameter shall not be used in the fill. If necessary, import soils used as structural fill should have an expansion index less than 20 and corrosivity properties that are equally or less detrimental to that of the existing onsite soils (see Figure B8).

7.4.9 Utility trenches should be properly backfilled in accordance with the following requirements of the Green Book (latest edition). The pipe should be bedded with clean sands (Sand Equivalent greater than 30) to a depth of at least 1 foot over the pipe, and the bedding material must be inspected and approved in writing by the Geotechnical Engineer (a representative of Geocon). The use of gravel is not acceptable unless used in conjunction with filter fabric to prevent the gravel from having direct contact with soil. The remainder of the trench backfill may be derived from onsite soil or approved import soil, compacted as necessary, until the required compaction is obtained. The use of a minimum 2-sack slurry is also acceptable as backfill. Prior to placing any bedding materials or pipes, the excavation bottom must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

7.4.10 All trench and foundation excavation bottoms must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing bedding materials, fill, steel, gravel, or concrete.

7.5 Exterior Concrete Slabs-on-Grade

7.5.1 Subsequent to the recommended grading, exterior concrete slabs-on-grade, not subject to vehicle loading, should be a minimum of 4 inches thick and minimum slab reinforcement should consist of No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Steel reinforcing should be positioned vertically near the slab midpoint. Crack control joints should be spaced at intervals not greater than 10 feet and should be constructed using saw-cuts or other methods as soon as practical following concrete placement. Crack control joints should extend a minimum depth of one-fourth the slab thickness. Construction joints should be designed by the project structural engineer.

7.5.2 The moisture content of the slab subgrade should be maintained and sprinkled as necessary to maintain a moist condition as would be expected in any concrete placement.

7.5.3 The recommendations of this report are intended to reduce the potential for cracking of slabs due to settlement. However, even with the incorporation of the recommendations presented herein, foundations and slabs-on-grade may exhibit some cracking due to minor soil movement and/or concrete shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

7.6 Miscellaneous Foundations

7.6.1 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures may be supported on conventional foundations bearing on a minimum of 12 inches of newly placed engineered fill. Where excavation and compaction cannot be performed or is undesirable, such as adjacent to property lines, foundations may be deepened as necessary to maintain a minimum 12-inch embedment into the undisturbed alluvial soils.

7.6.2 If the soils exposed in the excavation bottom are soft, compaction of the soft soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative. Miscellaneous foundations may be designed for a bearing value of 1,500 Pounds per square foot (psf) and should be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade and 12 inches into the recommended bearing material. The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.

7.6.3 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated.

7.7 Lateral Design

7.7.1 Resistance to lateral loading may be provided by friction acting at the base of foundations, slabs and by passive earth pressure. An allowable coefficient of friction of 0.40 may be used with the dead load forces in the undisturbed alluvium and properly compacted engineered fill.

8.10.2 Passive earth pressure for the sides of foundations and slabs poured against properly compacted engineered fill and undisturbed alluvium may be computed as an equivalent fluid having a density of 300 pcf with a maximum earth pressure of 3,000 pcf. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third. The allowable passive value may be doubled for isolated caissons, spaced a minimum of three times the caisson diameter.

7.8 Preliminary Pavement Recommendations

7.8.1 Where new paving is to be placed, it is recommended that all existing fill and soft or unsuitable alluvial materials be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing artificial fill and soft alluvium in the area of new paving is not required; however, paving constructed over existing unsuitable material may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of paving subgrade should be scarified, moisture conditioned to near optimum moisture content, and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

7.8.2 The following pavement sections are based on an assumed R-Value of 35. Once site grading activities are complete, an additional R-Value should be considered to confirm the properties of the soils serving as paving subgrade, prior to placing pavement.

7.8.3 The Traffic Indices listed below are estimates. Geocon does not practice in the field of traffic engineering. The actual Traffic Index for each area should be determined by the project civil engineer. If pavement sections for Traffic Indices other than those listed below are required, Geocon should be contacted to provide additional recommendations. Pavement thicknesses were determined following procedures outlined in the *California Highway Design Manual* (Caltrans). It is anticipated that the majority of traffic will consist of automobile and large truck traffic.

PRELIMINARY PAVEMENT DESIGN SECTIONS

Location	Estimated Traffic Index (TI)	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
Pickleball Court	N/A	3.0*	4.0*
Automobile Parking And Driveways	4.0	3.0	4.0
Trash Truck & Fire Lanes	7.0	4.0	8.0

*Actual thickness of section should be designed by the Pickleball court manufacturer

7.8.4 Asphalt concrete should conform to Section 203-6 of the "*Standard Specifications for Public Works Construction*" (Green Book). Class 2 aggregate base materials should conform to Section 26-1.02A of the "*Standard Specifications of the State of California, Department of Transportation*" (Caltrans). The use of Crushed Miscellaneous Base in lieu of Class 2 aggregate base is acceptable. Crushed Miscellaneous Base should conform to Section 200-2.4 of the "*Standard Specifications for Public Works Construction*" (Green Book, latest edition).

7.8.5 Unless specifically designed and evaluated by the project structural engineer, where exterior concrete paving will be utilized for support of vehicles, it is recommended that the concrete be a minimum of 5 inches of concrete reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Concrete paving supporting vehicular traffic should be underlain by a minimum of 4 inches of aggregate base and a properly compacted subgrade. The upper 12 inches of subgrade and base material should be compacted to 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

7.8.6 The performance of pavements is highly dependent upon providing positive surface drainage away from the edge of pavements. Ponding of water on or adjacent to the pavement will likely result in saturation of the subgrade materials and subsequent cracking, subsidence and pavement distress. If planters are planned adjacent to paving, it is recommended that the perimeter curb be extended at least 12 inches below the bottom of the aggregate base to minimize the introduction of water beneath the paving.

7.9 Temporary Excavations

7.9.1 Excavations of less than 5 feet in height may be required during grading operations. The excavations are expected to expose artificial fill and alluvial soils. Excavations up to 5 vertical feet may be attempted where loose fill or sands are not present and where not surcharged by equipment, traffic, or foundations.

7.9.2 Vertical excavations greater than 5 feet will require sloping or shoring measures in order to provide a stable excavation. Where sufficient space is available, temporary unsurcharged embankments could be sloped back at a uniform 1:1 slope gradient or flatter. A uniform slope does not have a vertical portion. Where space is limited, shoring measures will be required.

7.9.3 Where sloped embankments are utilized, the top of the slope should be barricaded to prevent vehicles and storage loads at the top of the slope within a horizontal distance equal to the height of the slope. If the temporary construction embankments are to be maintained during the rainy season, berms are suggested along the tops of the slopes where necessary to prevent runoff water from entering the excavation and eroding the slope faces. Geocon personnel should inspect the soils exposed in the cut slopes during excavation so that modifications of the slopes can be made if variations in the soil conditions occur. All excavations should be stabilized within 30 days of initial excavation.

7.10 Surface Drainage

7.10.1 Proper surface drainage is critical to the future performance of the project. Uncontrolled infiltration of irrigation excess and storm runoff into the soils can adversely affect the performance of the planned improvements. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change in the original designed engineering properties. Proper drainage should be maintained at all times.

7.10.2 All site drainage should be collected and controlled in non-erosive drainage devices. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2019 CBC 1804.4 or other applicable standards. In addition, drainage should not be allowed to flow uncontrolled over any descending slope. Discharge from downspouts, roof drains and scuppers are not recommended onto unprotected soils within 5 feet of the building perimeter. Planters which are located adjacent to foundations should be sealed to prevent moisture intrusion into the soils providing foundation support. Landscape irrigation is not recommended within 5 feet of the building perimeter footings except when enclosed in protected planters.

7.10.3 Positive site drainage should be provided away from structures, pavement, and the tops of slopes to swales or other controlled drainage structures. The pavement areas should be fine graded such that water is not allowed to pond.

7.10.4 Landscaping planters immediately adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. Either a subdrain, which collects excess irrigation water and transmits it to drainage structures, or impervious above-grade planter boxes should be used. In addition, where landscaping is planned adjacent to the pavement, it is recommended that consideration be given to providing a cutoff wall along the edge of the pavement that extends at least 12 inches below the base material.

7.11 Plan Review

7.11.1 Grading , foundations, and shoring plans (if required) should be reviewed by the Geotechnical Engineer prior to finalization to check that the plans have been prepared in substantial conformance with the recommendations of this report and to provide additional analyses or recommendations, if necessary.

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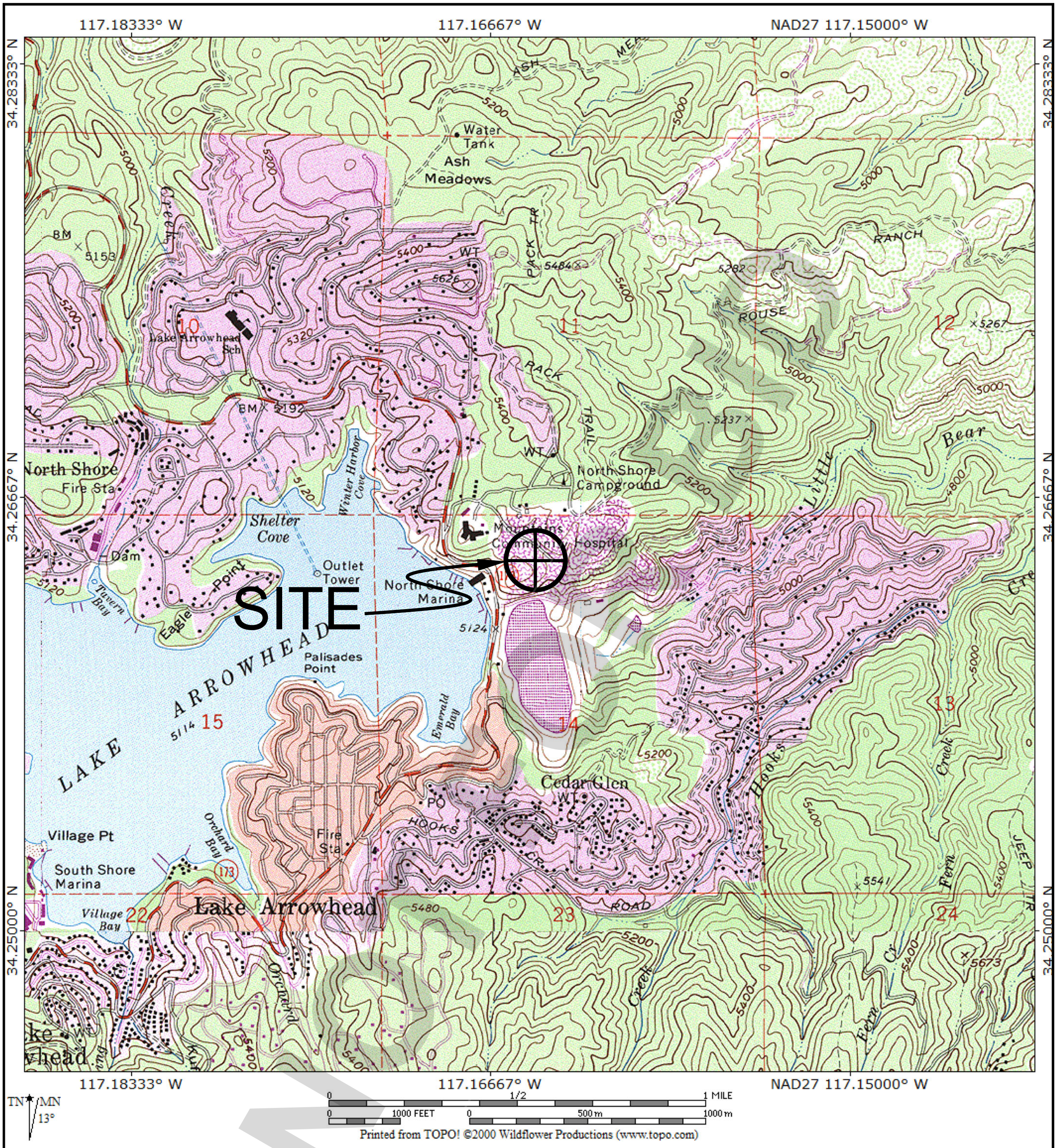

REFERENCE: U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, LAKE ARROWHEAD, CA QUADRANGLE

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DRAFTED BY: RA | CHECKED BY: SFK

VICINITY MAP

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

NOV 2023 | PROJECT NO. W1661-99-03 | FIG. 1

LEGEND

TP-10 Approximate Location of Test Pit

Approximate Location of Proposed Pickleball Courts

2 Approximate Depth of Existing Fill (in feet)

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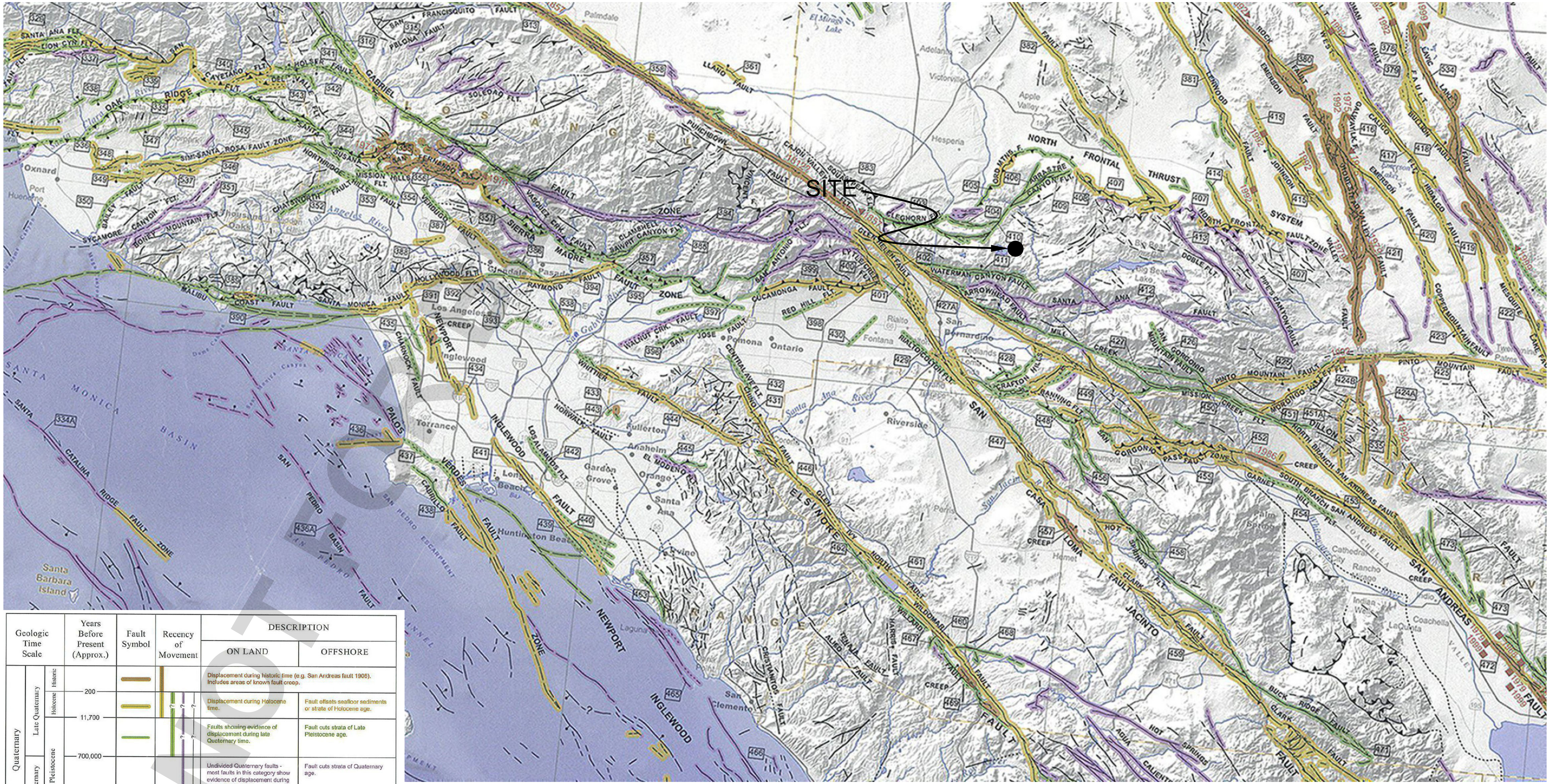
SITE PLAN

MACKAY PARK
321 ROUSE RANCH ROAD
ARROWHEAD, CALIFORNIA

NOV 2023 | PROJECT NO. W1661-99-03 | FIG. 2

Reference: Jennings, C.W. and Bryant, W. A., 2010, Fault Activity Map of California, California Geological Survey Geologic Data Map No. 6.



Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic	200			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	11,700			Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
		Pleistocene	700,000			Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
	Early Quaternary		1,600,000*			Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			4.5 billion (Age of Earth)			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

0 12 24 Miles

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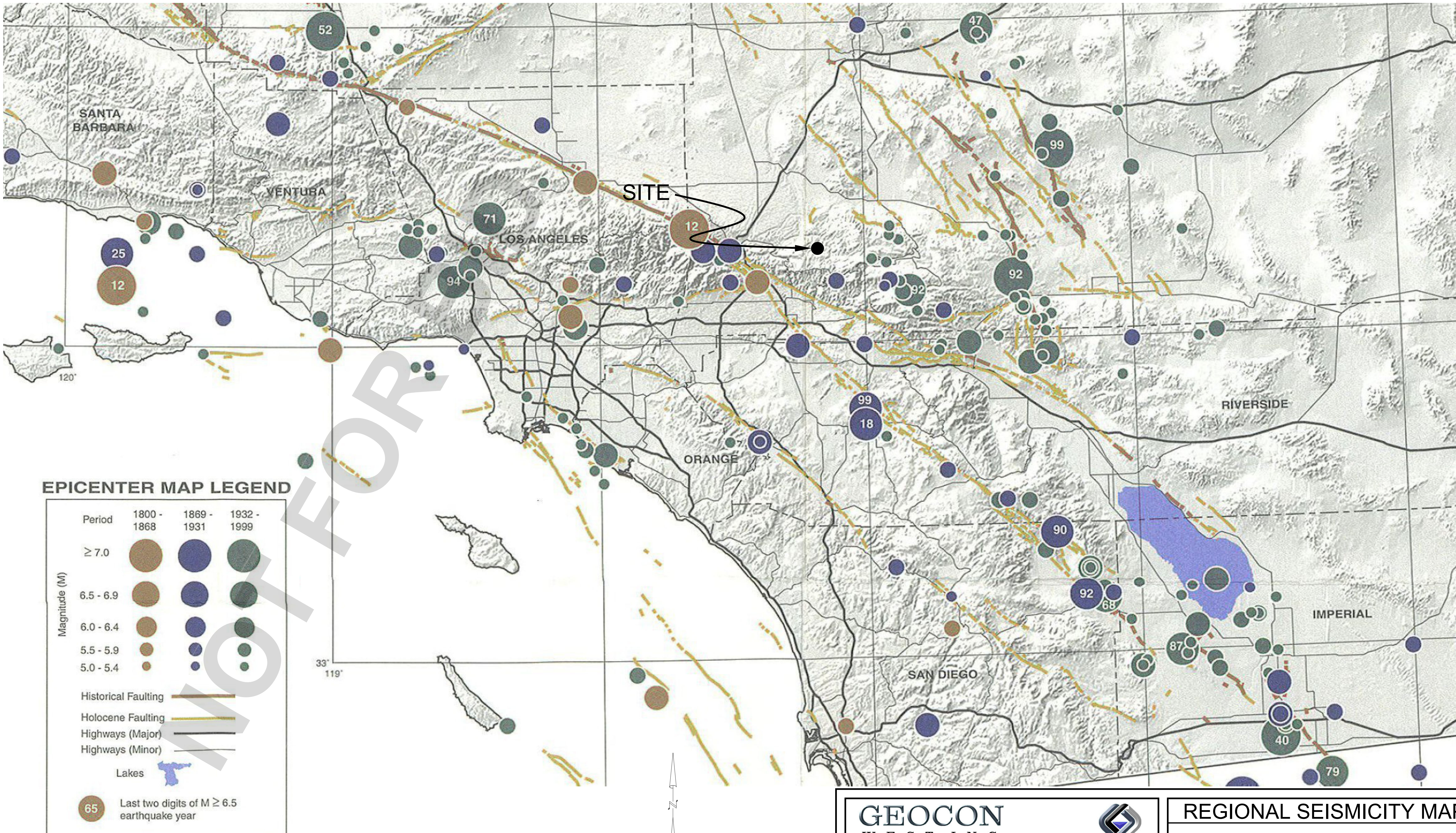
REGIONAL FAULT MAP

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

NOV 2023 | PROJECT NO. W1661-99-03 | FIG. 3



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N

0 20 40 Miles

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REGIONAL SEISMICITY MAP

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

NOV 2023	PROJECT NO. W1661-99-03	FIG.4

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

The site was explored from October 19 and 20, 2023, by excavating ten test pits using hand auger equipment and manual digging tools. The test pits were excavated to a maximum depth of approximately 4 feet below the existing ground surface. Representative and relatively undisturbed samples were obtained by driving a 3-inch, O. D., California Modified Sampler into the "undisturbed" soil mass with blows from a slide hammer. The California Modified Sampler was equipped with 1-inch high by 2³/₈-inch diameter brass sampler rings to facilitate soil removal and testing. Bulk samples were also obtained.

The soil conditions encountered in the test pits were visually examined, classified and logged in general accordance with the Unified Soil Classification System (USCS). The logs of the test pits are presented on Figures A1 through A10. The logs depict the soil and geologic conditions encountered and the depth at which samples were obtained. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the logs using visual observations, penetration rates, excavation characteristics and other factors. The transition between materials may be abrupt or gradual. Where applicable, the logs were revised based on subsequent laboratory testing. The location of the test pits are shown on Figure 2.

PROJECT NO. W1197-06-01B

TEST PIT 1

ELEV. (MSL.) **- -** DATE COMPLETED **10/20/2023**

EQUIPMENT **HAND AUGER** BY: **RP**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK @0-3'				**WOOD CHIPS: 3"** **ARTIFICIAL FILL** Silty Sand, medium dense, slightly moist, olive brown, fine- to coarse-grained, trace cobbles (to 5"). - wood chip layer			
2				SM	**SURFICIAL DEPOSITS** Silty Sand, medium dense, slightly moist, gray brown, fine- to coarse-grained, some cobbles (to 3").			

Total depth of test pit: 3 feet
Fill to 2 feet.
No groundwater encountered.
Backfilled with cuttings and tamped.
Surface restored with wood chips.

NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

Figure A1,
Log of Test Pit 1, Page 1 of 1

BORING LOGS.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TEST PIT 2 ELEV. (MSL.) - - DATE COMPLETED 10/20/2023 EQUIPMENT HAND AUGER BY: RP	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0 2	BULK @0-2.5'				**WOOD CHIPS: 4"** **ARTIFICIAL FILL** Silty Sand, medium dense, slightly moist, olive brown, fine- to coarse-grained, abundant cobbles (to 8"). - large boulder (refusal)			
					Total depth of test pit: 2.5 feet due to refusal Fill not penetrated through. No groundwater encountered. Backfilled with cuttings and tamped. Surface restored with wood chips. NOTE: The stratification lines presented herein represent the approximate boundary between earth types;			

Figure A2,
Log of Test Pit 2, Page 1 of 1

BORING LOGS.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. W1197-06-01B

TEST PIT 3

ELEV. (MSL.) **- -** DATE COMPLETED **10/19/2023**

EQUIPMENT **HAND AUGER** BY: **RP**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK @0-3'				**WOOD CHIPS: 3"**			
					ARTIFICIAL FILL Silty Sand with Gravel, medium dense, slightly moist, brown to olive brown, fine- to coarse-grained, trace cobbles (to 10").			
2	TP3@1.5						123.8	3.1
	TP3@2.5			SW	**SURFICIAL DEPOSITS** Sand, well-graded, dense, slightly moist, olive brown, fine- to coarse-grained, trace silt, abundant cobbles (to 8").		117.2	6.8

Total depth of test pit: 3 feet
Fill to 2 feet.
No groundwater encountered.
Backfilled with cuttings and tamped.
Surface restored with wood chips.

NOTE: The stratification lines presented herein represent the approximate boundary between earth types;

Figure A3,
Log of Test Pit 3, Page 1 of 1

BORING LOGS.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1197-06-01B

TEST PIT 4

ELEV. (MSL.) - - DATE COMPLETED 10/19/2023

EQUIPMENT HAND AUGER BY: RP

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK @0-3'				**WOOD CHIPS: 6"** **ARTIFICIAL FILL** Silty Sand with Gravel, medium dense, slightly moist, olive with gray mottling, fine- to coarse-grained, some cobbles (to 6").			
2				SW	**SURFICIAL DEPOSITS** Sand with Gravel, well-graded, dense, slightly moist, grayish brown, fine- to coarse-grained, trace cobbles (to 6").			

Total depth of test pit: 3 feet
Fill to 1.5 feet.
No groundwater encountered.
Backfilled with cuttings and tamped.
Surface restored with wood chips.

NOTE: The stratification lines presented herein represent the approximate boundary between earth types;

Figure A4,
Log of Test Pit 4, Page 1 of 1

BORING LOGS.GPJ

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ☒ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◪ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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TEST PIT 5

ELEV. (MSL.) - - DATE COMPLETED **10/19/2023**

EQUIPMENT **HAND AUGER** BY: **RP**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK @0-3'				**WOOD CHIPS: 4"** **ARTIFICIAL FILL** Silty Sand with Gravel, medium dense, slightly moist, grayish brown, fine- to coarse-grained, abundant cobbles (to 10").			
2	TP5@2'			SW	**SURFICIAL DEPOSITS** Sand, well-graded, medium dense, slightly moist, olive brown, fine- to coarse-grained, some cobbles (to 5").		123.3	6.4

Total depth of test pit: 3 feet
Fill to 2 feet.
No groundwater encountered.
Backfilled with cuttings and tamped.
Surface restored with wood chips.

NOTE: The stratification lines presented herein represent the approximate boundary between earth types;

Figure A5,
Log of Test Pit 5, Page 1 of 1

BORING LOGS.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TEST PIT 6

ELEV. (MSL.) - - DATE COMPLETED 10/19/2023

EQUIPMENT HAND AUGER BY: RP

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 2	BULK @0-3'				**WOOD CHIPS: 8"** **ARTIFICIAL FILL** Silty Sand with Gravel, medium dense, slightly moist, grayish brown, fine- to coarse-grained, trace cobbles (to 6").			
				SW	**SURFICIAL DEPOSITS** Sand with Cobbles, well-graded, dense, slightly moist, olive brown, fine- to coarse-grained, trace sitl, some cobbles (to 8").			

Total depth of test pit: 3 feet
Fill to 2.5 feet.
No groundwater encountered.
Backfilled with cuttings and tamped.
Surface restored with wood chips.

NOTE: The stratification lines presented herein represent the approximate boundary between earth types;

Figure A6,
Log of Test Pit 6, Page 1 of 1

BORING LOGS.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. W1197-06-01B

TEST PIT 7

ELEV. (MSL.) - - DATE COMPLETED 10/19/2023

EQUIPMENT HAND AUGER BY: RP

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**WOOD CHIPS: 4"**			
2	BULK @0-4'				**ARTIFICIAL FILL** Silty Sand with Cobbles, dense, slightly moist, olive with gray mottling, fine- to coarse-grained, abundant cobbles (to 10"). - olive brown			
4					- large boulder (refusal)			

Total depth of test pit: 4 feet due to refusal
Fill not penetrated through.
No groundwater encountered.
Backfilled with cuttings and tamped.
Surface restored with wood chips.

NOTE: The stratification lines presented herein represent the approximate boundary between earth types;

Figure A7,
Log of Test Pit 7, Page 1 of 1

BORING LOGS.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

TEST PIT 8

ELEV. (MSL.) - - DATE COMPLETED 10/20/2023

EQUIPMENT **HAND AUGER** BY: **RP**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK @0-3'				**WOOD CHIPS: 4"** **ARTIFICIAL FILL** Silty Sand with Gravel, medium dense, slightly moist, gray brown, fine- to coarse-grained, some cobbles (to 5").			
2	TP8@2'			SW	**SURFICIAL DEPOSITS** Sand, well-graded, dense, slightly moist, olive brown, fine- to coarse-grained, trave gravel (to 2").		126.8	8.0

Total depth of test pit: 3 feet
Fill to 1.5 feet.
No groundwater encountered.
Backfilled with cuttings and tamped.
Surface restored with wood chips.

NOTE: The stratification lines presented herein represent the approximate boundary between earth types;

Figure A8,
Log of Test Pit 8, Page 1 of 1

BORING LOGS.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TEST PIT 9

ELEV. (MSL.) - - DATE COMPLETED 10/20/2023

EQUIPMENT HAND AUGER BY: RP

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK @0-3'				**WOOD CHIPS: 3"** **ARTIFICIAL FILL** Silty Sand, medium dense, slightly moist, olive with gray mottling, fine- to coarse-grained, trace cobbles (to 5").			
2	TP9@2'			SM	**SURFICIAL DEPOSITS** Silty Sand with Gravel, medium dense, slightly moist, olive brown, fine- to coarse-grained, some cobbles (to 8").		117.4	14.8

Total depth of test pit: 3 feet
Fill to 1.5 feet.
No groundwater encountered.
Backfilled with cuttings and tamped.
Surface restored with wood chips.

NOTE: The stratification lines presented herein represent the approximate boundary between earth types;

Figure A9,
Log of Test Pit 9, Page 1 of 1

BORING LOGS.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	☒ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

TEST PIT 10

ELEV. (MSL.) - - DATE COMPLETED 10/20/2023

EQUIPMENT **HAND AUGER** BY: **RP**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK @0-3'				**WOOD CHIPS: 3"**			
					ARTIFICIAL FILL Silty Sand with Gravel, medium dense, slightly moist, olive with gray mottling, fine- to coarse-grained, abundant cobbles (to 8").			
2								
	TP10@2.5			SW	- wood chip layer - grayish brown		125.1	12.5
					SURFICIAL DEPOSITS Sand, well-graded, medium dense, slightly moist, olive brown, fine- to coarse-grained, some silt.			

Total depth of test pit: 3 feet
Fill to 2.5 feet.
No groundwater encountered.
Backfilled with cuttings and tamped.
Surface restored with wood chips.

NOTE: The stratification lines presented herein represent the approximate boundary between earth types;

Figure A10,
Log of Test Pit 10, Page 1 of 1

BORING LOGS.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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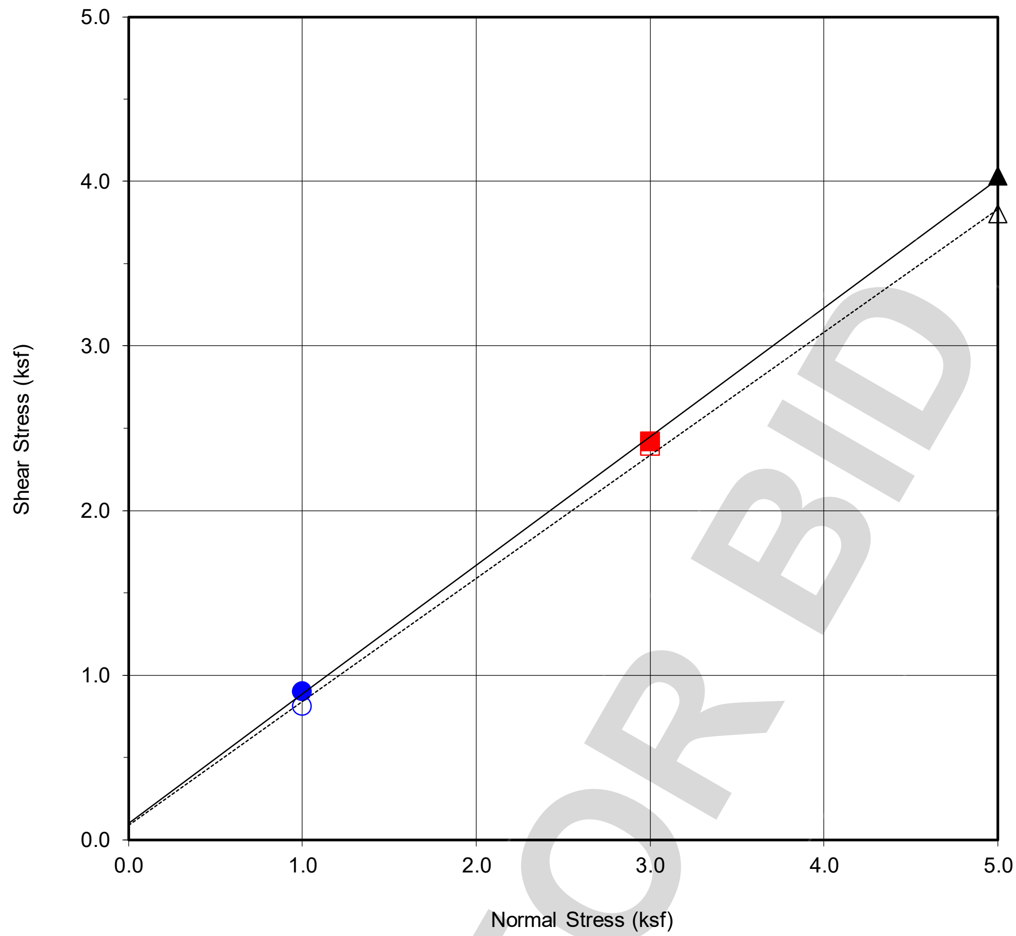
APPENDIX B

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the International ASTM, or other suggested procedures. Selected samples were tested for direct shear strength, consolidation characteristics, corrosivity, R-Value, in-place dry density and moisture content. The results of the laboratory tests are summarized in Figures B1 through B13. The in-place dry density and moisture content of the samples tested are presented on the boring logs, Appendix A.



Boring No.	**N/A**
Sample No.	**TP4@0-3**
Depth (ft)	**0-3**
Sample Type:	Bulk

Soil Identification:		
Well-Graded Sand w/ Gravel (SW)		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	102	38
Ultimate	89	37

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.90	■ 2.42	▲ 4.03
Shear Stress @ End of Test (ksf)	○ 0.81	□ 2.39	△ 3.80
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	7.5	7.5	7.4
Initial Dry Density (pcf)	117.0	117.1	116.9
Initial Degree of Saturation (%)	45.8	46.1	45.4
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	17.8	12.1	10.4

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

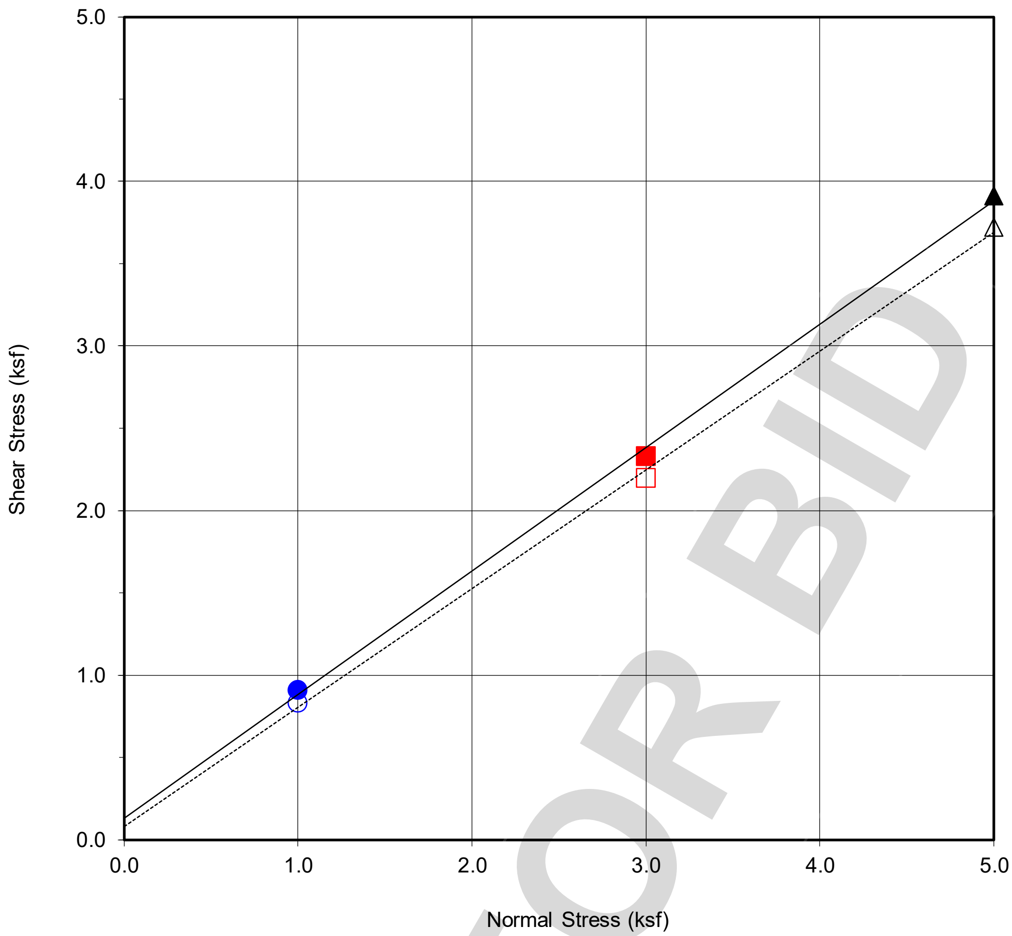
Checked by: RP

Project No.: W1661-99-03

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

November 2023

Figure B1



Boring No.	TP10
Sample No.	TP10@0-3'
Depth (ft)	0-3'
Sample Type:	Bulk

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.91	■ 2.33	▲ 3.91
Shear Stress @ End of Test (ksf)	○ 0.83	□ 2.20	△ 3.72
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	8.8	10.7	8.5
Initial Dry Density (pcf)	114.1	114.1	114.1
Initial Degree of Saturation (%)	49.8	60.3	48.0
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	11.1	10.2	9.7

Soil Identification:

Silty Sand w/ Gravel (SM)

Strength Parameters

	C (psf)	ϕ (^{o})
Peak	132	37
Ultimate	81	36

GEOCON

DIRECT SHEAR TEST RESULTS

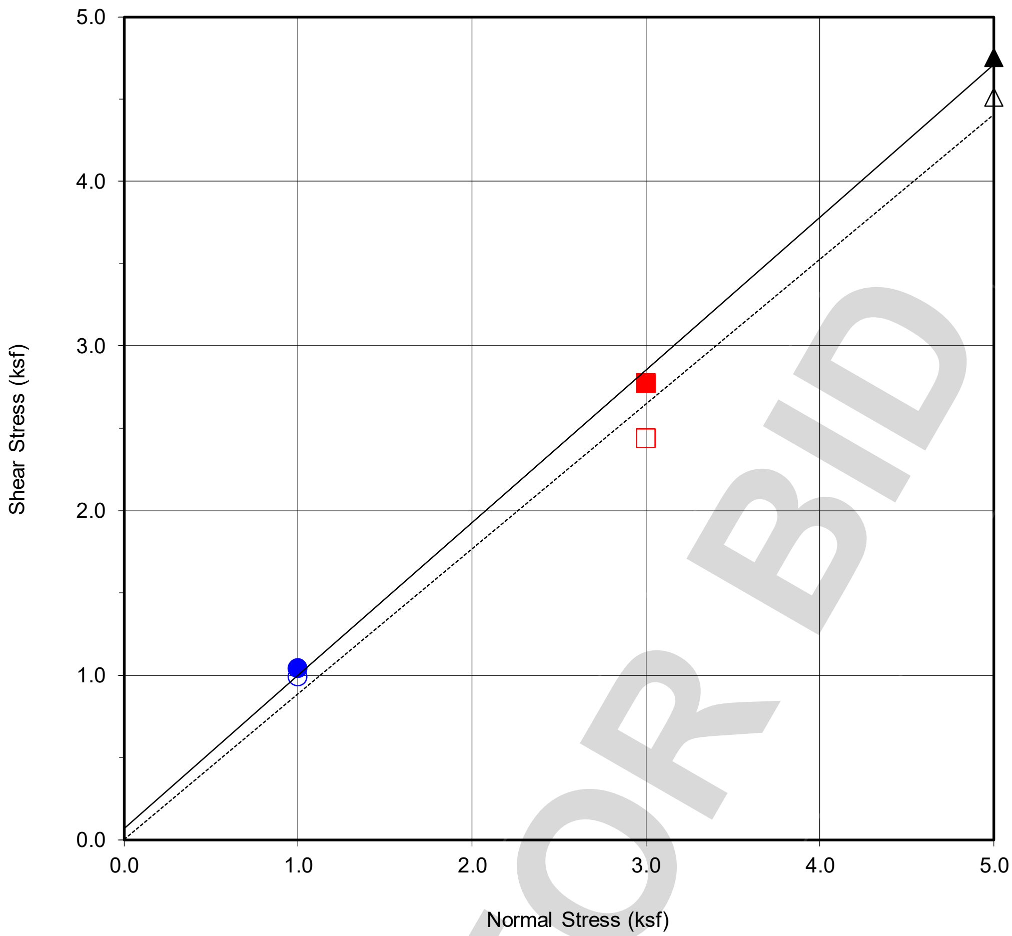
Consolidated Drained ASTM D-3080

Checked by: RP

Project No.: W1661-99-03

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

November 2023 Figure B2



Boring No.	**TP3**
Sample No.	**TP3@2.5'**
Depth (ft)	**2.5'**
Sample Type:	Ring

Soil Identification:		
Well-Graded Sand (SW)		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	71	43
Ultimate	4	41

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.04	■ 2.77	▲ 4.75
Shear Stress @ End of Test (ksf)	○ 0.99	□ 2.44	△ 4.51
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	6.9	8.6	9.5
Initial Dry Density (pcf)	112.3	111.1	114.0
Initial Degree of Saturation (%)	37.0	44.8	53.8
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	15.5	15.2	14.3

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

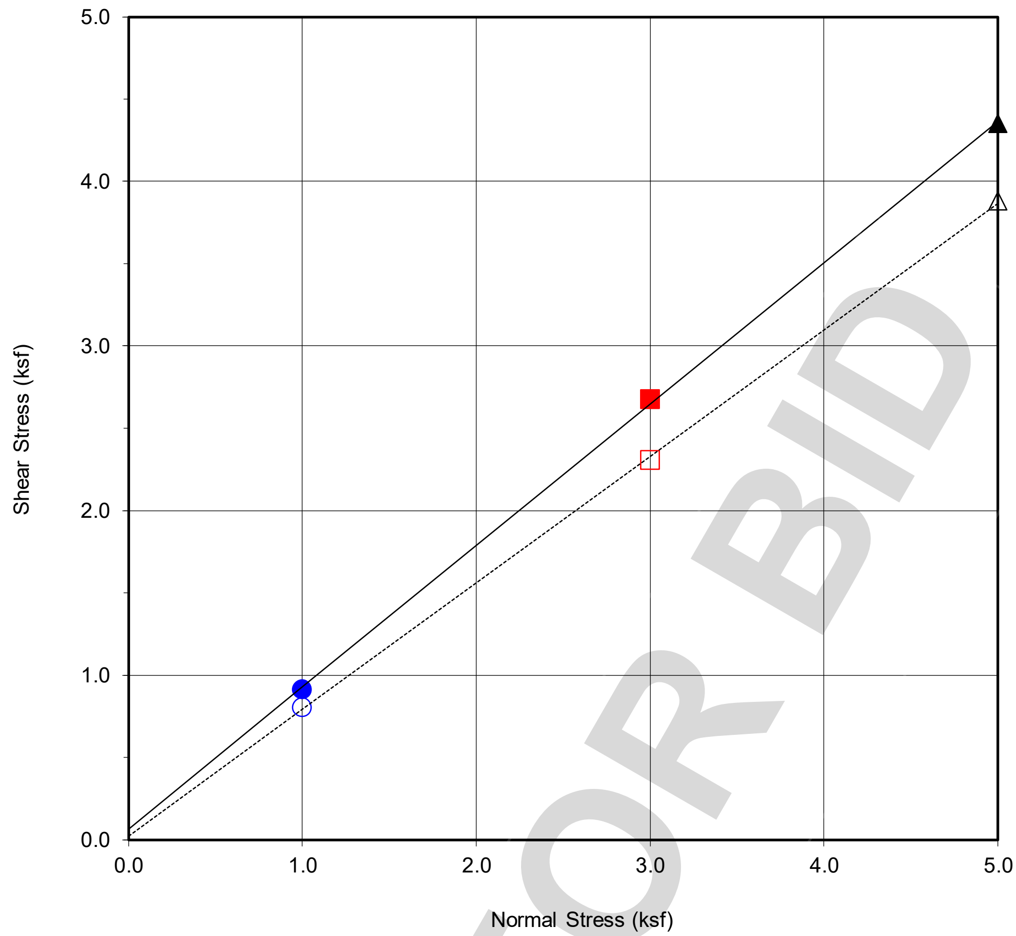
Checked by: RP

Project No.: W1661-99-03

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

November 2023

Figure B3



Boring No.	**TP9**
Sample No.	**TP9@2'**
Depth (ft)	**2'**
Sample Type:	Ring

Soil Identification:		
Well-Graded Sand (SW)		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	67	41
Ultimate	22	38

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.91	■ 2.68	▲ 4.35
Shear Stress @ End of Test (ksf)	○ 0.80	□ 2.30	△ 3.88
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	14.7	14.5	14.6
Initial Dry Density (pcf)	113.8	115.4	115.1
Initial Degree of Saturation (%)	82.4	84.7	84.6
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	17.1	15.3	15.0

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

Checked by: RP

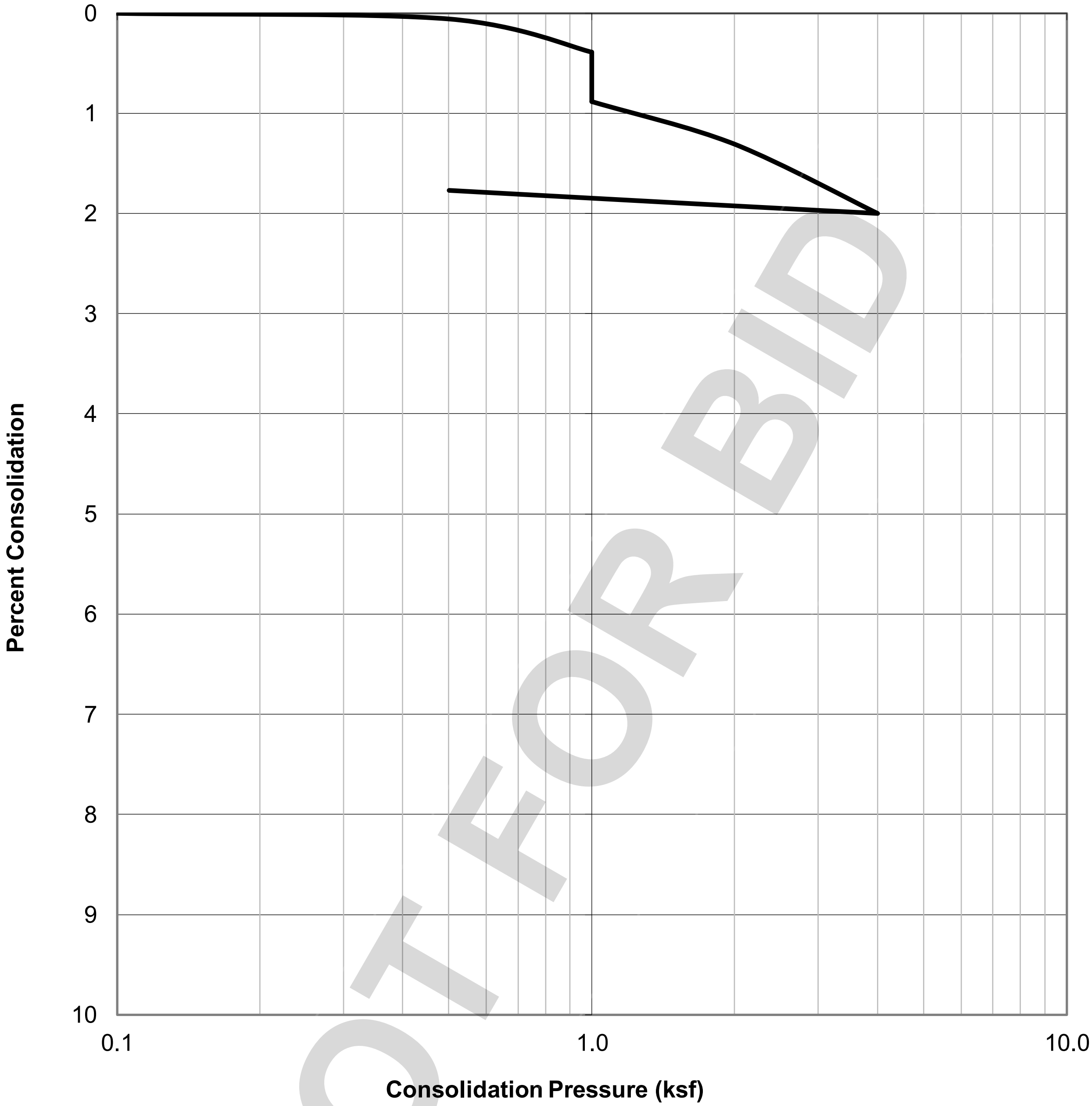
Project No.: W1661-99-03

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

November 2023

Figure B4

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
TP3@2.5'	Well-Graded Sand (SW)	107.9	8.7	14.9

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

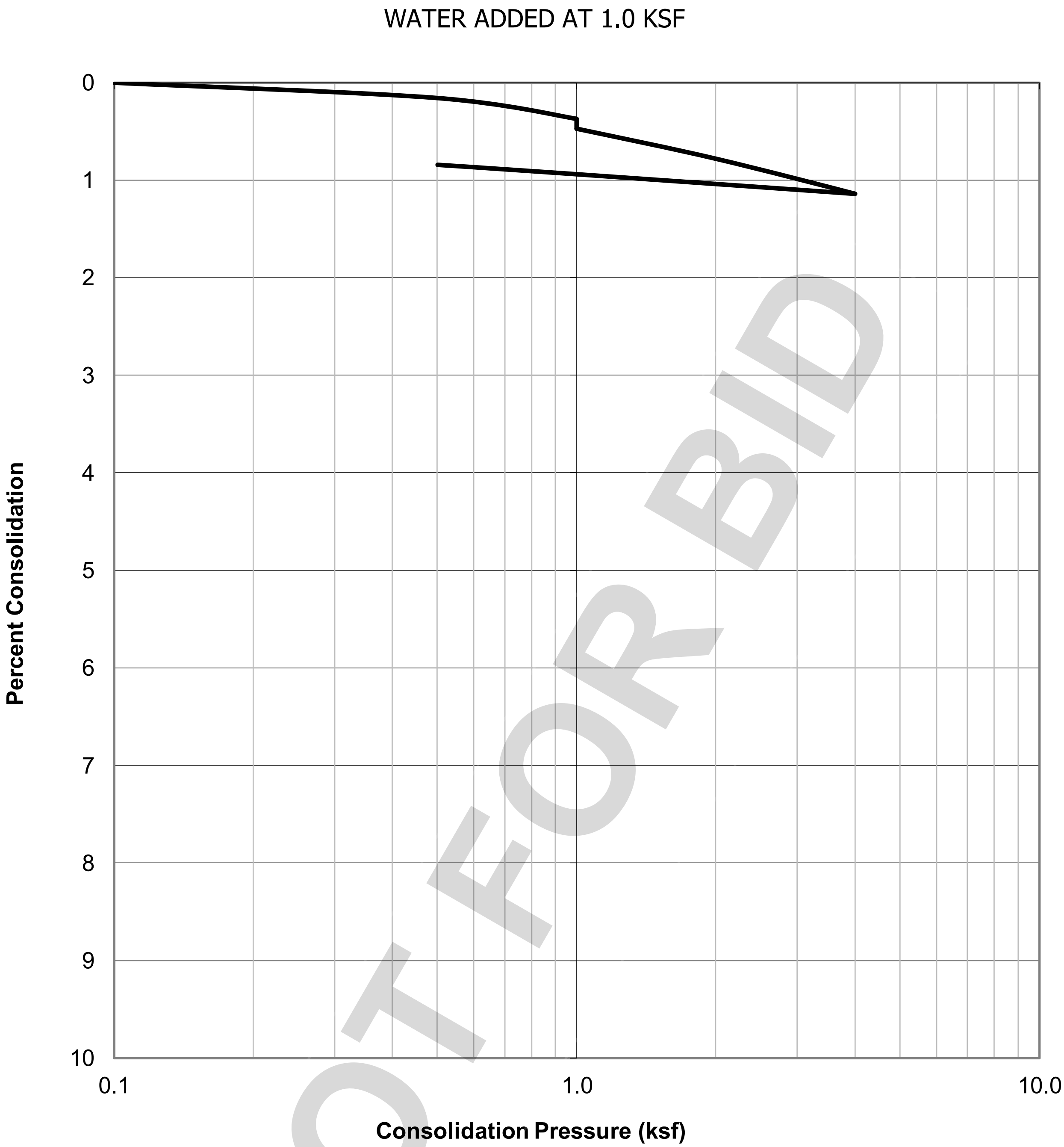
Checked by: RP

Project No.: W1661-99-03

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

November 2023

Figure B5



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
TP10@2.5	Well-Graded Sand (SW)	121.3	12.5	13.1

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: RP

Project No.: W1661-99-03

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

November 2023

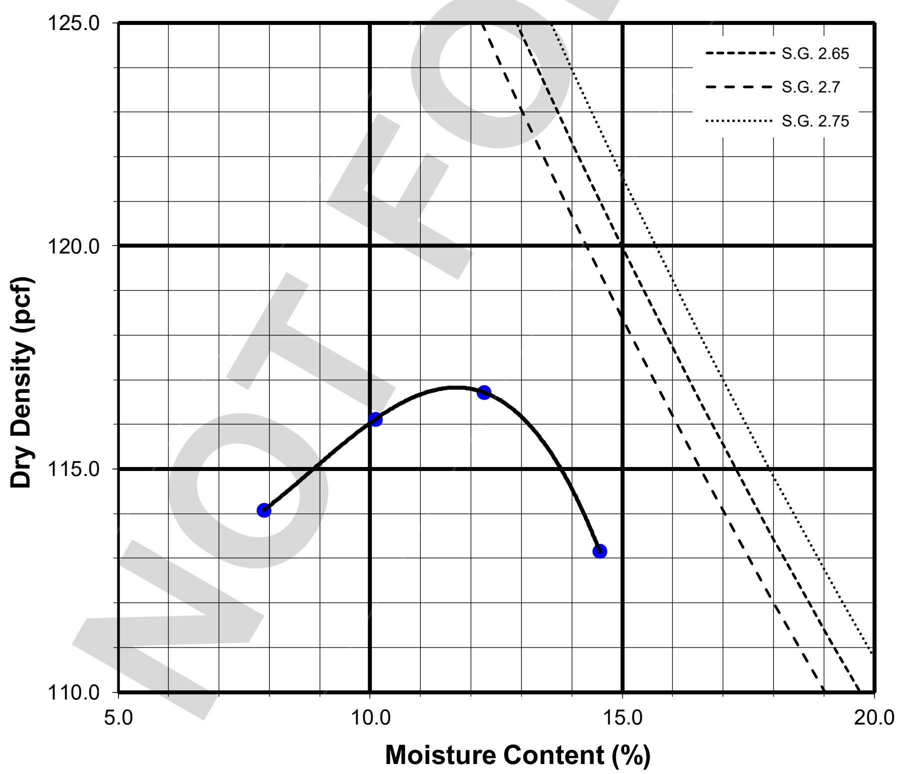
Figure B6

Sample No:

TP1 & TP2 MIXED @ 0-3'	Silty Sand (SM)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6016	6064	6043	5944		
Weight of Mold	(g)	4085	4085	4085	4085	4085	
Net Weight of Soil	(g)	1931	1979	1958	1859	-4085	
Wet Weight of Soil + Cont.	(g)	624.4	647.1	665.7	617.8		
Dry Weight of Soil + Cont.	(g)	580.7	590.1	598.4	583.3		
Weight of Container	(g)	148.0	124.8	135.9	146.0		
Moisture Content	(%)	10.1	12.3	14.6	7.9		
Wet Density	(pcf)	127.8	131.0	129.6	123.1	-270.4	
Dry Density	(pcf)	116.1	116.7	113.2	114.1		

Maximum Dry Density (pcf)	**117.0**	**Optimum Moisture Content (%)**	**11.5**



Preparation Method: A

GEOCON

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

Checked by: RP

Project No.: W1661-99-03

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

November 2023

Figure B7

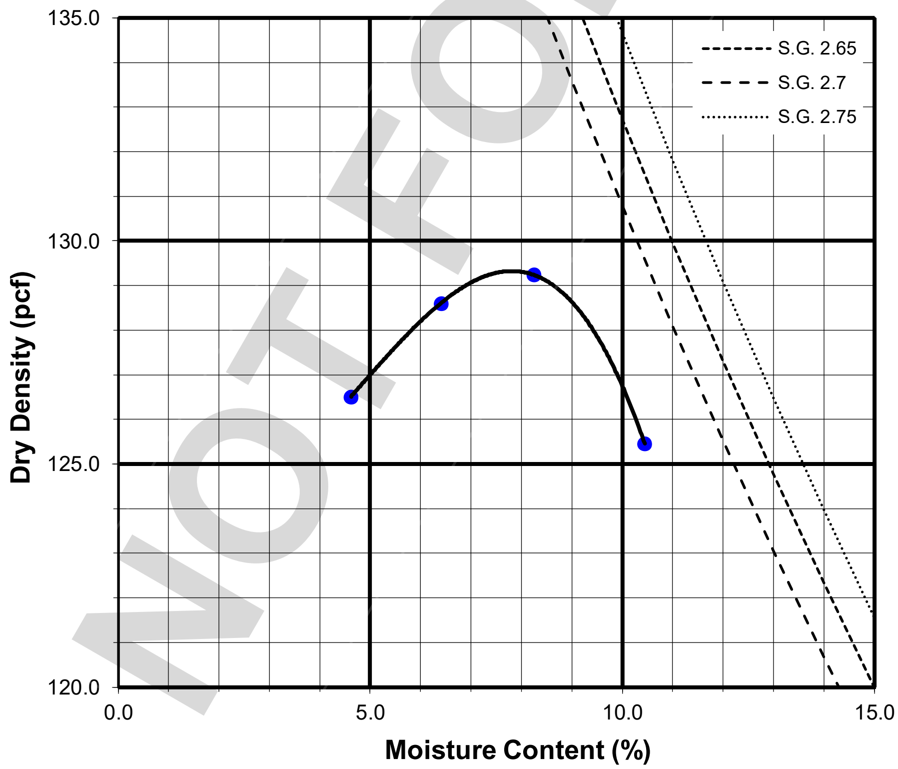
Sample No:

TP3 0-3'	Silty Sand w/ Gravel (SM)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6370	6416	6396	6302		
Weight of Mold	(g)	4303	4303	4303	4303	4303	
Net Weight of Soil	(g)	2067	2113	2093	1999	-4303	
Wet Weight of Soil + Cont.	(g)	719.4	757.2	772.4	615.8		
Dry Weight of Soil + Cont.	(g)	687.2	713.6	716.8	596.8		
Weight of Container	(g)	184.4	184.4	184.4	185.0		
Moisture Content	(%)	6.4	8.2	10.4	4.6		
Wet Density	(pcf)	136.8	139.9	138.6	132.3	-284.9	
Dry Density	(pcf)	128.6	129.2	125.5	126.5		

Maximum Dry Density (pcf)	**129.5**
Bulk Specific Gravity (dry)	**2.64**
Corrected Maximum Dry Density (pcf)	**132.5**

Optimum Moisture Content (%)	**7.5**
Oversized Fraction (%)	**10.0**
Corrected Moisture Content (%)	**7.0**



Preparation Method: A

GEOCON

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

Checked by: RP

Project No.: W1661-99-03

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

November 2023

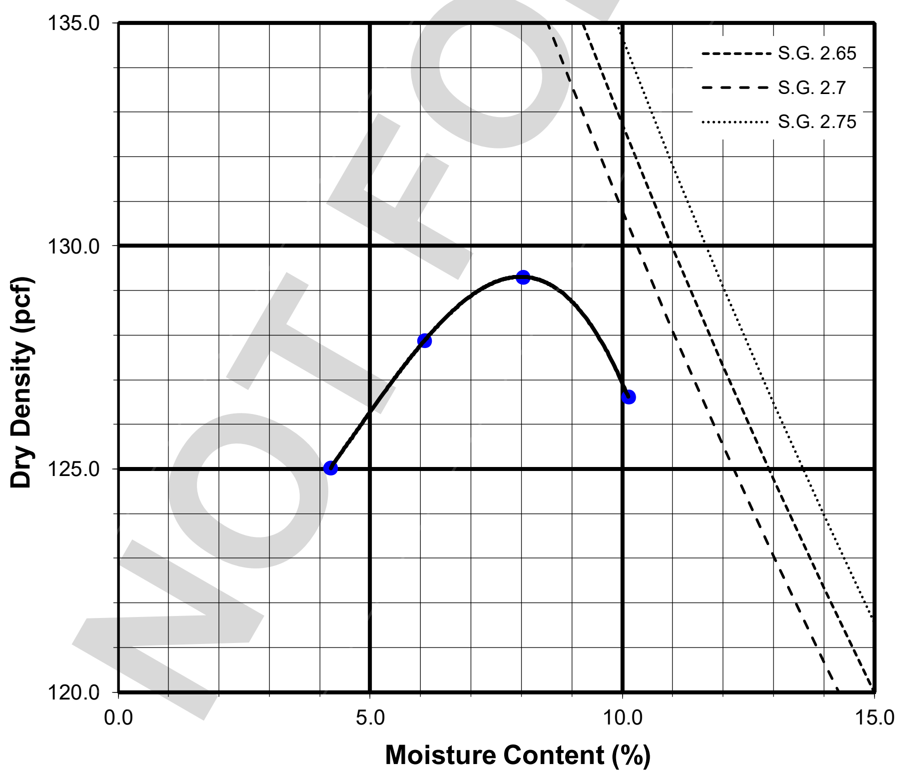
Figure B8

Sample No:

TP4@0-3'	Well-Graded Sand w/ Gravel (SW)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6352	6413	6409	6271		
Weight of Mold	(g)	4303	4303	4303	4303		
Net Weight of Soil	(g)	2049	2110	2106	1968		
Wet Weight of Soil + Cont.	(g)	624.2	682.2	689.6	689.2		
Dry Weight of Soil + Cont.	(g)	599.0	645.2	643.2	668.8		
Weight of Container	(g)	184.4	184.4	184.6	184.4		
Moisture Content	(%)	6.1	8.0	10.1	4.2		
Wet Density	(pcf)	135.7	139.7	139.4	130.3		
Dry Density	(pcf)	127.9	129.3	126.6	125.0		

Maximum Dry Density (pcf)	**129.5**	**Optimum Moisture Content (%)**	**7.5**
Bulk Specific Gravity (dry)	**2.50**	**Oversized Fraction (%)**	**13.0**
Corrected Maximum Dry Density (pcf)	**132.5**	**Corrected Moisture Content (%)**	**6.5**



Preparation Method: A

GEOCON

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

Checked by: RP

Project No.: W1661-99-03

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

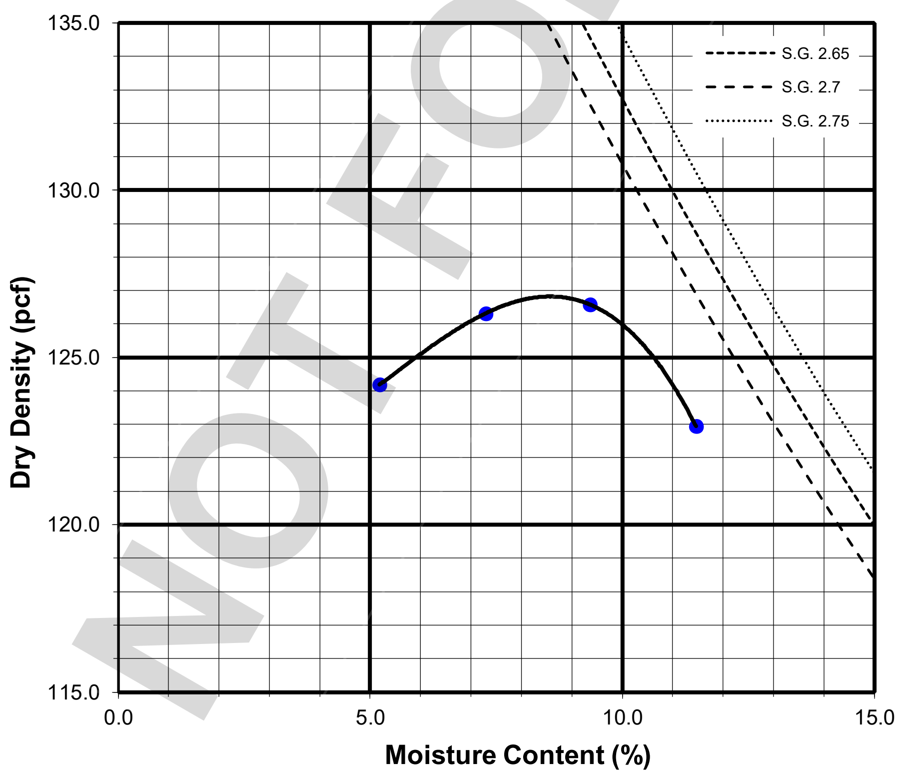
November 2023

Sample No:

TP10@0-3'	Silty Sand w/ Gravel (SM)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6132	6176	6155	6058		
Weight of Mold	(g)	4085	4085	4085	4085		
Net Weight of Soil	(g)	2047	2091	2070	1973		
Wet Weight of Soil + Cont.	(g)	707.3	687.3	723.3	668.6		
Dry Weight of Soil + Cont.	(g)	669.3	640.9	661.8	642.9		
Weight of Container	(g)	147.8	145.4	125.2	147.2		
Moisture Content	(%)	7.3	9.4	11.5	5.2		
Wet Density	(pcf)	135.5	138.4	137.0	130.6		
Dry Density	(pcf)	126.3	126.6	123.0	124.2		

Maximum Dry Density (pcf)	**127.0**	**Optimum Moisture Content (%)**	**8.5**



Preparation Method: A

GEOCON

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

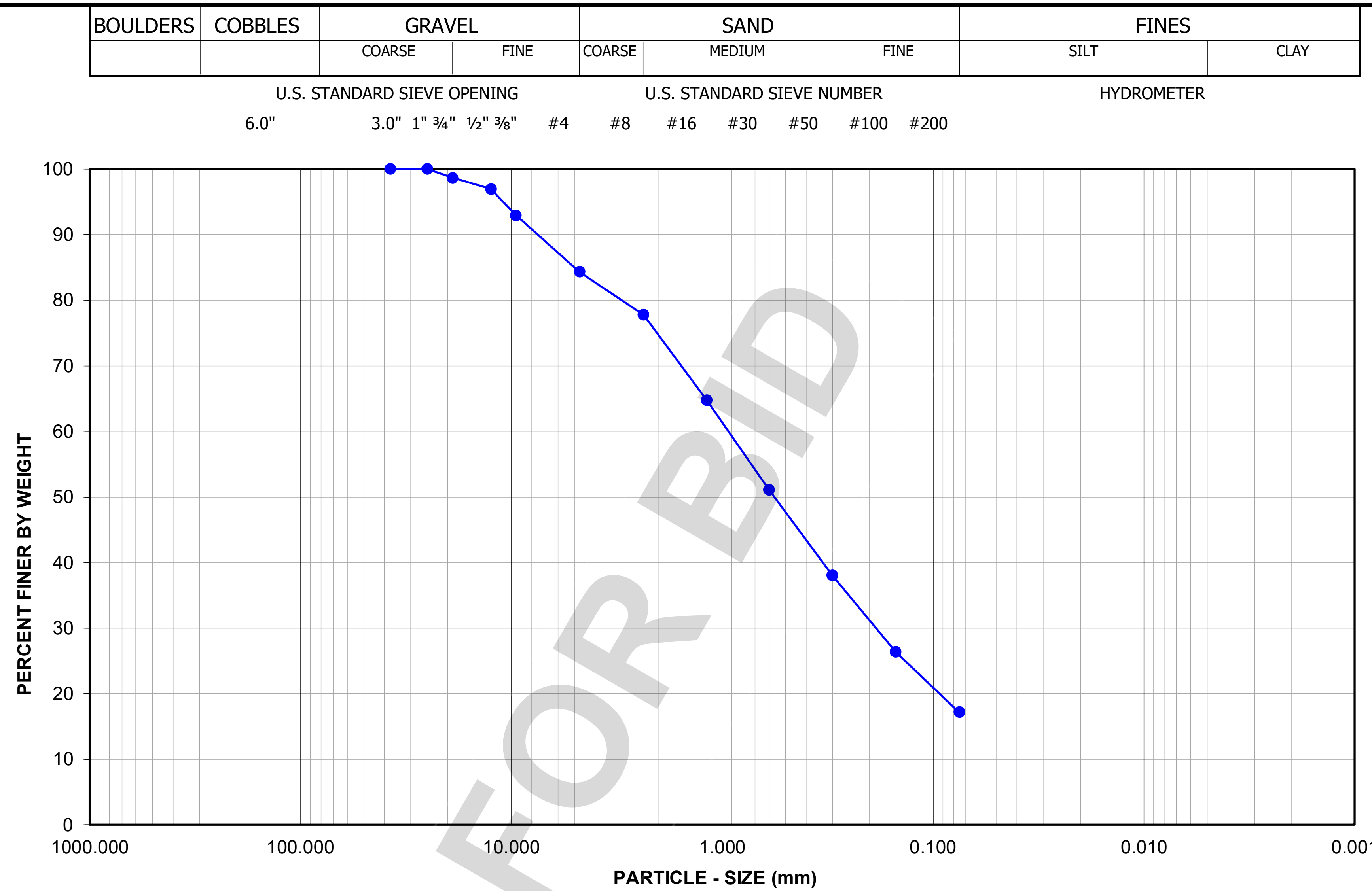
Checked by: RP

Project No.: W1661-99-03

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

November 2023

Figure B10



Exploration No.:	TP-5
Sample No.:	TP-5@0-3
Depth (feet):	0-3
Soil Type:	(SM)
Soil Identification:	Silty Sand w/ Gravel (SM)

GR:SA:FI : (%) 16 : 67 : 17

GEOCON

PARTICLE - SIZE DISTRIBUTION

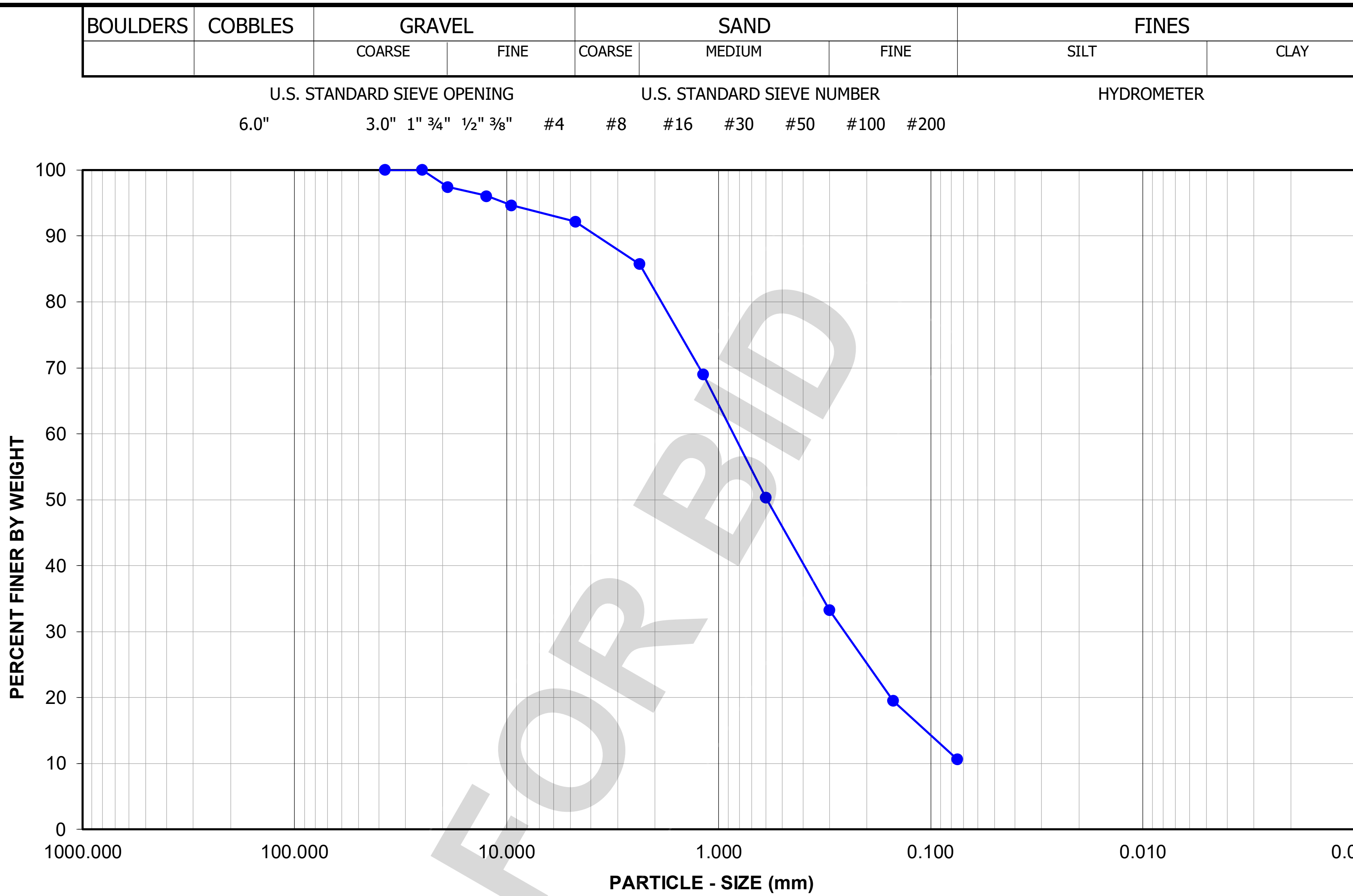
ASTM C-136

Checked by: RP

Project No.: W1661-99-03

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

November 2023 Figure B11



Exploration No.:	TP8
Depth (feet):	0-3
Soil Identification:	Silty Sand (SM)
Sample No.:	TP8@0-3
Soil Type:	SM

GR:SA:FI : (%) 8 : 81 : 11

GEOCON

PARTICLE - SIZE DISTRIBUTION

ASTM C-136

Checked by: RP

Project No.: W1661-99-03

MACKAY PARK
321 ROUSE RANCH ROAD
LAKE ARROWHEAD, CALIFORNIA

November 2023 Figure B12

SUMMARY OF LABORATORY
POTENTIAL OF HYDROGEN (pH) AND RESISTIVITY TEST RESULTS
AASHTO T289 ASTM D4972 and AASHTO T288 ASTM G187

Sample No.	pH	Resistivity (ohm centimeters)
TP9@0-3	7.3	7300 (Moderately Corrosive)

SUMMARY OF LABORATORY CHLORIDE CONTENT TEST RESULTS
AASHTO T291 ASTM C1218

Sample No.	Chloride Ion Content (%)
TP9@0-3	0.004

SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS
AASHTO T290 ASTM C1580

Sample No.	Water Soluble Sulfate (% SO_4)	Sulfate Exposure
TP9@0-3	0.010	S0