ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

June 12, 2020
J.N.: 2758.00

Mr. Eric Winquist
Comstock Properties
2301 Rosecrans Avenue, Suite 1150
El Segundo CA 90245

Subject: **Preliminary Geotechnical Investigation, Proposed Distribution Center, 2555 West 190th Street, City of Torrance, California**

Dear Mr. Winquist,

Pursuant to your request, ***Albus-Keefe & Associates, Inc***. is pleased to present to you our preliminary geotechnical investigation report for the subject development. This report presents the results of our field investigation, laboratory testing, engineering analyses, as well as our preliminary geotechnical recommendations for design and construction of the subject development.

We appreciate this opportunity to be of service to you. If you have any questions regarding the contents of this report, please do not hesitate to call this office.

Sincerely,

ALBUS-KEEFE & ASSOCIATES, INC.

David E. Albus
Principal Engineer

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purposes of our preliminary geotechnical investigation were to evaluate geotechnical conditions within the project area and to provide conclusions and recommendations relevant to the design and construction of the proposed improvements at the subject site. The scope of this investigation included the following:

- Review of the referenced conceptual site plan
- Review of the referenced historical aerial photographs and previous reports
- Review of published geologic and seismic data for the site and surrounding area
- Exploratory drilling and soil sampling
- Laboratory testing of selected soil samples
- Engineering analyses of data obtained from our review, exploration and laboratory testing
- Evaluation of site seismicity, liquefaction, and settlement potential
- Preparation of this report

1.2 SITE LOCATION AND DESCRIPTION

The site is located at the northeast intersection of Crenshaw Place and West 190th Street, in the city of Torrance, California. The site is bordered by large commercial/industrial buildings to the north and east, West 190th Street to the south. Crenshaw Place to the west. The location of the site and its relationship to the surrounding areas is shown on the Site Location Map, Figure 1.

The site is rectangular in shape and comprises approximately 13.5 acres of land. Three separate properties (APN: 4090-021-032, 4090-021-033, 4090-021-034) encompass the site. A two-story commercial building located at the northeast portion of the site and is currently unoccupied. The building includes a basement below the entire footprint of the building. Asphalt paved parking with drive aisles is located throughout the site. The asphalt paved parking lot to the east is in fair condition with only minimal cracking. The northwest and southwest asphalt paved parking lots are in poor condition with several cracks, raveling, weeds, and potholes.

The site is relatively level with elevations that vary from approximately 61 feet above mean sea level (MSL) to 64 feet above MSL based on Google Earth 2018. Area drains are present in several areas of the parking lot. Drainage at the site appears to be directed toward a few area drains and as sheet flow towards Crenshaw Place and West 190th Street. Vegetation at the site is sparse and consists of a ground cover, medium size shrubs, and medium sized trees located at the eastern portion of the site.

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SITE LOCATION MAP

Comstock Properties
Proposed Distribution Center
Northeast Corner of West 190th Street and Crenshaw Place
Torrance, California

NOT TO SCALE

FIGURE 1

1.3 PROPOSED DEVELOPMENT

Based on our review of the referenced Conceptual Site Plan, we understand the site will be developed for industrial use consisting of a 290,000 square foot distribution building. Associated interior driveways, parking spaces, perimeter/retaining walls, delivery loading areas, underground utilities, and landscape areas are also planned.

No grading or structural plans were available in preparing this report. However, we anticipate that minor rough grading of the site will be required to achieve future surface configuration and we expect the proposed distribution building will be a 2-story structure with concrete slabs on grade. Column loads are not anticipated to exceed 350 kips.

2.0 INVESTIGATION

2.1 RESEARCH

We have reviewed the referenced geologic publications, geologic maps, and historic aerial photos (see references). Data from these sources were utilized to develop some of the findings and conclusions presented herein.

Based on our review, the site was originally utilized for agricultural purposes until 1954. By 1963, a parking lot was constructed within the central and northeast portion of the site. At that time, the southeast corner appears to consist of graded land for future construction of a parking lot. In 1972, the entire site consisted of a parking lot. By 1994, the current two-story building is constructed at the northeast portion of the site and the parking lot is developed to its present-day configuration. The site has remained relatively unchanged since 1994.

2.2 PREVIOUS GEOTECHNICAL WORK

We also reviewed the referenced geotechnical investigation reports dated April 1, 1968 and December 28, 2007 prepared by Leroy Crandall & Associates and Golder Associates Inc, respectively. The investigation by Leroy Crandall was completed for the existing building within the northwest portion of the western property (4090-021-034). Six (6) exploratory borings were excavated within the existing building. The borings were excavated to the depth of 75 feet below the existing ground surface (bgs) utilizing a CME-75 truck mounted drill rig with hollow stem augers. The investigation by Golder was completed for the two properties (APN: 4090-021-032, 4090-021-033) at the western portion of the site. Their investigation consisted of excavating four (4) exploratory borings. The borings were excavated to depths ranging from 26.5 to 51.5 feet below the existing ground surface (bgs) utilizing a CME-75 truck mounted drill rig with hollow stem augers.

Pertinent exploratory and laboratory data presented by Golder Associates Inc. were utilized in developing some of the findings and conclusions discussed herein and are presented in Appendix C.

2.3 SUBSURFACE EXPLORATION

Subsurface exploration for this investigation was conducted on September 21, 2018, and consisted of the drilling of six (6) exploratory borings to depths ranging from approximately 21.5 to 51.5 feet below the existing ground surface (bgs). The borings were drilled using a truck-mounted, continuous flight, hollow-stem-auger drill rig. A representative of *Albus-Keefe & Associates, Inc.* logged the exploratory borings. Visual and tactile identifications were made of the materials encountered, and their descriptions are presented in the Exploration Logs in Appendix A. The approximate locations of the exploratory excavations completed by this firm are shown on the enclosed Geotechnical Map, Plate 1.

Bulk, relatively undisturbed and Standard Penetration Test (SPT) samples were obtained at selected depths within the exploratory borings for subsequent laboratory testing. Relatively undisturbed samples were obtained using a 3-inch O.D., 2.5-inch I.D., California split-spoon soil sampler lined with brass rings. SPT samples were obtained from the borings using a standard, unlined SPT soil sampler. During each sampling interval, the sampler was driven 18 inches with successive drops of a 140-pound automatic hammer falling 30 inches. The number of blows required to advance the sampler was recorded for each six inches of advancement. The total blow count for the lower 12 inches of advancement per soil sample is recorded on the exploration log. Samples were placed in sealed containers or plastic bags and transported to our laboratory for analyses. The borings were backfilled with auger cuttings upon completion of sampling. Borings within asphalt-paved areas were capped with asphalt cold patch.

2.4 LABORATORY TESTING

Selected samples of representative earth materials from our borings were tested in the laboratory. Tests consisted of USCS classification, in-situ moisture content and dry density, maximum dry density and optimum moisture content, consolidation/collapse, direct shear strength, expansion index, Atterberg Limits, corrosivity (pH, chloride, and resistivity), and soluble sulfate content. Descriptions of laboratory testing and the test results are presented in Appendix B and on the Exploration Logs in Appendix A.

3.0 GEOLOGIC CONDITIONS

3.1 SOIL CONDITIONS

Descriptions of the earth materials encountered during our investigation are summarized below and are presented in detail on the Exploration Logs presented in Appendix A.

The soils encountered within the site generally consisted of artificial fill materials overlying older alluvial deposits. The artificial materials were observed in exploratory borings B-1 through B-3 up to 5.0 feet below existing ground surface, however fills of this thickness are not anticipated to be widespread. The artificial materials generally consist of dark brown to medium brown clay that is typically moist and stiff to very stiff.

The older alluvial materials were encountered both beneath artificial fills as well as at the surface to the maximum depth explored, 51.5 feet below the existing ground surface. The older alluvial materials are generally comprised of interlayers of olive brown, grayish brown, reddish brown, gray, and light brown clay, silty sand, clayey sand, sandy silt, and sand. These materials are typically moist to wet and generally medium dense to dense/ stiff to very stiff.

3.2 GROUNDWATER CONDITIONS

Groundwater was encountered at 35 to 36 feet below existing ground surface during this investigation. A previous investigation within the western portion of the site by Golder Associates (2003) encountered groundwater at the depths ranging from 36.5 to 47 feet below the existing ground surface. Furthermore, at a site 0.5 miles to the west, groundwater was encountered at 22 feet by Delta (2008). The State of California groundwater website indicates present groundwater for the surrounding area is expected at 94.9 feet below existing ground surface. A review of the referenced Seismic Hazard Zone Report 027 indicates no historical groundwater level data in this area, but indicates that groundwater was expected to be “deep” throughout the area. From this data we can determine that a perched groundwater condition is present on site due to the interlayered nature of the subsurface.

3.3 FAULTING

Geologic literature does not indicate the presence of active faulting within the site. The site does not lie within an "Earthquake Fault Zone" as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act. The closest known active fault is the Newport-Inglewood fault located approximately 3.8 from the site. Table 3.1 provides a summary of all the known seismically active faults within 10 miles of the site, based on the 2008 National Seismic Hazard Maps.

TABLE 3.1
SUMMARY OF ACTIVE FAULTS

Name	Distance (miles)	Slip Rate (mm/yr.)	Preferred Dip (degrees)	Slip Sense	Rupture Top (km)	Fault Length (km)
Newport-Inglewood, alt 1	3.81	1	88	strike slip	0	65
Newport Inglewood Connected alt 1	3.81	1.3	89	strike slip	0	208
Newport Inglewood Connected alt 2	4.11	1.3	90	strike slip	0	208
Palos Verdes	4.54	3	90	strike slip	0	99
Palos Verdes Connected	4.54	3	90	strike slip	0	285
Puente Hills (LA)	9.6	0.7	27	thrust	2.1	22

4.0 ANALYSES

4.1 SEISMICITY

We have performed probabilistic seismic analyses utilizing the U.S. Seismic Design Maps web application by the U.S. Geological Survey (USGS). From our analyses, we obtain a PGA of 0.769g in accordance with Figure 22-7 of ASCE 7-16. The site factor for Site Class D in this range of PGA is F_{PGA} = 1.1. Therefore, the PGA_M = 1.1 x 0.769 = 0.846g.

4.2 STATIC SETTLEMENT

Analyses were performed to evaluate potential for static settlement of spread footings. Our analyses were based on the results of consolidation tests performed on selected fine-grained samples from our borings as well as the recorded blow counts for sampling of granular zones. For our analyses, we have assumed the existing fill would be removed and replaced with new compacted fill consisting of onsite soils. The consolidation characteristics of the new fill are anticipated to be slightly better than the in-situ older alluvial soils. Blow counts indicate that the fine-grained zones are more compressible and we have conservatively assumed the entire profile is comprised of fine-grained soils. We have conservatively assumed the footings would only be supported by the older alluvial soils. Values of 0.078 and 0.017 were selected for compression and rebound indexes, respectively. Testing indicates the soils have a preconsolidation stress of at least 4,000 psf.

Our analysis was based on a total column load of 350 kips. The load would be carried by a square footing 10 feet in width, embedded 2 feet below pad grade, and apply a bearing pressure of 3,500 psf. Based on this configuration, we obtain an estimated primary settlement of ¾ inches. Time rates were not performed on the consolidation tests because the soils are not fully saturated. Therefore, we do not have specific secondary compression indexes for use in analyses. Based on the stiff and over consolidated nature of the soils, we anticipate that secondary settlement would not exceed 33% of the primary settlement. From this, we estimate that total primary and secondary settlement would be less than 1 inch.

5.0 CONCLUSIONS

5.1 FEASIBILITY OF PROPOSED DEVELOPMENT

From a geotechnical point of view, the proposed site improvements are considered feasible provided the recommendations presented in this report are incorporated into the design and construction of the project. Furthermore, it is also our opinion that the proposed development will not adversely impact the stability of adjoining properties if the recommendations presented in this report are incorporated into site development. Key issues that could have significant fiscal impacts on the geotechnical aspects of the proposed site development are discussed in the following sections of this report.

5.2 GEOLOGIC HAZARDS

5.2.1 Ground Rupture

No active faults are known to project through the site nor does the site lie within the bounds of an "Earthquake Fault Zone" as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act. As such, the potential for ground rupture due to fault displacement beneath the site is considered very low. The nearest zoned fault is the Newport-Inglewood fault located approximately 3.8 miles to the northeast.

5.2.2 Ground Shaking

The site is located in a seismically active area that has historically been affected by moderate to occasionally high levels of ground motion. The site lies in relatively close proximity to several seismically active faults; therefore, during the life of the proposed development, the property will probably experience moderate to occasionally high ground shaking from these fault zones, as well as some background shaking from other seismically active areas of the southern California region. Design of proposed structures in accordance with the current CBC is anticipated to adequately mitigate concerns with ground shaking.

5.2.3 Liquefaction

Engineering research of soil liquefaction potential (Youd, et al., 2001) indicates that generally three basic factors must exist concurrently in order for liquefaction to occur. These factors include:

- A source of ground shaking, such as an earthquake, capable of generating soil mass distortions.
- A relatively loose silty and/or sandy soil.
- A relative shallow groundwater table (within approximately 50 feet below ground surface) or completely saturated soil conditions that will allow positive pore pressure generation.

The liquefaction susceptibility of the onsite subsurface soils was evaluated by analyzing the potential concurrent occurrence of the above-mentioned three basic factors. The liquefaction evaluation for this site was completed under the guidance of Special Publication 117A: Guidelines for Evaluating and Mitigating Seismic Hazards in California (CDMG, 2008).

The site is not located within a mapped liquefaction hazard zone by the California Geologic Survey due to the relatively deep groundwater and dense older alluvium in the general area. Perched groundwater was encountered during this firm’s investigation at 35 feet below the existing ground. However, the materials located below groundwater have high blow counts that indicate they are sufficiently dense enough to make liquefaction unlikely. Some blow counts below 35 feet were less than 30. However, very high blow counts above and below these values suggest the values les than 30 are likely due to sand boiling at the point of sampling. This condition will occur when insufficient water head is maintained in the auger stem during drilling and sampling. The higher water pressure just below the drill auger will try to flow into the stem where water pressure may be significantly lower and thereby cause boiling. The boiling reduces the resistance of the sands and lowers the blow count. We therefore conclude the risk of liquefaction at the site is Low and no mitigation is required.

5.3 STATIC SETTLEMENT

Assuming existing fill soils are removed and recompacted, we anticipate that total settlement of the proposed structure would not exceed 1 inch. Differential settlement is not anticipated to exceed ½ of the total settlement and therefore, is expected to be less than ½ inch over 30 feet. These magnitudes of settlement are considered within tolerable limits of proposed site development.

5.4 EARTHWORK AND MATERIAL CHARACTERISTICS

The subsurface soils are anticipated to be relatively easy to excavate with conventional heavy earthmoving equipment. Most of the existing fill materials and alluvium are above optimum moisture content and may require drying and/or mixing to achieve proper compaction. Although not encountered, the existing artificial fill soils may contain oversized debris that will require special handling and disposal.

Offsite improvements exist near the property lines. The presence of the existing improvements may limit removals of unsuitable materials adjacent the property lines. Special grading techniques, such as slot cutting or other acceptable criteria, may be required when grading adjacent the property lines. Specific recommendations can be provided by the geotechnical consultant upon request.

Onsite disposal systems, clarifiers and other underground improvements may be present beneath the site. If encountered during future rough grading, these improvements will require proper abandonment or removal.

5.5 SHRINKAGE AND SUBSIDENCE

Volumetric changes in earth quantities will occur when excavated onsite soil materials are replaced as properly compacted fill. We estimate the existing upper earth materials will shrink approximately 10 percent. Reprocessing of removal bottoms is anticipated to result in negligible subsidence. The estimates of shrinkage and subsidence are intended as an aid for project engineers in determining earthwork quantities. However, these estimates should be used with some caution since they are not absolute values. Contingencies should be made for balancing earthwork quantities based on actual shrinkage and subsidence that occurs during the grading process.

5.6 SOIL EXPANSION

Based on our laboratory test results and experience of the surrounding area, the near-surface soils within the site are generally anticipated to possess **Medium to High** expansion potentials. Golder Associates (2007) also indicated a High expansion potential in their laboratory testing. Additional testing for soil expansion will be required subsequent to rough grading and prior to construction of foundations and other concrete flatwork to confirm these conditions. The presence of expansive soils will tend to swell when wetted and shrink when dried. This characteristic will result in differential movement of structures and other site improvements. Specific recommendations to mitigate the adverse effects of expansive soils are provided in the following sections.

6.0 RECOMMENDATIONS

6.1 EARTHWORK

6.1.1 General Earthwork and Grading Specifications

All earthwork and grading should be performed in accordance with all applicable requirements of the grading codes of the City of Torrance, California and CAL OSHA, in addition to recommendations presented herein.

6.1.2 Pre-Grade Meeting and Geotechnical Observation

Prior to commencement of earthwork operations and foundation installation, we recommend a meeting be held between City Inspector, general contractor, civil engineer, and geotechnical consultant to discuss proposed earthwork and logistics.

We also recommend that a geotechnical consultant be retained to provide soil engineering and engineering geologic services during site development. This is to observe compliance with the design specifications and recommendations, and to allow design changes in the event that subsurface conditions differ from those anticipated. If conditions are encountered during construction that appears to be different than those indicated in this report, the project geotechnical consultant should be notified immediately. Design and construction revisions may be required.

6.1.3 Site Clearing

All previous structures, foundation elements, vegetation and deleterious materials should be removed from areas to receive fill placement. The project geotechnical consultant should be notified at the appropriate times to provide observation services during clearing operations to verify compliance with the above recommendations. Voids created by clearing should be left open for observation by the geotechnical consultant. Any unusual soil conditions or subsurface structures encountered during site clearing and/or grading should be brought to the immediate attention of the project geotechnical consultant for corrective recommendations.

We understand that the existing building to be demolished contains a full basement. At a minimum, the basement walls should be demolished and removed from the excavation. The basement slab and underlying footings may be left in place provided holes are cored through the slab. In general, the cores should be 4 inches in diameter and spaced about every 20 feet on center each way. The slab should then be covered with at least 6 inches of gravel or crushed concrete. Alternatively, the slab may be demolished in place by fracturing the slab to pieces generally no greater than about 3 feet square. As above, the slab should then be covered with at least 6 inches of gravel or crushed concrete.

Concrete and asphaltic concrete debris from demolition may be crushed to a maximum dimension of 1 inch then used as fill on the site. Materials that are crushed but create a poorly-graded material (generally of one size) should be blended with onsite soils in a 50/50 ratio for reuse as engineered fill. Alternately, concrete and asphaltic concrete debris may be crushed to a maximum particle size of 4 inches and incorporated into the fill by blending at a minimum ratio of 5 parts onsite soil and 1 part crushed concrete.

6.1.4 Site Preparation (Removals and Overexcavations)

All existing fill soils should be removed within the limits of the proposed building and pavement. Artificial fill was observed up to the 5 feet below existing ground surface (not including the existing basement excavation). Locally deeper removal may be required in the areas of previously existing underground facilities. No existing fill is anticipated to be present within the limits of the existing basement. In addition, the upper 1 to 2 feet of the older alluvium where exposed at the current surface may be weathered. Where these materials are weathered or otherwise disturbed, they should be removed to expose competent older alluvial soils.

The removals should extend laterally a distance of at least 5 feet beyond the limits of the proposed building or a 1:1 projection down and away from the bottom of the footings, whichever is greater. Removals for pavement and free-standing retaining walls may be limited to the edge of the foundations or pavement where lateral restrictions to removals are present such as property lines. The actual depth of removals should be verified by the geotechnical consultant during site grading.

Where removals are limited by existing structures, protected trees or property lines, special considerations may be required in the construction of affected improvements. Under such conditions, specific recommendations should be provided by this firm.

All removal excavations should be evaluated by the geotechnical consultant during grading to confirm the exposed conditions are as anticipated and to provide supplemental recommendations if required.

Following removals/overexcavation, the exposed grade should first be scarified to a depth of 6 inches, brought to at least 120 percent of the optimum moisture content, and then compacted to at least 90 percent of the laboratory standard.

6.1.5 Fill Placement

In general, materials excavated from the site may be reused as fill provided they are free of deleterious materials and particles greater than 4 inches in maximum dimension (oversized materials). Concrete and asphaltic concrete debris from demolition may be crushed to a maximum dimension of 1 inch then used as fill on the site. Materials that are crushed but create a poorly-graded material (generally of one size) should be blended with onsite soils in a 50/50 ratio for reuse as engineered fill. Alternately, concrete and asphaltic concrete debris may be crushed to a maximum particle size of 4 inches and incorporated into the fill by blending at a minimum ratio of 5 parts onsite soil and 1 part crushed concrete. Such materials should be mixed thoroughly with onsite soils to prevent nesting.

Crushed concrete and asphaltic concrete will create a fill material that is dissimilar in expansion characteristics to the onsite soils. As such, care should be taken to avoid filling some areas below the proposed building with a significant thickness of crushed material while adjacent areas have little or none. Use of the crushed material should be spread across the site as a relatively uniform blanket so the transition in thickness varies by no more than about 1 foot vertically across 20 feet horizontally. The existing basement may be backfilled exclusively with crushed material provided the area is capped with at least 3 feet of onsite soils.

All fill should be placed in lifts no greater than 8 inches in loose thickness, moisture conditioned to a uniform moisture of at least 120 percent of the optimum moisture content, then compacted in place to at least 90 percent of the laboratory standard. Each lift should be treated in a similar manner. Subsequent lifts should not be placed until the project geotechnical consultant has approved the preceding lift.

Excavations into site materials may expose soils with very differing characteristics. If such differing materials are created through excavation, they should be blended to create a relatively uniform soil mix when reused as fill below the structures. The blending of each lift should be observed and approved by the geotechnical consultant prior to placement of additional lifts of fill.

6.1.6 Import Materials

If import materials are required to achieve the proposed finish grades, the proposed import soils should have an Expansion Index (EI, ASTM D 4829) of less than 100, possess negligible soluble sulfate concentrations, include no particles greater than 4 inches in maximum dimension, and be free of deleterious materials. If import materials with significantly lower expansion potentials are brought to the site, special consideration will be necessary during fill placement to limit differential expansion between the import and native materials. Import sources should be indicated to the geotechnical consultant prior to hauling the materials to the site so that appropriate testing and evaluation of the fill materials can be performed in advance.

6.1.7 Temporary Excavations

Temporary construction slopes or trench excavations in site materials may be cut vertically up to a height of 4 feet provided that no surcharging of the excavations is present. Temporary slopes over 4 feet in height but no more than 10 feet in height should be laid back at a maximum gradient of 1:1 (H:V) or properly shored. If steeper cuts are required to avoid existing site improvements, then additional analyses by the geotechnical consultant will be required or the excavation should be shored.

Excavations should not be left open for prolonged periods of time. The project geotechnical consultant should observe all temporary cuts to confirm anticipated conditions and to provide alternate recommendations if conditions dictate. All excavations should conform to the requirements of CAL OSHA.

Where temporary excavations cannot accommodate a 1:1 layback or where surcharging occurs, shoring, slot cutting, underpinning, or other methods should be used. Specific recommendations for other options if considered should be provided by the geotechnical consultant based on review of the final design plans.

6.2 SEISMIC DESIGN PARAMETERS

For design of the project in accordance with Chapter 16 of the 2016 CBC, the following table presents the seismic design factors:

TABLE 6.1
2019 CBC (ASCE 7-16) Seismic Design Parameters

Parameter	Value
Site Class	D
Mapped MCE Spectral Response Acceleration, short periods, S_S	1.770
Mapped MCE Spectral Response Acceleration, at 1-sec. period, S_1	0.631
Site Coefficient, Fa	1.0
Site Coefficient, Fv	1.7
Adjusted MCE Spectral Response Acceleration, short periods, S_{MS}	1.919
Adjusted MCE Spectral Response Acceleration, at 1-sec. period, S_{M1}	1.672
Design Spectral Response Acceleration, short periods, S_{DS}	1.279
Design Spectral Response Acceleration, at 1-sec. period, S_{D1}	1.115
Seismic Design Category	D

MCE = Maximum Considered Earthquake

6.3 FOUNDATION DESIGN

The following recommendations are provided for preliminary design purposes. These recommendations have been based on the site materials exposed during our investigation, our understanding of the proposed development, and the assumption that the recommendations presented herein are incorporated into the design and construction of the project. Final recommendations should be provided by the project geotechnical consultant following review of final foundation plans as well as observation and testing of site materials during grading. Depending upon the design plans and actual site conditions, the recommendations provided herein may require modification.

6.3.1 Soil Expansion

Expansion potential of existing site materials is expected to vary from **Medium to High**. As such, we are providing recommendation for both conventional footings and post-tension foundation slabs. Design parameters provided herein are based on an EI of 102, PI of 34, and LL of 55. Additional testing of site soils should be performed by the project geotechnical consultant to confirm the basis of these recommendations during site grading.

6.3.2 Settlement

Foundations should be designed for total and differential static settlement up to 1 inch and ½-inch over 30 feet, respectively.

6.3.3 Allowable Bearing Value

Provided foundations are bearing into engineered fill, a bearing value of 3,000 pounds per square foot (psf) may be used for continuous and pad footings that have a minimum width of 12 inches and founded at a minimum depth of 12 inches below the lowest adjacent grade. This value may be increased by 130 psf and 410 psf for each additional foot in width and depth, respectively, up to a maximum value of 3,500 psf. Recommended allowable bearing values include both dead and live loads, and may be increased by one-third for wind and seismic forces.

6.3.4 Lateral Resistance

Provided site grading is performed and that foundations are founded in engineered fill, a passive earth pressure of 380 pounds per square foot per foot of depth (psf/ft) up to a maximum value of 1,900 pounds per square foot (psf) may be used to determine lateral bearing for footings. This value may be increased by one-third when designing for wind and seismic forces. A coefficient of friction of 0.26 times the dead load forces may also be used between concrete and the supporting soils to determine lateral sliding resistance. No increase in the coefficient of friction should be used when designing for wind and seismic forces.

The above values are based on footings placed directly against engineered fill. In the case where footing sides are formed, all backfill against the footings should be compacted to at least 90 percent of the laboratory standard.

6.3.5 Footings and Interior Slabs on Grade

Exterior continuous building footings should be founded at a minimum depth of 24 inches. Interior bearing wall footings should be founded at a minimum depth of 12 inches below the lowest adjacent slab subgrade. All continuous footings should be reinforced with a minimum of four No. 4 bars, two top and two bottom. The structural engineer may require different reinforcement and should dictate if greater than the recommendations herein.

Exterior isolated pad footings should be a minimum of 24 inches square and founded at a minimum depth of 24 inches below the lowest adjacent final grade. Interior isolated pad footings should be a minimum of 24 inches square and founded at minimum depth of 12 inches below the lowest adjacent slab subgrade.

Interior concrete slabs constructed on grade should have a minimum thickness of 6 inches and should be reinforced with at least No. 4 bars spaced 18 inches each way. Care should be taken to ensure the placement of reinforcement at mid-slab height. The structural engineer may recommend a greater slab thickness and reinforcement based on proposed use and loading conditions and such recommendations should govern if greater than the recommendations presented herein.

Design of the slab for special loading considerations may be based on a modulus of subgrade reaction (Kv1) of 150 pounds per cubic inch (pci). The modulus is based on an effective loading area of 1 foot by 1 foot. The modulus may be adjusted for other effective loading areas using the equation provided below.

$$k_b(pci) = 150\left\{\frac{b+1}{2b}\right\}^2$$

where “b” is the effective width of loading (minimum dimension) in feet.

Interior concrete slabs on grade in moisture-sensitive area should be underlain with a moisture vapor barrier consisting of a poly-vinyl chloride membrane such as 10-mil Visqueen, or equal. The membrane should be properly lapped, sealed, and protected with at least 4 inches of sand having an SE or 30 or more. One inch of sand may be placed over the membrane to aid in the curing of the concrete. This vapor barrier system is anticipated to be suitable for most flooring finishes that can accommodate some vapor emissions. However, this system may emit more than 4 pounds of water per 1000 sq. ft. and therefore, may not be suitable for all flooring finishes. Additional steps should be taken if such vapor emission levels are too high for anticipated flooring finishes.

Special consideration should be given to slabs in areas to receive ceramic tile or other rigid, crack-sensitive floor coverings. Design and construction should mitigate hairline cracking through the use of additional reinforcing and careful control of concrete slump.

Block-outs should be provided around interior columns to permit relative movement and mitigate distress to the floor slabs due to differential settlement that will occur between column footings and adjacent floor subgrade soils as loads are applied.

Prior to placing concrete, subgrade soils below slab-on-grade areas should be thoroughly moistened to provide moisture contents that are at least 120 percent of optimum to a depth of 12 inches.

Design of slabs in accordance with Section 1815 of the latest edition of the CBC, may be based on a Weighted plastic index of 35 and an Effective plastic index of 42.

6.3.6 Post-Tensioned Slab/Mat on grade

Perimeter edge beams for the post-tensioned slabs should have a minimum effective width of 12 inches and be founded at a minimum depth of 18 inches below the lowest adjacent final ground surface. Interior beams may be founded at a minimum depth of 12 inches below the tops of the finish floor slabs. Where a post-tensioned mat is utilized, the exterior edge of the mat should be embedded at least 8 inches below the lowest adjacent grade. The thickness of the floor slab/mat should be determined by the project structural engineer; however, we recommend a minimum slab thickness of 6.0 inches.

Design of the mat may be based on a modulus of subgrade reaction (Kv1) of 150 pounds per cubic inch (pci). The modulus is based on an effective loading area of 1 foot by 1 foot. The modulus may be adjusted for other effective loading areas using the equation provided below.

$$k_b(pci) = 150\left\{\frac{b+1}{2b}\right\}^2$$

where “b” is the effective width of loading (minimum dimension) in feet.

Concrete floor slabs in areas to receive carpet, tile, or other moisture sensitive coverings should be underlain with a minimum of 10-mil moisture vapor retarder conforming to ASTM E 1745, Class A. The membrane should be properly lapped, sealed, and underlain within a layer of sand at least 4 inches thick. One inch of sand may be placed over the membrane to aid in the curing of the concrete. The sand should have a SE no less than 30. This vapor retarder system is anticipated to be suitable for most flooring finishes that can accommodate some vapor emissions. However, this system may emit more than 4 pounds of water per 1000 sq. ft. and therefore, may not be suitable for all flooring finishes. Additional steps should be taken if such vapor emission levels are too high for anticipated flooring finishes. Where a mat is utilized, the sand may be reduced to 1 inch provided the mat is at least 6 inches thick.

Prior to placing concrete, subgrade soils below slab-on-grade/mat areas should be thoroughly moistened to provide moisture contents that are at least 120 percent of the optimum moisture content to a depth of 12 inches.

Based on the guidelines provided in the “Design of Post-Tensioned Slabs-on-Ground” 3rd Edition by Post-Tensioning Institute, the em and ym values are summarized below:

TABLE 6.2
PTI Design Parameters

Parameter	Value
Edge Lift Moisture Variation Distance, e_m	3.4 feet
Edge Lift, y_m	2.412 inches
Center Lift Moisture Variation Distance, e_m	5.8 feet
Center Lift, y_m	1.749 inches

6.3.7 Foundation Observations

Foundation excavation should be observed by the project geotechnical consultant to verify that they have been excavated into competent bearing soils and to the minimum embedment recommended above. These observations should be performed prior to placement of forms or reinforcement. The excavations should be trimmed neat, level and square. Loose, sloughed or moisture-softened materials and debris should be removed prior to placing concrete.

6.4 RETAINING/SCREEN WALLS

6.4.1 General

The following preliminary design and construction recommendations are provided for general retaining and screen walls. Final wall designs specific to the site development should be provided for review once completed. The structural engineer and architect should provide appropriate recommendations for sealing at all joints and applying moisture-proofing material on the back of the walls.

6.4.2 Allowable Bearing Value and Lateral Resistance

Retaining walls may be supported by conventional spread footings that utilize the bearing capacities and lateral resistance values provided in Sections 6.3.3 and 6.3.4. The passive pressure used for lateral bearing should be reduced by 50% for walls along the property line or where lateral removals are limited.

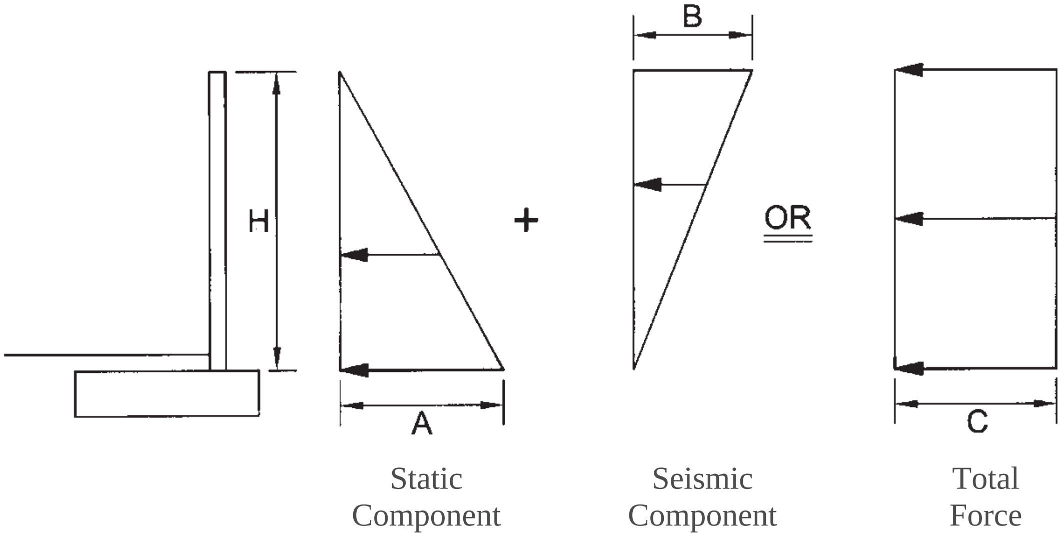
The above values are based on footings placed directly against properly compacted fill or competent native soils. In the case where footing sides are formed, all backfill against the footings should be compacted to at least 90 percent of the Modified Proctor standard.

6.4.3 Active Earth Pressures

Static and seismic earth pressures for level and 2:1 (H:V) backfill conditions are provided in Table 6.3. Seismic earth pressures provided herein are based on the method provided by Seed & Whitman (1970) using a peak ground acceleration (PGA) of 0.52g for 10% probability of exceedance in 50 years. As indicated in the 2016 CBC, retaining walls supporting 6 feet of backfill or less are not required to be designed for seismic earth pressures. Two sets of values are provided in the following table; one for select import with Expansion Index (EI) less than 20, and one for onsite materials with an expansion index between 90 and 130. The backfill material should be placed within a 1:1 plane projected up from the base of the wall stem. In addition, the values are based on drained backfill conditions and do not consider hydrostatic pressure. Furthermore, retaining walls should be designed to support adjacent surcharge loads imposed by other nearby footings or traffic loads in addition to the earth pressure.

TABLE 6.3

SEISMIC EARTH PRESSURES
Pressure Diagram



Active Pressure Values
Walls Using Select Import Backfill
(Soils with EI <20 & <30 passing 200 sieve)

Value	Level Backfill	2:1 Backfill
A	35H	59H
B	15.5H	15.5H
C	25H	37H

Active Pressure Values
Walls Using Onsite Soil Backfill
(Soils with EI <120)

Value	Backfill Condition	
	Level	2H:1V Slope
A	45H	72H
B	15.5H	15.5H
C	30H	44H

Note: H is in feet and resulting pressure is in psf. Design may utilize either the sum of the static component and the seismic component force diagrams or the total force diagram above. SEAOSC has suggested using a load factor of 1.7 for the static component and 1.0 for the seismic component. The actual load factors should be determined by the structural engineer.

6.4.4 Footing Reinforcement

All continuous footings should be reinforced with a minimum of two No. 4 bars on top and two No. 4 bars on the bottom. The structural engineer may require different reinforcement and should dictate if greater than the recommendations provided herein. Where recommended removals are limited due to space restrictions, greater reinforcement may be recommended. Specific recommendations should be provided by the geotechnical consultant during grading based on as-built conditions exposed in the field.

6.4.5 Footing Observations

Footing excavations should be observed by the project geotechnical consultant to verify that they have been excavated into competent bearing soils and to the minimum embedment recommended herein. These observations should be performed prior to placement of forms or reinforcement. The excavations should be trimmed neat, level, and square. Loose, sloughed or moisture-softened materials and debris should be removed prior to placing concrete.

6.4.6 Drainage and Moisture-Proofing

Retaining walls should be constructed with a perforated pipe and gravel subdrain to prevent entrapment of water in the backfill. The perforated pipe should consist of 4-inch-diameter, ABS SDR-35 or PVC Schedule 40 with the perforations laid down. The pipe should be embedded in ¾- to 1½-inch open-graded gravel wrapped in filter fabric. The gravel should be at least one foot wide and extend at least one foot up the wall above the footing and drainage outlet. Drainage gravel and piping should not be placed below outlets and weepholes. Filter fabric should consist of Mirafi 140N, or equal. Outlet pipes should be directed to positive drainage devices.

The use of weepholes may be considered in locations where aesthetic issues from potential nuisance water are not a concern. Weepholes should be 2 inches in diameter and provided at least every 6 feet on center. Where weepholes are used, perforated pipe may be omitted from the gravel subdrain.

Retaining walls supporting backfill should also be coated with a moisture-proofing compound or covered with such material to inhibit infiltration of moisture through the walls. Moisture-proofing material should cover any portion of the back of wall that will be in contact with soil and should lap over and onto the top of footing. A drainage panel should be provided between the soil backfill and water proofing. The panel should extend from the top of the backdrain gravel up to within 12 inches of finish grade. The top of footing should be finished smooth with a trowel to inhibit the infiltration of water through the wall. The project structural engineer should provide specific recommendations for moisture-proofing, water stops, and joint details.

If select backfill soil is used, the backfill should be placed within the zone defined by a 1:1 plane projected up from the back of the footing. Active pressures may be used for walls free to move at the top. For walls restrained from movement at the time of backfilling, at-rest pressures should be used.

6.4.7 Retaining Wall Backfill

Onsite soils having expansion index (EI) EI < 100 or select imported soils having EI < 20 may be used for backfill behind retaining walls provided the wall has been designed for earth pressures as discussed in Section 6.4.3. The project geotechnical consultant should approve the backfill used for retaining walls. Wall backfill should be thoroughly moistened to provide moisture contents slightly over optimum moisture content; placed in lifts no greater than 12 inches in thickness, and then mechanically compacted with appropriate equipment to at least 90 percent of the laboratory standard. Hand-operated compaction equipment should be used to compact the backfill placed immediately adjacent the wall to avoid damage to the wall. Flooding or jetting of backfill material is not recommended.

6.4.8 Wall Jointing

All site walls should be provided with cold joints through the masonry block section at horizontal spacing generally not exceeding 20 feet. If walls will be constructed in locations where removal of unsuitable soils was restricted to less than a 1 to 1 projection down from the foundation (such as property boundaries) the joints should be provided every 10 feet or other mitigation as recommended by the project geotechnical consultant. Joints should not extend through the footing nor should they be covered by a brittle finish such as stucco. Joints may be filled with a mastic caulking or covered by a facing strip attached to one side of the wall at the joint.

6.5 EXTERIOR FLATWORK

Exterior flatwork should be a minimum of 4 inches thick. Cold joints or saw cuts should be provided at least every 5 feet in each direction. Flatwork having a minimum dimension more than 5 feet should be reinforced with No. 3 bars spaced 18 inches center to center each way. Cold joints should be keyed or doweled. Special jointing detail should be provided in areas of block-outs, notches, or other irregularities to avoid cracking at points of high stress. Consideration should be given to doweling flatwork into adjacent footings at points of entry and where they meet curbs to mitigate differential left at cold joints.

Drainage from flatwork areas should be directed to local area drains or other appropriate collection devices designed to carry runoff water to the street or other approved drainage structures. The concrete flatwork should also be sloped at a minimum gradient of 1% away from building foundations and masonry walls.

Subgrade soils below flatwork areas should be thoroughly moistened prior to placing concrete. The moisture content of the soils should be at least 120 percent of the optimum moisture content and penetrate to a depth of approximately 12 inches into the subgrade. Flooding or ponding of the subgrade is not recommended. Moisture conditioning should be achieved by a light application of water to the subgrade just prior to pouring concrete. The geotechnical consultant should observe and verify the density and moisture content of subgrade soils prior to pouring concrete to verify the recommended pre-moistening recommendations have been met

6.6 CONCRETE MIX DESIGN

Laboratory testing of onsite soil indicates **negligible** soluble sulfate content. Concrete designed to follow the procedures provided in ACI 318, Section 4.3, Table 4.3.1 for negligible sulfate exposure are anticipated to be adequate for mitigation of sulfate attack on concrete. Upon completion of rough grading, an evaluation of as-graded conditions and further laboratory testing will be required for the site to confirm or modify the conclusions provided in this section.

6.7 CORROSION

Results of preliminary testing of soils for pH, chloride content, and minimum resistivity indicate the site is potentially **Severely Corrosive** to metals that are in contact or close proximity to onsite soils. As such, specific recommendations should be obtained from a corrosion specialist if construction will include metals that will be buried below ground surface at the site.

6.8 PRELIMINARY PAVEMENT DESIGN

6.8.1 Pavement Structural Sections

Based on the soil conditions present at the site and estimated traffic index, preliminary pavement structural sections are recommended in Table 6.4 below. Soil conditions vary significantly with respect to R-value. An assumed “R-value” of 5 was used for this preliminary pavement design to represent the typical condition we anticipate to be present following site grading. The sections provided below are for planning purposes only and should be re-evaluated subsequent to site grading. Final pavement sections should be based on actual R-value testing of in-place soils and analysis of anticipated traffic.

6.8.1 Subgrade Preparation

Prior to placement of paving elements, subgrade soils should be scarified 6 inches, moisture-conditioned to at least 120 percent of the optimum moisture content then compacted to at least 90 percent of the maximum dry density determined in accordance with ASTM D1557. Areas observed to pump or yield under vehicle traffic should be removed and replaced with firm and unyielding engineered compacted soil or aggregate base materials.

TABLE 6.4
PRELIMINARY PAVEMENT STRUCTURAL SECTIONS

Location	Traffic Index	Asphaltic Concrete (inches)	Portland Cement Concrete (inches)	Aggregate Base (inches)
Parking Stalls	N/A	3.0	--	6.0
Secondary Rear Entry	5.0	3.0		11.0
		--	7.50	--
Secondary Parking Drive Isles	5.5	4.0	--	10.0
		5.0	--	8.0
		--	8.0	--
Primary Front Entry & Truck Drive Aisles Loading Dock Area	7.5	5.0	--	17.0
		--	11.0	--

6.8.2 Aggregate Base

Aggregate base materials should be Crushed Aggregate Base or Crushed Miscellaneous Base conforming to Section 200-2 of the Standard Specification for Public Works Construction (Greenbook, 2015) or Class 2 Aggregate Base conforming to the Caltrans' Standard Specifications. The materials should be moisture conditioned to slightly over the optimum moisture content then compacted to at least 95 percent of ASTM D 1557.

6.8.3 Asphaltic Concrete

Paving asphalt should be PG 64-10 conforming to the requirements of Section 203-1 of the Greenbook. Asphalt concrete materials should conform to Section 203-6 and construction should conform to Section 302 of the Greenbook.

6.8.4 Portland Cement Concrete

Portland cement concrete used to construct concrete paving should conform to Section 201 of the Greenbook and should have a minimum compressive strength of 3,500 pounds per square inch (psi) at 28 days. Reinforcement and jointing of concrete pavement sections should be designed according to the minimum recommendations provided by the Portland Cement Association (PCA). For rigid pavement, transverse and longitudinal contraction joints should be provided at spacing no greater than 15 feet. Score joints may be constructed by saw cutting to a depth of ¼ of the slab thickness. Expansion/cold joints may be used in lieu of score joints. Such joints should be properly sealed. Where traffic will traverse over cold joints or edges of concrete paving, the edges should be thickened by 20% of the design thickness toward the edge over a horizontal distance of 5 feet.

6.9 POST GRADING CONSIDERATIONS

6.9.1 Site Drainage and Irrigation

The ground immediately adjacent to foundations should be provided with positive drainage away from the structures in accordance with 2019 CBC, Section 1804.4. No rain or excess water should be allowed to pond against structures such as walls, foundations, flatwork, etc.

Excessive irrigation water can be detrimental to the performance of the proposed site development. Water applied in excess of the needs of vegetation will tend to percolate into the ground. Such percolation can lead to nuisance seepage and shallow perched groundwater. Seepage can form on slope faces, on the faces of retaining walls, in streets, or other low-lying areas. These conditions could lead to adverse effects such as the formation of stagnant water that breeds insects, distress or damage of trees, surface erosion, slope instability, discoloration and salt buildup on wall faces, and premature failure of pavement. Excessive watering can also lead to elevated vapor emissions within buildings that can damage flooring finishes or lead to mold growth inside the home.

Key factors that can help mitigate the potential for adverse effects of overwatering include the judicious use of water for irrigation, use of irrigation systems that are appropriate for the type of vegetation and geometric configuration of the planted area, the use of soil amendments to enhance moisture retention, use of low-water demand vegetation, regular use of appropriate fertilizers, and seasonal adjustments of irrigation systems to match the water requirements of vegetation. Specific recommendations should be provided by a landscape architect or other knowledgeable professional.

6.9.2 Utility Trenches

Trench excavations should be constructed in accordance with the recommendations contained in Section 6.1.7 of this report. Trench excavations must also conform to the requirements of Cal/OSHA.

Trench backfill materials and compaction criteria should conform to the requirements of the local municipalities. As a minimum, utility trench backfill should be compacted to at least 90 percent of the laboratory standard. Materials placed within the pipe zone (6 inches below and 12 inches above the pipe) should consist of particles no greater than ¾ inches and have a SE of at least 30. The materials within the pipe zone should be moisture-conditioned and compacted by hand-operated compaction equipment. Above the pipe zone (>1 foot above pipe), the backfill may consist of general fill materials. Trench backfill should be moisture-conditioned to slightly over the optimum moisture content, placed in lifts no greater than 12 inches in thickness, and then mechanically compacted with appropriate equipment to at least 90 percent of the laboratory standard. For trenches with sloped walls, backfill material should be placed in lifts no greater than 8 inches in loose thickness, and then compacted by rolling with a sheepsfoot roller or similar equipment. The project geotechnical consultant should perform density testing along with probing to verify that adequate compaction has been achieved.

Within shallow trenches (less than 18 inches deep) where pipes may be damaged by heavy compaction equipment, imported clean sand having a SE of 30 or greater may be utilized. The sand should be placed in the trench, thoroughly watered, and then compacted with a vibratory compactor. For utility trenches located below a 1:1 (H:V) plane projecting downward from the outside edge of the adjacent footing base or crossing footing trenches, concrete or slurry should be used as trench backfill.

6.10 PERCOLATION CHARACTERISTICS

Based on the unfavorable subsurface profile and the recorded high perched groundwater at 22 feet, infiltration of storm water is considered unfeasible with the use of dry wells or shallow chambers. Los Angeles County follows the Los Angeles County Regional Water Quality Board requirements of a minimum infiltration rate of 0.3 in/hr. We anticipate this minimum infiltration rate will not be met at the project site.

6.11 PLAN REVIEW AND CONSTRUCTION SERVICES

We recommend ***Albus-Keefe & Associates, Inc*. be engaged to review any future development plans, including foundation plans prior to construction. This is to verify that the assumptions of this report are valid and that the preliminary conclusions and recommendations contained in this report have been properly interpreted and are incorporated into the project plans and specifications. If we are not provided the opportunity to review these documents, we take no responsibility for misinterpretation of our preliminary conclusions and recommendations.

We recommend that a geotechnical consultant be retained to provide soil engineering services during construction of the project. These services are to observe compliance with the design, specifications or recommendations, and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

If the project plans change significantly from the assumed development described herein, the project geotechnical consultant should review our preliminary design recommendations and their applicability to the revised construction. If conditions are encountered during construction that appear to be different than those indicated in this report or subsequent design reports, the project geotechnical consultant should be notified immediately. Design and construction revisions may be required.

7.0 LIMITATIONS

This report is based on the proposed development and geotechnical data as described herein. The materials encountered on the project site, described in other literature, and utilized in our laboratory testing for this investigation are believed representative of the total project area, and the conclusions and recommendations contained in this report are presented on that basis. However, soil and bedrock materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions and recommendations contained herein. As such, observation and testing by a geotechnical consultant during the grading and construction phases of the project are essential to confirming the basis of this report.

This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and time period. The contents of this report are professional opinions and as such, are not to be considered a guaranty or warranty.

This report should be reviewed and updated after a period of one year or if the site ownership or project concept changes from that described herein.

This report has been prepared for the exclusive use of **Comstock Properties** and their project consultants in the planning and design of the proposed development. This report has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

This report is subject to review by the controlling governmental agency.

Respectfully submitted,

ALBUS-KEEFE & ASSOCIATES, INC

David E. Albus
Principal Engineer
GE 2455

REGISTERED PROFESSIONAL ENGINEER
DAVID E. ALBUS
No. 2455
Exp. 12/31/20
GEOTECHNICAL
STATE OF CALIFORNIA

8.0 REFERENCES

Publications

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

California Department of Conservation, Division of Mines and Geology, *Seismic Hazard Zone Report for the Torrance 7.5-Minute Quadrangles, Los Angeles County, California*, Seismic Hazard Zone Report 035, 1998.

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Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J., Dobry, R., Finn, W.D.L., Harder, L.F., Hynes, M.E., Ishihara, K., Koester, J.P., Liao, S.S.C., Marcuson, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R.B., and Stokoe, K.H., *Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils*, Journal of Geotechnical and Geoenvironmental Engineering, October, 2001.

Plans

Conceptual Site Plan, 2555 W 190th Street Torrance, Torrance, CA 90504, USA, prepared by Ware Malcomb, Scale 1”=40’, dated November 7, 2016

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EXPLANATION

(Locations Approximate)

⊕ -Exploratory Boring (this report)

○ -Exploratory Boring
(Leroy Crandall &Associates, 4/1968)

● -Exploratory Boring
(Golder Associates, 12/2007)

APPROX. SCALE
1" = 100'

ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

GEOTECHNICAL MAP

Job No.: 2758.00 Date: 06/12/20 Plate: 1

APPENDIX A

EXPLORATION BORING LOGS

EXPLORATION LOG

Project:		Location:
Address:		Elevation:
Job Number:	Client:	Date:
Drill Method:	Driving Weight:	Logged By:

Depth (feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		EXPLANATION							
		Solid lines separate geologic units and/or material types.							
5		Dashed lines indicate unknown depth of geologic unit change or material type change.							
		Solid black rectangle in Core column represents California Split Spoon sampler (2.5in ID, 3in OD).			■				
		Double triangle in core column represents SPT sampler.			⧗				
10		**Vertical Lines** in core column represents Shelby sampler.			▥				
		Solid black rectangle in Bulk column respresents large bag sample.				■			
		Other Laboratory Tests:							
15		Max = Maximum Dry Density/Optimum Moisture Content							
		EI = Expansion Index							
		SO4 = Soluble Sulfate Content							
		DSR = Direct Shear, Remolded							
		DS = Direct Shear, Undisturbed							
		SA = Sieve Analysis (1" through #200 sieve)							
		Hydro = Particle Size Analysis (SA with Hydrometer)							
20		200 = Percent Passing #200 Sieve							
		Consol = Consolidation							
		SE = Sand Equivalent							
		Rval = R-Value							
		ATT = Atterberg Limits							

Albus-Keefe & Associates, Inc.

Plate A-1

EXPLORATION LOG

Project: Comstock - Torrance		Location: B-1
Address: 2869 W 190th St, Torrance, CA 90504		Elevation: 63.8
Job Number: 2758.00	Client: Comstock, Crosser & Assoc.	Date: 9/21/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Asphalt (AC): 3 inches							SO4 DS ATT pH Resist Ch
		Crushed Aggregate Base (CAB): 7 inches							
		ARTIFICIAL FILL (Af) Clay (CL): Medium to dark brown, moist, very stiff, fine grained sand, pores and carbonate nodules present, with sand		24	■		18.2	110.1	
		@ 4 ft, medium stiff, trace sand		8	■		20	103.7	Consol
5		**OLDER ALLUVIUM (Qoal)** Silt (ML): Light olive brown, moist, medium stiff, with clay and fine grained sand, carbonate nodules present		33	■		12.7	114.6	
		Clayey Sand (SC): Light grayish brown, moist, medium dense, fine grained sand, slight iron oxide, mica and carbonate present							
		@ 7 ft, increased sand, magnesium oxide specs							
10		Sand (SP): Tan, moist, dense, fine to medium grained sand		45	■		2.2	103.3	
		Sandy Clay (CL): Grayish brown, moist, hard, fine grained sand, with silt, iron oxide							
15				47	■				
		@ 16 ft, increased silt							
		Sand with Silt (SP-SM): Light brown, moist, dense, fine grained sand, iron oxide							
20				42	■		6.3	106.4	
		Silty Sand (SM): Light brown, moist, dense, fine grained sand, iron oxide							

EXPLORATION LOG

Project: Comstock - Torrance		Location: B-1
Address: 2869 W 190th St, Torrance, CA 90504		Elevation: 63.8
Job Number: 2758.00	Client: Comstock, Crosser & Assoc.	Date: 9/21/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
	@ 26 ft, few fine gravel, seashells present		40	■				
	Sandy Clay (CL): Light brown, very moist to wet, medium dense, fine grained sand, lenses of sandy silt, iron oxide							
30			22	■		34	89.4	
	Silty Sand (SM): Light brown, wet, medium dense, fine grained sand, thin layers of abundant seashells							
35		▽	30	■				
40	@ 40 ft, dense		38	■		26.9	94.8	
	Clay (CL): Bluish gray, very moist, stiff, with silt							
45			15	■				

Albus-Keefe & Associates, Inc.

EXPLORATION LOG

Project: Comstock - Torrance		Location: B-1
Address: 2869 W 190th St, Torrance, CA 90504		Elevation: 63.8
Job Number: 2758.00	Client: Comstock, Crosser & Assoc.	Date: 9/21/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	▨	@ 50 ft, very stiff, increased silt, mica present		21	■				
		End of boring at 51.5 feet. Perched groundwater encountered at 36 feet below existing ground surface. Backfilled with cuttings. patched with asphalt cold patch.							

EXPLORATION LOG

Project: Comstock - Torrance
Location: B-2
Address: 2869 W 190th St, Torrance, CA 90504
Elevation: 64.2
Job Number: 2758.00
Client: Comstock, Crosser & Assoc.
Date: 9/21/2018
Drill Method: Hollow-Stem Auger
Driving Weight: 140 lbs / 30 in
Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		Asphalt (AC): 1 inch							
		Crushed Aggregate Base (CAB): 6 inches							
		ARTIFICIAL FILL (Af) Clay (CL): Mottled dark brown with medium brown, moist, stiff, trace fine grained sand, trace pores		13	■		20.8	105	
		OLDER ALLUVIUM (Qoal) Clay (CL): Light brown, moist, very stiff, trace fine grained sand, trace magnesium and iron oxide, carbonate stringers, with silt		23	■		26.8	96.5	
5				28	■		28.6	94.2	
		@ 6 ft, no magnesium							
10		@ 10 ft, increased pores		20	■		29.3	92.1	Consol
15		@ 15 ft, increased silt		13	⧗				
20		@ 20 ft, Mottled light brown with light reddish brown, few pores, silt lenses		12	⧗				
		Silty Sand (SM): Brown, moist, dense, fine grained sand, iron oxide							

Albus-Keefe & Associates, Inc.

EXPLORATION LOG

Project: Comstock - Torrance		Location: B-2
Address: 2869 W 190th St, Torrance, CA 90504		Elevation: 64.2
Job Number: 2758.00	Client: Comstock, Crosser & Assoc.	Date: 9/21/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
				31	⧗				
		Clay (CL): Grayish brown, very moist, hard, few fine grained sand, iron oxide							
30				19	⧗				
		End of boring at 31.5 feet. No groundwater encountered. Backfilled with soil cuttings. Patched with asphalt cold patch.							

EXPLORATION LOG

Project: Comstock - Torrance	Location: B-3
Address: 2869 W 190th St, Torrance, CA 90504	Elevation: 62.8
Job Number: 2758.00 — Client: Comstock, Crosser & Assoc.	Date: 9/21/2018
Drill Method: Hollow-Stem Auger — Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	■	Asphalt (AC): 2 inches							
	▨	Crushed Aggregate Base (CAB): 6 inches							
	▨	**ARTIFICIAL FILL (Af)** Clay (CL): Medium brown, moist, stiff, trace fine grained sand, with silt, trace pores, carbonate stringers, iron oxide specs		13	■		25.6	94.7	
5	▨	**OLDER ALLUVIUM (Qoal)** Clay (CL): Light brown, moist, very stiff, trace fine grained sand, with silt, trace pores, carbonate stringers, iron oxide specs		34	■		24.6	98.2	
	▨	@ 6 ft, decreased carbonate stringers, with sand		38	■		25.3	97	
10	▨	@ 10 ft, trace fine gravel		32	■		27.3	94.3	
15	▨	@ 15 ft, sandy silt lense		10	⧗				
20	▨	@ 20 ft, hard, no sandy silt lense observed		20	⧗				
		End of boring at 215 feet. No groundwater encountered. Backfilled with soil cuttings. Patched with asphalt cold patch.							

Albus-Keefe & Associates, Inc.

Plate A-7

EXPLORATION LOG

Project: Comstock - Torrance		Location: B-4
Address: 2869 W 190th St, Torrance, CA 90504		Elevation: 64.7
Job Number: 2758.00	Client: Comstock, Crosser & Assoc.	Date: 9/21/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith- ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	■	Asphalt (AC): 2 inches							
	▨	**OLDER ALLUVIUM (Qoal)** Clay (CL): Medium olive brown, moist, very stiff, trace fine grained sand, trace pores, carbonate stringers		24	■		20	104.8	
	▨	@ 4 ft, stiff, increased pores		22	■		24.6	93.7	
5	▨								
	▨	@ 6 ft, Dark olive brown, very stiff, carbonate nodules, magnesium oxide specs		35	■		24.1	101.5	
10	▨	@ 10 ft, hard, with silt, carbonate stringers		43	■		23.7	101.9	
	⁘	Sandy Silt (ML): Light grayish brown, moist, very stiff, fine grained sand, mica present, iron oxide							
15	⁘			11	⧗				
20	⁘	@ 20 ft, hard		21	⧗				
		End of boring at 21.5 feet. No groundwater encountered. Backfilled with soil cuttings. Patched with asphalt cold patch							

Albus-Keefe & Associates, Inc.

EXPLORATION LOG

Project: Comstock - Torrance
Location: B-5
Address: 2869 W 190th St, Torrance, CA 90504
Elevation: 61.2
Job Number: 2758.00
Client: Comstock, Crosser & Assoc.
Date: 9/21/2018
Drill Method: Hollow-Stem Auger
Driving Weight: 140 lbs / 30 in
Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
	▨	**OLDER ALLUVIUM (Qoal)** Clay (CL): Medium brown, moist, stiff							
	▨			20	■		24.9	96.2	
5	▨	@ 4 ft, Mottled medium to dark brown, few coarse sand, carbonate stringers		20	■		24.7	97.8	
	▨	@ 6 ft, very stiff		27	■		24.3	99.4	
10	▨	@ 10 ft, Light brown, few fine sand, decreased silt, iron oxide, carbonate nodules and mica present		28	■		20.7	101.7	
	░	Silty Sand / Sandy Silt (SM/ML): Light gray, moist, medium dense / very stiff, fine grained sand, iron oxide							
15	░			15	⧗				
	░	Silty Sand (SM): Reddish brown, moist, dense, fine grained sand, iron oxide							
20	░			28	⧗				
		End of boring at 21.5 feet. No groundwater encountered. Backfilled with soil cuttings. Patched with asphalt cold patch.							

Albus-Keefe & Associates, Inc.

EXPLORATION LOG

Project: Comstock - Torrance
Location: B-6
Address: 2869 W 190th St, Torrance, CA 90504
Elevation: 61.9
Job Number: 2758.00
Client: Comstock, Crosser & Assoc.
Date: 9/21/2018
Drill Method: Hollow-Stem Auger
Driving Weight: 140 lbs / 30 in
Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	▨	**OLDER ALLUVIUM (Qoal)** Clay (CH): Light brown, moist, stiff, trace fine grained sand, few fine to coarse gravel, iron and magnesium oxide, trace pores, carbonate stringers, iron oxide specs							ATT
	▨			22	■		21.5	100.1	
	▨	@ 4 ft, very stiff, trace fine gravel		35	■		27.3	95.6	
5	▨								
	▨	@ 6 ft, no gravel		38	■		22.6	102.4	
10	▨	@ 10 ft, Medium brown, no pores and iron oxide		34	■		27.3	94.4	
15	▨	@ 15 ft, Light brown, iron oxide, few pores, with silt		19	■		29.8	88.8	Consol
	⁙	Sand with Silt (SP-SM): Mottled reddish brown and light gray, moist, dense, fine grained sand, iron oxide, mica present							
20	⁙			52	■				
	⁙	Silty Sand (SM): mottled light and medium brown, moist, dense, fine grained sand, iron oxide, mica present							

EXPLORATION LOG

Project: Comstock - Torrance		Location: B-6
Address: 2869 W 190th St, Torrance, CA 90504		Elevation: 61.9
Job Number: 2758.00	Client: Comstock, Crosser & Assoc.	Date: 9/21/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
				54	■		12.8	98.2	
		<u>Sandy Clay (CL):</u> Light gray, moist to wet, very stiff, fine grained sand, iron oxide, with silt							
30				19	■				
		<u>Silty Sand (SM):</u> Medium gray, wet, medium dense, fine grained sand							
			▽						
35		@ 35 ft, very dense		62	■		29	95	
40		@ 40 ft, medium dense		22	■				
45		@ 45 ft, light to medium gray, very moist, very dense, silt nodules, iron oxide and mica present		80	■		14.5	105.8	

EXPLORATION LOG

Project: Comstock - Torrance			Location: B-6
Address: 2869 W 190th St, Torrance, CA 90504			Elevation: 61.9
Job Number: 2758.00	Client: Comstock, Crosser & Assoc.		Date: 9/21/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in		Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	░	@ 50 ft, medium dense		22	■				
		End of boring at 51.5 feet. Perched groundwater encountered at 35 feet below existing ground surface. Backfilled with soil cuttings. Patched with asphalt cold patch.							

APPENDIX B

LABORATORY TEST PROGRAM

LABORATORY TESTING PROGRAM

Soil Classification

Soils encountered within the exploratory borings were initially classified in the field in general accordance with the visual-manual procedures of the Unified Soil Classification System (ASTM D2488). The samples were re-examined in the laboratory and classifications reviewed and then revised where appropriate. The assigned group symbols are presented in the Boring Logs provided in Appendix A.

In Situ Moisture and Density

Moisture content and dry density of in-place soil materials were determined in representative strata. Test data are summarized on the Boring Logs provided in Appendix A.

Maximum Dry Density and Optimum Moisture Content

Maximum dry density and optimum moisture content of onsite soils were determined for one selected sample in general accordance with Method A of ASTM D1557. Pertinent test values are given on Table B.

Consolidation

Consolidation tests were performed for selected soil samples in general conformance with ASTM D 2435. Axial loads were applied in several increments to a laterally restrained 1-inch-high sample. Loads were applied in geometric progression by doubling the previous load, and the resulting deformations were recorded at selected time intervals. The test samples were inundated at selected loads to evaluate the effects of a sudden increase in moisture content (hydro-consolidation potential). Results of the tests are graphically presented on Plates B-3 to B-6.

Direct Shear

Direct shear tests were performed for samples remolded to 90 percent of the maximum dry density. These tests were performed in general accordance with ASTM D3080. Three specimens were prepared for each test. The test specimens were artificially saturated, and then sheared under varied normal loads at a constant rate. Results are graphically presented on Plate B-7.

Atterberg Limits

Atterberg Limits (Liquid Limit, Plastic Limit, and Plasticity Index) were performed in accordance with Test Method ASTM D-4318. Pertinent test values are presented within Table B.

Expansion Potential

Expansion index testing was performed on selected samples. The test was performed in conformance with ASTM D 4829-11. The test results are presented on Table B.

Soluble Sulfate Content

A chemical analysis was performed on a selected soil sample to determine soluble sulfate content. The test was performed in accordance with California Test Method (CTM) 417. The test result is included in Table B.

Corrosion

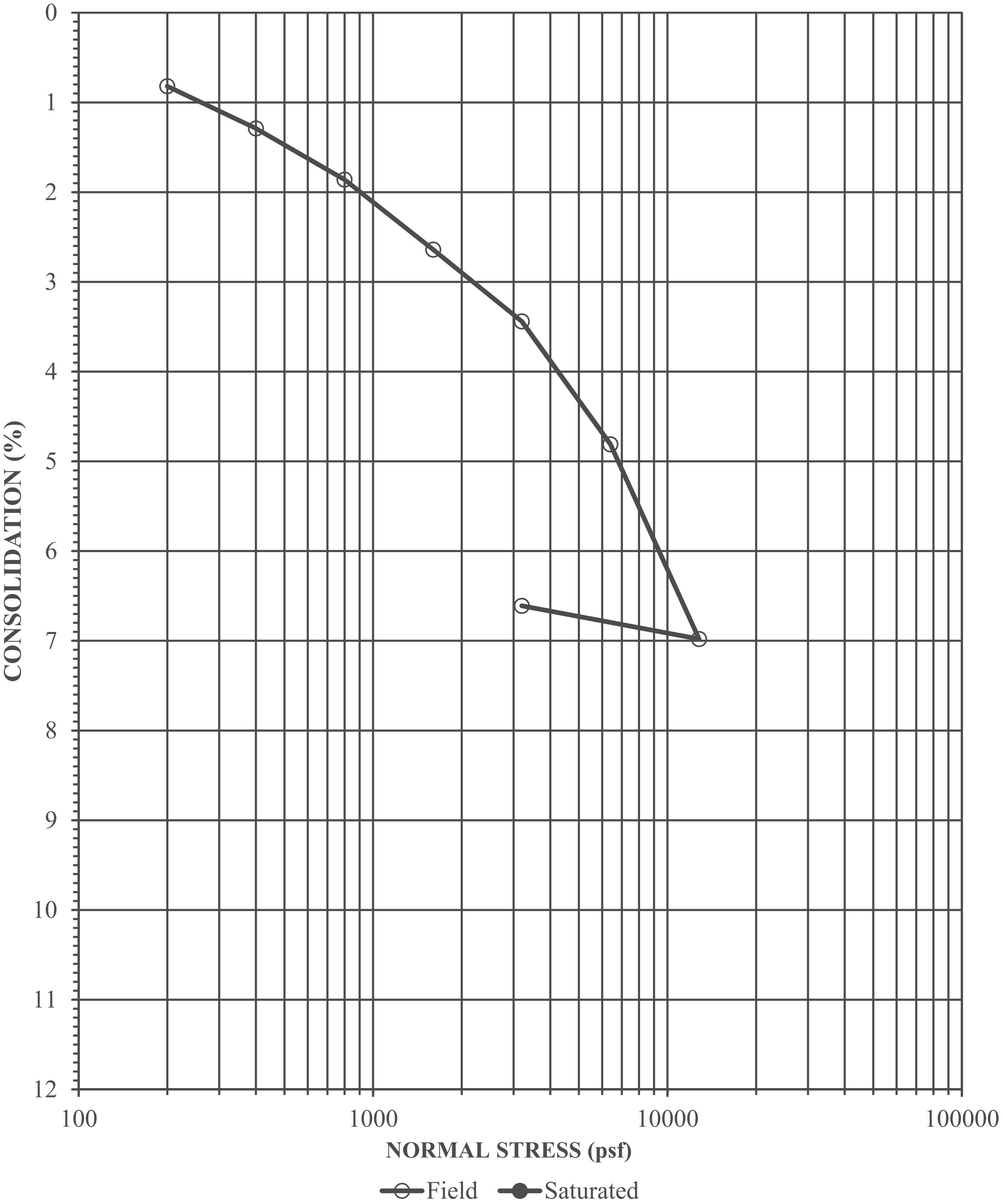
Select samples were tested for minimum resistivity, chloride, and pH in accordance with California Test Method (CTM) 643. Results of these tests are provided in Table B.

TABLE B
SUMMARY OF LABORATORY TEST RESULTS

Boring Number	Depth (feet)	Soil Type	Test Results	
B-1	0 – 5	Clay (CL)	Maximum Dry Density (pcf): Optimum Moisture Content (%): Soluble Sulfate Content (%): Sulfate Exposure: Expansion Index: Expansion Potential: Minimum Resistivity: pH: Chloride: Liquid Limit (%): Plastic Index (%):	122.0 pcf 13.5 % 0.007% Negligible 71 Medium 610 Ohm-cm 8.0 20 ppm 43 27
B-6	0 – 5	Clay (CH)	Expansion Index: Expansion Potential: Liquid Limit (%): Plastic Index (%):	102 High 55 34

Additional laboratory test results are provided on the boring logs provided in Appendix A and on the Plates that follow.

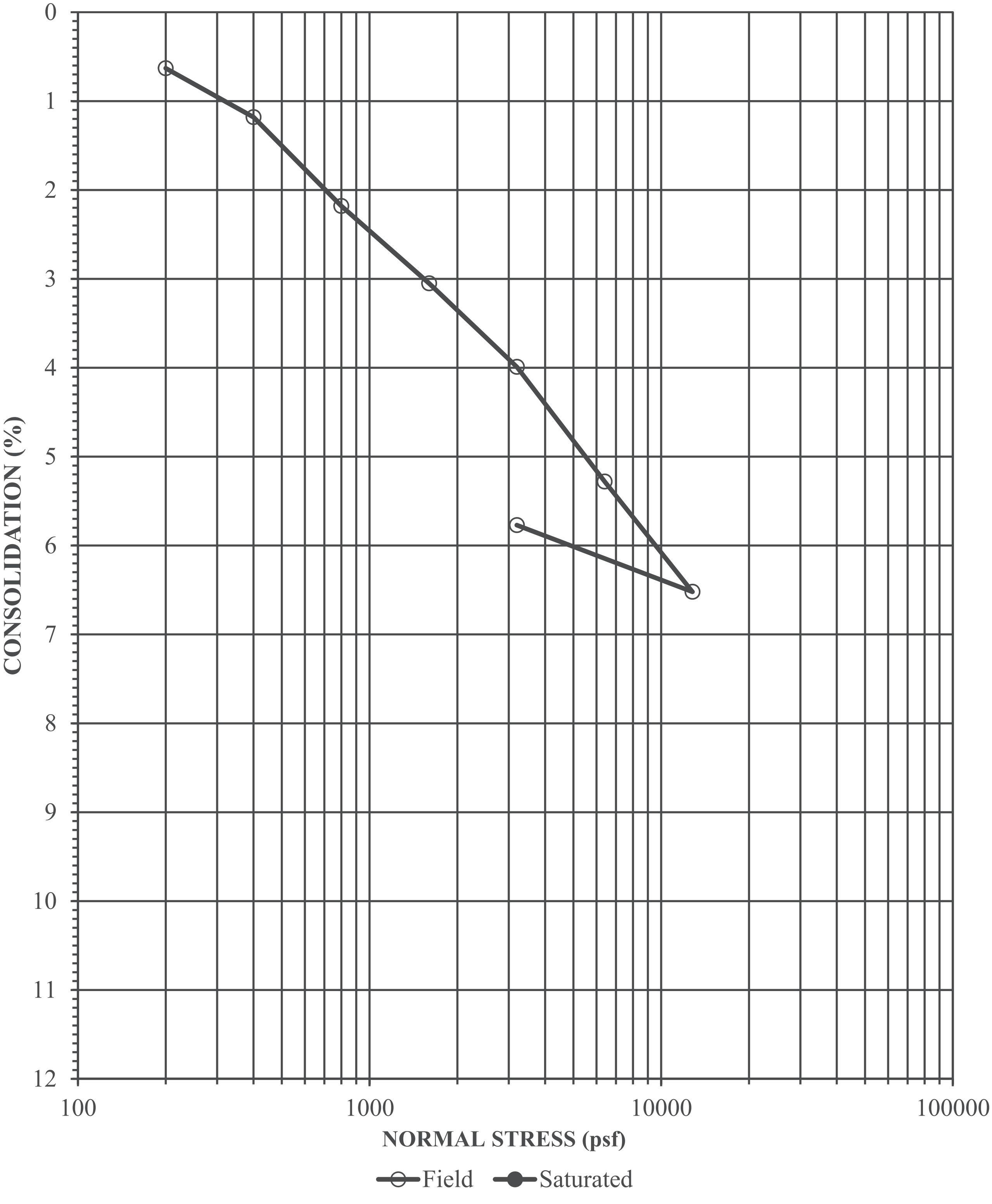
CONSOLIDATION



Job Number	Location	Depth	Description
2758.00	B-1	4	Silt (ML)

Initial Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Concent (%)
104.4	20.4	17.5

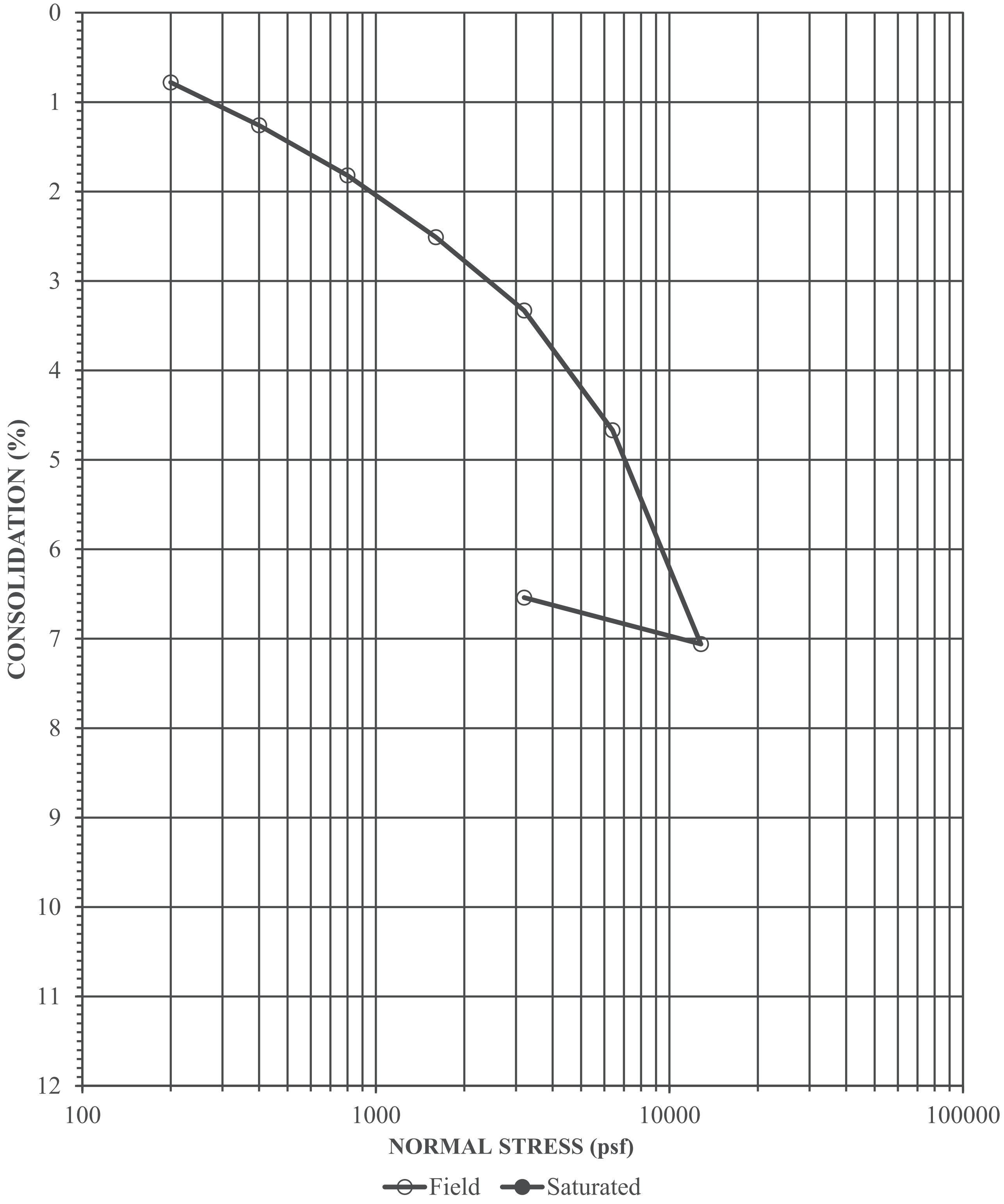
CONSOLIDATION



Job Number	Location	Depth	Description
2758.00	B-2	10	Clay (CL)

Initial Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Concent (%)
91.1	29.3	28.1

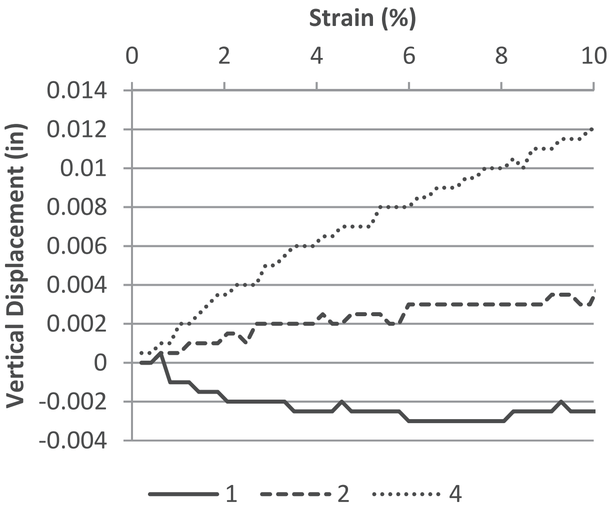
CONSOLIDATION

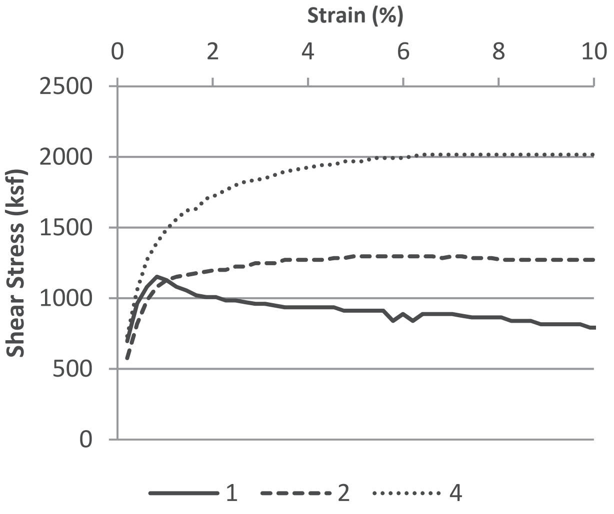


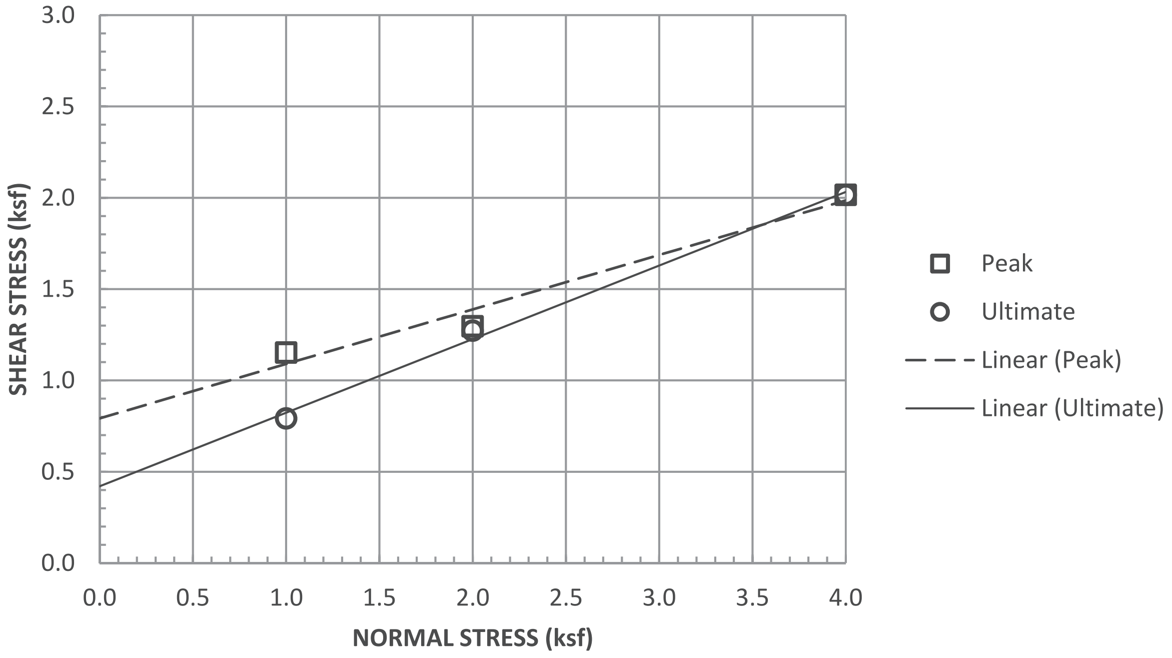
Job Number	Location	Depth	Description
2758.00	B-6	15	Clay (CL)

Initial Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Concent (%)
87.3	31.8	29.5

DIRECT SHEAR







Sample Type:	Remolded 90% of 122 @ 13.5%, Saturated		
Normal Stress (ksf)	1	2	4
Peak Shear Stress (ksf)	1.152	1.296	2.016
Peak Displacement (in)	0.003	0.004	0.012
Ultimate Shear Stress (ksf)	0.792	1.272	2.016
Ultimate Displacement (in)	0.25	0.25	0.25
Initial Dry Density (pcf)	109.8	109.8	109.8
Initial Moisture Content (%)	13.5	13.5	13.5
Final Moisture Content (%)	16.7	17.4	17.4
Strain Rate (in/min)	.005		

Job Number	Location	Depth	Description
2758.00	B-1	0-5	Clay (CL)

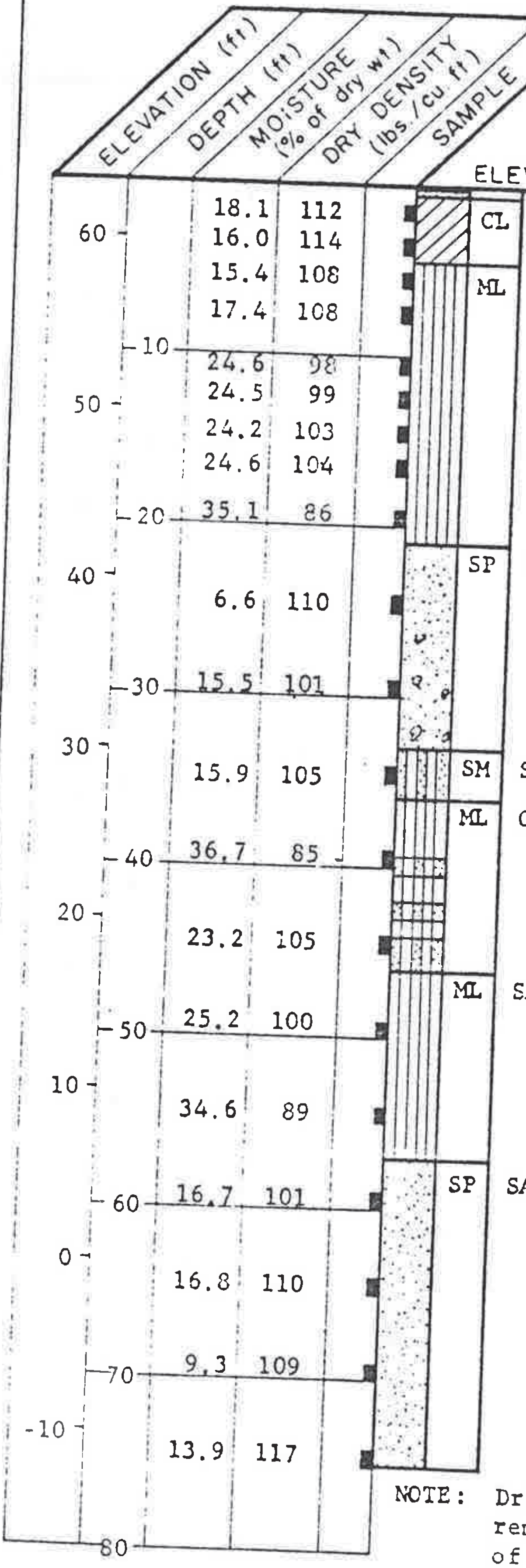
APPENDIX C

PREVIOUS EXPLORATORY BORINGS & LABORATORY TESTING

BORING 4

DATE DRILLED: **February 28, 1968**
EQUIPMENT USED: **6"-Diameter Rotary Wash**

ELEVATION 63.2



MOISTURE (% of dry wt)	DRY DENSITY (lbs./cu.ft)
18.1	112
16.0	114
15.4	108
17.4	108
24.6	98
24.5	99
24.2	103
24.6	104
35.1	86
6.6	110
15.5	101
15.9	105
36.7	85
23.2	105
25.2	100
34.6	89
16.7	101
16.8	110
9.3	109
13.9	117

3" ASPHALTIC PAVING - 2" SAND BASE

CL SILTY CLAY - dark brown

ML CLAYEY SILT - light brown

Streaks of alkali

SP SAND - fine, light brown

10% to 20% sea shells

SM SILTY SAND - fine, light brown

ML CLAYEY SILT - light brown

Layers of SILTY SAND

ML SANDY SILT - grey

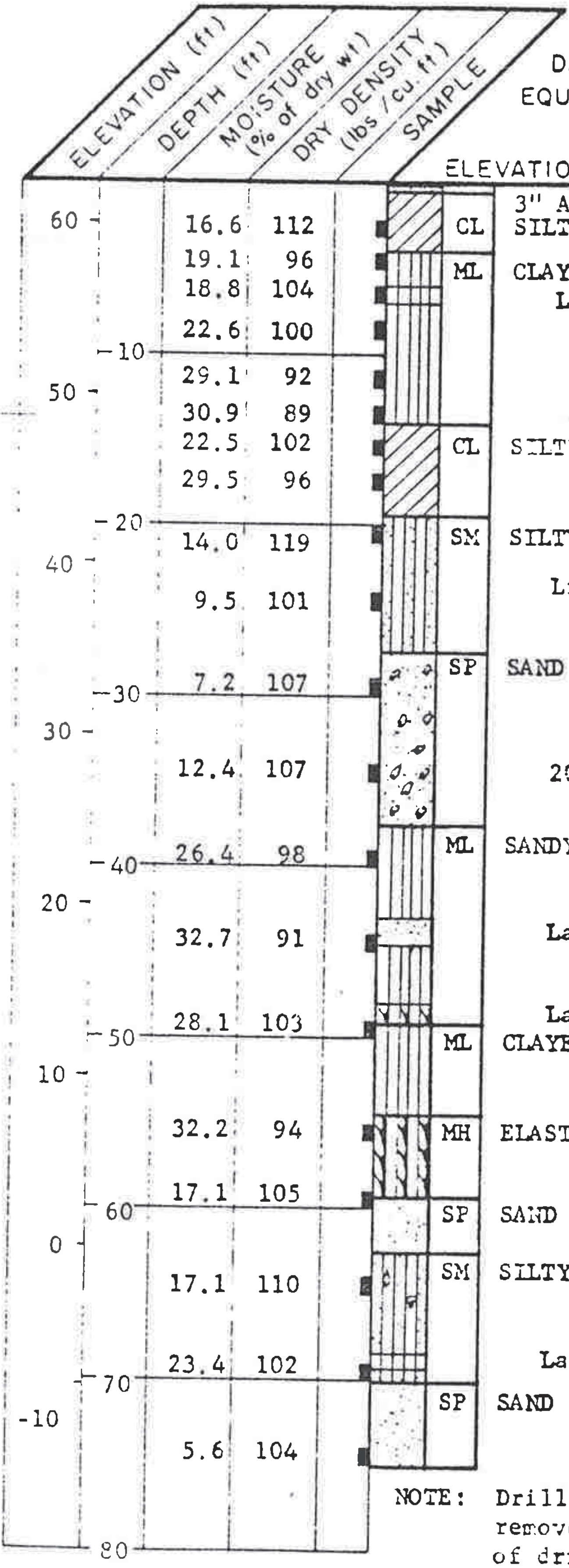
SP SAND - fine, grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 69 feet after completion of drilling; water level measured at a depth of 42 feet 21 hours after

BORING 5

DATE DRILLED. February 27, 1968
EQUIPMENT USED: 6"-Diameter Rotary Wash

ELEVATION 62.3



MOISTURE (% of dry wt)	DRY DENSITY (lbs/cu. ft)
16.6	112
19.1	96
18.8	104
22.6	100
29.1	92
30.9	89
22.5	102
29.5	96
14.0	119
9.5	101
7.2	107
12.4	107
26.4	98
32.7	91
28.1	103
32.2	94
17.1	105
17.1	110
23.4	102
5.6	104

3" ASPHALTIC PAVING - 2" SAND BASE
CL SILTY CLAY - dark brown
ML CLAYEY SILT - light brown
Layer of SANDY SILT
CL SILTY CLAY - greyish-brown
SM SILTY SAND - fine, greyish-brown
Light brown
SP SAND - fine, about 10% sea shells, light brown
20% to 25% sea shells
ML SANDY SILT - light brown
Layer of SAND
Layer of ELASTIC SILT
ML CLAYEY SILT - greyish-brown
MH ELASTIC SILT - greyish-brown
SP SAND - fine, grey
SM SILTY SAND - fine, few sea shells, grey
Layer of SANDY SILT
SP SAND - fine, grey

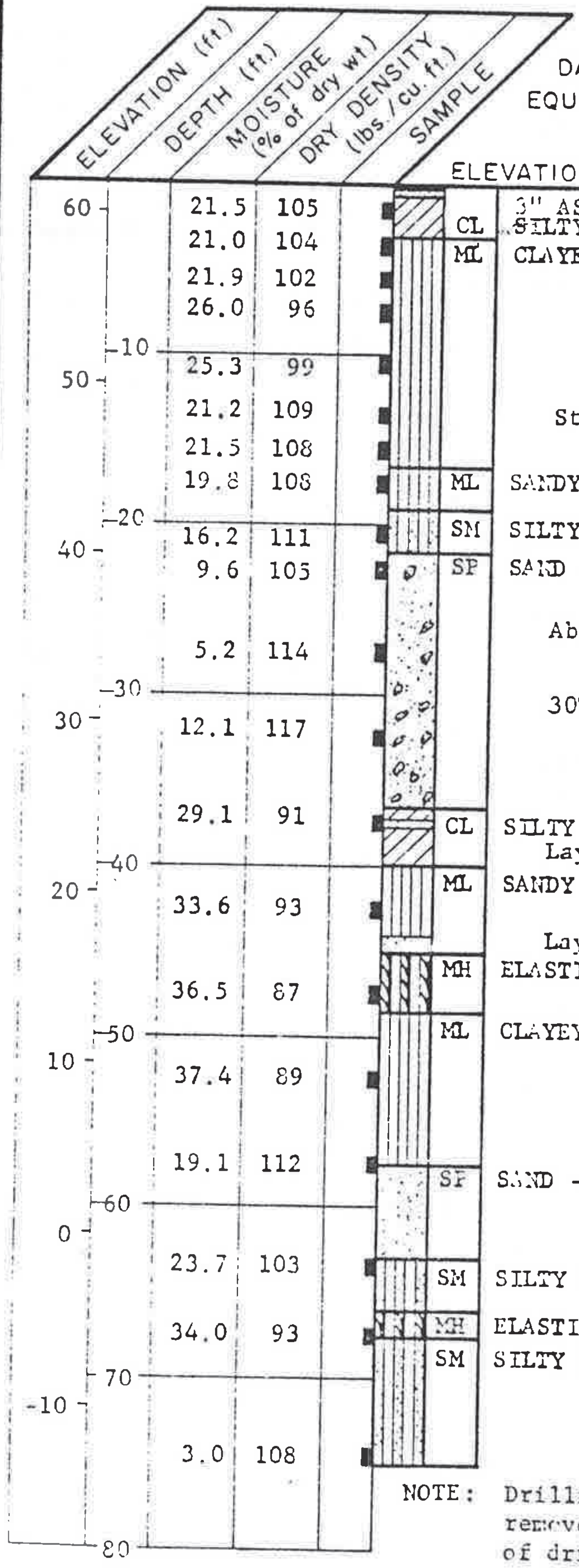
NOTE: Drilling mud used in drilling process. Mud removed to a depth of 64 feet after completion of drilling; water level measured at a depth of 42½ feet 46 hours after removing mud.

LOG OF BORING

BORING 6

DATE DRILLED: February 27, 1968
EQUIPMENT USED: 6"-Diameter Rotary Wash

ELEVATION 61.7



MOISTURE (% of dry wt)	DRY DENSITY (lbs./cu. ft.)
21.5	105
21.0	104
21.9	102
26.0	96
25.3	99
21.2	109
21.5	108
19.8	108
16.2	111
9.6	105
5.2	114
12.1	117
29.1	91
33.6	93
36.5	87
37.4	89
19.1	112
23.7	103
34.0	93
3.0	108

3" ASPHALTIC PAVING - 2" SAND BASE

CL SILTY CLAY - dark brown

ML CLAYEY SILT - light brown

Streaks of alkali

ML SANDY SILT - light brown

SM SILTY SAND - fine, light brown

SP SAND - fine, about 5% sea shells, light brown

About 10% sea shells

30% to 40% sea shells

CL SILTY CLAY - greyish-brown

Layer of SAND

ML SANDY SILT - greyish-brown

Layer of SAND

MH ELASTIC SILT - grey

ML CLAYEY SILT - greyish-brown

SP SAND - fine, greyish-brown

SM SILTY SAND - fine, grey

MH ELASTIC SILT - grey

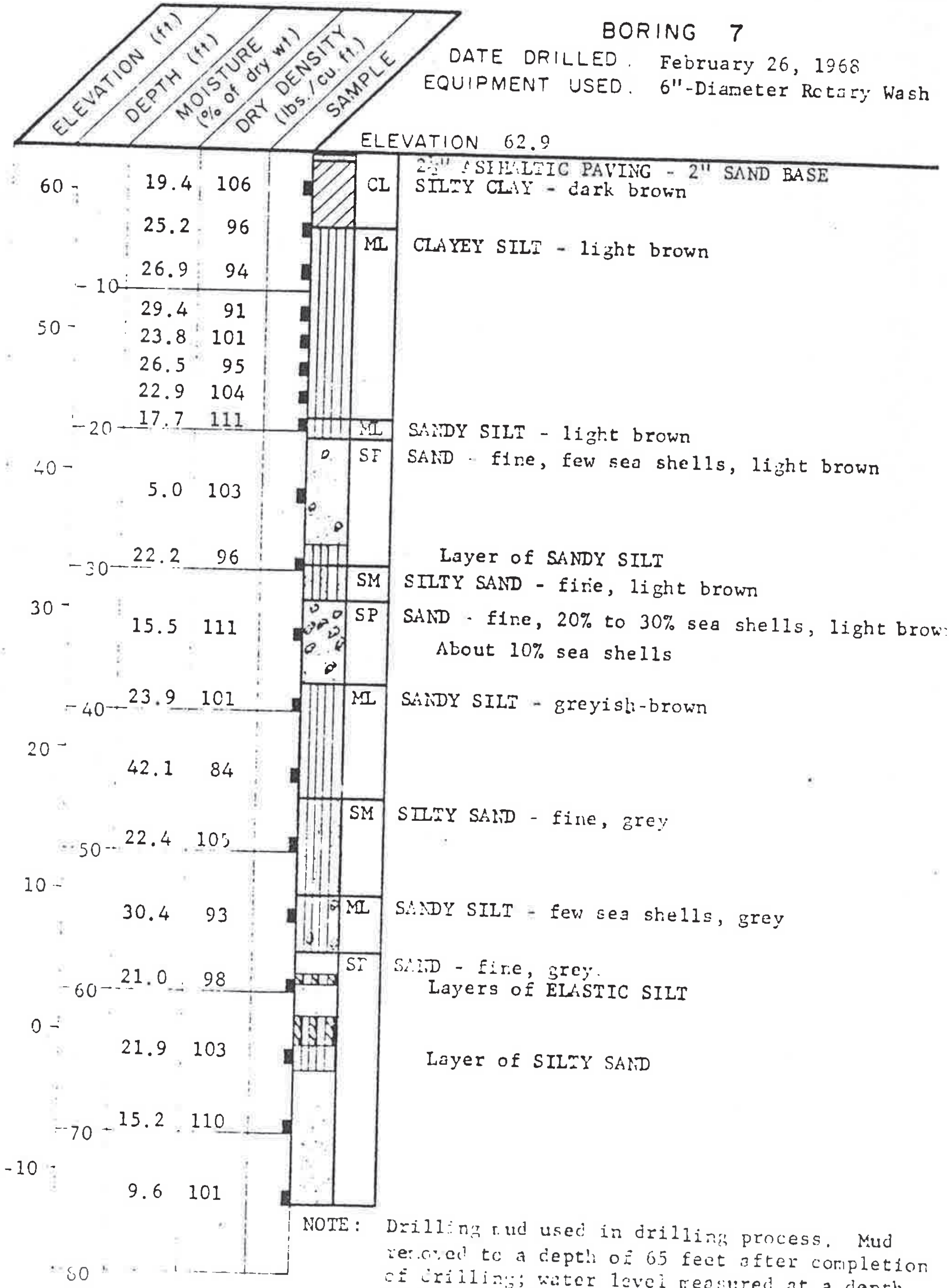
SM SILTY SAND - fine, grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 49 feet after completion of drilling; water level measured at a depth of 41 feet 41 hours after removing mud.

LOG OF BORING

BORING 7

DATE DRILLED . February 26, 1968
EQUIPMENT USED . 6"-Diameter Rotary Wash



MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)
19.4	106
25.2	96
26.9	94
29.4	91
23.8	101
26.5	95
22.9	104
17.7	111
5.0	103
22.2	96
15.5	111
23.9	101
42.1	84
22.4	105
30.4	93
21.0	98
21.9	103
15.2	110
9.6	101

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 65 feet after completion of drilling; water level measured at a depth of 49 feet 65 hours after removing mud.

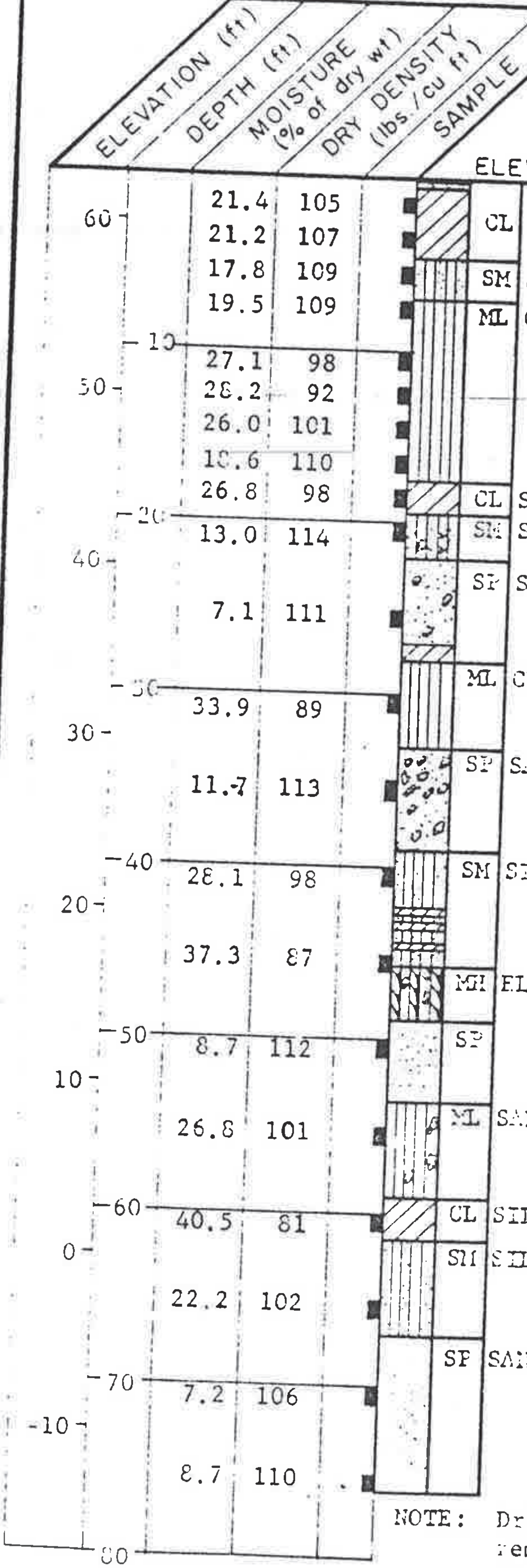
LOG OF BORING

LEROY CRANDALL & ASSOCIATES

BORING 8

DATE DRILLED: February 26, 1968
EQUIPMENT USED: 6"-Diameter Rotary Wash

ELEVATION 62.6



CL 3" ASPHALTIC PAVING - 2" SAND BASE
SILTY CLAY - dark brown

SM SILTY SAND - fine, brown

ML CLAYEY SILT - light brown

CL SILTY CLAY - light brown

SM SILTY SAND - fine, greyish-brown
10% to 15% sea shells

SP SAND - fine, few sea shells, light brown

Layer of SILTY CLAY

ML CLAYEY SILT - patches of Silty Sand, greyish-brown

SP SAND - fine, 20% to 30% sea shells, light brown

About 10% sea shells

SM SILTY SAND - fine, greyish-brown

Layers of SILTY CLAY

MH ELASTIC SILT - few sea shells, grey

SP SAND - fine, grey

ML SANDY SILT - few sea shells, grey

CL SILTY CLAY - grey

SM SILTY SAND - fine, grey

SP SAND - fine, grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of [illegible]5 feet after completion of drilling; no water in boring 69 hours after removing mud.

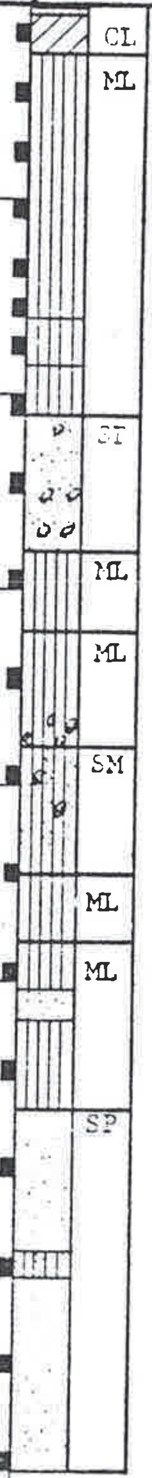
LOG OF BORING

BORING 9

DATE DRILLED February 28, 1968
EQUIPMENT USED 6"-Diameter Rotary Wash

ELEVATION 62.3

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs./cu. ft.)	SAMPLE
60		15.8	110	■
		17.6	97	■
		24.9	97	■
	10	28.2	92	■
50		23.1	101	■
		18.2	109	■
		14.3	115	■
	20	24.6	97	■
40		10.3	112	■
	30	41.3	81	■
30		26.7	92	■
	40	27.7	97	■
20		34.0	85	■
	50	25.1	101	■
10		28.5	94	■
	60	16.7	102	■
0		19.2	106	■
	70	11.4	107	■
-10		7.2	107	■
	80			



CL 3" ASPHALTIC PAVING - 2" SAND BASE
SILTY CLAY - dark brown
ML CLAYEY SILT - light brown

Layer of SANDY SILT

SP SAND - fine, few sea shells, light brown

10% to 20% sea shells

ML CLAYEY SILT - light brown

ML SANDY SILT - patches of Silty Sand, light brow

10% to 20% sea shells

SM SILTY SAND - fine, few sea shells, greyish-brown

ML CLAYEY SILT - greyish-brown

ML SANDY SILT - greyish-brown
Layer of SAND

SP SAND - fine, greyish-brown

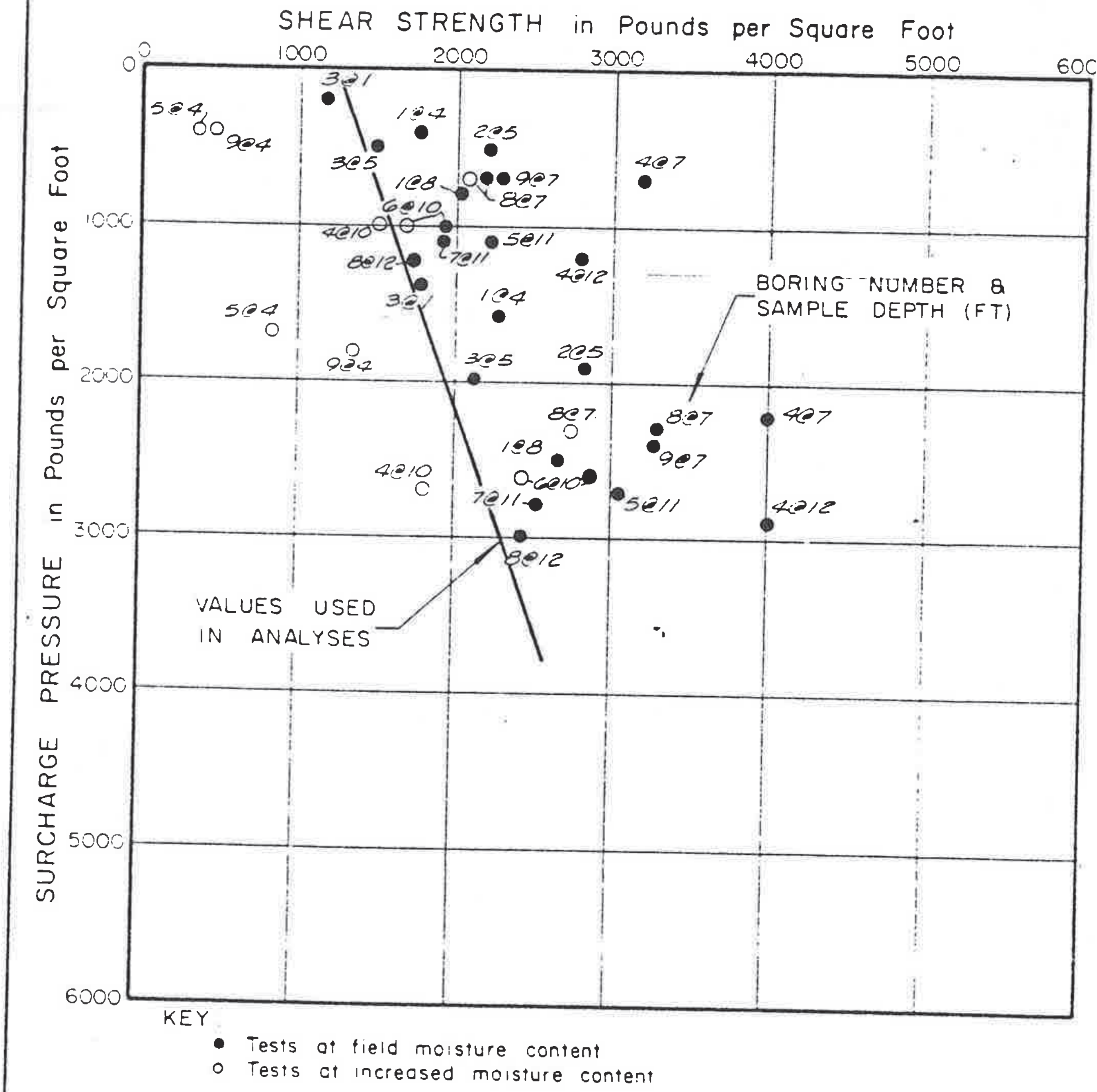
Layer of SILTY SAND

Grey

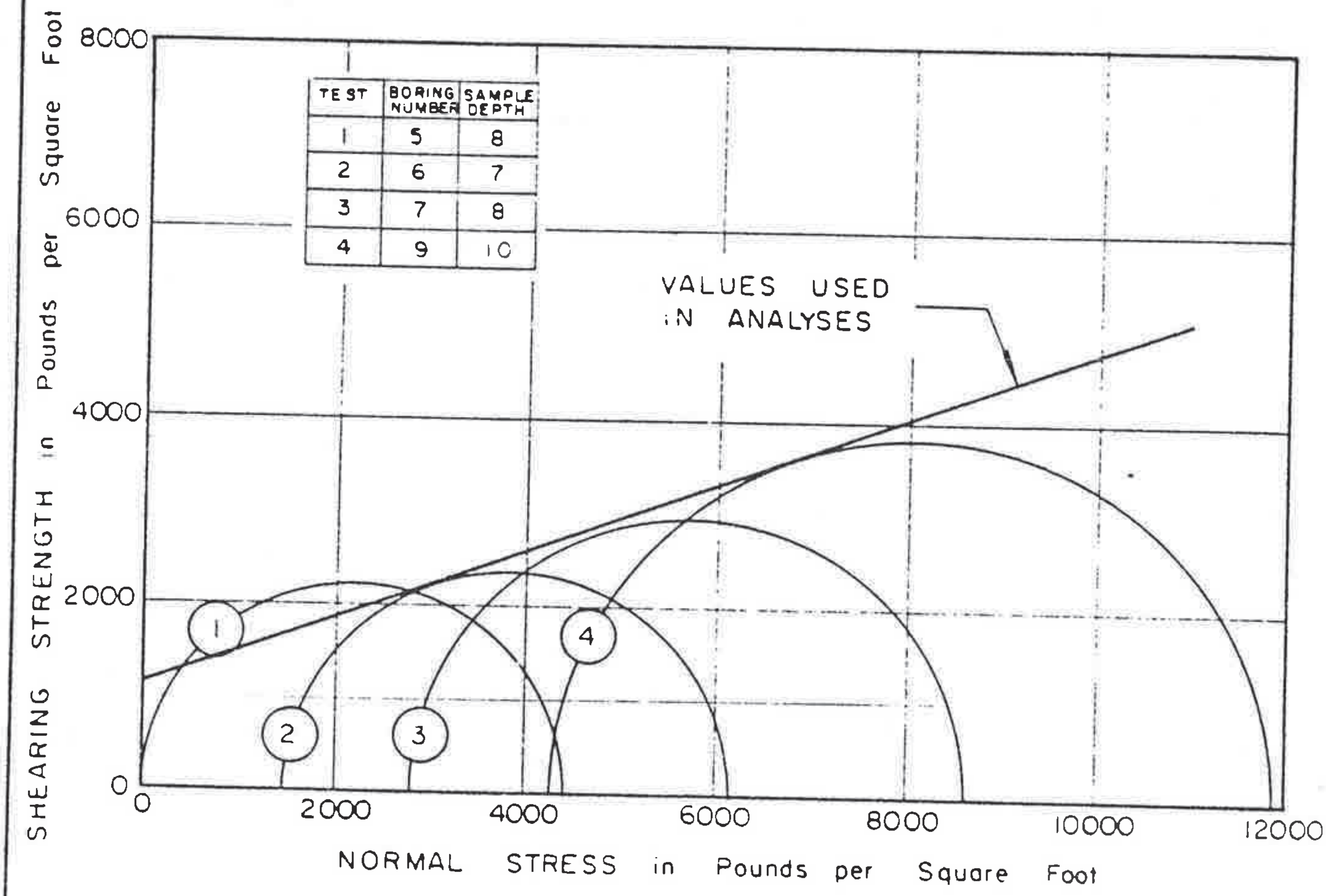
NOTE: Drilling mud used in drilling process. Mud removed to a depth of 74½ feet after completio of drilling; water level measured at a depth of 42½ feet 25 hours after removing mud.

LOG OF BORING

LEROY CRANDALL & ASSOCIATES



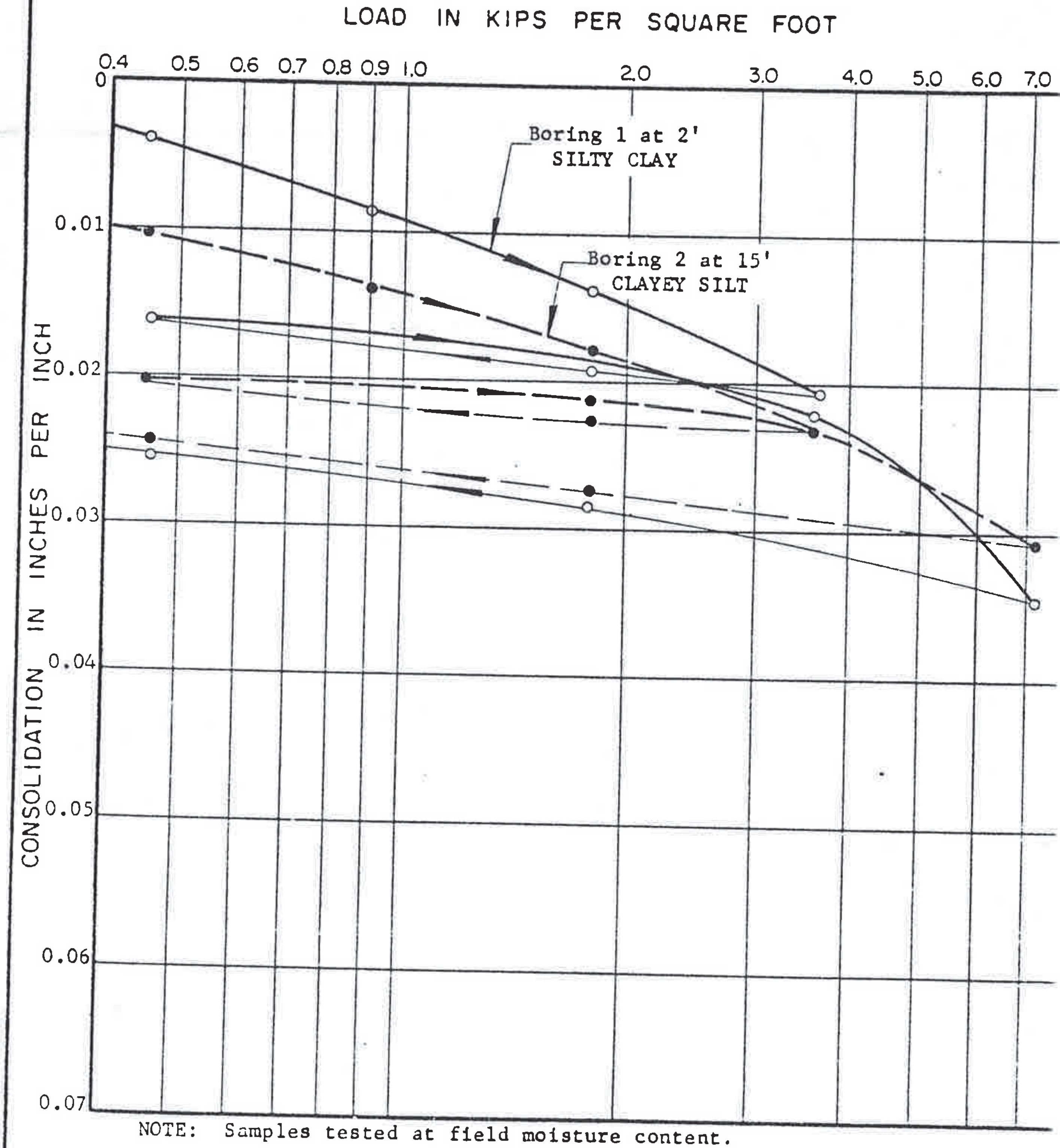
DIRECT SHEAR TEST DATA



TEST	BORING NUMBER	SAMPLE DEPTH
1	5	8
2	6	7
3	7	8
4	9	10

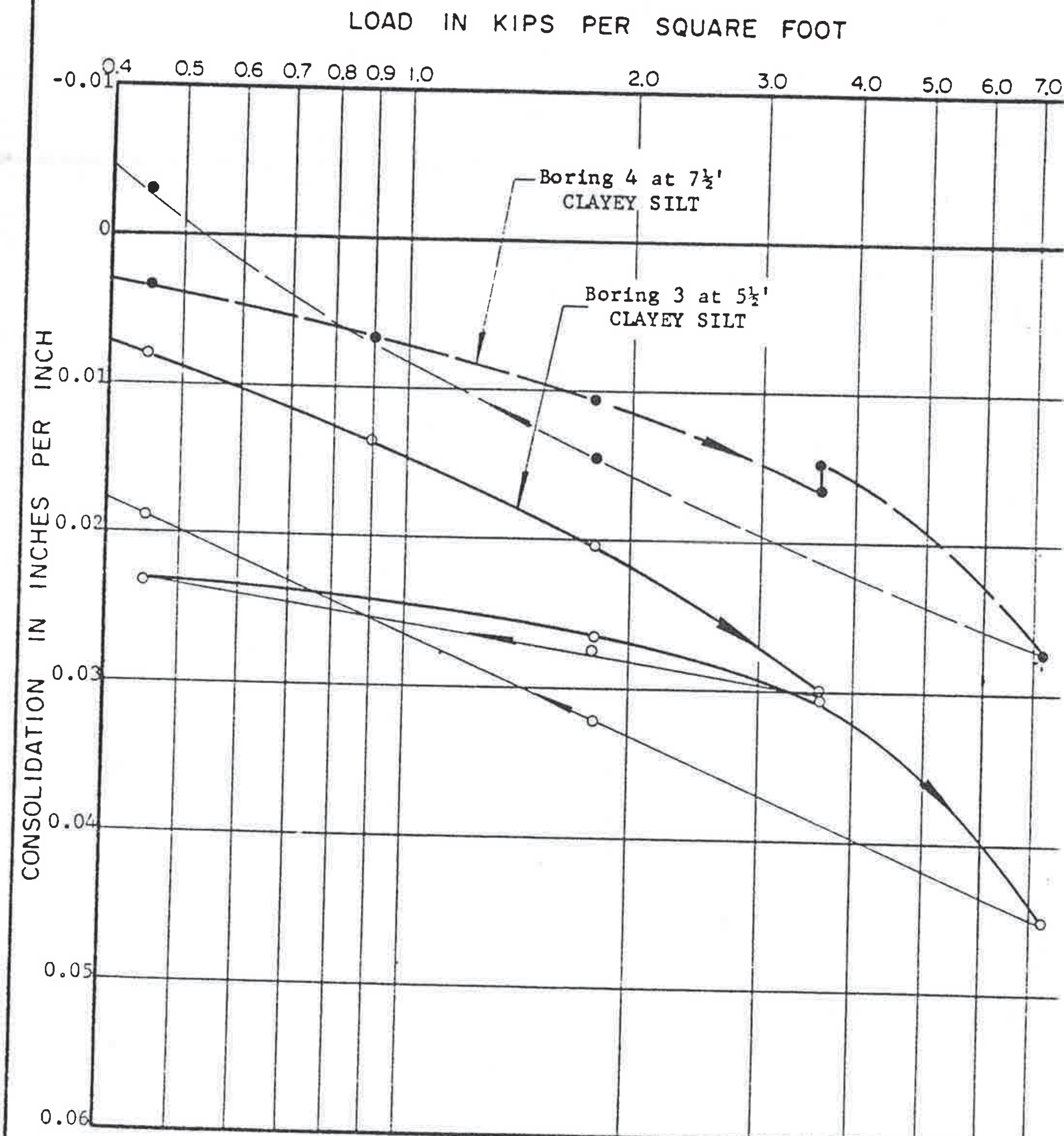
NOTE SAMPLES TESTED AT FIELD MOISTURE CONTENT UNDER CONSOLIDATED AND UNDRAINED CONDITIONS.

TRIAXIAL SHEAR TEST DATA



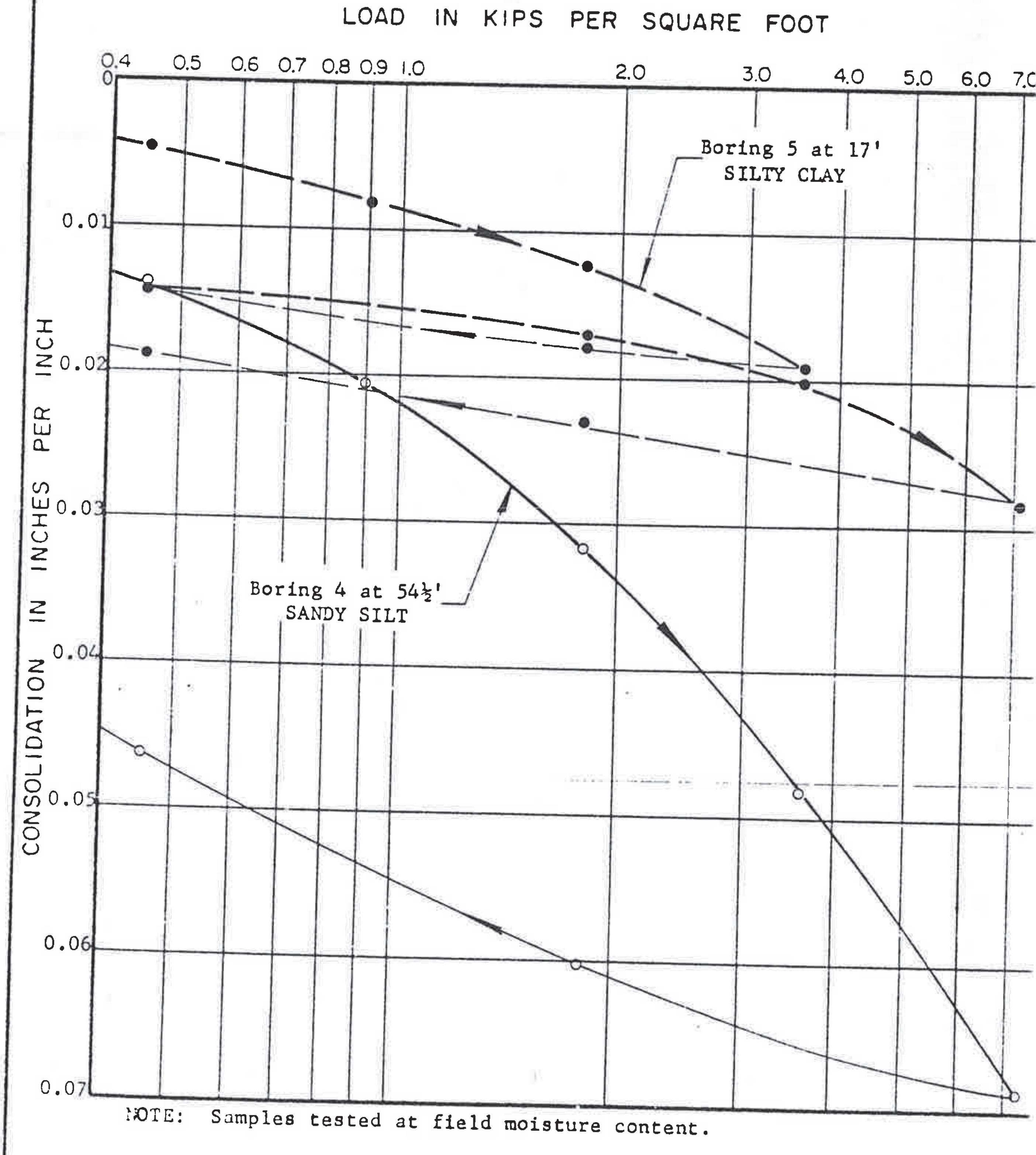
NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA



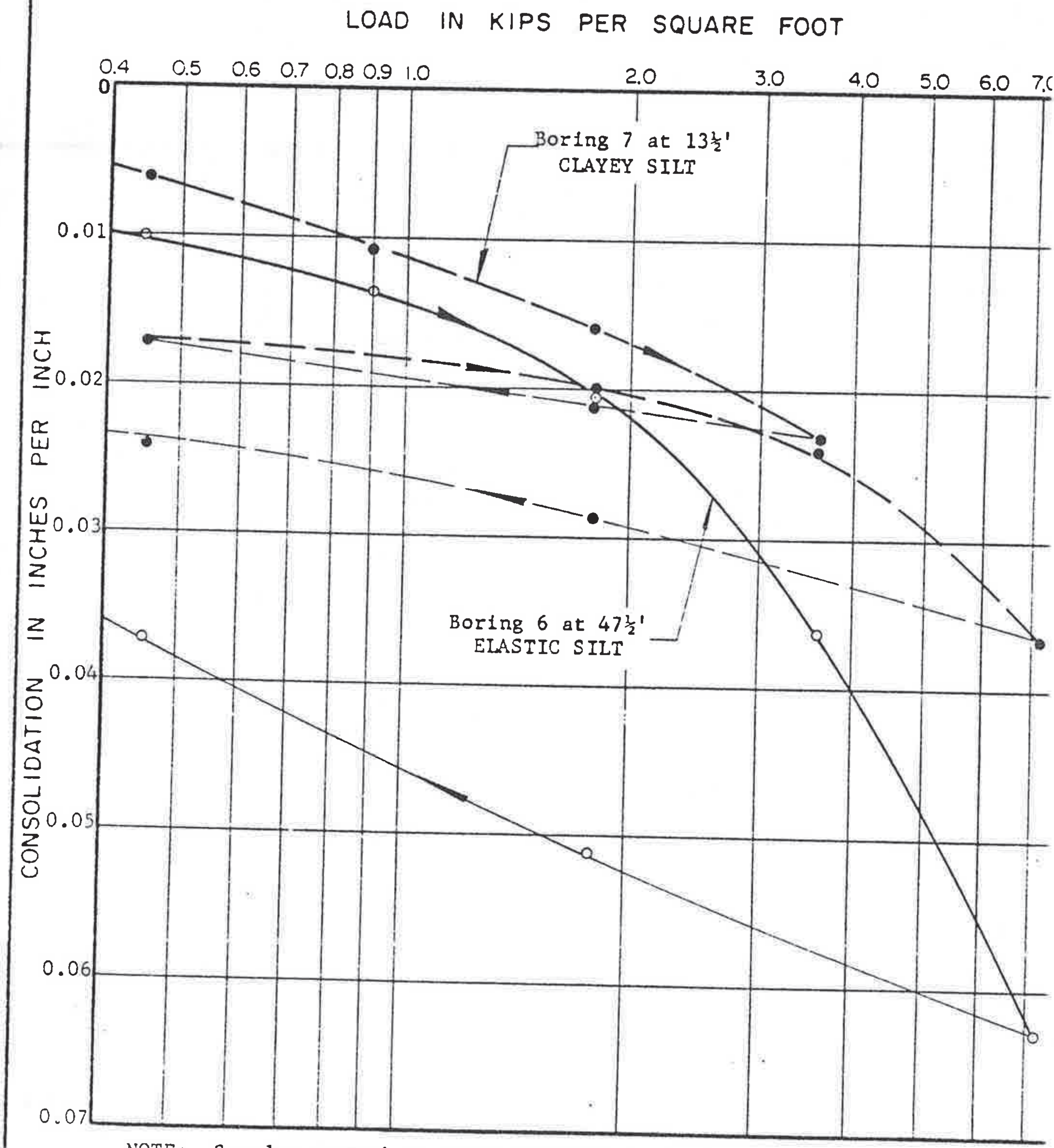
NOTE: Water added to samples after consolidation under a load of 3.6 kips per square foot.

CONSOLIDATION TEST DATA



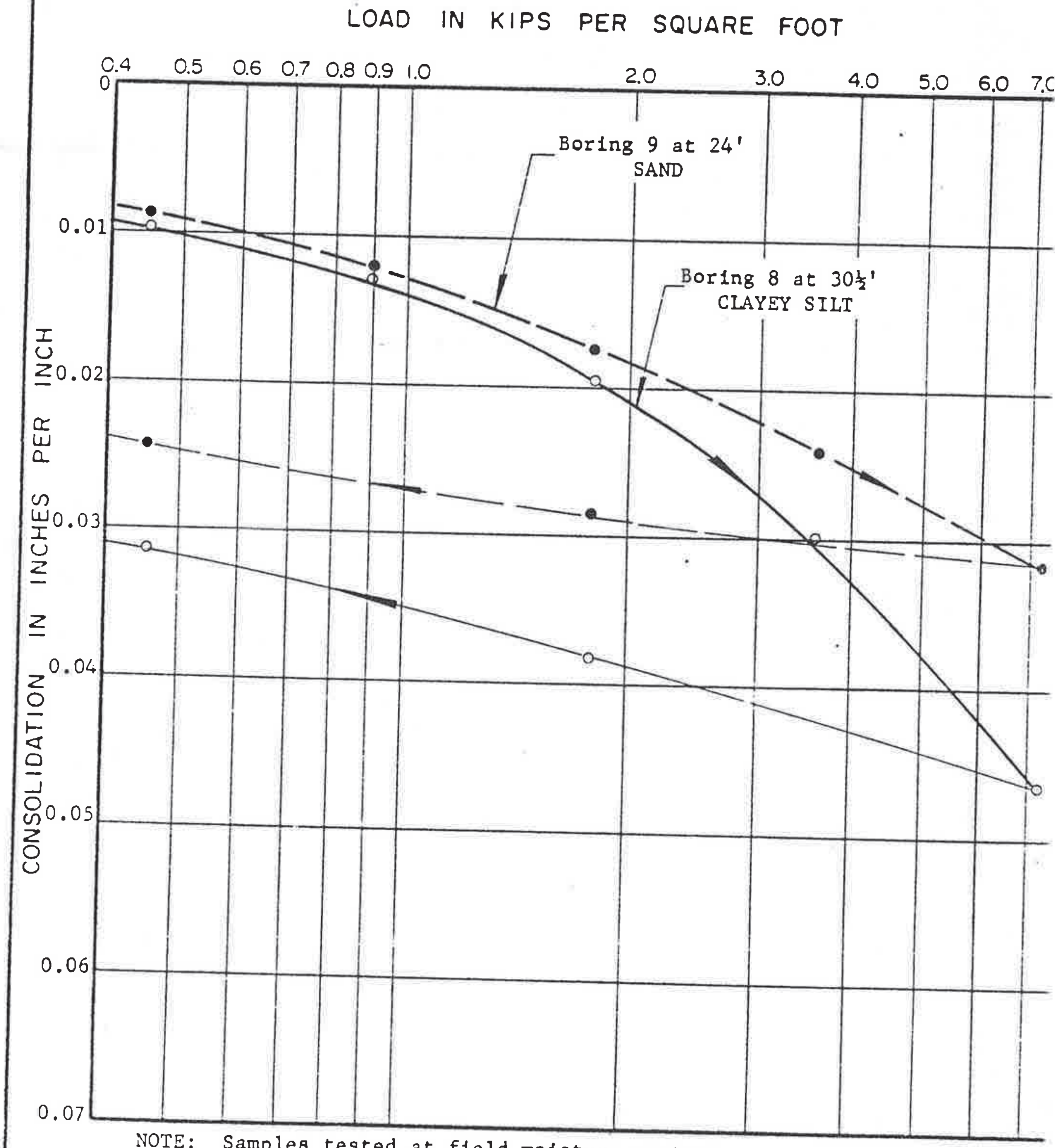
NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA



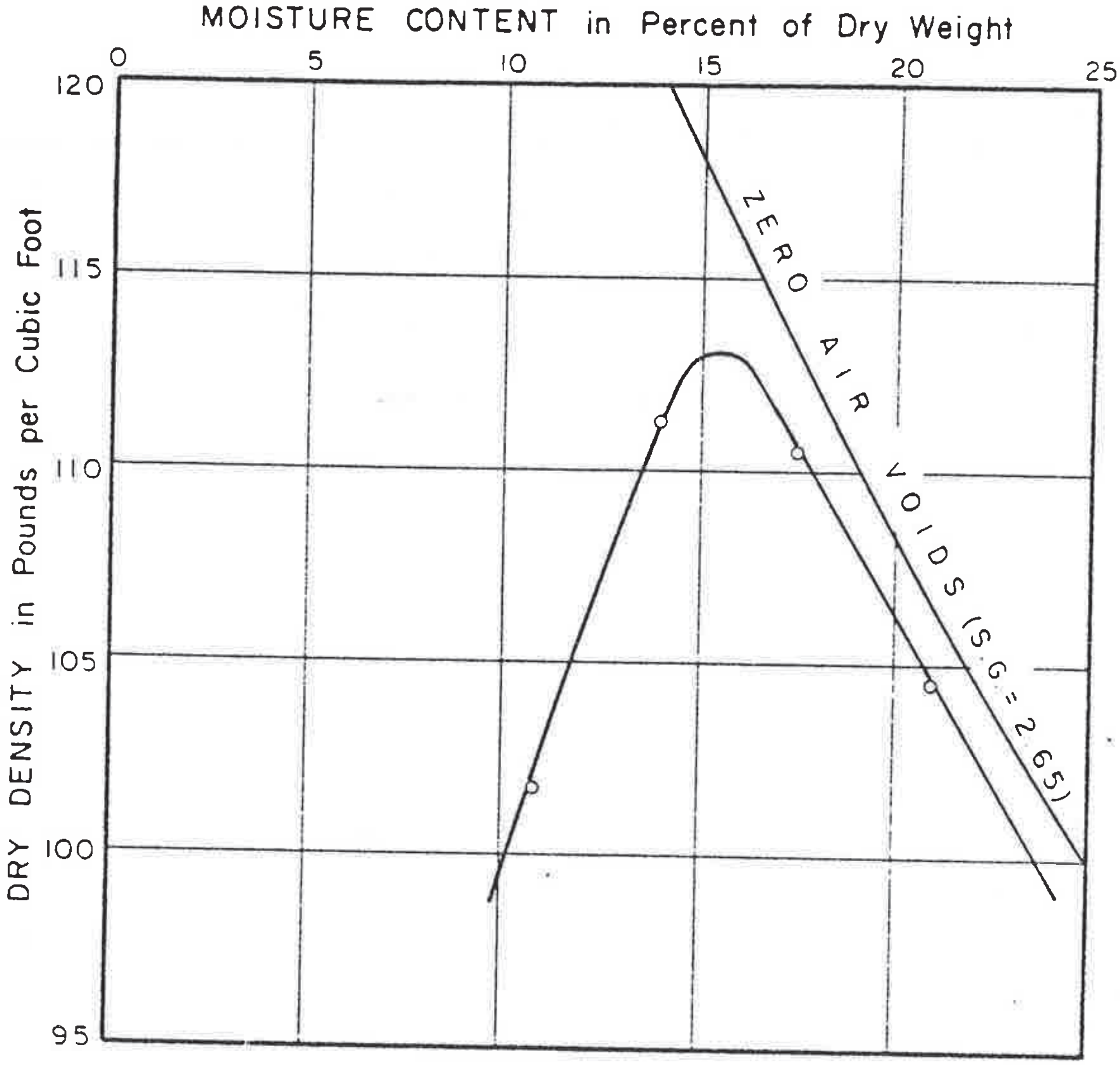
NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA



SOURCE: BORING 2, from 0' to 4'
SOIL TYPE: SILTY CLAY
MAXIMUM DRY DENSITY 113 lbs./cu. ft
OPTIMUM MOISTURE CONTENT: 15.5% of dry wt.
TEST METHOD: ASTM Designation D1557-66T (MODIFIED)

This method utilizes a 1/30-cubic-foot mold, in which each of three layers of soil is compacted by 25 blows of a 10-pound hammer falling 18 inches.

COMPACTION TEST DATA

BORING NUMBER AND SAMPLE DEPTH:	1 at 2'	3 at 1½'	4 at 3½'
SOIL TYPE:	SILTY CLAY	SILTY CLAY	SILTY CLAY
CONFINING PRESSURE: (Lbs./Sq.Ft.)	200	200	200
FIELD MOISTURE CONTENT: (%)	20.1	22.9	16.0
EXPANSION FROM FIELD TO SOAKED MOISTURE CONTENT: (%)	1.5	1.3	4.7
SOAKED MOISTURE CONTENT: (%)	21.6	24.6	20.7
SHRINKAGE FROM FIELD TO AIR-DRIED MOISTURE CONTENT: (%)	17.0	19.1	8.5
AIR-DRIED MOISTURE CONTENT: (%)	5.9	5.7	5.6
TOTAL VOLUME CHANGE: (%)	18.5	20.4	13.2

EXPANSION TEST DATA

BORING NUMBER AND SAMPLE DEPTH:	6 at 1'	8 at 1½'
SOIL TYPE:	SILTY CLAY	SILTY CLAY
CONFINING PRESSURE: (Lbs./Sq.Ft.)	200	200
FIELD MOISTURE CONTENT: (%)	21.5	21.4
EXPANSION FROM FIELD TO SOAKED MOISTURE CONTENT: (%)	0.9	1.6
SOAKED MOISTURE CONTENT: (%)	22.8	23.4
SHRINKAGE FROM FIELD TO AIR-DRIED MOISTURE CONTENT: (%)	15.7	17.8
AIR-DRIED MOISTURE CONTENT: (%)	5.9	6.4
TOTAL VOLUME CHANGE: (%)	16.6	19.4

EXPANSION TEST DATA

Golder Associates

REPORT OF BOREHOLE: LEGEND

CLIENT: The Travelers Companies, Inc.
PROJECT: Geotechnical Feasibility Study
LOCATION: 190th Street, Torrance, California
PROJECT NO.: 073-91955

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 inches
BOREHOLE: N:, E:
ELEVATION: DATUM:
INCLINATION: -90°
BOREHOLE DIAMETER: 7.5 inches

SHEET: 1 OF 1
DRILLER: Martini Drilling Corp.
DRILL RIG: CME-75
LOGGED: R. Hillman DATE: 11/14/07
CHECKED: A. Augello DATE: 11/21/07

Drilling					Sampling			Material Description					
METHOD	DRILL TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE OR FIELD TEST	SAMPLE TYPE	BLOWS PER 6 INCHES	GRAPHIC LOG	USCS	SOIL NAME, density, plasticity or particle size, color, moisture, minor components	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
Hollow Stem Auger			0					▨	CL	USCS group symbol (in accordance with ASTM D2487) Material Description USCS GROUP NAME, consistency or relative density, plasticity or gradation, color, moisture condition, other information (classifications made using visual-manual procedures in general accordance with ASTM D2488 and supplemented by laboratory test results)			
			5	5.0				░	SM	Estimated contact between different material types (location not exact as transition from one material type to another may be gradual) Blows Per Six Inches of Penetration Number of hammer blows required to drive sampler six inches, or recorded number of blows to drive sampler the specified distance (i.e., 50/4" = 50 blows delivered to drive sampler 4 inches)			
			10		S-1		3 5 9			Standard Penetration Test (2-inch outside diameter, 1.4-inch inside diameter split spoon sampler lined with brass rings)			
			15										
		▼								Groundwater level measured in the borehole during drilling			
			20							Additional Laboratory Testing AL = Atterberg Limits CR = Soil Corrosivity EI = Expansion Index GS = Grain Size			
			25										
				26.5									

Report of borehole must be read in conjunction with accompanying notes and abbreviations

Golder Associates

REPORT OF BOREHOLE: G-101

CLIENT: The Travelers Companies, Inc.
PROJECT: Geotechnical Feasibility Study
LOCATION: 190th Street, Torrance, California
PROJECT NO.: 073-91955

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 inches
BOREHOLE: N:, E:
ELEVATION: DATUM:
INCLINATION: -90°
BOREHOLE DIAMETER: 7.5 inches

SHEET: 1 OF 2
DRILLER: Martini Drilling Corp.
DRILL RIG: CME-75
LOGGED: R. Hillman DATE: 11/14/07
CHECKED: A. Augello DATE: 11/21/07

Drilling					Sampling			Material Description					
METHOD	DRILL TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE OR FIELD TEST	SAMPLE TYPE	BLOWS PER 6 INCHES	GRAPHIC LOG	USCS	SOIL NAME, density, plasticity or particle size, color, moisture, minor components	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
Hollow Stem Auger			0					■		2-inch-thick asphalt pavement			
								⊠	CH	3-inch-thick aggregate base layer			
				1.0	G-101@1'		2 2 3	▨	CH	FAT CLAY (FILL), medium stiff, dark grayish-brown, moist, some fine-grained sand			
								▨		FAT CLAY, medium stiff, dark grayish-brown, moist, some fine-grained sand			AL CR EI
								▨		Bulk soil sample collected from auger cuttings from 1 to 4 feet			
			5		G-101@5'		2 4 6	▨					
								▨		stiff, light brown from 6 feet			
			10		G-101@10'		3 4 6	▨		increased sand content from 10 feet			
			15	15.0	G-101@15'		6 7 11	▧	SC	CLAYEY SAND, medium dense, fine-grained, light brown, moist			
			20	20.0	G-101@20'		5 6 12	░	SM	SILTY SAND, medium dense, fine-grained, light grayish-brown with reddish-brown mottling, moist			
			25		G-101@25'		7 11 12	░		light brown from 25 feet			GS
			30		G-101@30'		6 12 7	░		very moist to wet at 30 feet - first groundwater seeps observed during drilling			
			35										

Report of borehole must be read in conjunction with accompanying notes and abbreviations

Golder Associates

REPORT OF BOREHOLE: G-101

CLIENT: The Travelers Companies, Inc.
PROJECT: Geotechnical Feasibility Study
LOCATION: 190th Street, Torrance, California
PROJECT NO.: 073-91955

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 inches
BOREHOLE: N:, E:
ELEVATION: DATUM:
INCLINATION: -90°
BOREHOLE DIAMETER: 7.5 inches

SHEET: 2 OF 2
DRILLER: Martini Drilling Corp.
DRILL RIG: CME-75
LOGGED: R. Hillman DATE: 11/14/07
CHECKED: A. Augello DATE: 11/21/07

Drilling					Sampling			Material Description					
METHOD	DRILL TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE OR FIELD TEST	SAMPLE TYPE	BLOWS PER 6 INCHES	GRAPHIC LOG	USCS	SOIL NAME, density, plasticity or particle size, color, moisture, minor components	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
Hollow Stem Auger			35	35.0	G-101@35'		1 2 3		CL	LEAN CLAY, medium stiff, light brown with gray and reddish-brown lenses, moist, some fine-grained sand			GS
		▼											
			40		G-101@40'		3 4 4			decreased sand content from 40 feet			
			45		G-101@45'		5 11 11						
				46.0					SM	SILTY SAND, medium dense, fine-grained, grayish-brown, moist			
			50	50.0	G-101@50'		2 4 5		ML	SANDY SILT, stiff, sand is fine-grained, grayish-brown, very moist, some clay			
				51.5						Bottom of boring at approximately 51.5 feet. Groundwater level measured at 36.5 feet 10 minutes after completion of drilling. Borehole backfilled with bentonite grout and asphalt pavement patched.			

Report of borehole must be read in conjunction with accompanying notes and abbreviations

Golder Associates

REPORT OF BOREHOLE: G-102

CLIENT: The Travelers Companies, Inc.
PROJECT: Geotechnical Feasibility Study
LOCATION: 190th Street, Torrance, California
PROJECT NO.: 073-91955

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 inches
BOREHOLE: N:, E:
ELEVATION: DATUM:
INCLINATION: -90°
BOREHOLE DIAMETER: 7.5 inches

SHEET: 1 OF 1
DRILLER: Martini Drilling Corp.
DRILL RIG: CME-75
LOGGED: R. Hillman DATE: 11/14/07
CHECKED: A. Augello DATE: 11/21/07

Drilling					Sampling			Material Description					
METHOD	DRILL TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE OR FIELD TEST	SAMPLE TYPE	BLOWS PER 6 INCHES	GRAPHIC LOG	USCS	SOIL NAME, density, plasticity or particle size, color, moisture, minor components	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
Hollow Stem Auger			0					■		3-inch-thick asphalt pavement			
								⊠	CH	4-inch-thick aggregate base layer			
					G-102@1'		2 3 6	▨		FAT CLAY (FILL), stiff, dark brown, moist, trace fine-grained sand			
				1.5				▨	CH	FAT CLAY, stiff, dark brown, moist, some fine-grained sand			
								▨					AL
			5		G-102@5'		2 3 4	▨		increased sand content, light brown from 5 feet			
			10		G-102@10'		3 5 7	▨		decreased sand content from 10 feet			
			15		G-102@15'		3 2 3	▨					
			20	20.0	G-102@20'		4 6 6	░	SM	SILTY SAND, medium dense, fine-grained, light brown, moist			
			25		G-102@25'		5 8 15	░					
				26.5						Bottom of boring at approximately 26.5 feet. Groundwater level not encountered during drilling. Borehole backfilled with bentonite grout and asphalt pavement patched.			

Report of borehole must be read in conjunction with accompanying notes and abbreviations

REPORT OF BOREHOLE: G-103

Golder Associates

CLIENT: The Travelers Companies, Inc.
PROJECT: Geotechnical Feasibility Study
LOCATION: 190th Street, Torrance, California
PROJECT NO.: 073-91955

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 inches
BOREHOLE: N:, E:
ELEVATION: DATUM:
INCLINATION: -90°
BOREHOLE DIAMETER: 7.5 inches

SHEET: 1 OF 2
DRILLER: Martini Drilling Corp.
DRILL RIG: CME-75
LOGGED: R. Hillman DATE: 11/14/07
CHECKED: A. Augello DATE: 11/21/07

Drilling					Sampling			Material Description					
METHOD	DRILL TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE OR FIELD TEST	SAMPLE TYPE	BLOWS PER 6 INCHES	GRAPHIC LOG	USCS	SOIL NAME, density, plasticity or particle size, color, moisture, minor components	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
Hollow Stem Auger			0							2-inch-thick asphalt pavement			
										3-inch-thick aggregate base layer			
					G-103@1'		1 3 2	▨	CH	FAT CLAY (FILL), medium stiff, dark grayish-brown, moist, trace fine-grained sand			
				2.0				░	SC	CLAYEY SAND (FILL), loose, fine-grained, brown with black and tan mottling, moist			
			5		G-103@5'		4 4 5						
				5.5				▨	CH	FAT CLAY, stiff, light brown, moist, trace fine-grained sand			
			10		G-103@10'		3 5 7			very stiff from 10 feet			
			15	15.0	G-103@15'		3 5 8	▨	CL	SANDY LEAN CLAY, stiff, sand is fine-grained, light brown, moist			
			20		G-103@20'		3 2 3			LEAN CLAY WITH SAND, medium stiff from 20 feet			GS
			25	25.0	G-103@25'		3 9 10	░	SM	SILTY SAND, medium dense, fine-grained, brown with gray mottling, moist			
			30	30.0	G-103@30'		6 14 12	░	SC	CLAYEY SAND, medium dense, fine- to coarse-grained, light brown, moist			
			35										

Report of borehole must be read in conjunction with accompanying notes and abbreviations

Golder Associates

REPORT OF BOREHOLE: G-103

CLIENT: The Travelers Companies, Inc.
PROJECT: Geotechnical Feasibility Study
LOCATION: 190th Street, Torrance, California
PROJECT NO.: 073-91955

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 inches
BOREHOLE: N:, E:
ELEVATION: DATUM:
INCLINATION: -90°
BOREHOLE DIAMETER: 7.5 inches

SHEET: 2 OF 2
DRILLER: Martini Drilling Corp.
DRILL RIG: CME-75
LOGGED: R. Hillman DATE: 11/14/07
CHECKED: A. Augello DATE: 11/21/07

Drilling					Sampling			Material Description					
METHOD	DRILL TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE OR FIELD TEST	SAMPLE TYPE	BLOWS PER 6 INCHES	GRAPHIC LOG	USCS	SOIL NAME, density, plasticity or particle size, color, moisture, minor components	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
Hollow Stem Auger			35		G-103@35'		3 3 6	▨	SC	first groundwater seeps observed at 35 feet			
				36.0				▨	CL	LEAN CLAY, stiff, gray with reddish-brown mottling, moist, some fine-grained sand			
			40		G-103@40'		3 4 8	▨		very stiff, reddish-brown from 40 feet			GS
			45		G-103@45'		1 2 3	▨		medium stiff, decreased sand content, dark gray from 45 feet			
		▼						▨					
			50		G-103@50'		2 3 4	▨		SANDY LEAN CLAY, very moist to wet at 50 feet			
				51.5						Bottom of boring at approximately 51.5 feet. Groundwater level measured at 47 feet 10 minutes after completion of drilling. Borehole backfilled with bentonite grout and asphalt pavement patched.			

Report of borehole must be read in conjunction with accompanying notes and abbreviations

Golder Associates

REPORT OF BOREHOLE: G-104

CLIENT: The Travelers Companies, Inc.
PROJECT: Geotechnical Feasibility Study
LOCATION: 190th Street, Torrance, California
PROJECT NO.: 073-91955

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 inches
BOREHOLE: N:, E:
ELEVATION: DATUM:
INCLINATION: -90°
BOREHOLE DIAMETER: 7.5 inches

SHEET: 1 OF 1
DRILLER: Martini Drilling Corp.
DRILL RIG: CME-75
LOGGED: R. Hillman DATE: 11/14/07
CHECKED: A. Augello DATE: 11/21/07

Drilling					Sampling			Material Description					
METHOD	DRILL TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE OR FIELD TEST	SAMPLE TYPE	BLOWS PER 6 INCHES	GRAPHIC LOG	USCS	SOIL NAME, density, plasticity or particle size, color, moisture, minor components	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
Hollow Stem Auger			0							2-inch-thick asphalt pavement			
									CH	3-inch-thick aggregate base layer			AL
				1.0	G-104@1'		2 2 3		CH	FAT CLAY (FILL), medium stiff, dark grayish-brown, moist, some fine-grained sand			
										FAT CLAY, medium stiff, dark grayish-brown, moist, some fine-grained sand			
			5		G-104@5'		2 1 2						
			10		G-104@10'		2 4 6			stiff, light brown from 10 feet			
			15	15.0	G-104@15'		2 5 5		CL	SANDY LEAN CLAY, stiff, sand is fine-grained, light brown, moist			
			20		G-104@20'		2 4 8						
			25	25.0	G-104@25'		3 10 10		SM	SILTY SAND, medium dense, fine-grained, brown, moist			
				26.0					SC	CLAYEY SAND, medium dense, fine- to coarse-grained, light brown, moist			
				26.5						Bottom of boring at approximately 26.5 feet. Groundwater level not encountered during drilling. Borehole backfilled with bentonite grout and asphalt pavement patched.			

SUMMARY OF LABORATORY TEST RESULTS

Client: Golder Associates Inc.
Project Name: Travelers / Torrance Geotech Feasibility
Project No.: 073-91955

HAI Project No: GLDL-07-012
Performed by: JT
Date: 12/7/2007

Boring No.	Depth (ft)	Atterberg Limits (ASTM D4318)			Particle-size Analysis of Soils (ASTM D422) (Percent Passing)								Expansion Index (ASTM D4829)	Corrosion				
														pH	Sulfates		Chlorides	Resistivity
		LL	PL	PI	3/8"	# 4	# 10	# 20	# 40	# 60	# 100	# 200			(ppm)	(%) by weight	(ppm)	(ohm-cm)
G-101	1 - 4	55	21	34									97	7.1	290	0.029	18	640
	25						100.0	99.9	99.8	98.9	49.8	12.3						
	35				100.0	97.5	95.7	94.5	94.1	93.3	91.2	88.9						
G-102	5	64	22	42														
G-103	20						100.0	99.3	98.3	97.4	91.0	70.8						
	40						100.0	99.9	99.8	99.6	97.9	90.2						
G-104	1	55	21	34														

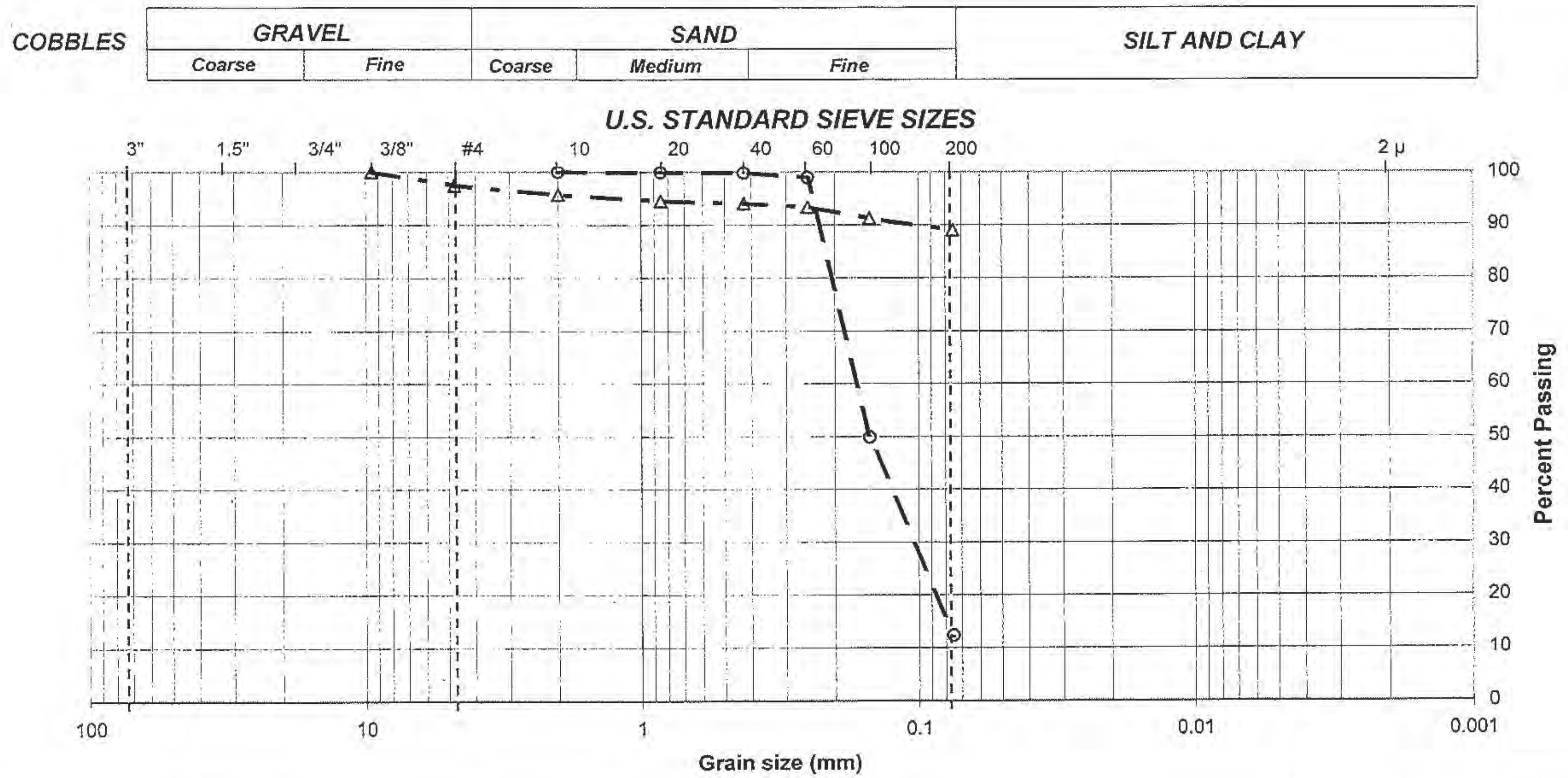
HAI HUSHMAND ASSOCIATES INC.
Geotechnical and Earthquake Engineers

HAI **HUSHMAND ASSOCIATES, INC.**
Geotechnical and Earthquake Engineers

PARTICLE-SIZE ANALYSIS OF SOILS
(ASTM D422)

Client: Golder Associates Inc.
Project Name: Travelers / Torrance Geotech Feasibility
Project No.: 073-91955

HAI Project No.: GLDL-07-012
Tested by: RY
Checked by: JT
Date: 11/08/07

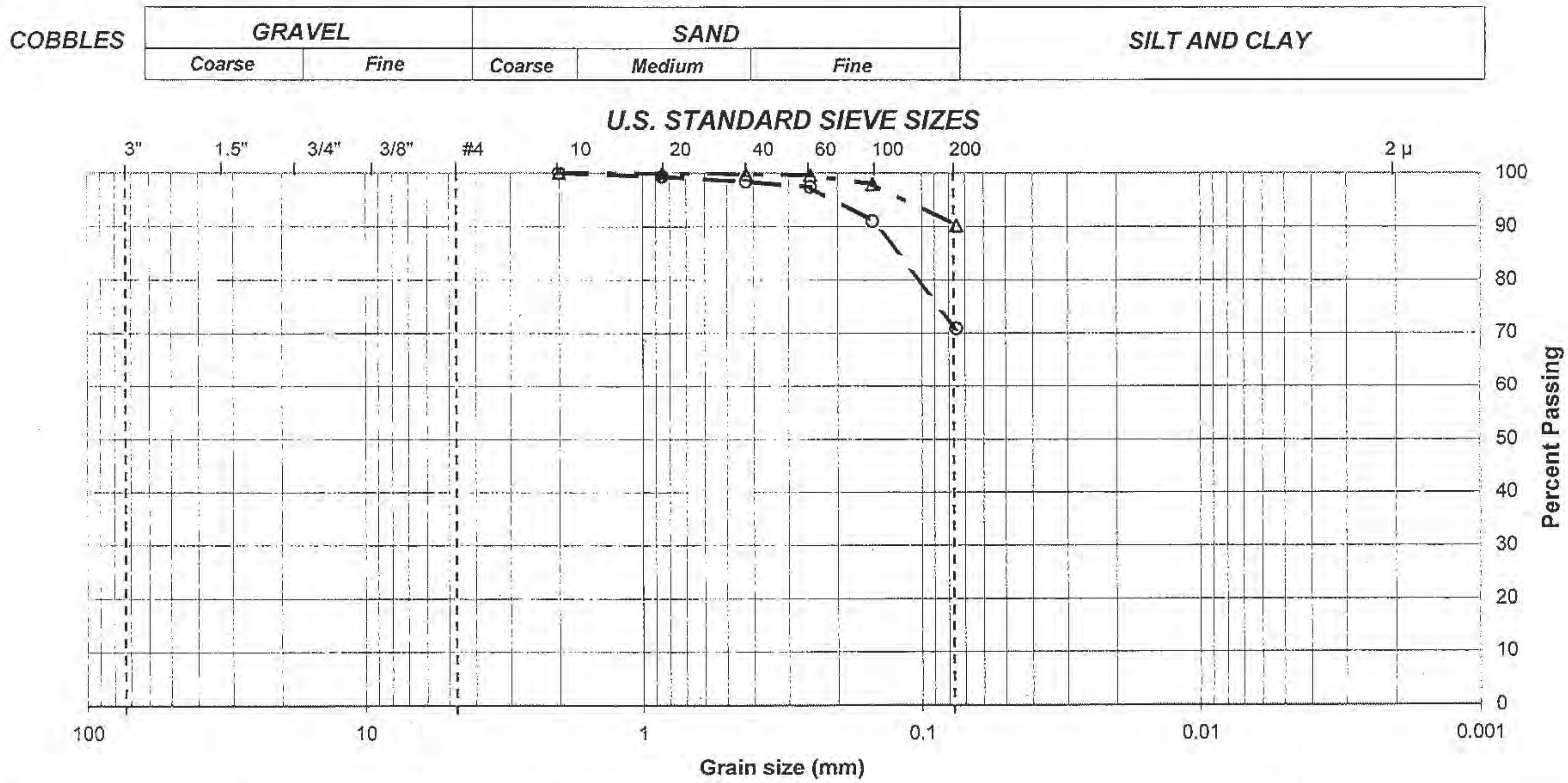


Boring No.	Depth (ft)	Symbol	LL	PI	USCS	% Gravel	% Sand	% Fines
G-101	25	○	---	---	Brown, Silty Sand (SM)	0.0	87.7	12.3
	35	△	---	---	Brown, Lean Clay (CL)	2.5	8.6	88.9

HAI **HUSHMAND ASSOCIATES, INC.**
Geotechnical and Earthquake Engineers

PARTICLE-SIZE ANALYSIS OF SOILS
(ASTM D422)

Client:	Golder Associates Inc.	***HAI Project No.:***	GLDL-07-012
Project Name:	Travelers / Torrance Geotech Feasibility	***Tested by:***	RY
Project No.:	073-91955	***Checked by:***	JT
		Date:	11/08/07



Boring No.	Depth (ft)	Symbol	LL	PI	USCS	% Gravel	% Sand	% Fines
G-103	20	○	---	---	Brown, Lean Clay with Sand (CL)	0.0	29.2	70.8
	40	△	---	---	Brown, Lean Clay (CL)	0.0	9.8	90.2

HAI ***HUSHMAND ASSOCIATES, INC.***
Geotechnical and Earthquake Engineers

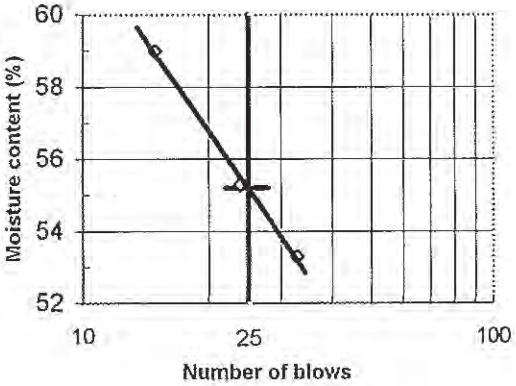
ATTERBERG LIMITS
(ASTM D 4318)

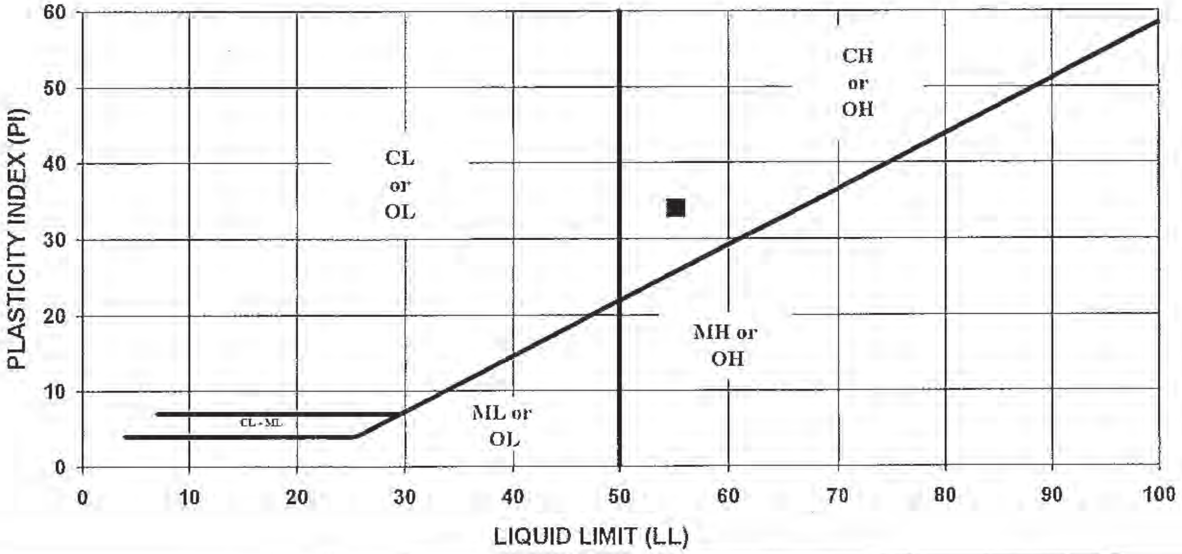
Client: Golder Associates Inc.
Project Name: Travelers / Torrance Geotech Feasibility
Project No.: 073-91955
Boring No.: G 101
Sample No.: -- ***Depth:*** 1 - 4'
Soil Description: Dark Brown, Fat Clay (CH)

HAI Project No.: GLDL-07-012
Tested by: PM
Checked by: JT
Date: 12/07/07

Test		LL	LL	LL	PL	PL
Tare No.		19	12	11	F	K
No. of blows		**33**	**24**	**15**		
Wt. of wet soil + tare	(g)	22.24	22.25	22.79	8.80	8.68
Wt. of dry soil + tare	(g)	18.26	18.26	18.32	7.45	7.36
Wt. of tare	(g)	10.79	11.04	10.74	1.12	1.11
Water content	**(%)**	**53.3**	**55.3**	**59.0**	**21.3**	**21.1**

Liquid Limit	**55**
Plastic Limit	**21**
Plasticity Index	**34**
USCS	**CH**





HAI **HUSHMAND ASSOCIATES, INC.**
Geotechnical and Earthquake Engineers

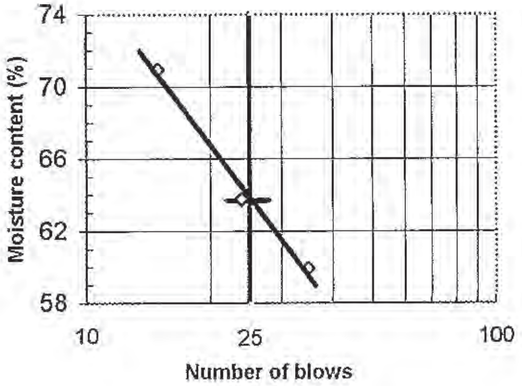
ATTERBERG LIMITS
(ASTM D 4318)

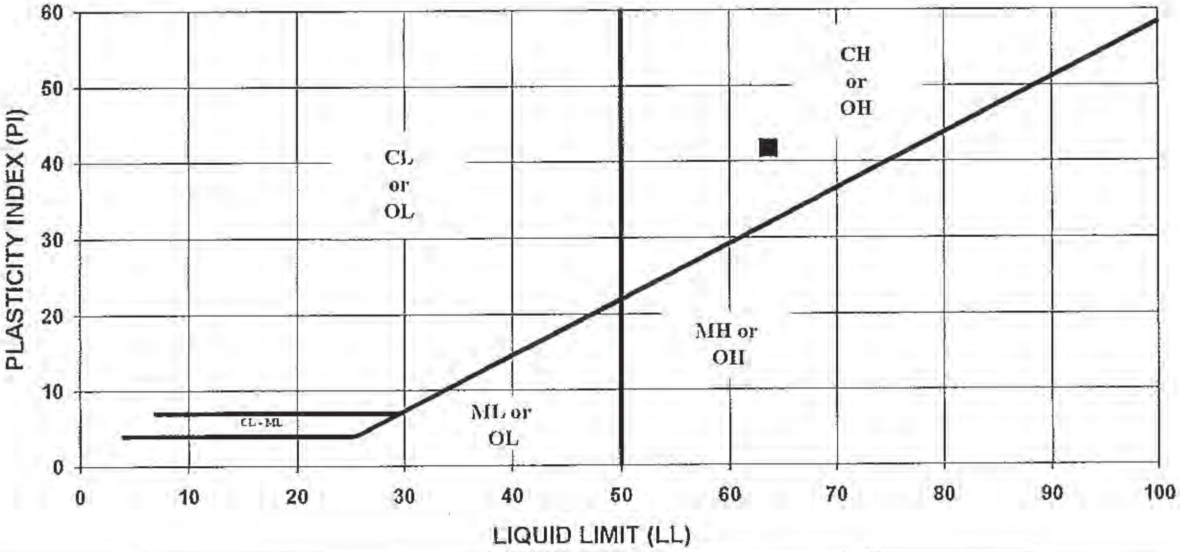
Client: Golder Associates Inc.
Project Name: Travelers / Torrance Geotech Feasibility
Project No.: 073-91955
Boring No.: G 102
Sample No.: -- ***Depth:*** 5'
Soil Description: Olive Brown, Fat Clay (CH)

HAI Project No.: GLDL-07-012
Tested by: PM
Checked by: JT
Date: 12/07/07

Test		LL	LL	LL	PL	PL
Tare No.		6	20	13	H	G
No. of blows		**35**	**24**	**15**		
Wt. of wet soil + tare	(g)	21.37	21.28	22.40	7.12	7.27
Wt. of dry soil + tare	(g)	17.52	17.26	17.65	6.04	6.16
Wt. of tare	(g)	11.09	10.95	10.95	1.11	1.12
Water content	**(%)**	**59.9**	**63.7**	**70.9**	**21.9**	**22.0**

Liquid Limit	**64**
Plastic Limit	**22**
Plasticity Index	**42**
USCS	**CH**





HAI **HUSHMAND ASSOCIATES, INC.**
Geotechnical and Earthquake Engineers

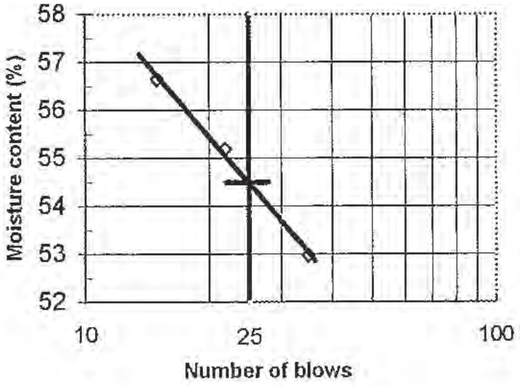
ATTERBERG LIMITS
(ASTM D 4318)

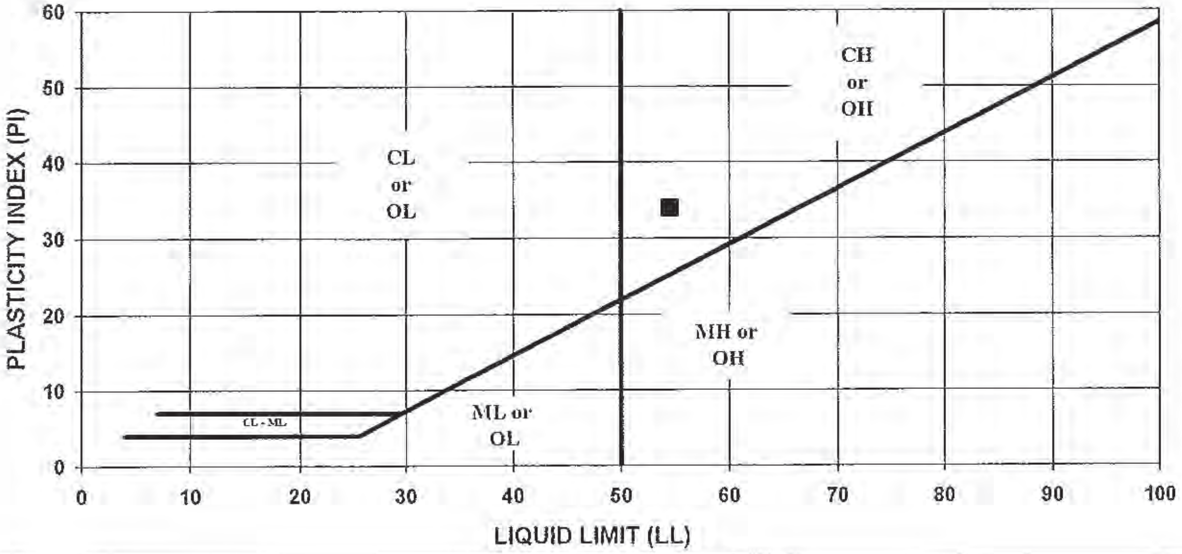
Client: Golder Associates Inc.
Project Name: Travelers / Torrance Geotech Feasibility
Project No.: 073-91955
Boring No.: G 104
Sample No.: -- ***Depth:*** 1'
Soil Description: Brown, Fat Clay (CH)

HAI Project No.: GLDL-07-012
Tested by: PM
Checked by: JT
Date: 12/07/07

Test		LL	LL	LL	PL	PL
Tare No.		3	14	5	A3	A1
No. of blows		**35**	**22**	**15**		
Wt. of wet soil + tare	(g)	21.97	21.49	21.84	7.76	7.53
Wt. of dry soil + tare	(g)	18.21	17.76	17.95	6.60	6.41
Wt. of tare	(g)	11.11	11.00	11.08	1.12	1.13
Water content	**(%)**	**53.0**	**55.2**	**56.6**	**21.2**	**21.2**

Liquid Limit	**55**
Plastic Limit	**21**
Plasticity Index	**34**
USCS	**CH**





HAI ***HUSHMAND ASSOCIATES, INC.***
Geotechnical and Earthquake Engineers

EXPANSION INDEX
(ASTM D4829)

Client: Golder Associates Inc.

Project Name: Travelers / Torrance Geotech Feasibility

Project No.: 073-91955

Sample No: **G 101** *Depth:* **1 - 4'**

Soil Description: Dark Brown, Fat Clay (CH)

HAI Project No.: GLDL-07-012

Tested by: PM

Checked by: JT

Date: 12/06/07

MOLDED SPECIMEN		
Wt. of wet soil + cont.	265.81	g
Wt. of dry soil + cont.	234.83	g
Wt. of container (F 1)	12.70	g
Wt. of water	30.98	g
Wt. of dry soil	222.13	g
Moisture Content	13.9	%
Wt. of wet soil + ring	552.93	g
Wt. of ring	193.40	g
Wt. of wet soil	359.53	g
Wet density of soil	108.9	pcf
Dry density of soil	95.6	pcf
Specific gravity of soil	2.75	pcf
Saturation	48.3	%

Date & time	**Elapsed time (min)**	**Dial Reading**	**Δh Expansion**
12/06-09:41	0	0	
12/06-09:51	10	-0.0005	
Add distilled water to sample			
12/07-09:41	1440	0.0979	0.0984

Sample after test		
Wt. of wet soil + ring	612.16	g
Wt. of dry soil + ring	507.04	g
Wt. of water	105.12	g
Wt. of dry soil	313.64	g
Final moisture content	33.5	%
Final Dry Density	86.5	pcf
Final Saturation	93.7	%

$$S= w*G_s*g_d \ / \ G_s*g_w - g_d$$

$$EI_{50}= EI_{meas} - \{(50 - S_{meas})(65+EI_{meas}/220-S_{meas})\}$$

$$EI=(rh/Ho)*1000$$

Expansion Index $_{meas}$ = 98

Expansion Index $_{50}$ = 97

CORROSION TEST

Client:	Golder Associates Inc.	***HAI Project No.:***	GLDL-07-012
Project Name:	Travelers / Torrance Geotech Feasibility	***Date:***	12/7/2007
Project No.:	073-91955		

Sample ID			G-101			
Depth (ft)			1 - 4			
Resistivity						
as-received		ohm-cm	640			
minimum		ohm-cm	640			
pH			7.1			
Electrical Conductivity		mS/cm	0.54			
Chemical Analyses						
Cations						
calcium	Ca^{2+}	mg/kg	228			
magnesium	Mg^{2+}	mg/kg	59			
sodium	Na^{1+}	mg/kg	163			
potassium	K^{1+}	mg/kg	20			
Anions						
carbonate	CO_3^{2-}	mg/kg	ND			
bicarbonate	HCO_3^{1-}	mg/kg	488			
flouride	F^{1-}	mg/kg	1.9			
chloride	Cl^{1-}	mg/kg	18			
sulfate	SO_4^{2-}	mg/kg	290			
phosphate	PO_4^{3-}	mg/kg	23			
Other Tests						
ammonium	NH_4^{1+}	mg/kg	26.6			
nitrate	NO_3^{1-}	mg/kg	24.9			
sulfide	S^{2-}	qual	na			
Redox		mV	na			

Minimum resistivity per CTM 643.
Electrical conductivity in millisiemens/cm and chemical analysis 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.

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