

**GEOTECHNICAL ENGINEERING REPORT,  
PROPOSED SUPERCHARGER STATION, RETAIL AND RESTAURANT  
BUILDINGS, PARKING LOT, AND INFILTRATION TESTING,  
0537-161-19**

for

YEWT

April 3, 2024

W.O. 7930

MDN 24098



April 3, 2024  
W.O. 7930

YEWT  
0537-161-19

**Subject: Geotechnical Engineering Report, Proposed Electrical  
Charger Stations, Retail and Restaurant Buildings, APN  
0537-161-19**

Dear YEWT:

As requested, GeoSoils Consultants, Inc. (GSC) has prepared a geotechnical engineering report for the subject site. The purpose of this report is to provide geotechnical engineering recommendations for site grading and foundations. This report presents the results of our research, site reconnaissance, subsurface exploration, laboratory testing, and provides geotechnical engineering recommendations for site grading. Development of the site is considered feasible from a geologic and geotechnical engineering perspective, provided the recommendations presented herein are incorporated into the design and implemented during construction. We appreciate this opportunity to be of service to you. If you have any questions regarding this report, or if we may be of further assistance to you, please do not hesitate to contact us.

Very truly yours,

GEOSOILS CONSULTANTS, INC.



ROSS MILLER  
Senior Staff Engineer



MAHAN PASDARPOUR, PE 90111  
Senior Project Engineer

cc: (1) Addressee

MDN 24098

**TABLE OF CONTENTS**

1.0 INTRODUCTION ..... 1

    1.1 Site Description ..... 1

    1.2 Proposed Development..... 2

    1.3 Scope of Services ..... 2

    1.4 Limitations..... 2

2.0 FIELD EXPLORATION ..... 3

3.0 LABORATORY TESTING ..... 3

4.0 FINDINGS..... 6

    4.1 Geologic Environment..... 6

        4.1.1 Earth Materials ..... 6

        4.1.2 Groundwater ..... 6

    4.2 Faulting And Seismicity..... 6

        4.2.1 Earthquake Characterization: ..... 7

        4.2.2 Earthquake Intensity:..... 7

        4.2.3 2022 California Building Code (CBC) Seismic Design Criteria ..... 7

    4.3 Secondary Earthquake Effects..... 8

        4.3.1 Ground Rupture ..... 8

        4.3.2 Landsliding ..... 9

        4.3.3 Seiches and Tsunamis ..... 9

        4.3.4 Dry Sand Settlement ..... 10

        4.3.5 Liquefaction..... 10

    4.4 Hydro Collapse ..... 11

5.0 CONCLUSIONS..... 12

6.0 RECOMMENDATIONS..... 12

    6.1 Removals..... 12

    6.2 Foundations ..... 12

        6.2.1 Continuous Footings ..... 13

    6.3 Interior Slab-on-grade ..... 15

    6.4 Exterior Slabs-on-grade ..... 19

    6.5 Pavement Sections ..... 20

6.5.1	Asphalt Concrete.....	20
6.5.2	Rigid Concrete Pavements.....	23
6.6	Infiltration Testing.....	23
6.7	Corrosion Characteristics of Soil.....	24
6.8	Grading .....	26
6.8.1	General .....	26
6.8.2	Site Preparation .....	27
6.8.3	Fill Placement.....	28
6.8.4	Construction Considerations .....	31
6.8.5	Temporary Excavation .....	32
6.8.6	Excavation Observation .....	33
6.8.7	Utility Trenching and Backfill .....	33
7.0	CLOSURE .....	35

**Enclosures**

References

Plate 1, Boring Location Map

Appendix A, Boring Logs

Plates A-1 through A-13, Boring Logs

Appendix B, Laboratory Test Results

Plate EI-1, Expansion Index Results

Plates CS-1 to CS-7, Collapse/Swell Test Diagrams

Plates C-1 to C-4, Consolidation Test Diagrams

Plates G-1, Grain Size Test Diagram

Plates DS-1 and DS-2, Direct Shear Test Diagrams

Plates MDD-1 to MDD-3, Maximum Dry Density

Plate L-1, Chemical Test Series

Plate RV-1, R-Value Test Result

Appendix C, Infiltration Results

Plates P-1 to P-3, Infiltration Data

cc: (1) Addressee

## **1.0 INTRODUCTION**

The purpose of this report is to provide geotechnical engineering data and recommendations to aid in the development of the subject site. The following sections provide a summary of our subsurface exploration, laboratory testing, general geologic and geotechnical engineering conditions, and recommendations for site grading, fill placement, and foundations.

This report has been prepared in accordance with generally accepted geotechnical engineering practices in the County of San Bernardino at the time it was prepared. The report presents a brief description of the site, the geotechnical engineering characteristics of the area, the seismicity of the area, an engineering analysis of the site characteristics, conclusions, and recommendations to develop the site.

Opinions presented in this report are based on an inspection of the site, geologic mapping, a review of the regional geologic maps and seismic hazard reports, review of any previous consultant reports for the subject area, subsurface exploration and lab testing, and our general knowledge of the geologic and soils engineering conditions in the site area. The opinions presented have been arrived at through the exercise of the generally understood standard of care for our profession and standard of engineering practice for the County of San Bernardino, as we understand it.

### **1.1 Site Description**

The subject site is located directly east of YEWT on a vacant lot, in the community of Yermo (see Figure 1). The lot is approximately 11.6 acres and extends to the intersection of Calico Blvd and Dividing Line Street. Existing residential structures are located along the southern portion of the proposed development. The site is relatively flat and is covered by low vegetation such as shrubs and bushes.



MDN 24098

SITE LOCATION MAP  
0537-161-19

FIGURE 1

W.O. NO.: 7930

DATE: 4/2024

## **1.2 Proposed Development**

The proposed development of the site will consist of constructing approximately nine single-story commercial buildings, a parking lot and electrical vehicle (ev) charging stations, and a retention trench and basin. The depth of the proposed basin is 5 feet tentatively.

## **1.3 Scope of Services**

Our scope of services included the following:

- Site reconnaissance.
- Review of regional geologic maps and seismic hazard reports.
- Excavated, sampled, and logged ten hollow stem auger borings to a maximum depth of 50 feet at the locations shown on Plate 1, Site Plan.
- Laboratory testing.
- Engineering analyses.
- Preparation of this report.

## **1.4 Limitations**

The findings and recommendations of this report were prepared in accordance with generally accepted professional geotechnical engineering principles and practice for the County of San Bernardino at this time. We make no other warranty, either express or implied. The conclusions and recommendations contained in this report are based on-site conditions disclosed in our site inspection and the referenced reports. Since our investigation was based on the site conditions observed and engineering analyses, the conclusions and recommendations contained herein are professional opinions. However, soil/rock conditions can vary significantly between borings; therefore, further refinements of our recommendations contained herein may be necessary due to changes in the building plans or what is encountered during site grading.

## **2.0 FIELD EXPLORATION**

Ten borings, to the maximum depth of 50 feet, were excavated on the site at the locations shown on Plate 1. Soil samples were obtained with a California ring sampler, SPT sampler and bulk samples. The hollow stem auger borings used the standard 140 lb. hammer with a 30-inch drop.

A representative from our firm continuously observed the borings excavations, logged the subsurface conditions, and collected representative soil samples. All samples were stored in watertight containers and later transported to our laboratory for further visual examination and testing, as deemed necessary. After the borings were completed, they were backfilled with soil cuttings.

The enclosed boring logs (Plates A-1 to A-13) describe the vertical sequence of soils and materials encountered in the borings, based primarily on our field classifications, and supported by our subsequent laboratory examination and testing.

## **3.0 LABORATORY TESTING**

### **In Situ Moisture Content and Dry Unit Weight**

In-place moisture content and dry unit weight of selected, relatively undisturbed ring soil samples were determined in accordance with the current version of the Test Methods ASTM D2216 and ASTM D7263, respectively. Once the dry unit weights had been determined, in-place densities of underlying soil profile were estimated. In those cases where ring samples were obtained, the moisture content and dry unit weights are presented on Boring Logs, Appendix A.

### **Grain Size Distribution**

A grain size analysis was performed on a selected bulk sample of onsite soils in accordance with the current versions of Test Method ASTM-D6913 and ASTM-D1140. The test result is graphically presented on Plate G-1.

### **Expansion Index**

Expansion index testing was performed on selected bulk samples of the on-site soils in accordance with the current version of Test Method ASTM D4829-07. The test results are presented in Plate EI-1. Additional testing will be performed at the completion of grading. The test results indicate an expansion index of 1 (Very Low range).

### **One-Dimensional Collapse and Swell Test**

One-dimensional collapse and swell tests were performed on the selected ring samples. This test was performed in general accordance with Test Method ASTM D 4546-21. The samples were inundated at an approximate load of one ton per square foot to monitor the hydro-consolidation. Results of the consolidation are presented on Plates CS-1 to CS-7.

### **Consolidation Test**

Consolidation tests were performed on the selected ring samples. This test was performed in general accordance with Test Method ASTM D 2435-04. The samples were inundated at an approximate load of one ton per square foot to monitor the hydro-consolidation. Loads were applied to the sample in several increments in geometric progression and resulting deformations were recorded at selected time intervals. Results of the consolidation are presented on Plates C-1 to C-4.

### **Direct Shear**

Two shear tests were performed in a strain-control type Direct Shear Machine. The samples were sheared under carrying confining loads in order to determine the Coulomb shear strength parameters: cohesion ( $c$ ), and angle of internal friction ( $\phi$ ) for peak and residual or re-shear strength conditions. This test was performed in general accordance with the current version of Test Method ASTM D 3080. The sample was

tested in an artificially saturated condition. The results are plotted, and a linear approximation is drawn of the failure curve. The results of the direct shear test are graphically presented on Plate DS-1 and DS-2.

### **Compaction Tests**

Compaction tests are performed on selected bulk samples of the on-site soils to determine moisture density relationships of the typical surficial soils encountered on the site. The laboratory standard used was in accordance with ASTM Test Designation D-1557-12.

<b>TABLE 1 COMPACTION TEST RESULTS</b>			
<b>Sample</b>	<b>Description</b>	<b>Maximum Dry Density (pcf)</b>	<b>Optimum Moisture Content (%)</b>
B-2 @ 2.5-5'	Brown, slightly silty, very fine to coarse SAND	128.0	8.5
B-2 @ 5-7'	Light brown, slightly silty, very fine to fine SAND	115.0	11.0
B-8 @ 7-10'	Brown, slightly silty, very fine to fine SAND	120	11.5

### **Chemical Tests**

Chemical testing for soil corrosiveness was performed by an outside laboratory and the results are presented in Appendix B. The results of the testing are discussed in Section 6 and additional testing will be completed at the end of grading.

### **R-Value**

An R-value test was performed per Caltrans standard CA 301 on a surficial sample and the result is in Appendix B.

## **4.0 FINDINGS**

### **4.1 Geologic Environment**

Geologic conditions on the subject site were determined through research (See Geologic Map, Figure 2), field mapping, and subsurface exploration, and the results were superimposed on the Boring Location Map, Plate 1. During grading, a geologist should be present to confirm the geologic conditions encountered on the site are consistent with those presented herein. The following sections present our findings concerning subsurface and groundwater conditions.

#### 4.1.1 Earth Materials

##### Alluvium (Qa)

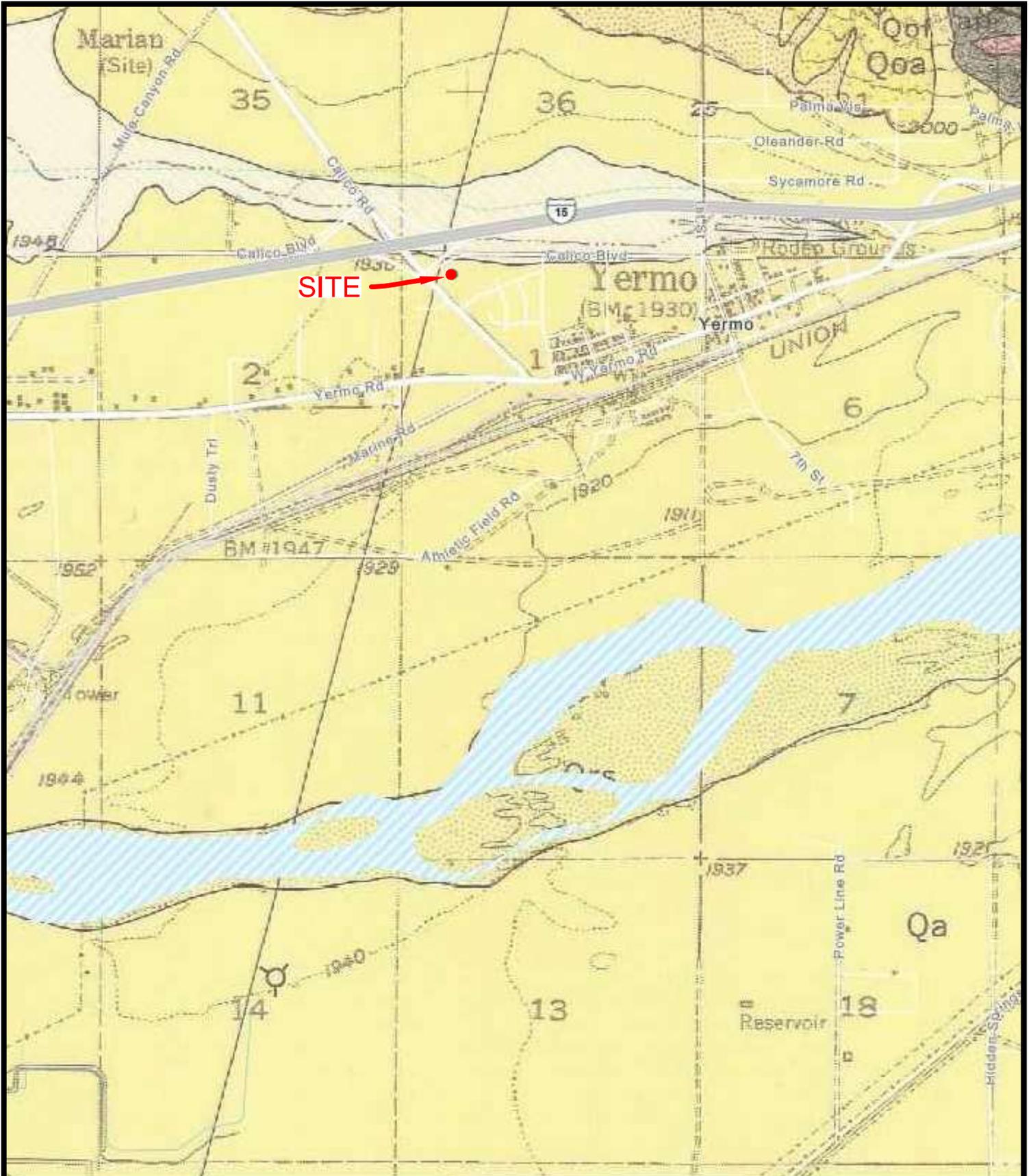
Alluvial deposit was encountered in our borings to a maximum depth of 50 feet. The deposit consists of light to reddish brown, slightly silty Sand.

#### 4.1.2 Groundwater

Groundwater was not encountered to the maximum depth of 50 feet in our borings on the site. Fluctuations in the level of ground water can occur due to seasonal climatic variations, changes in the land use and other factors.

### **4.2 Faulting And Seismicity**

The project site is not located within an Alquist-Priolo Earthquake Fault Zone and there are no active faults on or adjacent to the property (Figure 3). Although there are no faults on or adjacent to the property, there are faults near the site that can cause moderate to intense ground shaking during the lifetime of the proposed development. Therefore, earthquake resistant design is recommended. The closest active fault to the site is the Calico Fault located approximately 3 miles to the east.



GeoSoils Consultants Inc.  
 GEOTECHNICAL • GEOLOGIC

GEOLOGIC MAP  
 0537-161-19

W.O. NO.: 7930  
 DATE: 4/2024

FIGURE 2

MDN 24098



MDN 24098

SEISMIC HAZARD ZONE MAP  
0537-161-19

W.O. NO.: 7930

DATE: 4/2024

**FIGURE 3**

#### 4.2.1 Earthquake Characterization:

Earthquakes are characterized by magnitude, which is a quantitative measure of the earthquake strength, based on strain energy released during a seismic event. The magnitude of an earthquake is constant for any given site and is independent of the site in question.

#### 4.2.2 Earthquake Intensity:

The intensity of an earthquake at a random site is not constant and is subject to variations. The intensity is an indirect measurement of ground motion at a particular site and is affected by the earthquake magnitude, the distance between the site and the hypocenter (the location on the fault at depth where the energy is released), and the geologic conditions between the site and the hypocenter. Intensity, which is often measured by the Mercalli scale, generally increases with increasing magnitude and decreases with increasing distance from the hypocenter. Topography may also affect the intensity of an earthquake from one site to another. Topographic effects such as steep sided ridges or slopes may result in a higher intensity than sites located in relatively flat-lying areas.

#### 4.2.3 2022 California Building Code (CBC) Seismic Design Criteria

The 2022 CBC (California Building Code) seismic coefficient criteria are provided in the table below for structural design consideration. Under the Earthquake Design Regulations of Chapter 16, Section 1613 of the CBC 2022, the following coefficients apply for the proposed Type II structures at the site. Site Class D-Default should be used for the site. The following seismic data is presented for preliminary design purposes. Ground motion parameters based on the Mapped Risk-Targeted Maximum Considered Earthquake ( $MCE_r$ ) were determined and adhere to requirements discussed in ASCE 7-16 referenced by the 2022 California Building Code. The parameters include 5% critical

damping for 0.2- and 1.0-second time periods. A summary of parameters is provided in the table below for a Site Class D designation. These values may only be used when the value of the seismic response coefficient  $C_s$  satisfies equations 12.8-2, 12.8-3, or 12.8-4 of the ASCE 7-16 Standard.

<b>TABLE 2 SEISMIC PARAMETERS</b>	
<b>Description</b>	<b>Value</b>
Mapped Response (0.2 second), $S_s$	1.633
Mapped Spectral Response (1.0 second), $S_1$	0.573
Short Period Site Coefficient, $F_a$	1.2
1-second Period Site Coefficient, $F_v$	Null
Adjusted Maximum Considered Earthquake Spectral Response (0.2 second), $S_{MS}$	1.96
Adjusted Maximum Considered Earthquake Spectral Response (1.0 second), $S_{M1}$	Null
5-percent Damped Design Spectral Response (0.2 second), $S_{DS}$	1.306
5-percent Damped Design Spectral Response (1.0 second), $S_{D1}$	Null
Maximum Considered Earthquake Geometric Mean Peak Ground Acceleration, $PGA_M$	0.872
*Site Coordinates: Latitude: 34.9075883°, Longitude: -116.8352049	

Conformance to the above criteria for seismic excitation does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a maximum level earthquake occurs. The primary goal of seismic design is to protect life and not to avoid all damage, since such design may be economically prohibitive. Following a major earthquake, a building may be damaged beyond repair, yet not collapse.

### 4.3 Secondary Earthquake Effects

Ground shaking produced during an earthquake can result in a number of potentially damaging phenomena classified as secondary earthquake effects. These secondary effects include ground rupture, landslides, seiches and tsunamis, seismically induced settlement, and liquefaction. Descriptions of each of these phenomena and how it could potentially affect the proposed site are described as follows:

#### 4.3.1 Ground Rupture

Ground rupture occurs when movement on a fault breaks the ground surface and usually occurs along pre-existing fault traces where zones of weakness

already exist. The State has established Earthquake Fault Zones for the purpose of mitigating the hazard of fault rupture by prohibiting the location of most human occupancy structures across the traces of active faults.

Earthquake fault zones are regulatory zones that encompass surface traces of active faults with a potential for future surface fault rupture. The site is not located within the State established Earthquake Fault Zone. The Hazard associated with ground rupture for the site is considered low.

#### 4.3.2 Landsliding

Landslides are slope failures that occur where the horizontal seismic forces act to induce soil and/or bedrock failures. The most common effect is reactivation or movement on a pre-existing landslide. Typically, existing slides that are stable under static conditions (i.e., factor-of-safety above one) become unstable and move during strong ground shaking. The site is relatively flat and not subject to landslide Hazard.

#### 4.3.3 Seiches and Tsunamis

A seiche is the resonant oscillation of a body of water, typically a lake or swimming pool caused by earthquake shaking (waves). The hazard exists where water can be splashed out of the body of water and impact nearby structures. No bodies of constant water are near the site, therefore, the hazards associated with seiches are considered low.

Tsunamis are seismic sea waves generated by undersea earthquakes or landslides. When the ocean floor is offset or tilted during an earthquake, a set of waves are generated similar to the concentric waves caused by an object dropped in water.

Tsunamis can have wavelengths of up to 120 miles and travel as fast as 500 miles per hour across hundreds of miles of deep Ocean. Upon reaching

shallow coastal waters, the once two-foot-high wave can become up to 50 feet in height causing great devastation to structures within reach. Tsunamis can generate seiches as well. Due to the distance of the site relative to the ocean, seiches and tsunamis are not considered a hazard to the site.

#### 4.3.4 Dry Sand Settlement

Dry sand settlement can occur during moderate and large earthquakes when loose, natural or fill sandy soils are densified and settle, often unevenly across a site. In order for dry sand settlement to occur, the following four factors are required: 1) Relatively dry soil or soil situated above the groundwater table; 2) undrained loading (strong ground shaking), such as by earthquake; 3) contractive soil response during shear loading, which is often the case for a soil which is initially in a loose or uncompacted state; and 4) susceptible soil type; such as clean, uniformly graded sands. Structures situated above seismically densifying dry sandy soils may experience settlement. Based on site exploration, this site is considered to have very low susceptibility to dry sand settlement. This is due primarily to the presence of dense granular material with relatively high fine content in shallow depths. However, due to some potentially lenticular loose sandy layers within Boring 2, Buildings 'B' and 'C', as shown on Plate 1, should be designed with a ½ inch total, ¼ inch differential seismic settlement, based on our judgment.

#### 4.3.5 Liquefaction

Liquefaction is a soil softening dynamic response, by which an increase in the excess pore water pressure results in partial to full loss of soil shear strength and post-liquefaction dissipation of this pore water pressure results in ground settlement shortly after the earthquake. In order for liquefaction to occur, the following four factors are required: 1) saturated soil or soil situated below the groundwater table; 2) undrained loading (strong ground shaking), such as by earthquake; 3) contractive soil response during shear loading, which is often

the case for a soil which is initially in a loose or uncompacted state; and 4) susceptible soil type; such as clean, uniformly graded sands, non-plastic silts, or gravels. Groundwater was not encountered in any of the borings to a maximum depth of 50 feet. Additionally, the site is underlain by dense material. Therefore, it is our opinion that liquefaction is not considered a potential hazard on this site.

#### **4.4 Hydro Collapse**

Hydro-collapse is a condition where dry or moist soils undergo settlement upon being wetted. In many cases no additional surcharge load is necessary to trigger the Hydro-collapse. The potential for Hydro-collapse has been evaluated based upon observations, the results of Swell/Collapse and Consolidation tests, and moisture-density determinations for samples taken from the field. Los Angeles County, Department of Public Works, Materials Engineering Division consider potentially collapsible soils as generally having (a) low moisture contents (<8%), (b) low in-situ density(<108pcf), and these soils can potentially be subject to 2 or greater collapse.

A total of 4 consolidation tests and 7 collapse-and-swell tests with inundation at 1.0 tsf load (hydro collapse test) were performed and are presented within Appendix B. The samples have a range of 0.5% to 2.8% volume change. After modification of collapse percentage for overburden pressure per ASTM D 5333-03, an average of 1.5% collapse was considered from depth of 5 to 20 feet below the grade, assuming 5 feet removal for the entire site. Therefore, a total and differential Hydro-collapse settlement of 2.7 and 1.35 inches respectively, should be considered for design purposes. We note that the soil below depths of 20 feet is very dense with high unit weight and therefore, the potential for hydro-collapse below depths of 20 feet is very low.

## **5.0 CONCLUSIONS**

The development of the subject site is considered feasible from a geologic and geotechnical engineering viewpoint, provided that the recommendations presented in this report are followed during grading.

## **6.0 RECOMMENDATIONS**

### **6.1 Removals**

Removals shall extend a minimum of five (5) feet below existing ground surface or proposed grades in the entire site, whichever is lower in elevation. Removals shall extend a minimum of five (5) feet beyond the building footprint or equal to the depth of removal, whichever is greater. A minimum of three (3) feet of compacted fill is required below bottom of footings. Deeper removals may be required if soft or dry soil conditions are observed during grading or if hardpan conditions are observed. Preparation of areas to receive fill and fill placement shall be performed as discussed under "*Grading section*".

### **6.2 Foundations**

The following recommendations are provided for preliminary design purposes and the final expansion index should be determined following grading. In our opinion continuous footings with slab-on-grade or post-tensioned interior slabs may be used to support the proposed structures.

All foundations should meet current slope setback requirements. Foundations should be designed for very low-expansive soil conditions. The proposed improvements should be found into the compacted fill. Under no circumstances should foundations be cast atop loose, soft, or slough, debris, topsoil, or surfaces covered by standing water. Prior to placing concrete in a foundation excavation, an inspection should be made by our representative to ensure that the foundation's subgrade is free of loose and disturbed soils and is embedded in the recommended material. We offer the

following site-specific recommendations and comments for purposes of foundation design and construction.

#### 6.2.1 Continuous Footings

The proposed structures may be supported on continuous footings with slab-on-ground or post-tensioned interior slab. Exterior isolated pad footings should be connected to adjacent footings via tie beams.

#### Subgrade Preparation

All conventional footings should be constructed on firm, unyielding certified compacted fill. All compacted fills should be compacted to at least 90 percent of the Modified Proctor maximum laboratory density, as determined by ASTM D-1557-02 compaction method. Pre-moistening of all areas to receive concrete is recommended. The moisture content of the subgrade soils should be equal to or slightly greater than optimum moisture and verified by the Geotechnical Engineer to a depth of 18 inches below adjacent grade within 24 hours of concrete placement. Footing's subgrades shall be prepared in accordance with the *Grading* section of this report.

#### Minimum Dimensions

Continuous footings should have a width of at least 12 inches. Interior and perimeter footings should extend at least 18 inches below the lowest adjacent grade. Exterior isolated pad footings intended for support of roof overhangs such as decks, patio covers, and similar miscellaneous construction should be a minimum of 18 inches square and founded at a minimum depth of 18 inches below the lowest adjacent final grade. The building's exterior isolated pad footings should be connected to adjacent footings via tie beams.

TABLE 3 BUILDING'S CONTINUOUS FOOTINGS DIMENSIONS					
Number of Stories	Expansion Index	Footing Width, Inch	Depth Below the lowest adjacent final grade, inch		Reinforcement
			Perimeter Footings	Interior Footings	
1	Very Low	12	18	18	Two #4 bars; one top, one bottom
Exterior Pad Footing	Very Low	18	18		

Bearing Capacity

Footings with at least above minimum dimensions may be designed for a preliminary allowable bearing pressure of 1,500 pounds per square foot (psf) for dead plus live loads, with a one-third increase allowed when considering additional short-term wind or seismic loading. The allowable bearing value may be increased by 300 pounds per square foot per foot increase in depth or width to a maximum of 3000 psf. The weight of the footings may be neglected for design purposes. All footings located adjacent to utility lines should be embedded below a 1:1 plane extending up from the bottom edge of the utility trench.

Settlement

The footings should be designed based on a very low-expansive soils condition. Total and differential settlement, due to static loads, is not expected to exceed about 2.7 and 1.35 inches, respectively, for the proposed improvements supported on footings, provided that the foundations are designed and constructed as recommended.

As mentioned in Section 4.3.4 “*Dry Sand Settlement*”, the footing foundations for buildings ‘B’ and ‘C’ should be designed to accommodate a seismic total and differential settlement of approximately ½ and ¼ inch, respectively. The rest of the buildings and structures on site need not take seismic settlement

into account. Static and seismic settlements should be combined in accordance with applicable codes such as ASCE 7-22.

#### Lateral Capacity

Lateral loads may be resisted by friction between the bottom of the footings and the supporting subgrade, and by passive soil pressure acting against the footings cast neat in foundation excavations or backfilled with properly compacted structural fill. A coefficient of friction of 0.4 may be assumed for design for footings supported on compacted fill. We recommend an equivalent fluid pressure of 500 pounds per cubic foot for ultimate passive soil resistance and not to exceed 2,000 pounds per cubic foot, where appropriate. The upper foot of passive soil resistance should be neglected where soil adjacent to the footing is not covered and protected by a concrete slab or pavement. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

#### General Structural Design

We recommend that foundations be reinforced with a minimum 2, No. 4 rebar both top and bottom steel, to provide structural continuity and to permit spanning of local irregularities.

### **6.3 Interior Slab-on-grade**

#### General Recommendations

Interior concrete slab-on-grade may be used along with footings. Interior slabs on grade should be at least 4 inches thick, and they may be dwelled into the foundation system in habitable areas. Concrete slabs should be reinforced with at least No. 3 rebar at 18 inches on-center in both directions for very low expansive soil. All slab reinforcement should be properly positioned at mid-height in the slab during placement of concrete. A uniform modulus of subgrade reaction ( $K_v$ ) of 30 pounds per cubic inch

(pci) may be assumed for slab-on-grade design. We note that a uniform 8-inch PT slab poured monolithically with deepened footings/grade beams would be considered a post-tension mat foundation with stiffening grade beams.

### Underlayment

In areas where dampness of concrete floor slabs would be undesirable, such as habitable building interior, concrete slabs should be underlain by a minimum 10 mil vapor barrier sandwiched between two (2) one-inch imported sand layers. This vapor barrier shall be lapped and sealed (especially around the utility perforations) adequately to provide a continuous waterproof barrier under the entire slab. To reduce vapor transmission up through concrete slabs, the vapor barrier should be high quality, UV-resistant conforming to the requirements of ASTM E 1745 Class A, with a water vapor transmission rate less than or equal to 0.01 perms (such as 15-mil thick “Stego Wrap Class A”). The vapor barrier should be installed in accordance with ASTM E 1643. All seams and penetrations of the vapor barrier should be sealed in accordance with manufacturer’s recommendations.

### Water: Cement Ratio

The permeability of concrete is affected significantly by the water:cement ratio of the concrete mix, with lower water:cement ratios producing more damp-resistant slabs and stronger concrete. Where moisture protection is important such as basements below water table, the structural engineer should choose an appropriate water:cement ratio for concrete slabs. Other steps that may be taken to reduce moisture transmission through the concrete slabs include moist curing for 5 to 7 days and allowing the slab to dry for a period of two months or longer prior to placing floor coverings. Also, prior to installation of the floor covering, it may be appropriate to test the slab moisture content for adherence to the manufacturer’s requirements and to determine whether a longer drying time is necessary. Where the concrete will be placed directly on the vapor barrier, the structural engineer should choose an appropriate water:cement ratio in order to avoid potential effects of slab curling,

crusting and cracking. To increase the workability of the concrete, mid-range plasticizers can be added to the mix. Water should not be added to the concrete mix unless the slump is less than specified and the water:cement ratio will not exceed the design value.

#### Subgrade Preparation

The subgrade soils below concrete flatwork areas to a minimum depth of 18 inches should be compacted to a minimum relative compaction of 90 percent at or slightly above the optimum moisture content. Pre-saturation of the subgrade below slabs will not be required; however, prior to placing concrete, the subgrade below all dwelling and garage floor slab areas should be thoroughly moistened to achieve a moisture content that is at least equal to or no more than 6 percent greater than optimum moisture content to a minimum depth of 12 inches below the bottoms of the slabs.

#### Post-Tensioned Design

Post-tensioned slabs should be designed in accordance with the recommendations of the Post-Tensioning Institute. Based on review of laboratory data for the on-site materials, the on-site materials have a very low expansion index. Deepened footings/edges around the slab perimeter must be used to minimize non-uniform surface moisture migration (from an outside source) beneath the slab. An edge depth of at least 8 inches should be considered. The bottom of the deepened footing/edge should be designed to resist tension, using cable or reinforcement per the Structural Engineer. Specific recommendations for Post Tension Institute methods are presented below.

Post-tensioned slabs should be designed in accordance with the recommendations of the Post-Tensioning Institute. Post-tensioned slabs should have sufficient stiffness to resist excessive bending due to non-uniform swell and shrinkage of subgrade soils. The differential movement can occur at the corner, edge, or center of slab. The potential for differential uplift can be evaluated using the design specifications of the

Post-Tensioning Institute. The following table presents suggested minimum coefficients to be used in the Post-Tensioning Institute design method.

<b>TABLE 4 SUGGESTED PT SLAB DESIGN COEFFICIENTS</b>	
<b>Description</b>	<b>Value</b>
Thornthwaite Moisture Index	-20 in/year
Depth to Constant Soil Suction	9 feet
Constant Soil Suction (pf)	3.9

The coefficients are considered minimums and may not be adequate to represent worst case conditions such as adverse drainage, excess watering, and/or improper landscaping and maintenance. The above parameters are applicable provided structures have gutters and downspouts, yard drains, and positive drainage is maintained away from structure perimeters. Also, the values may not be adequate if the soils below the foundation become saturated or dry such that shrinkage occurs. The parameters are provided with the expectation that subgrade soils below the foundations are maintained in a relatively uniform moisture condition. Responsible irrigation of landscaping adjacent to the foundation must be practiced since over-irrigation of landscaping can cause problems. Therefore, it is important that information regarding drainage, site maintenance, settlements and effects of expansive soils be passed on to future homeowners.

Based on the above parameters, the following preliminary values were obtained from the Post Tension Institute Design manual. If a stiffer slab is desired, higher values of  $y_m$  may be warranted. Please note that we will revise the following preliminary PT slab design values after rough grading in our final compaction report upon some additional testing of the compacted fill.

<b>Description</b>	<b>Value</b>
Soil Subgrade Expansion Index	Very Low
$e_m$ center lift	9.0 ft
$e_m$ edge lift	4.7 ft
$Y_m$ center lift	0.25 in
$Y_m$ edge lift	0.45 in

## **6.4 Exterior Slabs-on-grade**

### Subgrade Preparation

To reduce the potential for distress to exterior concrete flatwork, the subgrade soils below concrete flatwork areas to a minimum depth of 12 inches (or deeper, as either prescribed elsewhere in this report or determined in the field) should be moisture conditioned to at least equal to, or slightly greater than, the optimum moisture content and then compacted to a minimum relative compaction of 90 percent.

As a further measure to reduce the potential for concrete flatwork cracking, subgrade soils should be thoroughly moistened prior to placing concrete. The moisture content of the soils should be at least the optimum moisture content to a minimum depth of 18 inches into the subgrade. Flooding or ponding of the subgrade is not considered feasible to achieve the above moisture conditions since this method would likely require construction of numerous earth berms to contain the water. Therefore, moisture conditioning should be achieved with sprinklers, or a light spray applied to the subgrade over a period of few to several days just prior to pouring concrete. Pre-watering of the soils is intended to promote uniform curing of the concrete, reduce the development of shrinkage cracks and reduce the potential for differential expansion pressure on freshly poured flatwork. A representative of the project geotechnical consultant should observe and verify the density and moisture content of the soils, and the depth of moisture penetration prior to pouring concrete.

### Drainage

Drainage from patios and other flatwork areas should be directed to local area drains and/or graded earth swales designed to carry runoff water to the adjacent streets or other approved drainage structures. The concrete flatwork should be sloped at a minimum gradient of one percent, or as prescribed by project civil engineer or local codes, away from building foundations, retaining walls, masonry garden walls and slope areas.

### Thickened Edge

To improve performance, exterior slabs-on-grade may be constructed with a thickened edge to improve edge stiffness and to reduce the potential for water seepage under the edge of the slabs and into the underlying base and subgrade. In our opinion, the thickened edges should be at least 8 inches wide and ideally should extend at least 8 inches below the bottom of the slab.

## **6.5 Pavement Sections**

### 6.5.1 Asphalt Concrete

Based on the materials encountered in our borings and laboratory test results, it is our opinion that an R-value of 53 is appropriate for the design of the parking area and drive isle pavements.

Using estimated Traffic Indices for various pavement loading conditions, we calculated the minimum pavement section thicknesses presented in the table below based on the pavement design procedure described in Chapter 630 of the Caltrans Highway Design Manual for design life of 20-year. We note that it is the civil engineer's responsibility to choose an appropriate traffic index for various pavement systems. Any local jurisdiction minimum pavement sections should be followed.

TABLE 6 MINIMUM PAVEMENT SECTION THICKNESSES		
Traffic Index	Asphalt Thickness (in)	Aggregate Thickness (in)
4	3.00	4.00
4.5	3.00	4.00
5	3.00	4.00
5.5	3.00	4.00
6	3.50	4.00
7	4.00	4.00
8	5.00	4.50
9	5.50	5.50
10	6.50	6.00

If the pavements are constructed in two stages, the above table provides the minimum pavement section, and for any traffic index, pavements should not have less than 4 inches AC over 4 inches of AB, and the initial course graded AC (Binder) layer for construction traffic should not have less than 2.5 inches thickness, while the final fine-grained AC (Surface) layer, should not have less than 1.5 inches thickness. We note that constructing pavements in two stages may pose some hazards for the overall performance of pavement due to heavy construction equipment traffic on the relatively thin initial layer. Any driveway shoulder should have at least 4 inches of AC over 4 inches of AB.

The Asphalt Concrete pavements may be underlain by approximately 3 feet of compacted fill to a minimum relative compaction of 90 percent. Subgrade soils immediately below the aggregate base, to a minimum depth of 12 inches, should be compacted to a minimum relative compaction of 95 percent based on ASTM D1557. Final subgrade compaction should be performed prior to placing base materials and after utility-trench backfills have been compacted and tested.

Asphalt concrete and aggregate base should conform to and be placed in accordance with the requirements of the Caltrans Standard Specifications, latest edition, except that compaction of subgrades and aggregate base material should be based on ASTM Test D1557. The base course should be

compacted to 95 percent or more of the maximum dry density as evaluated by ASTM D1557. The base materials should also meet the specifications for Crushed Aggregate Base, Crushed Miscellaneous Base or Processed Miscellaneous Base as defined in Section 200-2 of the current edition of the Standard Specifications for Public Works Construction (Greenbook).

AC Paving:

Prime coat may be omitted if all of the following conditions are met:

1. The asphalt pavement layer is placed within two weeks of completion of base and/or subbase course.
2. Traffic is not routed over completed base before paving.
3. Construction is completed during the dry season of May through October.
4. The base is free of dirt and debris.

If construction is performed during the wet season of November through April, prime coat may be omitted if no rain occurs between completion of base course and paving, and the time between completion of base and paving is reduced to three days, provided the base is free of dirt and debris. Where prime coat has been omitted and rain occurs, traffic is routed over base course, or paving is delayed, measures shall be taken to restore base course, subbase course, and subgrade to conditions that will meet specifications as directed by the geotechnical engineer.

We recommend that measures be taken to limit the amount of surface water that seeps into the aggregate base and subgrade below vehicle pavements, particularly where the pavements are adjacent to landscape areas. Seepage of water into the pavement base material can soften the subgrade, thereby increasing the amount of pavement maintenance that is required and shortening the pavement service life. Deepened curbs extending 4-inches

below the bottom of the aggregate base layer are generally effective in limiting excessive water seepage below the edges of pavement and into the subgrade. Other types of water cutoff devices or edge drains may also be considered to maintain pavement service life.

#### 6.5.2 Rigid Concrete Pavements

If any portion will be constructed with Portland cement concrete (PCC), we recommend the pavement consist of at least 4 inches of PCC over 3 feet of fill compacted to a minimum relative compaction of 90 percent. Subgrade soils immediately below the PCC, to a minimum depth of 12 inches, should be compacted to a minimum relative compaction of 95 percent based on ASTM D1557. Un-reinforced concrete for the 6-inch-thick driveway pavement should have a 28-day compressive strength of at least 3,500 psi. PCC pavements should be laterally constrained with curbs or shoulders and sufficient control joints should be incorporated in the design and construction to limit and control cracking.

The soil subgrade and aggregate base below the pavement section should be prepared and compacted as recommended above. The use of a moisture cut-off or thickened edge along the edges of the driveway would be desirable in order to reduce water seepage below the edges of the driveway and into the underlying aggregate base and subgrade, which can lead to premature pavement distress.

### 6.6 Infiltration Testing

An infiltration trench is proposed along the southern border of the site and will consist of an area approximately five (5) feet deep. This trench will lead into a proposed infiltration basin located on the eastern corner of the property. This basin will consist of an area approximately eight (8) feet deep. The final design of the systems should be reviewed by this office. Three infiltration tests were performed, two along the

proposed trench (B-6 and B-7) and one within the proposed basin (B-8). Three 8-inch diameter borings (B-6, B-7, and B-8) were excavated to depths ranging between 5 and 10 feet. Infiltration testing was performed in accordance with San Bernardino County requirements and the results are presented in Appendix C.

Consolidation tests were performed on samples obtained from the above borings and the results are presented in Appendix B. The test results indicate a potential for hydro consolidation. Please refer to Section 4.4 “*Hydro Collapse*” for details regarding potential settlement.

No groundwater was encountered during the excavations. The borings were presoaked prior to the infiltration testing. The result of percolation rate without factor of safety is included in below table, and a minimum factor of safety of 2 should be considered for design purposes. The infiltration rate below for the proposed trench is the average of the two tests performed along the trench.

TABLE 7 PERCOLATION TEST RESULTS	
TEST LOCATION	RATE (Inches per hour)
Infiltration Trench (B-6 & B-7)	1.06
Infiltration Basin (B-8)	7.85
Note: This rate does not include the correction factor	

It is our professional opinion that the site is suitable for the proposed storm water infiltration systems.

## 6.7 Corrosion Characteristics of Soil

As a screening level study, limited chemical and electrical tests were performed by Earth System Consultants on samples considered representative of the onsite soils to identify potential corrosive characteristics of these soils (See Appendix A). The common indicators that are generally associated with soil corrosivity, among other indicators, include water-soluble sulfate (a measure of soil corrosivity on concrete), water-soluble chloride (a measure of soil corrosivity on metals embedded in concrete),

pH (a measure of soil acidity), and minimum electrical resistivity (a measure of corrosivity on metals embedded in soils).

It should be noted that GSC does not practice corrosion engineering; therefore, the test results, opinion and engineering judgment provided herein should be considered as general guidelines only. Additional analyses, and/or determination of other indicators, would be warranted, especially for cases where buried metallic building materials (such as copper and cast or ductile iron pipes) in contact with site soils are planned for the project. In many cases, the project geotechnical engineer may not be informed of these choices. Therefore, for conditions where such elements are considered, we recommend that other, relevant project design professionals (e.g., the architect, landscape architect, civil and/or structural engineer, etc.) to be involved. We also recommend considering a qualified corrosion engineer to conduct additional sampling and testing of near-surface soils during the final stages of site grading to provide a complete assessment of soil corrosivity. Recommendations to mitigate the detrimental effects of corrosive soils on buried metallic and other building materials that may be exposed to corrosive soils should be provided by the corrosion engineer as deemed appropriate.

In general, a soil's water-soluble sulfate levels and pH relate to the potential for concrete degradation; water-soluble chlorides in soils impact ferrous metals embedded or encased in concrete, e.g., reinforcing steel; and electrical resistivity is a measure of a soil's corrosion potential to a variety of buried metals used in the building industry, such as copper tubing and cast or ductile iron pipes. T presents test results with an interpretation of current code approach and guidelines that are commonly used in the building construction industry. The table includes the code-related classifications of the soils as they relate to the various tests, as well as a general recommendation for possible mitigation measures in view of the potential adverse impact of corrosive soils on various components of the proposed structures in direct contact with site soils. The guidelines provided herein should be evaluated and

confirmed, or modified, in their entirety by the project structural engineer, corrosion engineer and/or the contractor responsible for concrete placement for structural concrete used in the project.

TABLE 8 SOIL CORROSIVITY SCREENING RESULTS				
Test (Test Method Designation)	Test Location	Test Results	Classification	General Recommendations
Soluble Sulfate (Cal 417)	B-2 @ 5'-7.5'	189 ppm	<b>S0<sup>(1)</sup> - Not Applicable</b>	Type II cement; minimum $f'_c = 2,500$ psi <sup>(2)</sup> ; no water/cement ratio restrictions.
pH (Cal 643)	B-2 @ 5'-7.5'	8.0	<b>Moderately Alkaline</b> <sup>(3)</sup>	No special recommendations
Soluble Chloride (Cal 422)	B-2 @ 5'-7.5'	182 ppm	<b>C1 – Moderate</b> <sup>(3)</sup>	Residence: No special recommendations; $f'_c$ should not be less than 2,500 psi.
Resistivity (Cal 643)	B-2 @ 5'-7.5'	1,000 ohm-cm	<b>Highly Corrosive</b> <sup>(4)</sup>	If metal utilities are buried, consult a corrosion engineer.
Notes: 1. ACI 318-14, Section 19.3 2. $f'_c$ , 28-day unconfined compressive strength of concrete 3. ACI 318-14, Section 19.3 4. Pierre R. Roberge, "Handbook of Corrosion Engineering"				

## 6.8 Grading

Grading of the site will consist of a removal and recompacting operation of the existing near surface material to create level pads and associated streets. We offer the following recommendations and construction considerations concerning earthwork grading at the site.

### 6.8.1 General

Monitoring: We recommend that all earthwork (i.e., clearing, site preparation, fill placement, etc.) should be conducted with engineering control under observation and testing by the Geotechnical Engineer and in accordance with the requirements within the *Grading* section of this report.

Job Site Safety: At all times, safety should have precedence over production work. If an unsafe job condition is observed, it should be brought to the attention of the grading contractor or the developer's representative. Once this condition is noted, it should be corrected as soon as possible, or work related to the unsafe condition should be terminated.

The contractor for the project should realize that services provided by GSC do not include supervision or direction of the actual work performed by the contractor, his employees, or agents. GSC will use accepted geotechnical engineering and testing procedures; however, our testing and observations will not relieve the contractor of his primary responsibility to produce a completed project conforming to the project plans and specifications. Furthermore, our firm will not be responsible for job or site safety on this project, as this is the responsibility of the contractor.

#### 6.8.2 Site Preparation

Existing Structure Location: The General Contractor should locate all surface and subsurface structures on the site or on the approved grading plan prior to preparing the ground.

Existing Structure Removal: Any underground structures (e.g., septic tanks, wells, pipelines, foundations, utilities, etc.) that have not been located prior to grading should be removed or treated in a manner recommended by the Geotechnical Engineer.

Clearing and Stripping: The construction areas should be cleared and stripped of all vegetation, trees, bushes, sod, topsoil, artificial fill, debris, asphalt, concrete, and other deleterious material prior to fill placement.

Removals: Please refer to the *Removals* section of this report for specific recommendations for removals.

Subgrade Preparation: We recommend that the subgrade for those areas receiving any fill be prepared by scarifying the upper 12 inches and moisture conditioning, as required to obtain at least optimum moisture, but not greater than 120 percent of optimum. The scarified areas shall be compacted to at least 90 percent of the maximum laboratory density, as determined by ASTM D-1557-12 compaction method. All areas to receive fill should be observed by the Geotechnical Engineer prior to fill placement.

Subgrade Verification and Compaction Testing: Regardless of material or location, all fill material should be placed over properly compacted subgrades in accordance with this section. The condition of all subgrades shall be verified by the Geotechnical Engineer before fill placement or earthwork grading begins. Earthwork monitoring and field density testing shall be performed during grading to provide a basis for opinions concerning the degree of soil compaction attained. The Contractor should be responsible for notifying the Geotechnical Engineer when such areas are ready for inspection. Inspection of the subgrade may also be required by the controlling governmental agency within the respective jurisdictions. Density tests should also be made on the prepared subgrade to receive fill, unless the areas are underlain by dense alluvium, as required by the Geotechnical Engineer.

### 6.8.3 Fill Placement

Laboratory Testing: Representative samples of materials to be utilized as compacted fill should be analyzed in a laboratory to determine their physical properties. If any material other than that previously tested is encountered during grading, the appropriate analysis of this material should be conducted.

On-Site Fill Material: The on-site soils, in our opinion, are adequate for re-use in controlled fills provided the soils do not contain any organic matter, debris, and that over-sized rocks are buried in accordance with the recommendations under *Rock Fragments*.

Rock Fragments: The alluvium on the site should be free of oversized rocks. Any rock fragments over 6 inches should be kept below a depth of 5 feet below proposed grade. Rocks greater than 6 inches in diameter should be taken off site or placed in accordance with the recommendations of the Geotechnical Engineer. Rocks greater than 6 inches in diameter shall be kept out of all street areas to a depth below the deepest proposed utility line. Rocks shall not be placed in concentrated pockets, shall be surrounded with fine grained material, and the distribution of the rocks shall be supervised by the Geotechnical Engineer. A sufficient amount of fine-grained material shall be placed around the rocks to prevent nesting and to fill all void space. An adequate amount of water will be required to force fines into any open voids.

Fill Placement: Approved on-site material shall be evenly placed, watered, processed, and compacted in controlled horizontal layers not exceeding eight inches in loose thickness, and each layer should be thoroughly compacted with approved equipment. The fill should be placed and compacted in horizontal layers, unless otherwise recommended by the Geotechnical Engineer.

Compaction Criteria - Shallow Fills: For fills less than 40 feet in vertical thickness, each layer shall be compacted to at least 90 percent of the maximum laboratory density for material used as determined by ASTM D-1557-12. The field density shall be determined by the ASTM D-1556-07 method or equivalent. Where moisture content of the fill or density testing yields compaction results less than 90 percent, additional compaction effort and/or moisture conditioning, as necessary, shall be performed, until the fill material is in accordance with the requirements of the Geotechnical Engineer.

Fill Material - Moisture Content: All fill material placed must be moisture conditioned, as required to obtain at least optimum moisture, but not greater than 120 percent. If excessive moisture in the fill results in failing results or an

unacceptable “pumping” condition, then the fill should be allowed to dry until the moisture content is within the necessary range to meet the required compaction requirements or reworked until acceptable conditions are obtained.

Keying and Benching: All fills should be keyed and benched through all topsoil, slopewash, alluvium or colluvium or creep material into firm material where the slope receiving fill is steeper than 5:1 (Horizontal: Vertical) or as determined by Geotechnical Engineer. The standard acceptable bench height is four feet into suitable material. The key for side hill fills should be a minimum of 15 feet within compacted fill or firm materials, with a minimum toe embankment of 2 feet into compacted fill, unless otherwise specified by the Geotechnical Engineer.

Slope Face - Compaction Criteria: The Contractor should be required to obtain a minimum relative compaction of 90 percent out to the finish slope face of fill slopes. This may be achieved by either overbuilding the slope a minimum of five feet, and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment, or by any other procedure which produces the required compaction. If the method of achieving the required slope compaction selected by the Contractor fails to produce the necessary results, the Contractor should rework or rebuild such slopes until the required degree of compaction is obtained, at no additional cost to the Owner or Geotechnical Engineer. Slope testing will include testing the outer 6 inches to 3 feet of the slope face during and after placement of the fill. In addition, during grading, density tests will be taken periodically on the flat surface of the fill three to five feet horizontally from the face of the slope.

Slope Face - Contractor’s Responsibility: The Contractor should prepare a written detailed description of the method or methods he would employ to obtain the required slope compaction. Such documents should be submitted

to the Geotechnical Engineer for review and comments prior to the start of grading.

Slope Face - Vegetation: All fill slopes should be planted or protected from erosion by methods specified in the geotechnical report or required by the controlling governmental agency.

Density Testing Intervals: In general, density tests should be conducted at minimum intervals of 2 feet of fill height or every 500 to 1,000 cubic yards. Due to the variability that can occur in fill placement and different fill material characteristics, a higher number of density tests may be warranted to verify that the required compaction is being achieved.

Grading Control: Earthwork monitoring and field density testing shall be performed by the Geotechnical Engineer during grading to provide a basis for opinions concerning the degree of soil compaction attained. The Contractor should receive a copy of the Geotechnical Engineer's *Daily Field Engineering Report* which will indicate the results of field density tests for that day. Where failing tests occur or other field problems arise, the Contractor shall be notified of such conditions by written communication from the Geotechnical Engineer in the form of a conference memorandum, to avoid any misunderstanding arising from oral communication.

Drainage Devices: Drainage terraces should be constructed in compliance with the ordinances of controlling governmental agencies, or with the recommendations of the Geotechnical Engineer or Engineering Geologist.

#### 6.8.4 Construction Considerations

Erosion Control: Erosion control measures, when necessary, should be provided by the Contractor during grading and prior to the completion and construction of permanent drainage controls.

Compaction Equipment: It is also the Contractor's responsibility to have suitable and sufficient compaction equipment on the project site to handle the amount of fill being placed and the type of fill material to be compacted. If necessary, excavation equipment should be shut down to permit completion of compaction in accordance with the recommendations contained herein. Sufficient watering devices/equipment should also be provided by the Contractor to achieve optimum moisture content in the fill material.

Final Grading Considerations: Care should be taken by the Contractor during final grading to preserve any berms, drainage terraces, interceptor swales, or other devices of a permanent nature on or adjacent to the property.

#### 6.8.5 Temporary Excavation

Where the necessary space is available, temporary unsurcharged embankments may be sloped back without shoring. The slope should not be cut steeper than the following gradient:

<b>TABLE 9 TEMPORARY EXCAVATION SLOPE</b>	
<b>Height</b>	<b>Temporary Gradient (Horizontal:Vertical)</b>
0 - 5'	Near Vertical
above 5'	1:1

In areas where soils with little or no binder are encountered, shoring or flatter excavation slopes shall be made. These recommended temporary excavation slopes do not preclude local ravelling or sloughing.

All applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health Act, and the Construction Safety Act should be met.

Where sloped embankments are used, the top of the slope should be barricaded to prevent equipment and heavy storage loads within five feet of the top of the slope. If the temporary construction embankments are to be maintained for long periods, berms should be constructed along the top of the slope to prevent runoff water from eroding the slope faces. The soils exposed in the temporary backcut slopes during excavation should be observed by our personnel so that modifications of the slopes can be made if variations in the soil conditions occur. The temporary excavation slopes should be supported within three weeks.

#### 6.8.6 Excavation Observation

All footing and other excavations should be observed by an Engineering Geologist or Geotechnical Engineering prior to placement of any steel to verify that the proper foundation material has been encountered. The County Inspector should also observe the excavation.

#### 6.8.7 Utility Trenching and Backfill

Utility Trenching: Open excavations and excavations that are shored shall conform to all applicable Federal, State, and local regulations.

Backfill Placement: Approved on-site or imported fill material shall be evenly placed, watered, processed, and compacted in controlled horizontal layers not exceeding eight inches in loose thickness, and each layer should be thoroughly compacted with approved equipment. All fill material should be moisture conditioned, as required to obtain at least optimum moisture, but not greater than 120 percent of optimum moisture content. The fill should be placed and compacted on a horizontal plane, unless otherwise recommended by the Geotechnical Engineer.

As an alternative to on-site or imported fill material, for shallow trenches where pipe or utility lines may be damaged by mechanical compaction equipment, such as under building floor slabs, imported clean sand having a sand equivalent (SE) value of 30 or greater may be utilized. The sand backfill materials should be watered to achieve near optimum moisture conditions and then tamped into place. No specific relative compaction will be required; however, observation, probing, and if deemed necessary, testing should be performed by a representative of the project geotechnical consultant to verify an adequate degree of compaction.

Backfill Compaction Criteria: Each layer of utility trench backfill shall be compacted to at least 90 percent of the maximum laboratory density determined by ASTM D-1557-12. The field density shall be determined by the ASTM D-1556-07 method or equivalent. Where moisture content of the fill or density testing yields compaction results less than 90 percent, additional compaction effort and/or moisture conditioning, as necessary, shall be performed, until the compaction criteria is reached.

Exterior Trenches Adjacent to Footings: Exterior trenches, paralleling a footing and extending below a 1H:1V plane projected from the outside bottom edge of the footing, should be compacted to 90 percent of the laboratory standard. Sand backfill, unless it is similar to the in-place fill, should not be allowed in the trench backfill areas. Density testing, along with probing, should be accomplished to verify the desired results.

Pipe Bedding: We recommend that a minimum of 6 inches of bedding material should be placed in the bottom of the utility trench. All bedding materials shall extend at least 4 inches above the top of utilities which require protection during subsequent trench backfilling. All trenches shall be wide enough to allow for compaction around the haunches of the pipe.

Groundwater Migration: Backfilled utility trenches may act as French drains to some extent, and considerable groundwater flow along utility bedding and backfill should be expected. Wherever buried utilities, or structures which they may intersect, could be adversely affected by such drainage, provisions shall be made to collect groundwater migrating along the trench lines. These situations include where buried utilities enter buildings, particularly where they enter below grade mechanical rooms, and where buried utilities enter junction boxes or switching stations that are intended to remain dry. Mitigation measures include, but are not limited to, placement of perforated drainpipes below and continuous with bedding materials, and placement of seepage barriers such as lean mix concrete or controlled density fill (CDF).

## **7.0 CLOSURE**

We appreciate this opportunity to be of continued service to you. If you have any questions regarding the content of this report or any other aspects of the project, please do not hesitate to contact us.

April 3, 2024  
W.O. 7930

## **REFERENCES**

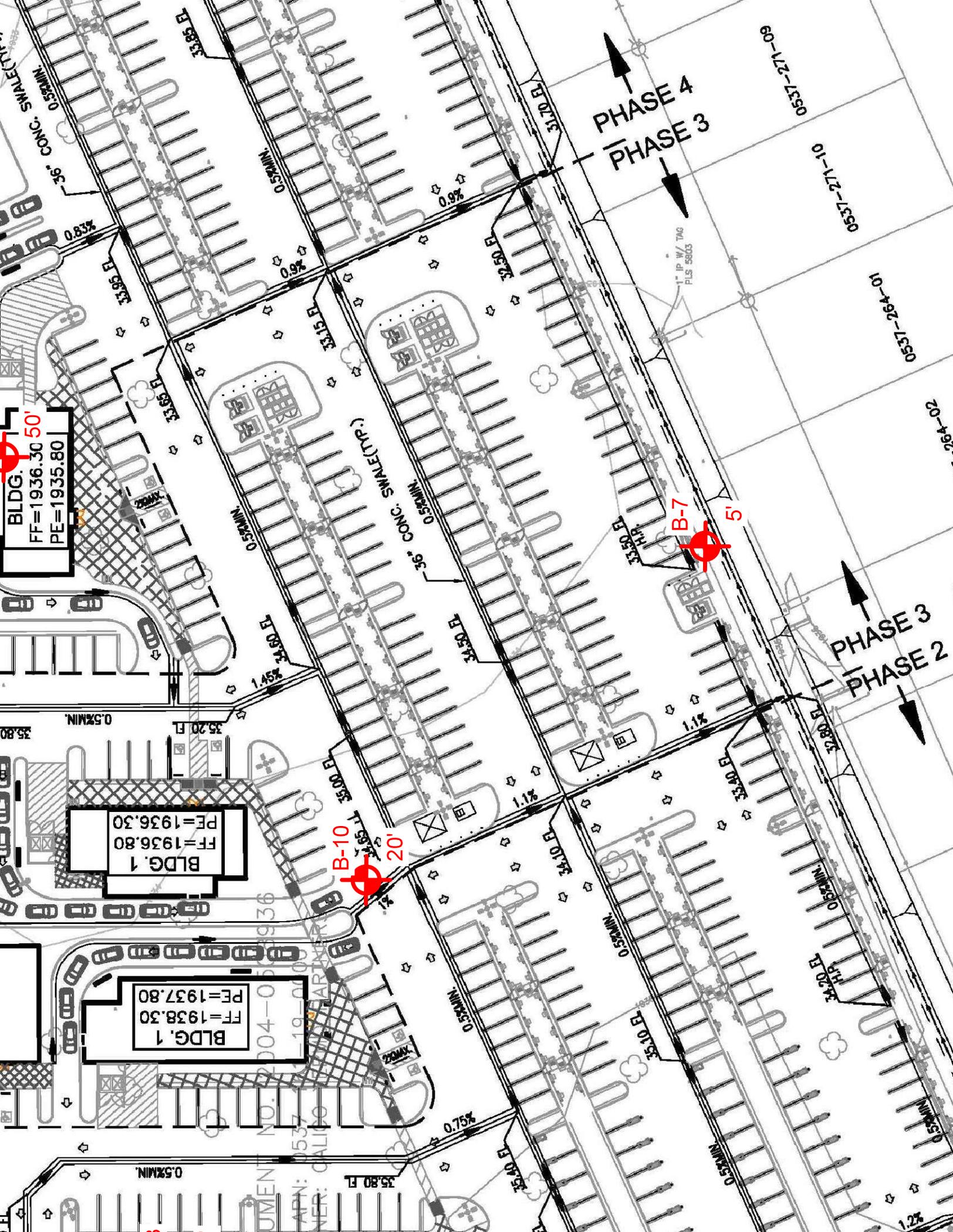
ACI 302.1R-15, Guide to Concrete Floor and Slab Construction.

ASCE/SEI 7-22, Minimum Design Loads and Associated Criteria For Buildings and Other Structures, American Society of Civil Engineers

California Building Code (CBC), 2022, California Code of Regulations, Title 24, Part 2, Volume I and II.

California Geological Survey (2008), Guidelines for Evaluating and Mitigating Seismic Hazards in California, Special Publication 117A.

MDN 24098



BLDG. 1  
FF=1936.30  
PE=1935.80

BLDG. 1  
FF=1936.80  
PE=1936.30

BLDG. 1  
FF=1938.30  
PE=1937.80

B-10  
20'

B-7  
5'

B-5

PHASE 4  
PHASE 3

PHASE 3  
PHASE 2

PERMITS NO. 2004-05-1936  
APRN: 0537  
LIC. NO. 19000  
CITY OF CALIFORNIA

1" IP W/ TAG  
PLS 5803

0537-271-09

0537-271-10

0537-264-01

064-02

12%

April 3, 2024  
W.O. 7930

**APPENDIX A**  
**EXPLORATION DATA**

MDN 24098

# GEOTECHNICAL BORING LOG

<b>PROJECT NAME</b>	<b>Ringle</b>		<b>W.O.</b>	<b>7930</b>
DRILLING COMPANY	Choice	DATE STARTED	2/20/2024	BORING NO. B-1
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RG	SHEET
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140	GROUND ELEV.
DIAMETER OF HOLE (IN)	8	DROP (IN)	30	GW ELEV.

Boring Location:

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
0			<b>0-20', ALLUVIUM (Qa)</b>			
	[California Ring]	23/29/25	2.5', Light gray to light reddish brown sand, fine to medium grained, dense, dry	1.1	113.0	
5	[California Ring]	13/13/14	5', Light brown to reddish brown, silty sand, fine to medium grained, dense, slightly moist	6.7		
	[California Ring]	12/14/12	7.5', Light brown to light reddish brown sand, fine to coarse grained, dense, slightly moist, no recovery			
10	[California Ring]	6/6/0	10', Light gray to light brown sand with gravel, fine to coarse grained, moderately dense dry	1.1		
	[California Ring]	25/26/36	12.5', Light gray to light reddish brown sand with gravel, fine to coarse grained, dense, dry	1.6	114.4	
15	[California Ring]	7/8/9	15', Light brown to light reddish brown sand with gravel, fine to coarse grained, moderately dense, dry	1.1		
20	[California Ring]	15/16/17	20', Light gray to light brown sand with gravel, dense, dry, fine to coarse grained	1.2		
			TD=20' No groundwater			
25						
30						

**LEGEND**

- Standard Penetration Test
- California Ring
- Rock Core
- Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-1**



# GEOTECHNICAL BORING LOG

<b>PROJECT NAME</b>	<b>Ringle</b>		<b>W.O.</b>	<b>7930</b>
DRILLING COMPANY	Choice	DATE STARTED	2/19/2024	BORING NO. B-2
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RG	SHEET
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140	GROUND ELEV.
DIAMETER OF HOLE (IN)	8	DROP (IN)	30	GW ELEV.

Boring Location:

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
0			<b>0-50', ALLUVIUM (Qa)</b>			
	[California Ring]	7/8/9	2.5', Light brown, fine to medium grained sand, slightly dense, slightly moist	10.4	104.0	
5	[California Ring]	2/4/4	5', Light brown to light grayish sand, fine to coarse grained, slightly dense to loose, slightly moist	3.1		
	[California Ring]	11/21/34	7.5', Light gray to light orange brown sand, fine to coarse grained, dense, slightly moist	3.6	109.9	
10	[California Ring]	3/6/7	10', Light gray to light orange brown sand, fine to coarse grained, slightly dense to dense, dry	1.0		
	[California Ring]	20/32/35	12.5', Light gray to light reddish brown sand, fine to coarse grained, moderately dense, dry	0.9	119.5	
15	[California Ring]	12/14/16	15', Reddish brown sand, fine grained, dense, slightly moist	2.7		
20	[California Ring]	9/11/14	20', Light gray to reddish brown sand, fine to coarse grained, dense, slightly moist	4.8		
25	[California Ring]	11/11/15	25', Light gray sand, fine to medium grained, slightly moist	6.0		
30	[California Ring]	11/25/30	30', Light brown sand, fine to medium grained, dense, slightly moist			

**LEGEND**

- Standard Penetration Test
- California Ring
- Rock Core
- Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-2**



# GEOTECHNICAL BORING LOG

<b>PROJECT NAME</b>	<b>Ringle</b>	<b>W.O.</b>	<b>7930</b>
DRILLING COMPANY	Choice	DATE STARTED	2/19/2024
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RG
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140
DIAMETER OF HOLE (IN)	8	DROP (IN)	30
		BORING NO.	B-2
		SHEET	
		GROUND ELEV.	
		GW ELEV.	

Boring Location:

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
35	☒	17/21/22	35', Light gray to light brown sand, fine to medium grained, moderately dense, slightly moist			
40	☒	17/50 for 6	40', Light gray to light brown sand, fine to coarse grained, moderately dense to very dense, slightly moist			
45	☒	18/30/30	45', Light gray to light brown, very dense, slightly moist, fine to medium grained			
50	☒	40/50 for 6	50', Light gray to light brown sand with pebbles, fine to coarse grained, very dense, slightly moist			
			TD=50' No groundwater			
55						
60						
65						

**LEGEND**

- Standard Penetration Test
- California Ring
- Rock Core
- Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-3**



# GEOTECHNICAL BORING LOG

<b>PROJECT NAME</b>	<b>Ringle</b>	<b>W.O.</b>	<b>7930</b>
DRILLING COMPANY	Choice	DATE STARTED	2/19/2024
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RG
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140
DIAMETER OF HOLE (IN)	8	DROP (IN)	30
Boring Location:		BORING NO.	B-3
		SHEET	
		GROUND ELEV.	
		GW ELEV.	

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
0			<b>0-50', ALLUVIUM (Qa)</b>			
		8/8/9	2.5', Light gray sand, fine to medium grained, slightly dense, slightly moist	6.0		
5		21/41/45	5', Light brown sand, fine to medium grained, very to dense, slightly moist	6.0	110.6	
		6/10/11	7.5', Light brown sand, fine to medium grained, dense, slightly moist	5.6		
10		12/32/50	10', Light brown to light gray sand, fine to coarse grained, dense, dry	0.8	113.7	
		5/12/20	12.5', Light brown to light gray sand, fine to coarse grained, dense, dry	1.5		
15		20/50 for 5"	15', Light brown sand with pebbles, fine to coarse grained, slightly dense, dry	1.6	115.6	
20		12/14/16	20', Light brown sand with pebbles, fine to coarse grained, slightly dense, dry	0.8		
25		14/20/22	25', Light brown sand with pebbles, fine to coarse grained, slightly to moderately dense, dry	1.6		
30		12/13/13	30', Light gray, silty sand, fine to medium grained, slightly dense, slightly moist			

**LEGEND**

-  Standard Penetration Test
-  California Ring
-  Rock Core
-  Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-4**



# GEOTECHNICAL BORING LOG

<b>PROJECT NAME</b>	<b>Ringle</b>	<b>W.O.</b>	<b>7930</b>
DRILLING COMPANY	Choice	DATE STARTED	2/19/2024
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RG
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140
DIAMETER OF HOLE (IN)	8	DROP (IN)	30
		BORING NO.	B-3
		SHEET	
		GROUND ELEV.	
		GW ELEV.	

Boring Location:

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
35	☒	13/16/25	35', Light brown sand, fine to medium grained, dense, slightly moist			
40	☒	13/23/30	40', Light brown to light gray sand, fine to coarse grained, very dense, slightly moist			
45	☒	14/13/23	45', Light brown to light gray sand, fine to coarse grained, dense, slightly moist			
50	☒	13/27/30	50', Light reddish brown to light gray, fine to coarse grained, very dense, slightly moist			
			TD=50' No groundwater			
55						
60						
65						

**LEGEND**

- Standard Penetration Test
- California Ring
- Rock Core
- Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-5**



# GEOTECHNICAL BORING LOG

<b>PROJECT NAME</b>	<b>Ringle</b>	<b>W.O.</b>	<b>7930</b>
DRILLING COMPANY	Choice	DATE STARTED	2/19/2024
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RG
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140
DIAMETER OF HOLE (IN)	8	DROP (IN)	30
		BORING NO.	B-4
		SHEET	
		GROUND ELEV.	
		GW ELEV.	

Boring Location:

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
0			<b>0-50', ALLUVIUM (Qa)</b>			
		27/32/35	2.5', Light brown, silty sand, fine to medium grained, dense, slightly moist	5.2	103.5	
5		12/15/12	5', Light brown sand, fine to medium grained, dense, slightly moist	6.2		
		25/50 for 6	7.5', Light brown to light reddish brown sand, fine to coarse grained, very dense, slightly moist	4.4	112.0	
10		8/10/13	10', Light brown, silty sand, fine to medium grained, dense, slightly moist	6.4		
		12/32/46	12.5', Light brown to light reddish brown sand, fine to medium grained, moderately very dense, slightly moist	4.6	101.7	
15		6/14/18	15', Light brown sand, fine to medium grained, dense, slightly moist	3.3		
20		7/11/12	20', Light gray to light brown sand with pebbles, slightly dense, dry	0.8		
25		12/19/18	25', Light brown sand with gravel and pebbles, dense, dry	0.9		
30		13/21/28	30', Light gray to light brown sand, fine to medium grained, very dense, slightly moist			

**LEGEND**

-  Standard Penetration Test
-  California Ring
-  Rock Core
-  Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-6**



# GEOTECHNICAL BORING LOG

<b>PROJECT NAME</b>	<b>Ringle</b>	<b>W.O.</b>	<b>7930</b>
DRILLING COMPANY	Choice	DATE STARTED	2/19/2024
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RG
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140
DIAMETER OF HOLE (IN)	8	DROP (IN)	30
		GROUND ELEV.	
		GW ELEV.	

Boring Location:

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
35		16/20/16	35', Light brown, silty sand, fine to medium grained, dense, slightly moist			
40		13/17/26	40', Light brown, silty sand, fine to medium grained, dense, slightly moist			
45		16/25/30	45', Light brown to light gray sand, fine to coarse grained, very dense, slightly moist			
50		20/26/32	50', Light gray sand, fine to coarse grained, very dense, slightly moist			
55			TD=50' No groundwater			
60						
65						

**LEGEND**

-  Standard Penetration Test
-  California Ring
-  Rock Core
-  Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-7**



# GEOTECHNICAL BORING LOG

<b>PROJECT NAME</b>	<b>Ringle</b>	<b>W.O.</b>	<b>7930</b>
DRILLING COMPANY	Choice	DATE STARTED	2/19/2024
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RG
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140
DIAMETER OF HOLE (IN)	8	DROP (IN)	30
		BORING NO.	B-5
		SHEET	
		GROUND ELEV.	
		GW ELEV.	

Boring Location:

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
0			<b>0-20', ALLUVIUM (Qa)</b>			
	[X]	12/20/20	2.5', Light gray, silty sand, fine to medium grained, dense, slightly moist	4.9		
5	[//]	15/50 for 5"	5', Light brown, silty sand, fine to medium grained, moderately dense, slightly moist	7.6	90.8	
	[X]	10/11/12	7.5', Light brown to reddish brown, silty sand, fine to medium grained, slightly dense, slightly moist	6.4		
10	[//]	12/43/50 for 5"	10', Light gray to light reddish brown sand with gravel, fine to coarse grained, dense, slightly moist	5.7	106.2	
	[X]	12/12/11	12.5', Light brown sand, fine to coarse grained, slightly dense, slightly moist	4.5		
15	[//]	21/50 for 5"	15', Light brown to light reddish brown, dense, slightly moist, fine to coarse grained	3.8	100.7	
20	[X]	10/16/24	20', Light gray to light brown sand with gravel, fine to coarse grained, dense, slightly moist	3.00		
			TD=20' No groundwater			
25						
30						

**LEGEND**

- Standard Penetration Test
- California Ring
- Rock Core
- Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-8**



# GEOTECHNICAL BORING LOG

<b>PROJECT NAME</b>	<b>Ringle</b>	<b>W.O.</b>	<b>7930</b>
DRILLING COMPANY	Choice	DATE STARTED	2/19/2024
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RG
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140
DIAMETER OF HOLE (IN)	8	DROP (IN)	30
Boring Location:		GROUND ELEV.	
		BORING NO.	B-6
		SHEET	
		GW ELEV.	

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
0			<b>0-5', ALLUVIUM (Qa)</b>			
2.5	California Ring	25/50 for 6	2.5', Light gray to light brown sand, fine to coarse grained, dense, slightly moist	4.3	103.6	
5	Standard Penetration Test	6/8/2010	5', Light gray to light brown sand, fine to coarse grained, slightly dense, slightly moist  TD=5' No groundwater	10.00		
10						
15						
20						
25						
30						

**LEGEND**

- Standard Penetration Test
- California Ring
- Rock Core
- Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-9**



# GEOTECHNICAL BORING LOG

<b>PROJECT NAME</b>	<b>Ringle</b>	<b>W.O.</b>	<b>7930</b>
DRILLING COMPANY	Choice	DATE STARTED	2/19/2024
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RG
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140
DIAMETER OF HOLE (IN)	8	DROP (IN)	3
		BORING NO.	B-7
		SHEET	
		GROUND ELEV.	
		GW ELEV.	

Boring Location:

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
0			<b>0-5', ALLUVIUM (Qa)</b>			
2.5		8/10/14	2.5', Brown to grayish brown sand, fine to coarse grained, slightly dense, slightly moist	7.8		
5		20/32/50 for 5"	Light brown sand, fine to coarse grained, very dense, slightly dense	5.0	106.9	
			TD=5' No groundwater			
10						
15						
20						
25						
30						

**LEGEND**

- Standard Penetration Test
- California Ring
- Rock Core
- Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-10**



# GEOTECHNICAL BORING LOG

<b>PROJECT NAME</b>	<b>Ringle</b>		<b>W.O.</b>	<b>7930</b>
DRILLING COMPANY	Choice	DATE STARTED	2/19/2024	BORING NO. B-8
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RG	SHEET
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140	GROUND ELEV.
DIAMETER OF HOLE (IN)	8	DROP (IN)	30	GW ELEV.

Boring Location:

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
0			<b>0-10', ALLUVIUM (Qa)</b>			
	[California Ring]	32/50 for 6	2.5', Brown to light brown sand, fine to coarse grained, dense, slightly moist	6.8	101.0	
5	[Standard Penetration Test]	2/6/8	5', Light brown sand, fine to coarse grained, slightly dense, slightly moist	3.2		
	[California Ring]	13/30/50	7.5', Light brown sand, fine to coarse grained, very dense, slightly moist	2.9	108.0	
10	[Standard Penetration Test]	13/13/10	10', Light brown, silty sand, fine to medium grained, dense, slightly moist	3.6		
			TD=5' No groundwater			
15						
20						
25						
30						

**LEGEND**

- Standard Penetration Test
- California Ring
- Rock Core
- Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-11**



# GEOTECHNICAL BORING LOG

<b>PROJECT NAME</b>	<b>Ringle</b>	<b>W.O.</b>	<b>7930</b>
DRILLING COMPANY	Choice	DATE STARTED	2/20/2024
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RG
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140
DIAMETER OF HOLE (IN)	8	DROP (IN)	30
		BORING NO.	B-9
		SHEET	
		GROUND ELEV.	
		GW ELEV.	

Boring Location:

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
0			<b>0-20', ALLUVIUM (Qa)</b>			
	[Cross-hatch]	6/7/9	2.5', Light brown, silty sand, fine to medium grained, slightly dense, slightly moist	7.2		
5	[Diagonal lines]	12/13/14	5', Light gray to light brown sand with gravel and pebbles, dense, slightly moist, fine to coarse grained, no recovery			
	[Cross-hatch]	14/17/25	7.5', Light gray to light brown sand with gravel, fine to coarse grained, dense, slightly moist	2.0		
10	[Diagonal lines]	25/35/43	10', Light brown sand with gravel, fine to coarse grained, very dense, dry	0.7	118.4	
	[Cross-hatch]	17/16/15	12.5', Light brown to brown, silty sand, fine to medium grained, dense, slightly moist	3.4		
15	[Diagonal lines]	26/50 for 5"	15', Light brown to brown, silty sand, fine to medium grained, dense, slightly moist	4.1	103.4	
20	[Cross-hatch]	15/16/17	20', Light brown, silty sand, fine to medium grained, dense, slightly moist	3.0		
			TD=20' No groundwater			
25						
30						

**LEGEND**

- Standard Penetration Test
- California Ring
- Rock Core
- Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-12**



# GEOTECHNICAL BORING LOG

<b>PROJECT NAME</b>	<b>Ringle</b>		<b>W.O.</b>	<b>7930</b>
DRILLING COMPANY	Choice	DATE STARTED	2/20/2024	BORING NO. B-10
TYPE OF DRILL RIG	Truck Mounted	LOGGED BY	RG	SHEET
DRILLING METHOD	Hollow Stem	HAMMER WT (lbs)	140	GROUND ELEV.
DIAMETER OF HOLE (IN)	8	DROP (IN)	30	GW ELEV.

Boring Location:

Depth (ft)	Sample Type	Blows / 6"	GEOTECHNICAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Other Tests
0			<b>0-20', ALLUVIUM (Qa)</b>			
	[Cross-hatch]	11/13/17	2.5', Light brown, silty sand, fine to medium grained, dense, slightly moist	6.3		
5	[Diagonal lines]	40/35/39	5', Light brown, silty sand, fine to medium grained, very dense, slightly moist	2.4	121.6	
	[Cross-hatch]	7/9/10	7.5', Light brown, silty sand, fine to medium grained, dense, slightly moist	5.6		
10	[Diagonal lines]	17/40/50	10', Light gray to light brown sand with gravel, very dense, slightly moist	1.3	111.7	
	[Cross-hatch]	13/13/14	12.5', Light brown, silty sand, fine to coarse grained, dense, slightly moist	3.1		
15	[Diagonal lines]	32/50 for 5"	15', Light brown, silty sand, fine to medium grained, dense, slightly moist	4.9	106.4	
20	[Cross-hatch]	14/16/22	20', Light brown to brown, silty sand, fine to medium grained, dense, slightly moist	3.4		
			TD=20' No groundwater			
25						
30						

**LEGEND**

- Standard Penetration Test
- California Ring
- Rock Core
- Bulk Sample

- SIEVE: Grain Size Analysis
- #200: Washed Sieve #200
- MAX: Maximum Dry Density
- DS: Direct Shear
- C/S: Collapse/Swell
- CONS: Consolidation
- HYDR: Hydrometer Analysis
- EXPAN: Expansion Index
- CHEM: Chemical Tests
- R-V: R-Value
- PI: Atterberge Limits Tests

PLATE **A-13**



April 3, 2024  
W.O. 7930

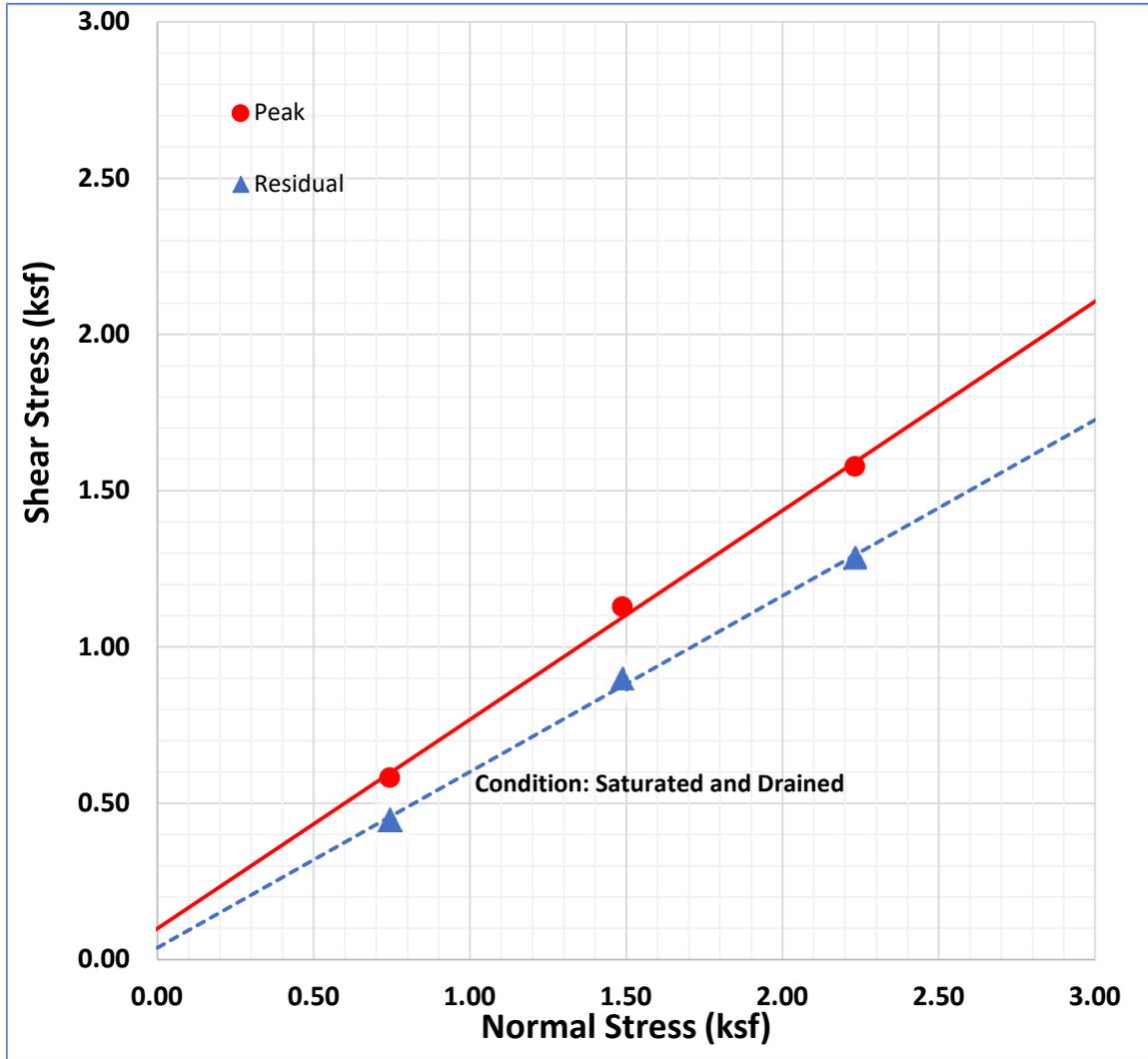
**APPENDIX B**

**LAB DATA**

MDN 24098

Peak	
C (psf)	$\phi$ (°)
100	33.5

Residual	
C (psf)	$\phi$ (°)
40	29



Along or Cross Bedding?
N/A

Initial Moisture Content (%)
21.21

Natural or Remolded?
Remolded

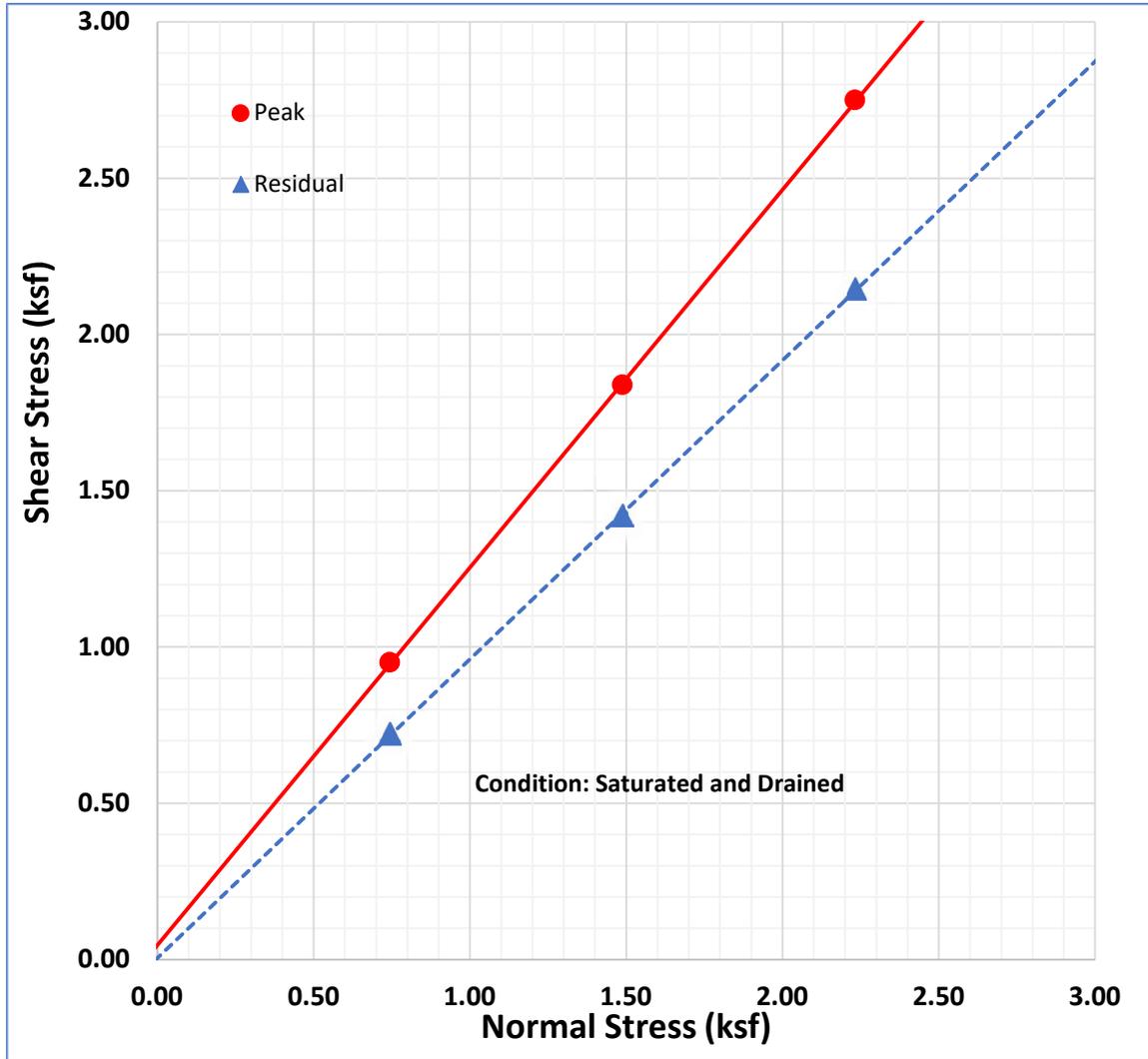
Initial Dry Density (pcf)
103.5

**DIRECT SHEAR DIAGRAM**

**Plate: DS-1**

Peak	
C (psf)	$\phi$ (°)
50	50

Residual	
C (psf)	$\phi$ (°)
0	43.5



Along or Cross Bedding?
N/A

Final Moisture Content (%)
22.43

Natural or Remolded?
Natural

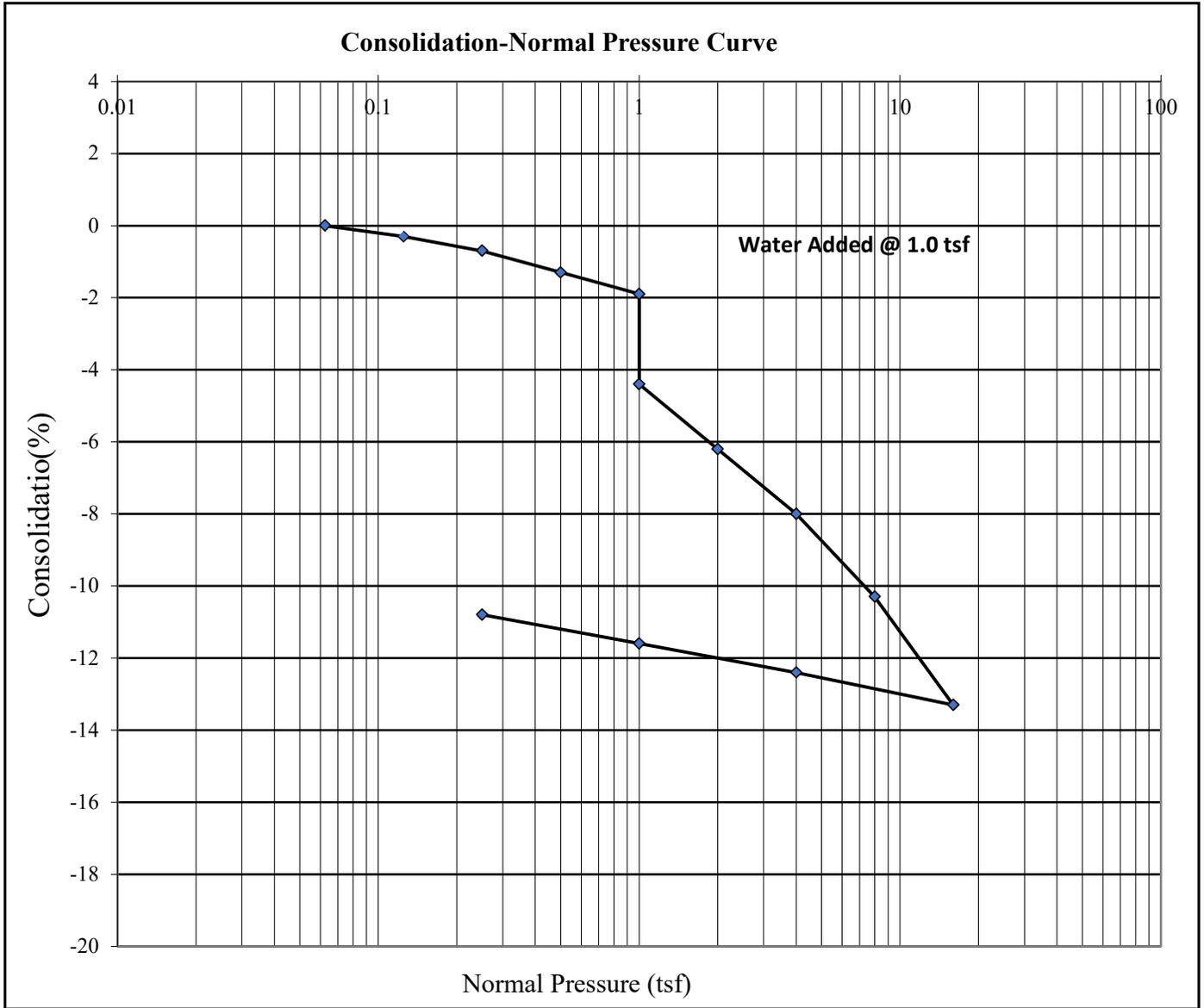
Initial Dry Density (pcf)
110.6

**DIRECT SHEAR DIAGRAM**

**Plate: DS-2**



**Client:** Ringle  
**Work Order:** 7930  
**Test Date:** 3/11/2024  
**Sample:** B-2 @ 7.5'  
**Soil Classification:** Light brown slightly silty very fine to fine SAND.  
**Test Procedure:** ASTM D 2435-04  
**Lab and QC By:** RA



Init. Moisture Content (%)	23.12
Init. Dry Density (PCF)	109.9
Init. Void Ratio	0.77

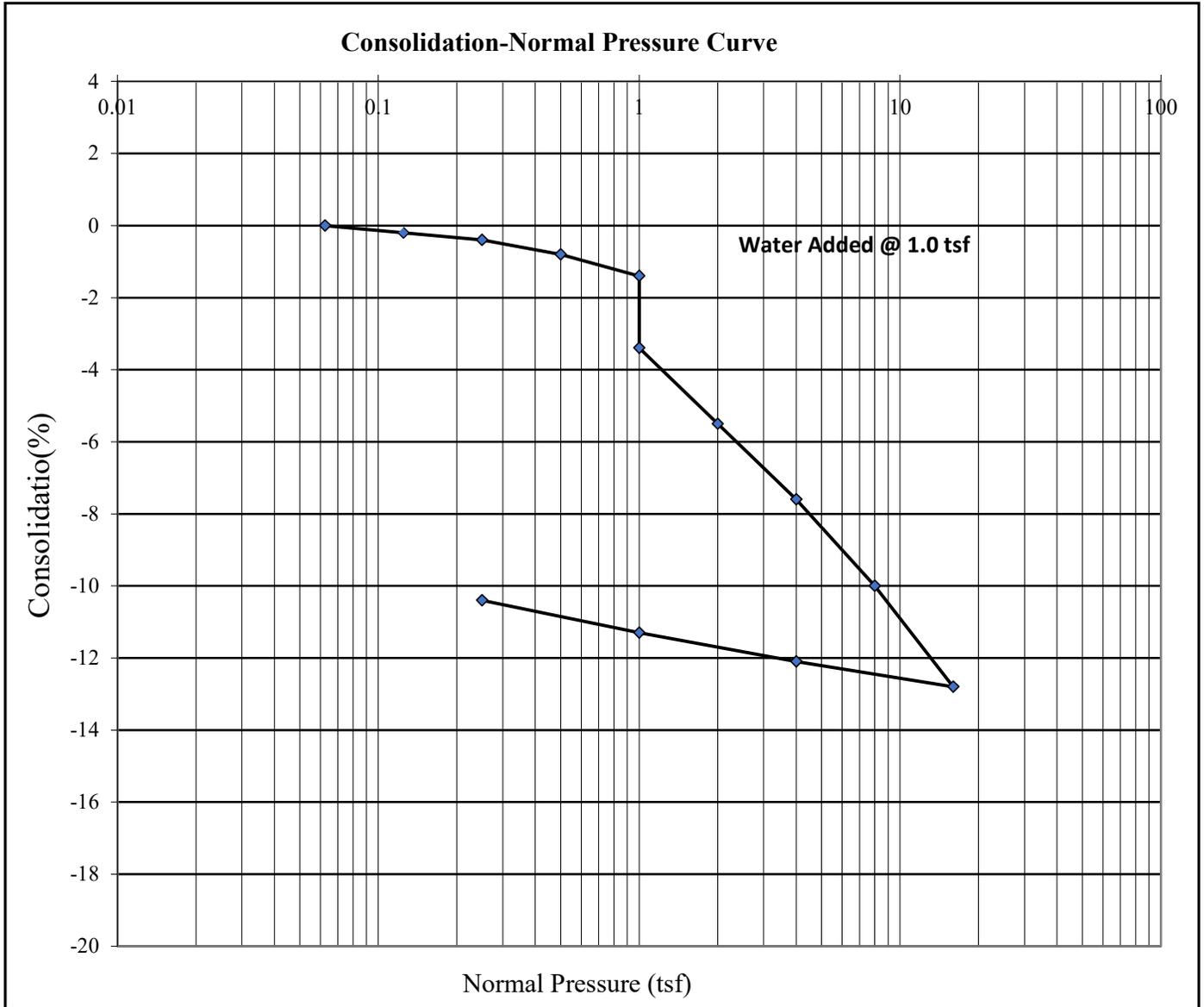
% Hydroconsolidation:	-2.5
Total Consolidation @ 16 tsf	-13.3

**CONSOLIDATION TEST DIAGRAM**

**Plate: C-1**



**Client:** Ringle  
**Work Order:** 7930  
**Test Date:** 3/11/2024  
**Sample:** B-3 @ 5.0'  
**Soil Classification:** Light brown slightly silty very fine to fine SAND.  
**Test Procedure:** ASTM D 2435-04  
**Lab and QC By:** RA



Init. Moisture Content (%)	15.97
Init. Dry Density (PCF)	110.6
Init. Void Ratio	0.51

% Hydroconsolidation:	-2.0
Total Consolidation @ 16 tsf	-12.8

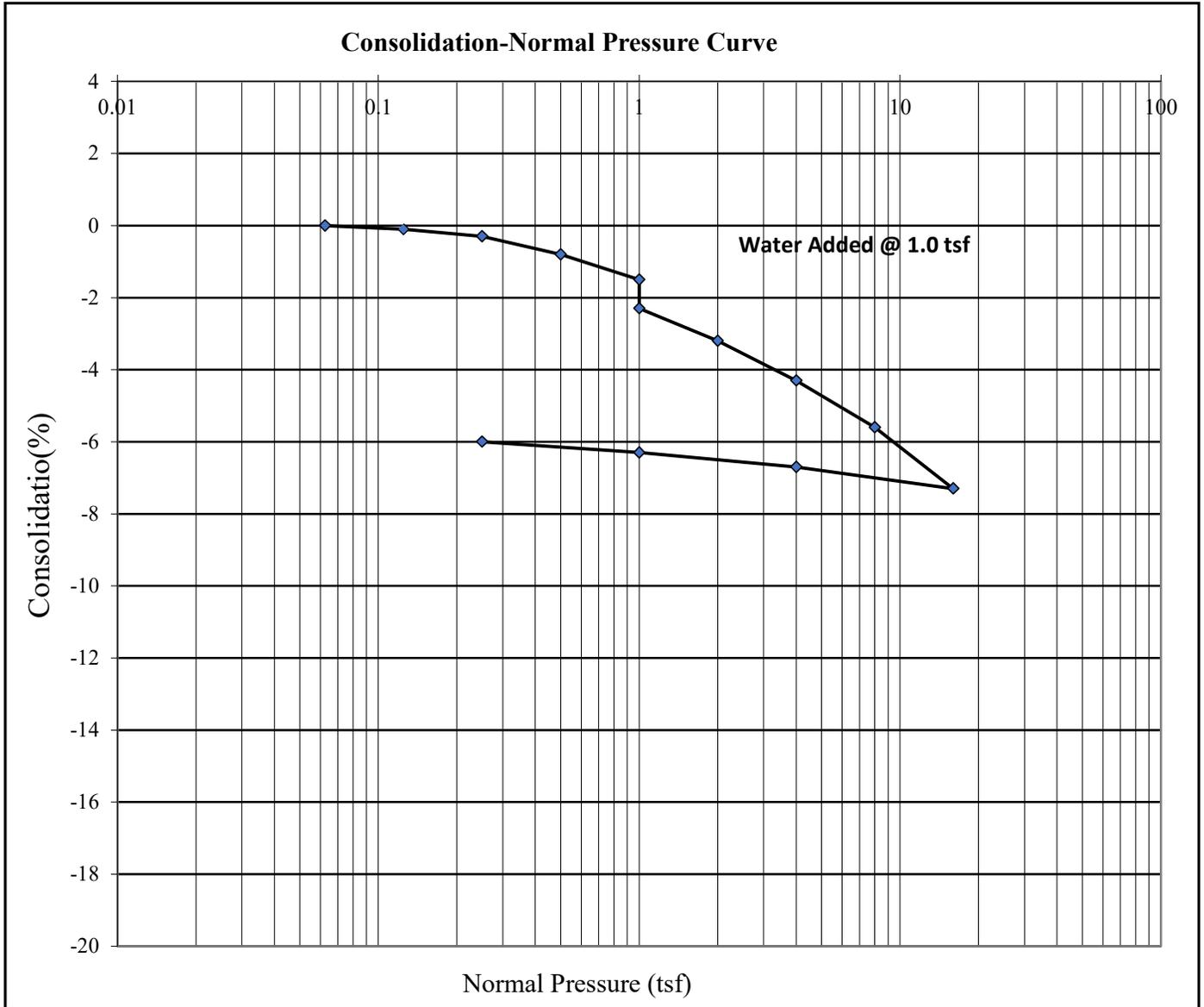
**CONSOLIDATION TEST DIAGRAM**

**Plate: C-2**



**Client:**  
**Work Order:**  
**Test Date:**  
**Sample:**  
**Soil Classification:**  
**Test Procedure:**  
**Lab and QC By:**

Ringle  
 7930  
 3/15/2024  
 B-9 @ 10.0'  
 Light brown very fine to coarse SAND.  
 ASTM D 2435-04  
 RA



Init. Moisture Content (%)	14.28
Init. Dry Density (PCF)	118.4
Init. Void Ratio	0.43

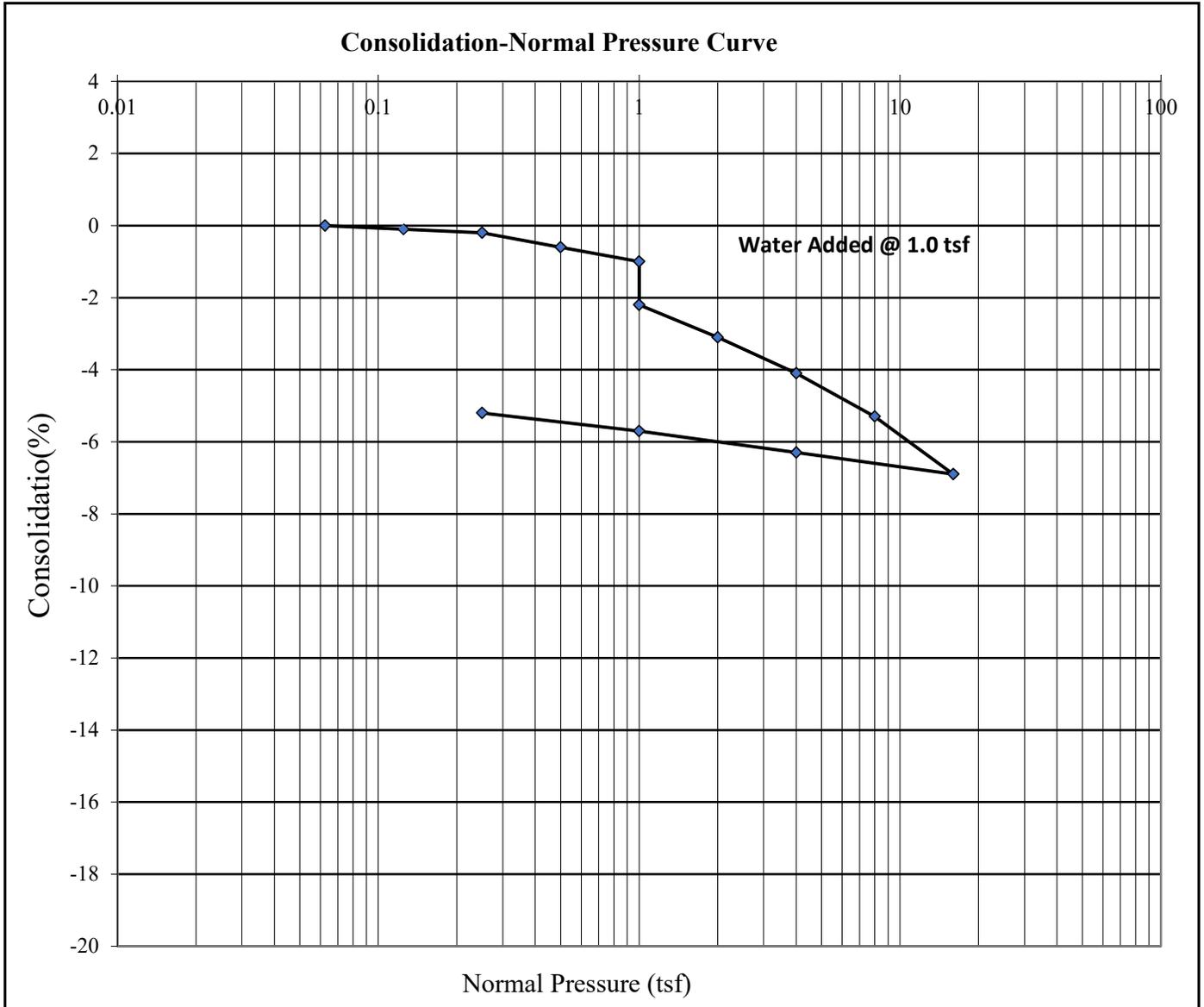
% Hydroconsolidation:	-0.8
Total Consolidation @ 16 tsf	-7.3

**CONSOLIDATION TEST DIAGRAM**

**Plate: C-3**



**Client:** Ringle  
**Work Order:** 7930  
**Test Date:** 3/11/2024  
**Sample:** B-10 @ 10.0'  
**Soil Classification:** Light brown slightly silty very fine to fine SAND.  
**Test Procedure:** ASTM D 2435-04  
**Lab and QC By:** RA



Final Moisture Content (%)	22.25
Init. Dry Density (PCF)	111.7
Init. Void Ratio	0.67

% Hydroconsolidation:	-1.2
Total Consolidation @ 16 tsf	-6.9

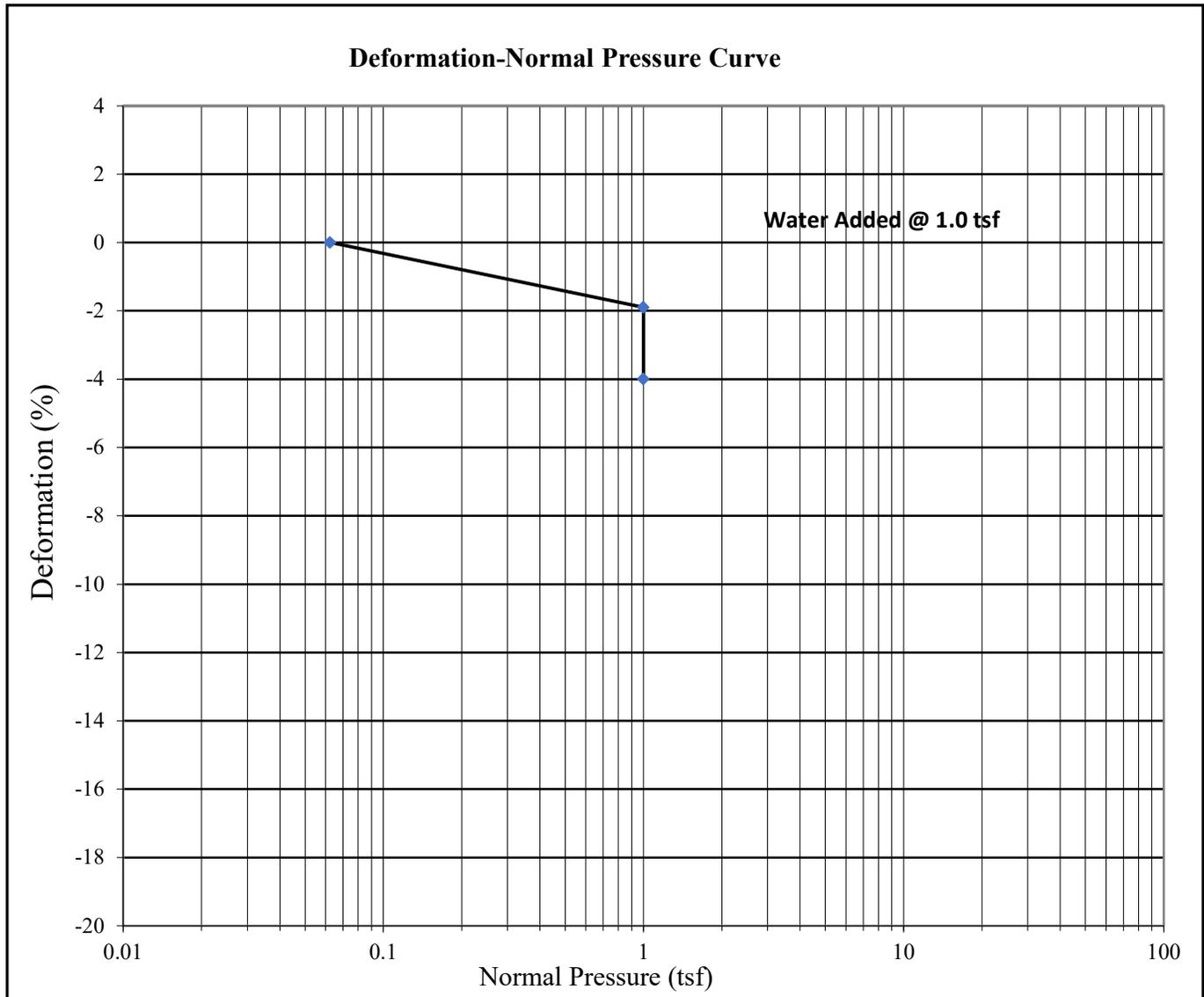
**CONSOLIDATION TEST DIAGRAM**

**Plate: C-4**



**Client:**  
**Work Order:**  
**Test Date:**  
**Sample:**  
**Soil Classification:**  
**Test Procedure:**  
**Lab and QC By:**

Ringle  
 7930  
 3/13/2024  
 B-1 @ 12.5'  
 Light brown very fine to coarse SAND.  
 ASTM D 4546-21  
 RA



Init. Moisture Content (%)	16.14
Init. Dry Density (PCF)	114.4
Init. Void Ratio	0.45

Hydroconsolidation (%) :	-2.1
Swell (%) :	0.0

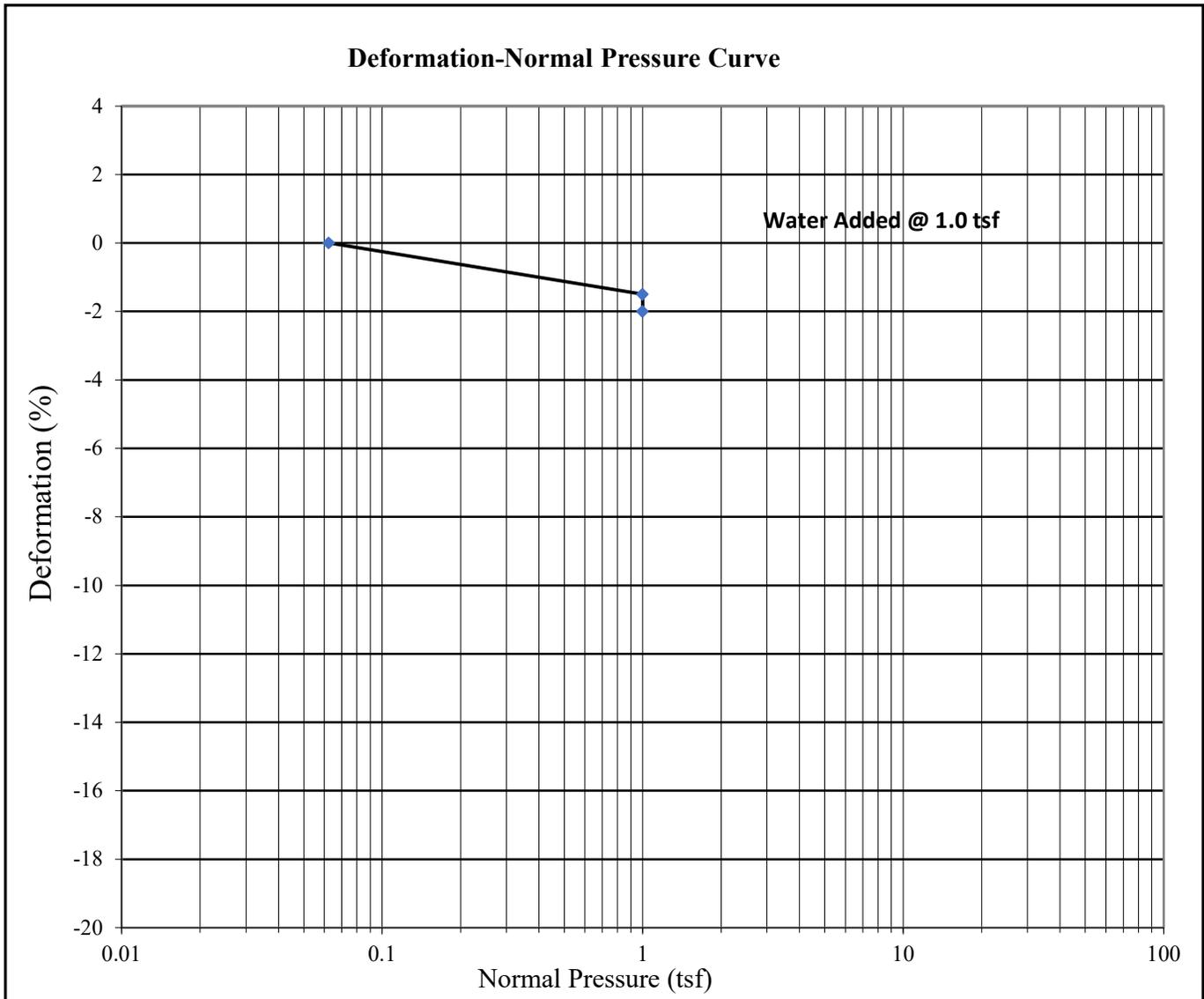
**COLLAPSE/SWELL TEST DIAGRAM**

**Plate: CS-1**



**Client:**  
**Work Order:**  
**Test Date:**  
**Sample:**  
**Soil Classification:**  
**Test Procedure:**  
**Lab and QC By:**

Ringle  
 7930  
 3/13/2024  
 B-2 @ 12.5'  
 Light orange brown very fine to coarse SAND.  
 ASTM D 4546-21  
 RA



Final Moisture Content (%)	13.94
Init. Dry Density (PCF)	119.5
Init. Void Ratio	0.37

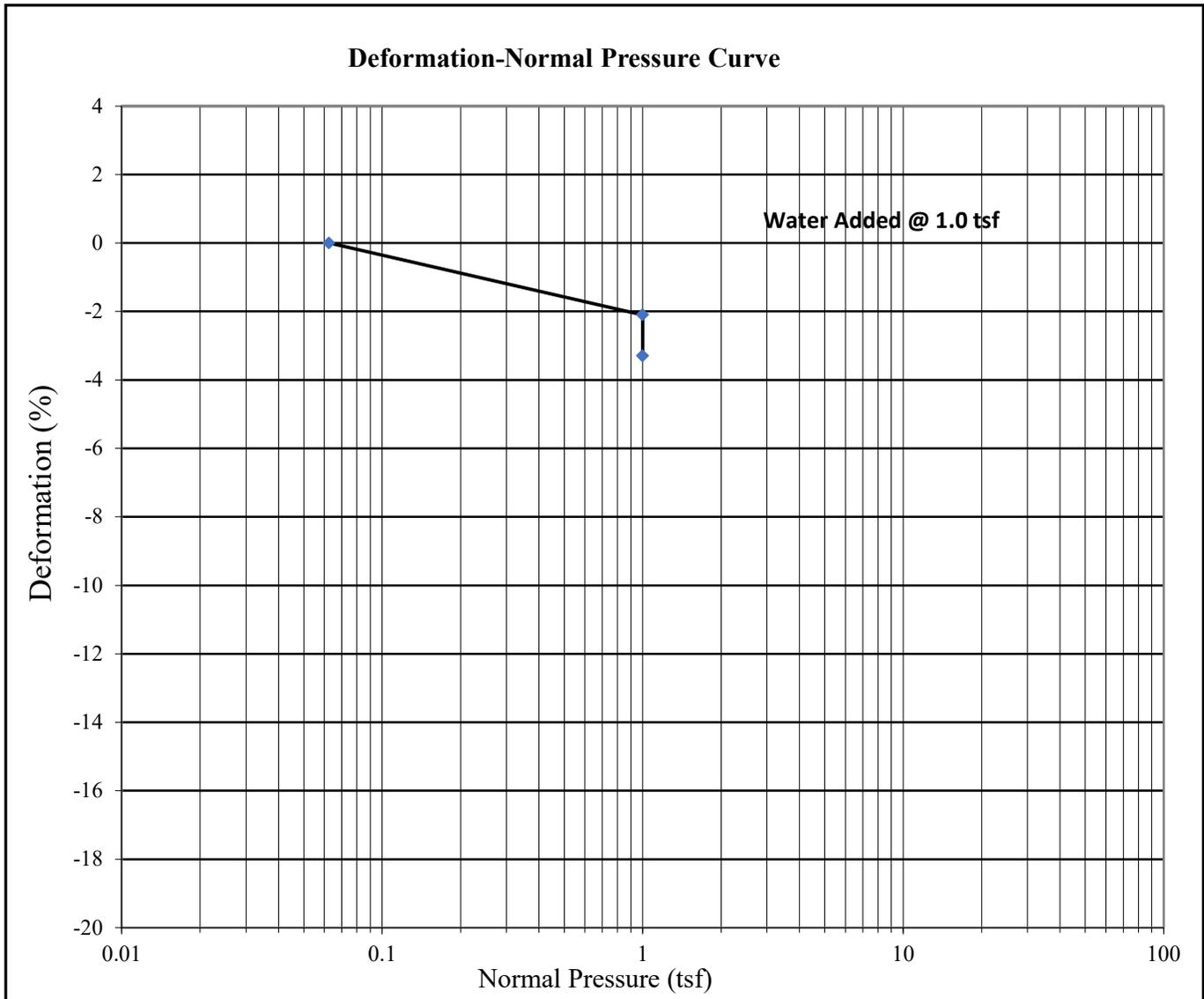
Hydroconsolidation (%) :	-0.5
Swell (%) :	0.0

**COLLAPSE/SWELL TEST DIAGRAM**

**Plate: CS-2**



**Client:** Ringle  
**Work Order:** 7930  
**Test Date:** 3/13/2024  
**Sample:** B-4 @ 12.5'  
**Soil Classification:** Light brown slightly clayey very fine to fine SAND.  
**Test Procedure:** ASTM D 4546-21  
**Lab and QC By:** RA



Init. Moisture Content (%)	26.09
Init. Dry Density (PCF)	101.7
Init. Void Ratio	0.77

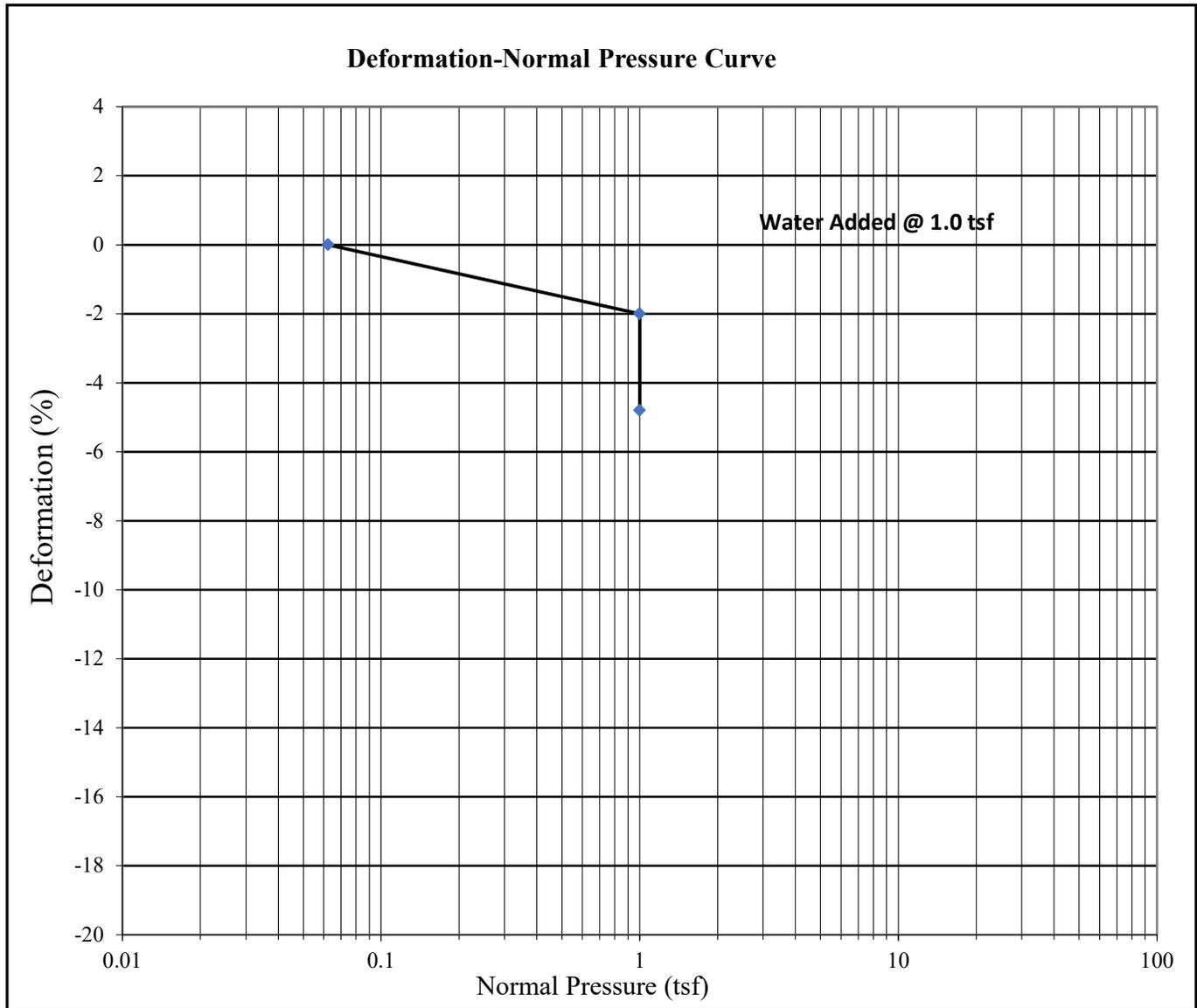
Hydroconsolidation (%) :	-1.2
Swell (%) :	0.0

**COLLAPSE/SWELL TEST DIAGRAM**

**Plate: CS-3**



**Client:** Ringle  
**Work Order:** 7930  
**Test Date:** 3/13/2024  
**Sample:** B-5 @ 15.0'  
**Soil Classification:** Light brown slightly clayey very fine to fine SAND.  
**Test Procedure:** ASTM D 4546-21  
**Lab and QC By:** RA



Init. Moisture Content (%)	25.73
Init. Dry Density (PCF)	100.7
Init. Void Ratio	0.77

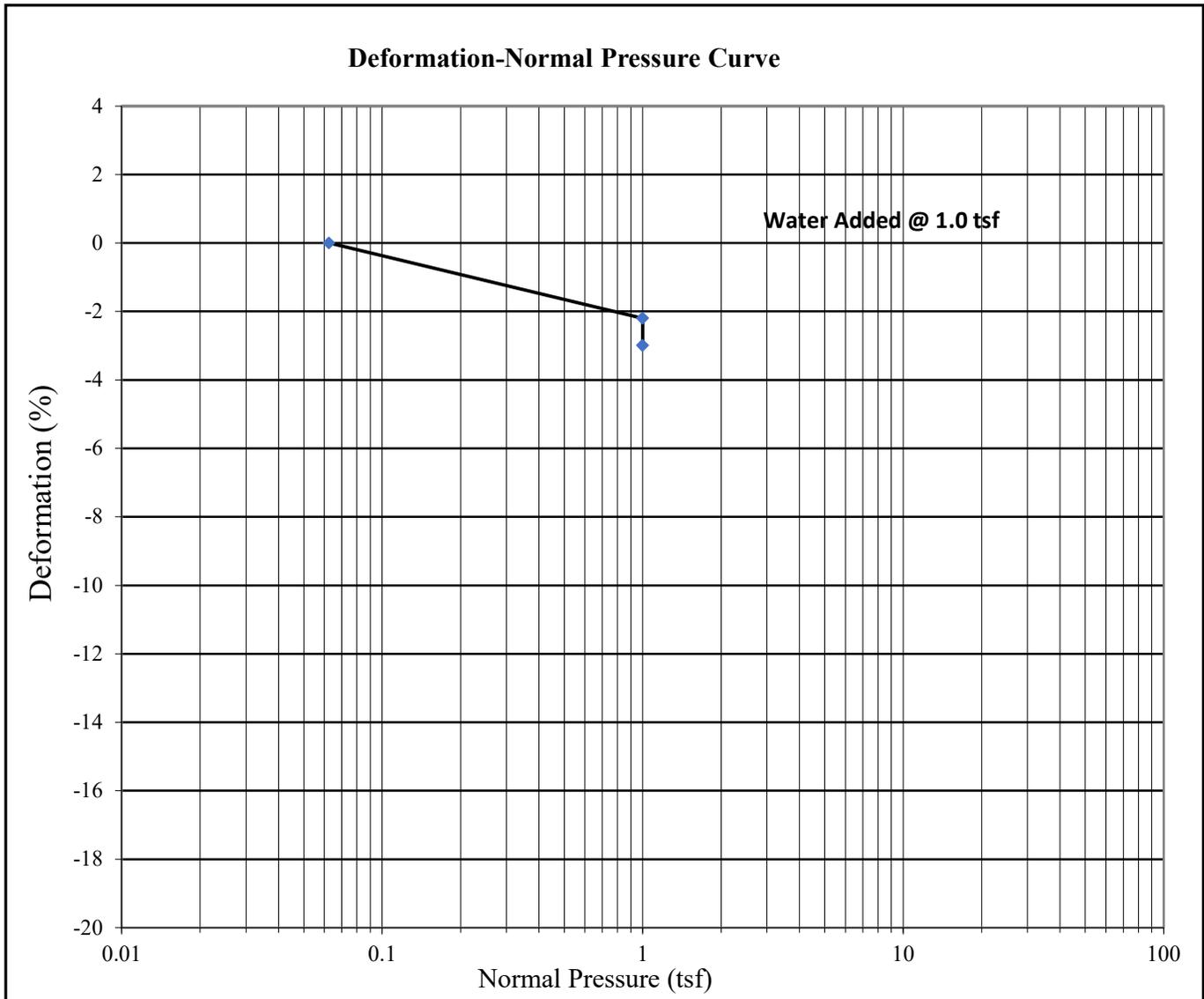
Hydroconsolidation (%) :	-2.8
Swell (%) :	0.0

**COLLAPSE/SWELL TEST DIAGRAM**

**Plate: CS-4**



**Client:** Ringle  
**Work Order:** 7930  
**Test Date:** 3/15/2024  
**Sample:** B-6 @ 2.5'  
**Soil Classification:** Light brown slightly clayey very fine to fine SAND.  
**Test Procedure:** ASTM D 4546-21  
**Lab and QC By:** RA



Init. Moisture Content (%)	21.85
Init. Dry Density (PCF)	103.6
Init. Void Ratio	0.66

Hydroconsolidation (%) :	-0.8
Swell (%) :	0.0

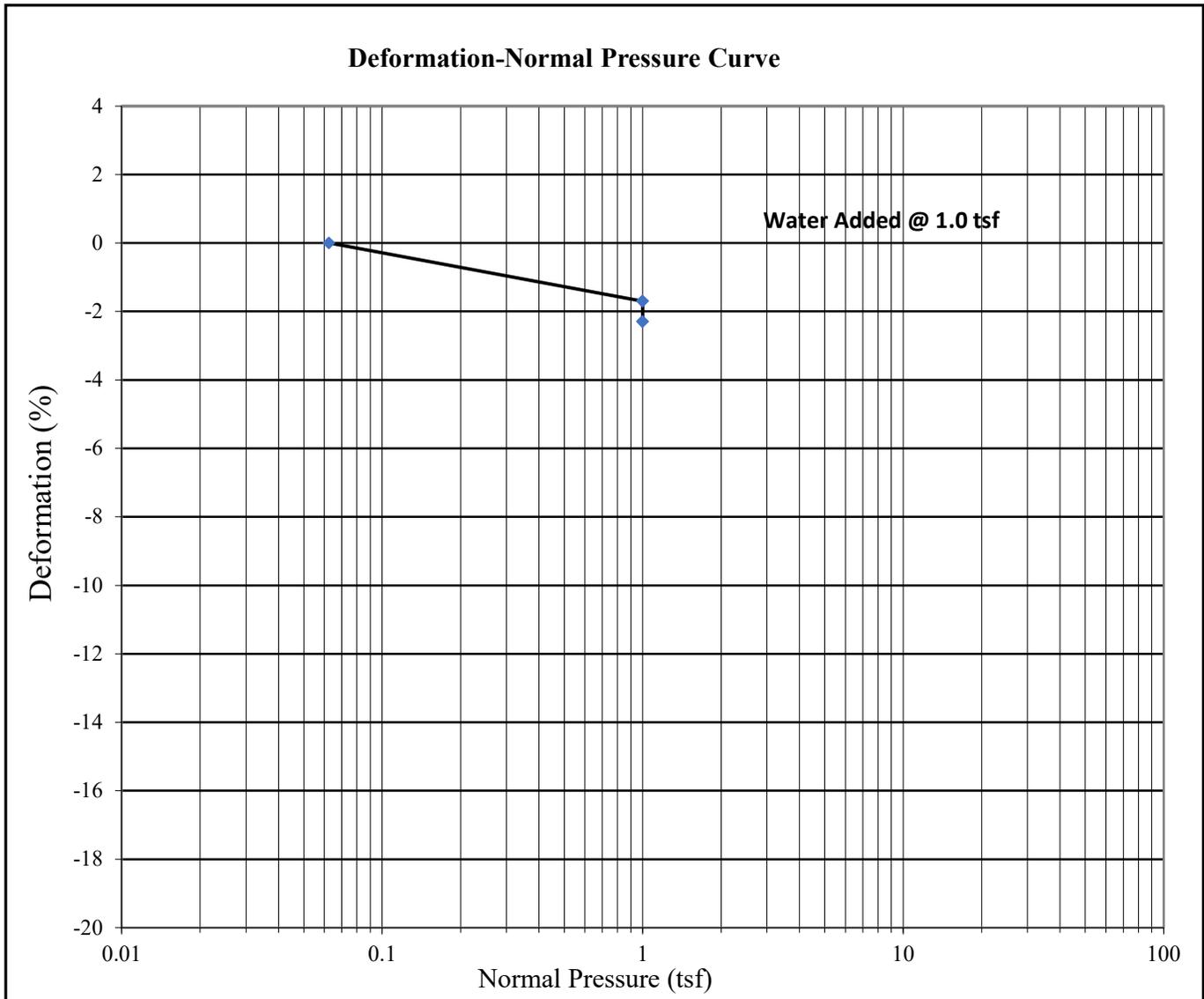
**COLLAPSE/SWELL TEST DIAGRAM**

**Plate: CS-5**



**Client:**  
**Work Order:**  
**Test Date:**  
**Sample:**  
**Soil Classification:**  
**Test Procedure:**  
**Lab and QC By:**

Ringle  
 7930  
 3/15/2024  
 B-7 @ 5.0'  
 Light brown slightly silty very fine to fine SAND.  
 ASTM D 4546-21  
 RA



Init. Moisture Content (%)	18.43
Init. Dry Density (PCF)	106.9
Init. Void Ratio	0.53

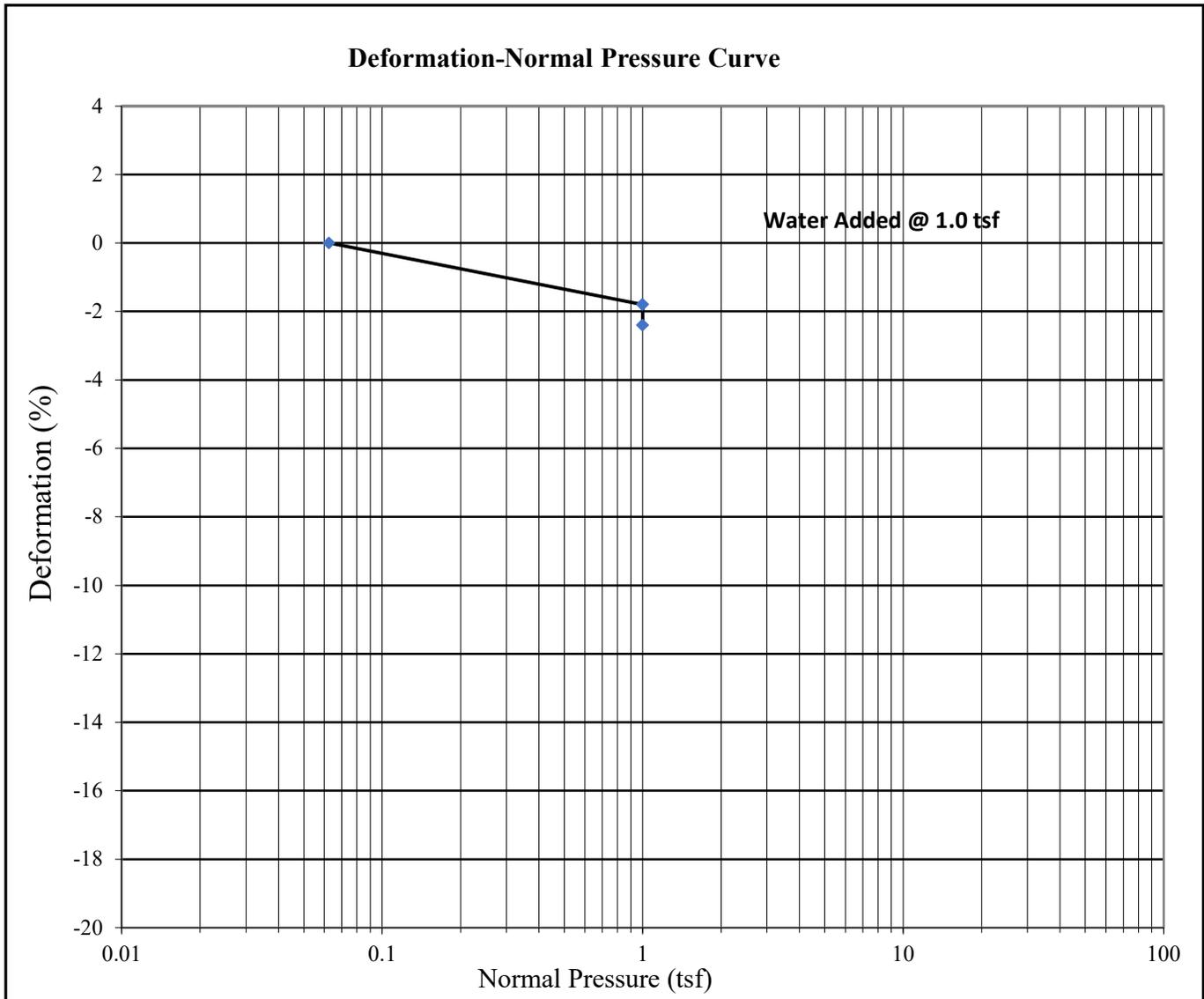
Hydroconsolidation (%) :	-0.6
Swell (%) :	0.0

**COLLAPSE/SWELL TEST DIAGRAM**

**Plate: CS-6**



**Client:** Ringle  
**Work Order:** 7930  
**Test Date:** 3/15/2024  
**Sample:** B-8 @ 7.5'  
**Soil Classification:** Light brown slightly clayey very fine to fine SAND.  
**Test Procedure:** ASTM D 4546-21  
**Lab and QC By:** RA



Init. Moisture Content (%)	19.10
Init. Dry Density (PCF)	108.0
Init. Void Ratio	0.55

Hydroconsolidation (%) :	-0.6
Swell (%) :	0.0

**COLLAPSE/SWELL TEST DIAGRAM**

**Plate: CS-7**



### Table 1 - Laboratory Tests on Soil Samples

GeoSoils Consultants, Inc.  
Ringle  
Your #7930, HDR Lab #24-0084LAB  
5-Mar-24

**Sample ID**

B-2  
@ 5.0'-7.5'

Resistivity	Units		
as-received	ohm-cm		14,800
minimum	ohm-cm		1,000
<b>pH</b>			8.0
<b>Electrical</b>			
<b>Conductivity</b>	mS/cm		0.36
<b>Chemical Analyses</b>			
<b>Cations</b>			
calcium	Ca <sup>2+</sup>	mg/kg	41
magnesium	Mg <sup>2+</sup>	mg/kg	2.0
sodium	Na <sup>1+</sup>	mg/kg	336
potassium	K <sup>1+</sup>	mg/kg	6.0
ammonium	NH <sub>4</sub> <sup>1+</sup>	mg/kg	ND
<b>Anions</b>			
carbonate	CO <sub>3</sub> <sup>2-</sup>	mg/kg	59
bicarbonate	HCO <sub>3</sub> <sup>1-</sup>	mg/kg	76
fluoride	F <sup>1-</sup>	mg/kg	3.0
chloride	Cl <sup>1-</sup>	mg/kg	182
sulfate	SO <sub>4</sub> <sup>2-</sup>	mg/kg	189
nitrate	NO <sub>3</sub> <sup>1-</sup>	mg/kg	4.0
phosphate	PO <sub>4</sub> <sup>3-</sup>	mg/kg	ND
<b>Other Tests</b>			
sulfide	S <sup>2-</sup>	qual	na
Redox		mV	na

Minimum resistivity and pH per CTM 643, Chloride per CTM 422, Sulfate per CTM 417

Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.

mg/kg = milligrams per kilogram (parts per million) of dry soil.

Redox = oxidation-reduction potential in millivolts

ND = not detected

na = not analyzed

# EXPANSION INDEX TEST

ASTM D-4829

**Ringle**

**7930**

<b>Project Information</b>	
Project Name:	Ringle
Work Order No.:	7930
Date of Test:	26-Feb-24
Tract Number:	

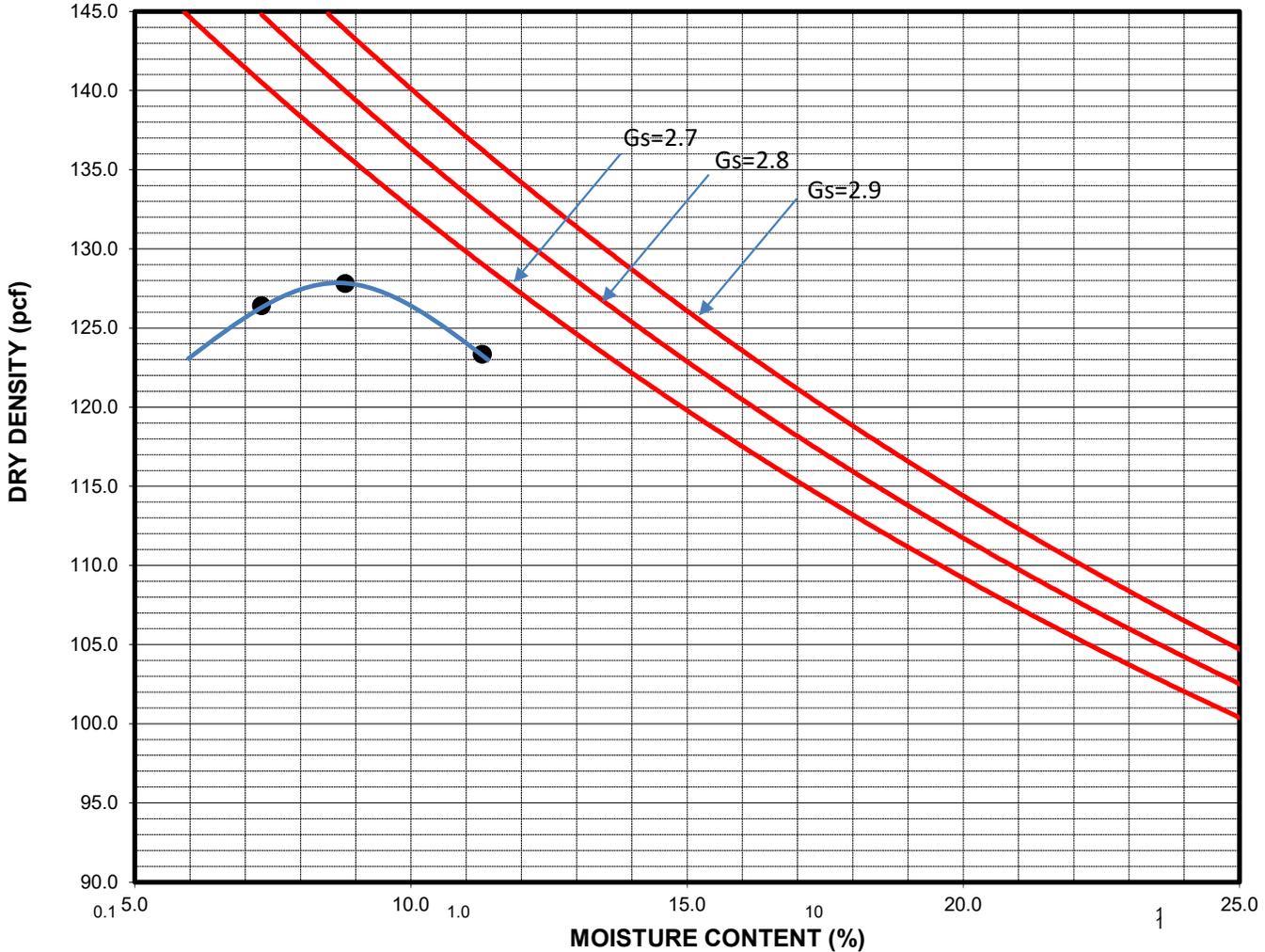
<b>Constants</b>			
<b>Calculations</b>		Vol. wet soil (cf):	0.0073
		Specific Gravity:	2.70
Boring/Lot #:	<b>B-2</b>	<b>B-8</b>	
Depth of Test (ft):	<b>2.5'-5.0'</b>	<b>7.0'-10.0'</b>	
Soil Classification:	Brown slightly silty very fine to coarse SAND.	Brown slightly silty very fine to fine SAND.	
Wet Weight + Ring (lbs):	1.3445	1.3310	
Ring Weight (lbs):	0.4275	0.4290	
Wet Weight (lbs):	0.9170	0.9020	
Wet Density (pcf):	125.6	123.6	
Moisture (%):	7.8	9.9	
Dry Density (pcf):	116.5	112.4	
Saturation (%):	47.2	53.6	
Initial Reading:	0.3650	0.3470	
Final Reading:	0.3670	0.3470	
Expansion, H, (inches):	0.0020	0.0000	
Expansion Index:	1	1	
Expansion Potential:	<b>Very Low</b>	<b>Very Low</b>	
<b>After Test</b>			
Wet Weight (g):	439.1	425.7	
Dry Weight (g):	385.2	370.3	
Water Loss (g):	53.9	55.4	
Moisture (%):	14.0	15.0	

Expansion Index Table: **0 - 20 = Very Low**  
**21 - 50 = Low**  
**51 - 90 = Medium**  
**91 - 130 = High**  
**130 & Up = Very High**



**Client:**  
**Work Order:**  
**Test Date:**  
**Sample:**  
**Soil Classification:**  
**Compaction Procedure:**  
**Lab and QC by:**

Ringle  
 7930  
 2/26/2024  
 B-2 @ 2.5'-5.0'  
 Brown slightly silty very fine to coarse SAND.  
 ASTM D 1557 Method A  
 RA



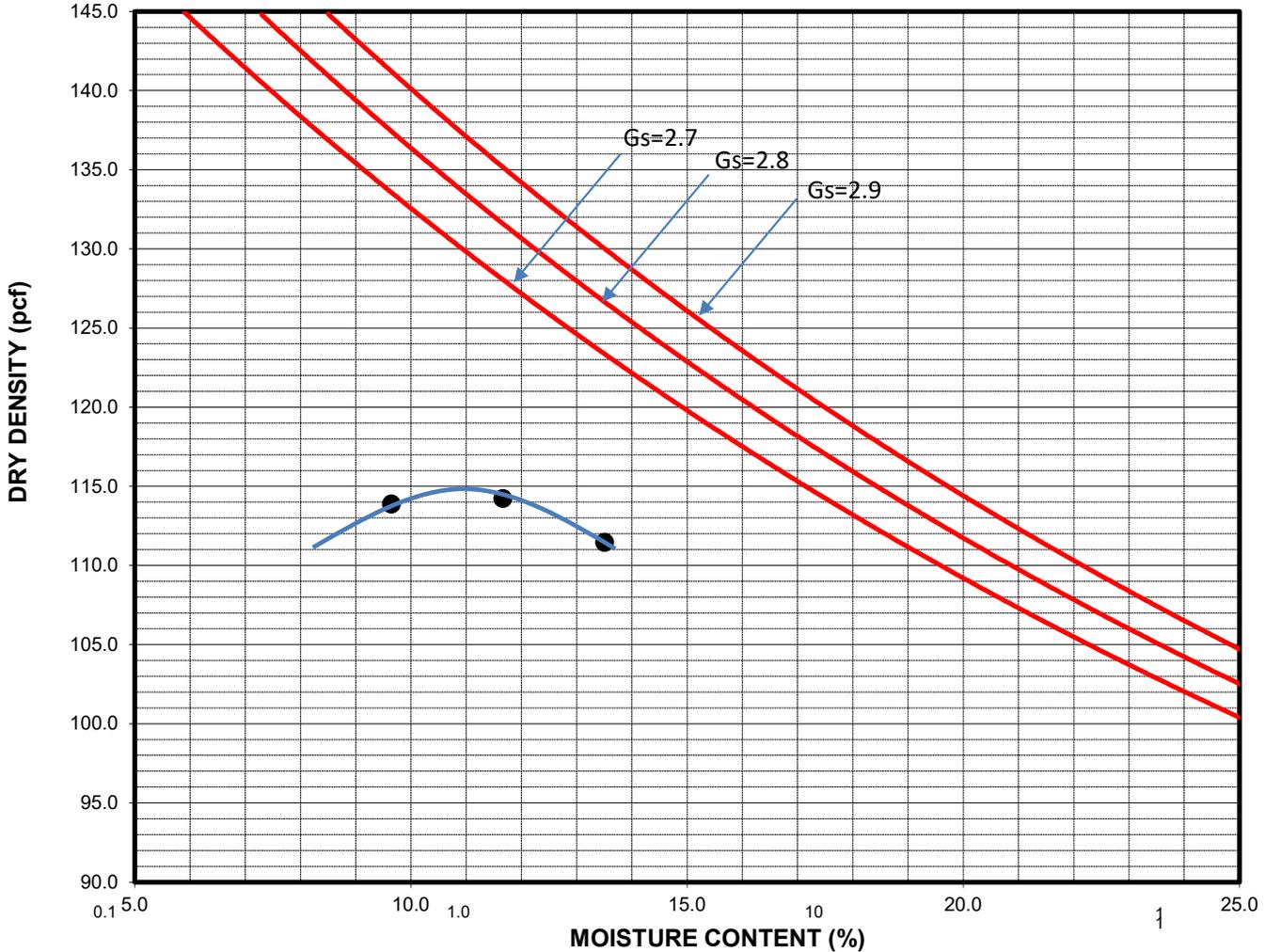
<b>MAXIMUM DRY DENSITY:</b>	<b>128.0</b>
<b>OPTIMUM MOISTURE CONTENT (%):</b>	<b>8.5</b>

A	Mold diameter (in)	4	4	4	4	4
B	Mold height (in)	4.581	4.581	4.581	4.581	4.581
C	Wt. of Mold (g)	4276	4276	4276	4276	4276
D	Moist Soil + Mold (g)	6329	6381	6354	0	0
E	Soil Wt. (g)	2053	2105	2078	-4276	-4276
F	Volume of mold (ft3)	0.0334	0.0334	0.0334	0.0334	0.0334
G	Volume of mold (cm3)	944.99	944.99	944.99	944.99	944.99
H	Moist Density (g/cm3)	2.17251	2.2275368	2.198965068	-4.524916	-4.52492
M	Wt. of wet soil (g)	200	200	200	200	200
N	Wt. of dry soiltare (g)	186.4	183.8	179.7	176.1	175
O	Wt. of water (g)	13.6	16.2	20.3	23.9	25
P	Moisture Content (%)	7.3	8.8	11.3	#N/A	#N/A
Q	Dry Density (g/cm3)	2.0	2.0	2.0	#N/A	#N/A
R	Dry Unit Weight (pcf)	126.4	127.8	123.3	#N/A	#N/A

**Plate: MDD-1**

**Client:**  
**Work Order:**  
**Test Date:**  
**Sample:**  
**Soil Classification:**  
**Compaction Procedure:**  
**Lab and QC by:**

Ringle  
 7930  
 3/16/2024  
 B-2 @ 5.0'-7.0'  
 Light brown slightly silty very fine to fine SAND.  
 ASTM D 1557 Method A  
 RA



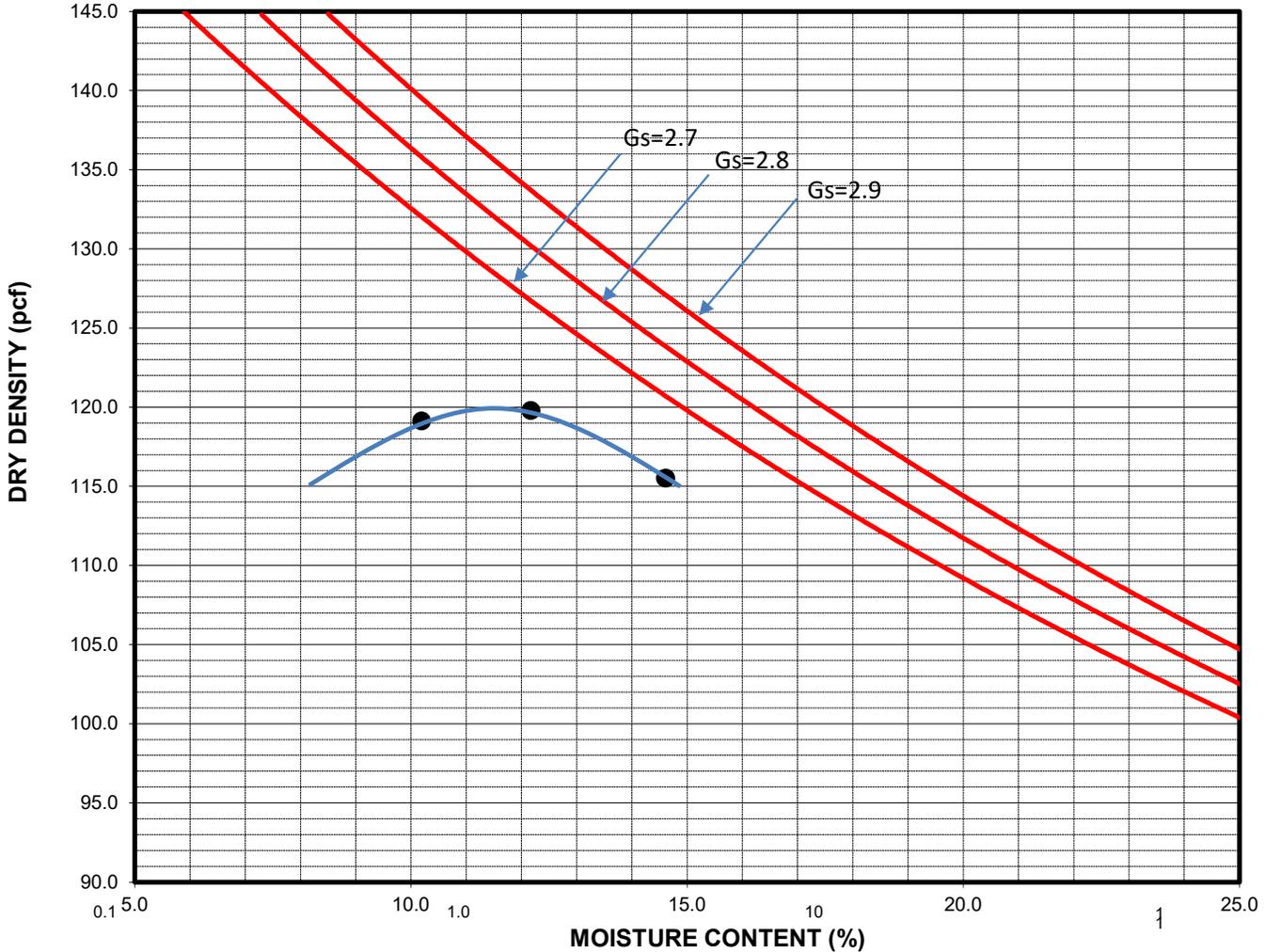
<b>MAXIMUM DRY DENSITY:</b>	<b>115.0</b>
<b>OPTIMUM MOISTURE CONTENT (%):</b>	<b>11.0</b>

A	Mold diameter (in)	4	4	4	4	4
B	Mold height (in)	4.581	4.581	4.581	4.581	4.581
C	Wt. of Mold (g)	4276	4276	4276	4276	4276
D	Moist Soil + Mold (g)	6166	6207	6191	0	0
E	Soil Wt. (g)	1890	1931	1915	-4276	-4276
F	Volume of mold (ft3)	0.0334	0.0334	0.0334	0.0334	0.0334
G	Volume of mold (cm3)	944.99	944.99	944.99	944.99	944.99
H	Moist Density (g/cm3)	2.00002	2.0434079	2.026476471	-4.524916	-4.52492
M	Wt. of wet soil (g)	200	200	200	200	200
N	Wt. of dry soiltare (g)	182.4	179.1	176.2	176.1	175
O	Wt. of water (g)	17.6	20.9	23.8	23.9	25
P	Moisture Content (%)	9.6	11.7	13.5	#N/A	#N/A
Q	Dry Density (g/cm3)	1.8	1.8	1.8	#N/A	#N/A
R	Dry Unit Weight (pcf)	113.9	114.2	111.5	#N/A	#N/A

**Plate: MDD-2**

**Client:**  
**Work Order:**  
**Test Date:**  
**Sample:**  
**Soil Classification:**  
**Compaction Procedure:**  
**Lab and QC by:**

Ringle  
 7930  
 3/19/2024  
 B-8 @ 7.0'-10.0'  
 Brown slightly silty very fine to fine SAND.  
 ASTM D 1557 Method A  
 RA



<b>MAXIMUM DRY DENSITY:</b>	<b>120.0</b>
<b>OPTIMUM MOISTURE CONTENT (%):</b>	<b>11.5</b>

A	Mold diameter (in)	4	4	4	4	4
B	Mold height (in)	4.581	4.581	4.581	4.581	4.581
C	Wt. of Mold (g)	4276	4276	4276	4276	4276
D	Moist Soil + Mold (g)	6263	6310	6280	0	0
E	Soil Wt. (g)	1987	2034	2004	-4276	-4276
F	Volume of mold (ft3)	0.0334	0.0334	0.0334	0.0334	0.0334
G	Volume of mold (cm3)	944.99	944.99	944.99	944.99	944.99
H	Moist Density (g/cm3)	2.10267	2.1524037	2.120657361	-4.524916	-4.52492
M	Wt. of wet soil (g)	200	200	200	200	200
N	Wt. of dry soiltare (g)	181.5	178.3	174.5	174.5	175
O	Wt. of water (g)	18.5	21.7	25.5	25.5	25
P	Moisture Content (%)	10.2	12.2	14.6	#N/A	#N/A
Q	Dry Density (g/cm3)	1.9	1.9	1.9	#N/A	#N/A
R	Dry Unit Weight (pcf)	119.1	119.8	115.5	#N/A	#N/A

**Plate: MDD-3**

# ANAHEIM TEST LAB, INC

196 Technology Drive, Unit D  
Irvine, CA 92618  
Phone (949) 336-6544

GEOISOILS CONSULTANTS, INC.  
6634 VALJEAN AVE.  
VAN NUYS, CA 91406

DATE: 3/4/2024

P.O. NO.: Transmittal

LAB NO.: C-7728

SPECIFICATION: CA 301

MATERIAL: Brown, Clayey Sand

---

Work Order No.: 7930  
Client Name: Ringle  
Sample ID: B-2 @ 2.5-5'

## ANALYTICAL REPORT "R" VALUE

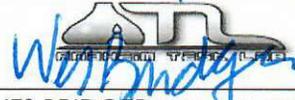
BY EXUDATION

BY EXPANSION

53

N/A

RESPECTFULLY SUBMITTED



---

WES BRIDGER LAB MANAGER

# "R" VALUE CA 301

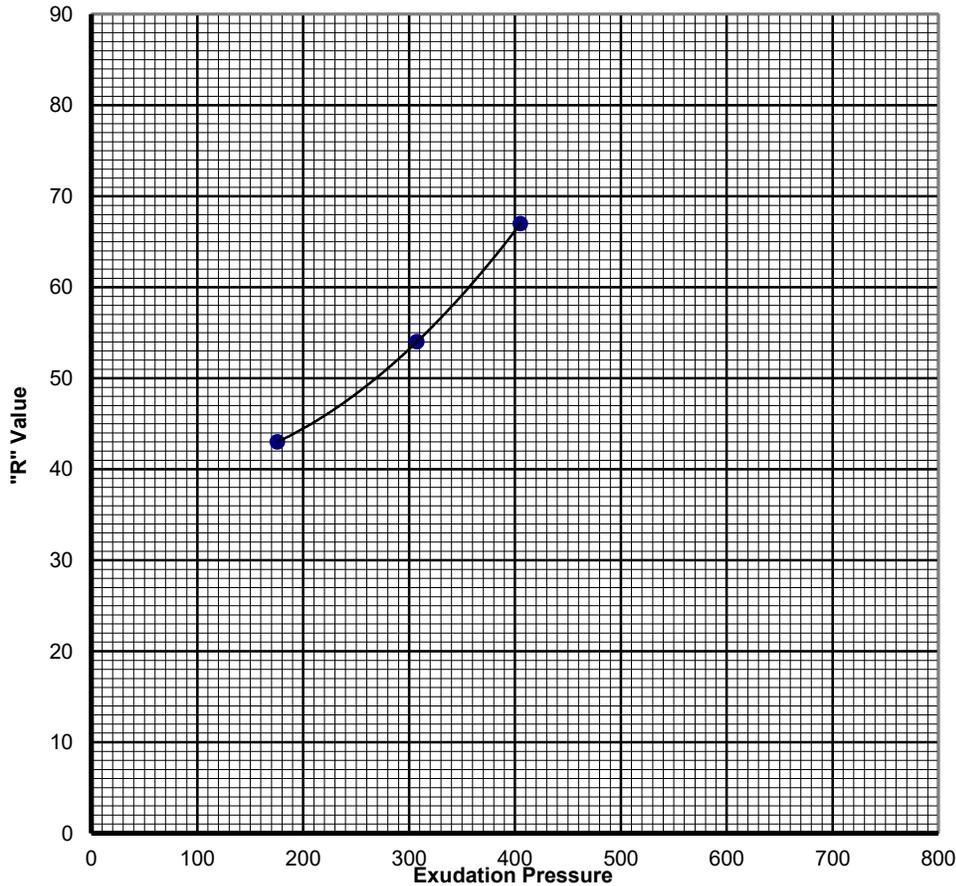
Client: GeoSoils Consultants, Inc.  
 Client Reference No.: 7930  
 Sample: B-2 @ 2.5-5'

ATL No.: C 7728 Date: 3/4/2024

Soil Type: Brown, Clayey Sand

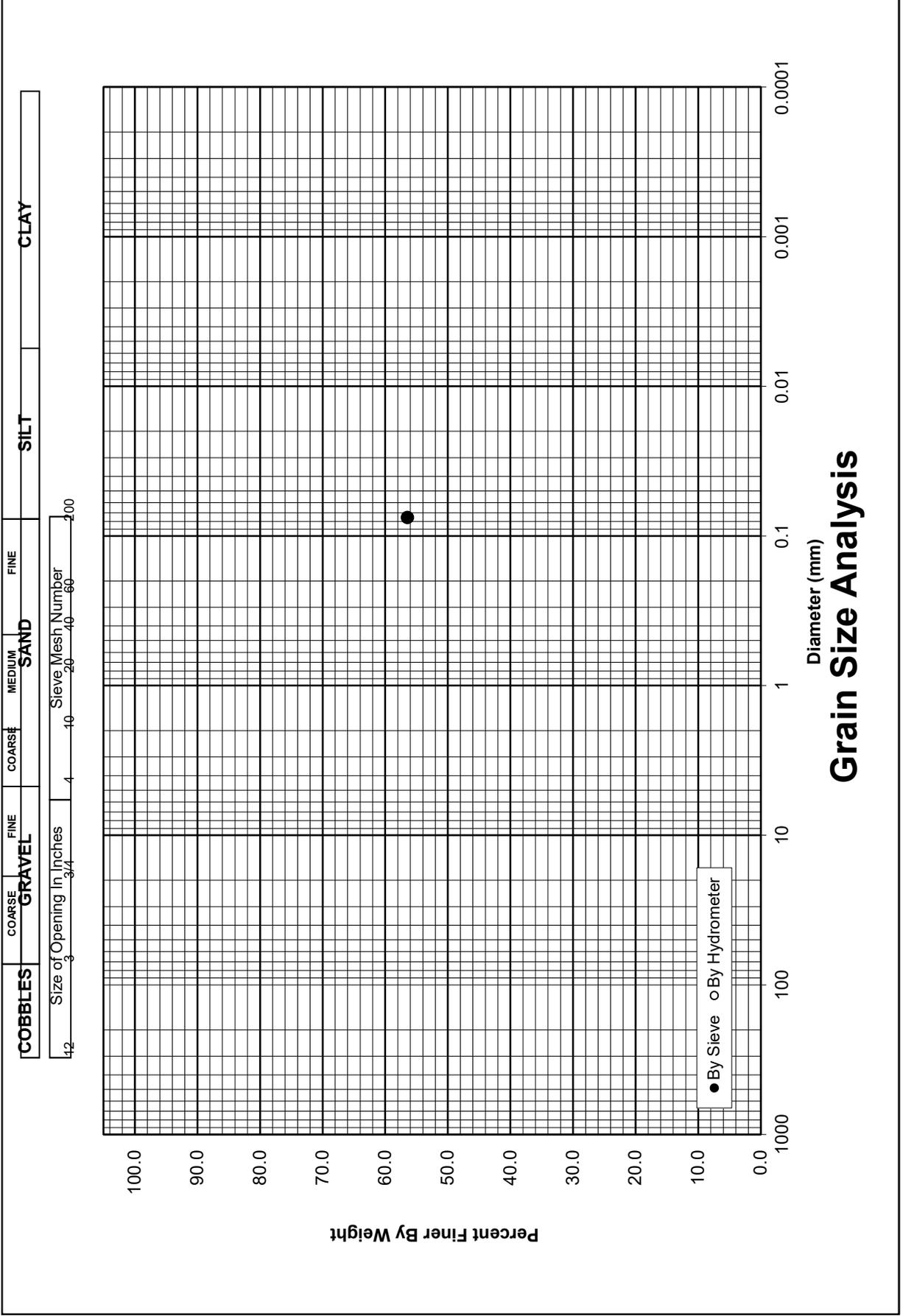
TEST SPECIMEN		A	B	C	D
Compactor Air Pressure	psi	350	150	250	
Initial Moisture Content	%	7.3	7.3	7.3	
Moisture at Compaction	%	9.1	9.8	9.4	
Briquette Height	in.	2.50	2.56	2.53	
Dry Density	pcf	129.0	127.8	128.6	
EXUDATION PRESSURE	psi	405	176	307	
EXPANSION PRESSURE	psf	0	0	0	
Ph at 1000 pounds	psi	23	37	29	
Ph at 2000 pounds	psi	42	73	59	
Displacement	turns	3.44	3.94	3.71	
"R" Value		67	43	54	
CORRECTED "R" VALUE		67	43	54	

Final "R" Value	
BY EXUDATION: @ 300 psi	<b>53</b>
BY EXPANSION: TI = 5.0	<b>N/A</b>



W.O. 7930  
Lab and QC By: RA  
Date of Test: 4/24

B-10 @ 7.5'  
Light brown sandy SILT.  
Moisture (%): 5.9



April 3, 2024  
W.O. 7930

**APPENDIX C**  
**INFILTRATION RESULTS**

MDN 24098

Infiltration Rate, Porchet Method		
Project Location: 36017 Calico Road, Yermo		
Boring: B-6	Logged By: RG	
Date: 2/20/2024	Project Number: 7930	
Time Interval, $\Delta t$	10	minutes
Test Hole Radius, $r$	8	inches
Initial Depth to Water, $D_0$	0	inches
Final Depth to Water, $D_f$	2.25	inches
Total Depth of Test Hole, $D_T$	60	inches
$I_t = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$		
Initial Height of Water, $H_0$	60	inches
Final Height of Water, $H_f$	57.75	inches
Change in Height, $\Delta H$	2.25	inches
Average Head Height, $H_{avg}$	58.88	inches
Tested Infiltration Rate	0.86	in/hr
Factor of Safety	2	
Design Infiltration Rate =	<b>0.43</b>	in/hr

**Plate P-1**

Infiltration Rate, Porchet Method		
Project Location: 36017 Calico Road, Yermo		
Boring: B-7	Logged By: RG	
Date: 2/20/2024	Project Number: 7930	
Time Interval, $\Delta t$	10	minutes
Test Hole Radius, $r$	8	inches
Initial Depth to Water, $D_0$	0	inches
Final Depth to Water, $D_f$	3.25	inches
Total Depth of Test Hole, $D_T$	60	inches
$I_t = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$		
Initial Height of Water, $H_0$	60	inches
Final Height of Water, $H_f$	56.75	inches
Change in Height, $\Delta H$	3.25	inches
Average Head Height, $H_{avg}$	58.38	inches
Tested Infiltration Rate	1.25	in/hr
Factor of Safety	2	
Design Infiltration Rate =	<b>0.63</b>	in/hr

**Plate P-2**

Infiltration Rate, Porchet Method		
Project Location: 36017 Calico Road, Yermo		
Boring: B-8	Logged By: RG	
Date: 2/20/2024	Project Number: 7930	
Time Interval, $\Delta t$	10	minutes
Test Hole Radius, $r$	8	inches
Initial Depth to Water, $D_0$	60	inches
Final Depth to Water, $D_f$	78	inches
Total Depth of Test Hole, $D_T$	120	inches
$I_t = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$		
Initial Height of Water, $H_0$	60	inches
Final Height of Water, $H_f$	42	inches
Change in Height, $\Delta H$	18	inches
Average Head Height, $H_{avg}$	51.00	inches
Tested Infiltration Rate	7.85	in/hr
Factor of Safety	2	
Design Infiltration Rate =	<b>3.93</b>	in/hr





