



## Geotechnologies, Inc.

*Consulting Geotechnical Engineers*

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April 3, 2019  
File Number 21644

Walter N. Marks, Inc.  
8758 Venice Boulevard, Suite 100  
Culver City, California 90034

Attention: Walter Marks

Subject: Geotechnical Engineering Investigation  
Proposed Mixed-Use Tower Development  
5401-5425 Wilshire Boulevard, Los Angeles, California

Dear Mr. Marks:

This letter transmits the Geotechnical Engineering Investigation for the subject property prepared by Geotechnologies, Inc. This report provides geotechnical recommendations for the development of the site, including earthwork, seismic design, retaining walls, excavations, shoring and foundation design. Engineering for the proposed project should not begin until approval of the geotechnical investigation is granted by the local building official. Significant changes in the geotechnical recommendations may result due to the building department review process.

The validity of the recommendations presented herein is dependent upon review of the geotechnical aspects of the project during construction by this firm. The subsurface conditions described herein have been projected from limited subsurface exploration and laboratory testing. The exploration and testing presented in this report should in no way be construed to reflect any variations which may occur between the exploration locations or which may result from changes in subsurface conditions.

Should you have any questions please contact this office.

Respectfully submitted,  
GEOTECHNOLOGIES, INC.

STANLEY S. TANG  
R.C.E. 56178



SST:km

Distribution: (4) Addressee

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**GEOTECHNICAL ENGINEERING INVESTIGATION  
PROPOSED MIXED-USE TOWER DEVELOPMENT  
5401-5425 WILSHIRE BOULEVARD  
LOS ANGELES, CALIFORNIA**

**INTRODUCTION**

This report presents the results of the geotechnical engineering investigation performed on the subject property. The purpose of this investigation was to identify the distribution and engineering properties of the earth materials underlying the site, and to provide geotechnical recommendations for the design of the proposed development.

This investigation included excavation of three exploratory borings, collection of representative samples, laboratory testing, engineering analysis, review of published geologic data, review of available geotechnical engineering information and the preparation of this report. The exploratory excavation locations are shown on the enclosed Plot Plan. The results of the exploration and the laboratory testing are presented in the Appendix of this report.

**PROPOSED DEVELOPMENT**

Information concerning the proposed development was furnished by Keating Architecture. The site is proposed to be developed with a 42-story mixed-use residential tower. The proposed development will be constructed over 3 subterranean levels, extending on the order of 44 feet below the existing site grade.

The proposed development will be supported on a mat foundation. Preliminary loading provided by the project structural engineer, Englekirk, indicate that the average bearing pressure will be between 1,800 and 3,300 pounds per square foot below the portion of mat foundation supporting the podium structure, and an average bearing pressure of 9,300 pounds per square foot below the



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tower structure. The mat foundation is anticipated to vary between 7 to 12 feet in thickness. Grading will consist of excavations between 51 and 57 feet in depth for the proposed subterranean parking levels and foundation elements.

Any changes in the design of the project or location of any structure, as outlined in this report, should be reviewed by this office. The recommendations contained in this report should not be considered valid until reviewed and modified or reaffirmed, in writing, subsequent to such review.

### **SITE CONDITIONS**

The property is located at 5401-5425 Wilshire Boulevard, in the Miracle Mile district of the City of Los Angeles, California. The site is bounded by two, 2-story residential properties to the north, by South Cloverdale Avenue to the east, by Wilshire Boulevard to the south, and by South Cochran Avenue to the west. The Metro Purple Line subway extension traverses below Wilshire Boulevard approximately 50 feet below the ground surface.

The site is relatively level with approximately 2 feet of elevation change across the site. Drainage across the site is by sheetflow to the city streets. The vegetation on the site consists of isolated trees and planters. The neighboring development consists primarily of mid-rise to high-rise commercial buildings, and multi-family residential structures.

### **GEOTECHNICAL EXPLORATION**

#### **FIELD EXPLORATION**

The site was explored between September 11, 2018, and September 14, 2018, by excavating 3 exploratory borings. The exploratory borings varied between 70 and 100 feet in depth below the existing site grade. The borings were excavated with the aid of a truck-mounted drilling



machine, equipped with an automatic hammer, and using 8-inch diameter hollowstem augers. The exploration locations are shown on the Plot Plan and the geologic materials encountered are logged on Plates A-1 through A-3.

### **Geologic Materials**

Fill materials underlying the subject site consist of silty clays, which are dark brown in color, moist, medium firm to stiff, fine grained. Fill thickness ranging from 2½ and 5 feet was encountered in the exploratory borings.

The upper native soils to an approximate depth of 40 feet below the existing site grade consist of the Lakewood Formation, comprising primarily of sandy to silty clays, with occasional layers of silty sands. The silty clay layers within the upper 40 feet of the site are highly plastic with high moisture content, and are compressive under high loads. The native soils below a depth of 40 feet consist of the San Pedro Formation, comprising primarily of dense and very dense silty sands and sands with occasional layers of stiff sandy clays.

Bedrock consisting of shale and siltstone of the Fernando Formation was encountered at a depth of 92½ feet below the existing site grade in Boring Number 1. The rock is moderately to well bedded, light gray to gray, moist, moderately hard to hard. More detailed soil profiles may be obtained from individual boring logs.

### **Groundwater**

Groundwater was encountered between 25½ and 28½ feet below the existing site grade during exploration. The historic highest groundwater level was established by review of California Geological Survey Seismic Hazard Zone Report of the Hollywood Quadrangle (SHZR 026), Plate 1.2 entitled “Historically Highest Ground Water Contours”. Review of this plate indicates that the historically highest groundwater level is on the order of 10 feet below ground surface.



Fluctuations in the level of groundwater may occur due to variations in rainfall, temperature, and other factors not evident at the time of the measurements reported herein. Fluctuations also may occur across the site. High groundwater levels can result in changed conditions.

### **Caving**

Caving could not be directly observed during exploration due to the type of excavation equipment utilized. Based on the experience of this firm, large diameter excavations, excavations that encounter granular, cohesionless soils and excavations below the groundwater table will most likely experience caving.

## **SEISMIC EVALUATION**

### **REGIONAL GEOLOGIC SETTING**

The subject property is located in the northern portion of the Peninsular Ranges Geomorphic Province. The Peninsular Ranges are characterized by northwest-trending blocks of mountain ridges and sediment-floored valleys. The dominant geologic structural features are northwest trending fault zones that either die out to the northwest or terminate at east-trending reverse faults that form the southern margin of the Transverse Ranges.

### **REGIONAL FAULTING**

Based on criteria established by the California Division of Mines and Geology (CDMG) now called California Geologic Survey (CGS), faults may be categorized as active, potentially active, or inactive. Active faults are those which show evidence of surface displacement within the last 11,000 years (Holocene-age). Potentially-active faults are those that show evidence of most recent surface displacement within the last 1.6 million years (Quaternary-age). Faults showing no evidence of surface displacement within the last 1.6 million years are considered inactive for most purposes, with the exception of design of some critical structures.



Buried thrust faults are faults without a surface expression but are a significant source of seismic activity. They are typically broadly defined based on the analysis of seismic wave recordings of hundreds of small and large earthquakes in the southern California area. Due to the buried nature of these thrust faults, their existence is usually not known until they produce an earthquake. The risk for surface rupture potential of these buried thrust faults is inferred to be low (Leighton, 1990). However, the seismic risk of these buried structures in terms of recurrence and maximum potential magnitude is not well established. Therefore, the potential for surface rupture on these surface-verging splays at magnitudes higher than 6.0 cannot be precluded.

## **SEISMIC HAZARDS AND DESIGN CONSIDERATIONS**

The primary geologic hazard at the site is moderate to strong ground motion (acceleration) caused by an earthquake on any of the local or regional faults. The potential for other earthquake-induced hazards was also evaluated including surface rupture, liquefaction, dynamic settlement, inundation and landsliding.

### **Surface Rupture**

In 1972, the Alquist-Priolo Special Studies Zones Act (now known as the Alquist-Priolo Earthquake Fault Zoning Act) was passed into law. The Act defines “active” and “potentially active” faults utilizing the same aging criteria as that used by California Geological Survey (CGS). However, established state policy has been to zone only those faults which have direct evidence of movement within the last 11,000 years. It is this recency of fault movement that the CGS considers as a characteristic for faults that have a relatively high potential for ground rupture in the future.

CGS policy is to delineate a boundary from 200 to 500 feet wide on each side of the known fault trace based on the location precision, the complexity, or the regional significance of the fault. If



a site lies within an Earthquake Fault Zone, a geologic fault rupture investigation must be performed that demonstrates that the proposed building site is not threatened by surface displacement from the fault before development permits may be issued.

Ground rupture is defined as surface displacement which occurs along the surface trace of the causative fault during an earthquake. Based on research of available literature, no known active faults or potentially active faults underlie the subject site. In addition, the subject site is not located within an Alquist-Priolo Earthquake Fault Zone. Based on these considerations, the potential for surface ground rupture at the subject site is considered low.

### **Liquefaction**

Liquefaction is a phenomenon in which saturated silty to cohesionless soils below the groundwater table are subject to a temporary loss of strength due to the buildup of excess pore pressure during cyclic loading conditions such as those induced by an earthquake. Liquefaction-related effects include loss of bearing strength, amplified ground oscillations, lateral spreading, and flow failures.

The Seismic Hazards Maps of the State of California (CDMG, 1999), does not classify the site as part of the potentially “Liquefiable” area. This determination is based on groundwater depth records, soil type and distance to a fault capable of producing a substantial earthquake.

The proposed subterranean levels and foundation elements will extend between 51 and 57 feet below the existing site grade. Based on the dense nature of the underlying Older Alluvial soils and bedrock below the proposed structure, the potential for liquefaction occurring at the site is considered to be remote.



### **Dynamic Dry Settlement**

Seismically-induced settlement or compaction of dry or moist, cohesionless soils can be an effect related to earthquake ground motion. Such settlements are typically most damaging when the settlements are differential in nature across the length of structures.

Some seismically-induced settlement of the proposed structures should be expected as a result of strong ground-shaking, however, due to the uniform nature of the underlying geologic materials, excessive differential settlements are not expected to occur.

### **Tsunamis, Seiches and Flooding**

Tsunamis are large ocean waves generated by sudden water displacement caused by a submarine earthquake, landslide, or volcanic eruption. Review of the County of Los Angeles Flood and Inundation Hazards Map, Leighton (1990), indicates the site does not lie within the mapped tsunami inundation boundaries.

Seiches are oscillations generated in enclosed bodies of water which can be caused by ground shaking associated with an earthquake. No major water-retaining structures are located immediately up gradient from the project site. Therefore, the risk of flooding from a seismically-induced seiche is considered to be remote.

According to the County of Los Angeles General Plan, the site is within the potential inundation boundary of Hollywood Reservoir. A determination of whether a higher site elevation would remove the site from the potential inundation zones is beyond the scope of this investigation.



## **Landsliding**

The probability of seismically-induced landslides occurring on the site is considered to be low due to the general lack of elevation difference slope geometry across or adjacent to the site.

## **CONCLUSIONS AND RECOMMENDATIONS**

Based upon the exploration, laboratory testing, and research, it is the finding of Geotechnologies, Inc. that construction of the proposed mixed-use development is considered feasible from a geotechnical engineering standpoint provided the advice and recommendations presented herein are followed and implemented during construction.

Between 2½ and 5 feet of existing fill materials was encountered during exploration at the site. Due to the variable nature and the varying depths of the existing fill materials, the existing fill materials are considered to be unsuitable for support of the proposed foundations, floor slabs, or additional fill. The proposed development will be constructed over 3 subterranean levels, extending on the order of 51 to 57 feet below the existing site grade when considering the proposed mat foundation. Excavation of the proposed subterranean levels will remove the existing fill materials and expose the underlying dense San Pedro Formation. The proposed structure may be supported on a mat foundation bearing in the dense San Pedro Formation, comprising primarily of dense and very dense silty sands and sands with occasional layers of stiff sandy clays.

Excavation of the proposed subterranean level will require shoring and dewatering measures to provide a stable and dry excavation due to the depth of the excavation, the presence of groundwater, and the proximity of adjacent structures.

The validity of the conclusions and design recommendations presented herein is dependent upon review of the geotechnical aspects of the proposed construction by this firm. The subsurface



conditions described herein have been projected from borings on the site as indicated and should in no way be construed to reflect any variations which may occur between these borings or which may result from changes in subsurface conditions. Any changes in the design or location of any structure, as outlined in this report, should be reviewed by this office. The recommendations contained herein should not be considered valid until reviewed and modified or reaffirmed subsequent to such review.

## **SEISMIC DESIGN CONSIDERATIONS**

### **Shearwave Velocity Measurements**

Geophysical measurements were performed at the site by GeoPentech to access the site characterization for ground motion analyses. Both Refraction Microtremor (ReMi) and Multi-Channel Analysis of Surface Waves (MASW) geophysical surveys were performed to collect the shear-wave velocity of subsurface material. The measurements were made from the existing ground surface. The resulting shearwave velocities ( $V_{S30}$ ) are provided in the following table.

| <b>Depth Range (feet)</b> | <b>Average Shearwave Velocity (ft/sec)</b> |
|---------------------------|--------------------------------------------|
| 0-100                     | 1,039                                      |
| 10-110                    | 1,140                                      |
| 20-120                    | 1,218                                      |
| 30-130                    | 1,316                                      |
| 40-140                    | 1,420                                      |

### **2016 California Building Code Seismic Parameters**

Based on information derived from the subsurface investigation, the site soils within the upper 100 feet of the ground surface may be classified as Site Class D, which corresponds to a “Stiff Soil” Profile, according to Table 20.3-1 of ASCE 7-10. This information and the site coordinates were input into the ASCE 7 Hazard Tool to calculate the ground motions for the site.



| <b>2016 CALIFORNIA BUILDING CODE SEISMIC PARAMETERS</b>                                      |        |
|----------------------------------------------------------------------------------------------|--------|
| Site Class                                                                                   | D      |
| Mapped Spectral Acceleration at Short Periods ( $S_s$ )                                      | 2.054g |
| Site Coefficient ( $F_a$ )                                                                   | 1.0    |
| Maximum Considered Earthquake Spectral Response for Short Periods ( $S_{MS}$ )               | 2.054g |
| Five-Percent Damped Design Spectral Response Acceleration at Short Periods ( $S_{DS}$ )      | 1.369g |
| Mapped Spectral Acceleration at One-Second Period ( $S_1$ )                                  | 0.793g |
| Site Coefficient ( $F_v$ )                                                                   | 1.5    |
| Maximum Considered Earthquake Spectral Response for One-Second Period ( $S_{M1}$ )           | 1.189g |
| Five-Percent Damped Design Spectral Response Acceleration for One-Second Period ( $S_{D1}$ ) | 0.793g |

It should be noted that the tower project will be designed using the Performance-Based Design method. A separate ground motion report will be prepared and will be reviewed by the Peer Review Panel, in accordance with the requirements of the Los Angeles Tall Building Structural Design Council (LATBSDC). The values presented above are the code based values, and will be superseded by the site specific values to be presented in the Ground Motion Report for the design of the tower.

### **FILL SOILS**

The maximum depth of fill encountered on the site was 5 feet. This material and any fill generated during demolition should be removed during the excavation of the subterranean levels and wasted from the site.



## **EXPANSIVE SOILS**

The geologic materials encountered within the upper 5 feet of the project site are in the high expansion range. The Expansion Index was found to be between 118 and 124 for bulk samples remolded to 90 percent of the laboratory maximum density. Recommended reinforcing is noted in the "Miscellaneous Foundations" section of this report.

## **DEWATERING**

Groundwater was encountered between 25½ and 28½ feet below the existing site grade during exploration. The historic highest groundwater level was established by review of California Geological Survey Seismic Hazard Zone Report of the Hollywood Quadrangle (SHZR 026), Plate 1.2 entitled "Historically Highest Ground Water Contours". Review of this plate indicates that the historically highest groundwater level is on the order of 10 feet below ground surface.

Since the subterranean levels will extend below the historically highest groundwater level, the Building Official will require that the building be designed for potential hydrostatic and buoyancy pressures unless a permanent dewatering drainage system is installed below the base of the structure.

Based on discussion with the project design team, it is recommended that the proposed structure be structurally designed for the hydrostatic pressure. The proposed subterranean walls shall be designed for full hydrostatic pressure based on the existing ground surface, so that the wall subdrain system may be eliminated. In addition, the proposed mat foundation shall be designed for uplift pressure based on the he historically highest groundwater level.



## **METHANE ZONES**

Based on review of the Navigate LA (<http://navigatela.lacity.org/NavigateLA/>) website, maintained by the City of Los Angeles, the subject property is located within a Methane Zone as designated by the City. A qualified methane consultant should be retained to consider the requirements and implications of the City's Methane Zone designation. A copy of the portion of the map covering the Project Site is included herein.

## **GRADING GUIDELINES**

The following grading guidelines may be utilized for any miscellaneous site grading which may be required as part of the proposed development.

### **Site Preparation**

- A thorough search should be made for possible underground utilities and/or structures. Any existing or abandoned utilities or structures located within the footprint of the proposed grading should be removed or relocated as appropriate.
- All vegetation, existing fill, and soft or disturbed geologic materials should be removed from the areas to receive controlled fill. All existing fill materials and any disturbed geologic materials resulting from grading operations shall be completely removed and properly recompacted prior to foundation excavation.
- Any vegetation or associated root system located within the footprint of the proposed structures should be removed during grading.
- Subsequent to the indicated removals, the exposed grade shall be scarified to a depth of six inches, moistened to optimum moisture content, and recompacted in excess of the minimum required comparative density.
- The excavated areas shall be observed by the geotechnical engineer prior to placing compacted fill.



### **Compaction**

The City of Los Angeles Department of Building and Safety requires a minimum 90 percent of the maximum density, except for cohesionless soils having less than 15 percent finer than 0.005 millimeters, which shall be compacted to a minimum 95 percent of the maximum density in accordance with the most recent revision of the Los Angeles Building Code. Based on the laboratory test results performed by this firm, the granular soils encountered at the site would require the 95 percent compaction requirement.

All fill should be mechanically compacted in layers not more than 8 inches thick. All fill shall be compacted to at least 90 percent (or 95 percent for cohesionless soils having less than 15 percent finer than 0.005 millimeters) of the maximum laboratory density for the materials used. The maximum density shall be determined by the laboratory operated by Geotechnologies, Inc. using the test method described in the most recent revision of ASTM D 1557.

Field observation and testing shall be performed by a representative of the geotechnical engineer during grading to assist the contractor in obtaining the required degree of compaction and the proper moisture content. Where compaction is less than required, additional compactive effort shall be made with adjustment of the moisture content, as necessary, until a minimum of 90 percent (or 95 percent for cohesionless soils having less than 15 percent finer than 0.005 millimeters) compaction is obtained.

### **Acceptable Materials**

The excavated onsite materials are considered satisfactory for reuse in the controlled fills as long as any debris and/or organic matter is removed. Any imported materials shall be observed and tested by the representative of the geotechnical engineer prior to use in fill areas. Imported materials should contain sufficient fines so as to be relatively impermeable and result in a stable subgrade when compacted. Any required import materials should consist of geologic materials



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with an expansion index of less than 50. The water-soluble sulfate content of the import materials should be less than 0.1% percentage by weight.

Imported materials should be free from chemical or organic substances which could affect the proposed development. A competent professional should be retained in order to test imported materials and address environmental issues and organic substances which might affect the proposed development.

### **Utility Trench Backfill**

Utility trenches should be backfilled with controlled fill. The utility should be bedded with clean sands at least one foot over the crown. The remainder of the backfill may be onsite soil compacted to 90 percent (or 95 percent for cohesionless soils having less than 15 percent finer than 0.005 millimeters) of the laboratory maximum density. Utility trench backfill should be tested by representatives of this firm in accordance with the most recent revision of ASTM D-1557.

### **Wet Soils**

At the time of exploration, the soils which will be exposed at the bottom of the excavation were above optimum moisture content. It is anticipated that the excavated material to be placed as compacted fill, and the materials exposed at the bottom of excavated plane may require significant drying and aeration prior to recompaction.

Pumping (yielding or vertical deflection) of the high-moisture content soils at the bottom of the excavation may occur during operation of heavy equipment. Where pumping is encountered, angular minimum 1-inch gravel should be placed and worked into the subgrade. The exact thickness of the gravel would be a trial and error procedure, and would be determined in the field. It would likely be on the order of 1 to 2 feet thick.



The gravel will help to densify the subgrade as well as function as a stabilization material upon which heavy equipment may operate. It is not recommended that rubber tire construction equipment attempt to operate directly on the pumping subgrade soils prior to placing the gravel. Direct operation of rubber tire equipment on the soft subgrade soils will likely result in excessive disturbance to the soils, which in turn will result in a delay to the construction schedule since those disturbed soils would then have to be removed and properly recompacted. Extreme care should be utilized to place gravel as the subgrade becomes exposed.

### **Shrinkage**

Shrinkage results when a volume of soil removed at one density is compacted to a higher density. A shrinkage factor between 5 and 15 percent should be anticipated when excavating and recompacting the existing fill and underlying native geologic materials on the site to an average comparative compaction of 92 percent.

### **Weather Related Grading Considerations**

When rain is forecast all fill that has been spread and awaits compaction shall be properly compacted prior to stopping work for the day or prior to stopping due to inclement weather. These fills, once compacted, shall have the surface sloped to drain to an area where water can be removed.

Temporary drainage devices should be installed to collect and transfer excess water to the street in non-erosive drainage devices. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. Drainage should not be allowed to flow uncontrolled over any descending slope.



Work may start again, after a period of rainfall, once the site has been reviewed by a representative of this office. Any soils saturated by the rain shall be removed and aerated so that the moisture content will fall within three percent of the optimum moisture content.

Surface materials previously compacted before the rain shall be scarified, brought to the proper moisture content and recompact prior to placing additional fill, if considered necessary by a representative of this firm.

### **Geotechnical Observations and Testing During Grading**

Geotechnical observations and testing during grading are considered to be a continuation of the geotechnical investigation. It is critical that the geotechnical aspects of the project be reviewed by representatives of Geotechnologies, Inc. during the construction process. Compliance with the design concepts, specifications or recommendations during construction requires review by this firm during the course of construction. Any fill which is placed should be observed, tested, and verified if used for engineered purposes. Please advise this office at least twenty-four hours prior to any required site visit.

### **FOUNDATION DESIGN**

It is recommended that the proposed structure be supported on a mat foundation bearing in the underlying dense San Pedro Formation, encountered at or below a depth of 40 feet below the existing ground surface. The San Pedro Formation comprises primarily of dense and very dense silty sands and sands with occasional layers of stiff sandy clays. In addition to the structural loading, the proposed mat foundation system shall be designed to resist the potential hydrostatic uplift pressure based on the historically highest groundwater level.



## **Mat Foundation**

The proposed development will be supported on a mat foundation. Preliminary loading provided by the project structural engineer, Englekirk, indicate that the average bearing pressure will be between 1,800 and 3,300 pounds per square foot below the portion of mat foundation supporting the podium structure, and an average bearing pressure of 9,300 pounds per square foot below the tower structure. The mat foundation is anticipated to vary between 7 to 12 feet in thickness. Foundation bearing pressure will vary across the mat footings, with the highest concentrated loads located at the central cores of the mat foundations.

Given the size of the proposed mat foundation, the average bearing pressure of 9,300 pounds per square foot is well below the allowable bearing pressures, with factor of safety well exceeding 3. For design purposes, an average bearing pressure of 10,000 pounds per square foot, with locally higher pressures up to 15,000 pounds per square foot may be utilized in the mat foundation design. The mat foundation may be designed utilizing a modulus of subgrade reaction of 250 pounds per cubic inch. This value is a unit value for use with a one-foot square footing. The modulus should be reduced in accordance with the following equation when used with larger foundations.

$$K = K_1 * [(B + 1) / (2 * B)]^2$$

where

K = Reduced Subgrade Modulus

K<sub>1</sub> = Unit Subgrade Modulus

B = Foundation Width (feet)

The bearing values indicated above are for the total of dead and frequently applied live loads, and may be increased by one third for short duration loading, which includes the effects of wind or seismic forces. Since the recommended bearing value is a net value, the weight of concrete in the foundations may be taken as 25 pounds per cubic foot and the weight of the soil backfill may be neglected when determining the downward load on the foundations.



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In addition to the structural loading, the proposed mat foundation system shall be designed to resist the potential hydrostatic uplift pressure based on the historically highest groundwater level. The uplift pressure acting against the bottom of the mat foundation would be equivalent to  $62.4(H)$  psf, where H is the depth measured from the bottom of the mat foundation from the historically highest groundwater level in feet.

### **Lateral Design**

Resistance to lateral loading may be provided by friction acting at the base of foundations and by passive earth pressure. An allowable coefficient of friction of 0.30 may be used with the dead load forces.

Passive earth pressure for the sides of foundations poured against undisturbed or recompacted soil may be computed as an equivalent fluid having a density of 200 pounds per cubic foot with a maximum earth pressure of 2,000 pounds per square foot. The passive earth pressure and the allowable coefficient of friction were determined based on a minimum safety factor of two, and without the reliance on the cohesion strength component. When combining passive and friction for lateral resistance, the passive component should be reduced by one third. A one-third increase in the passive value may be used for wind or seismic loads.

### **Foundation Settlement**

The majority of the foundation settlement is expected to occur on initial application of loading. It is anticipated that total settlement on the order of  $2\frac{1}{2}$  to  $3\frac{1}{2}$  inches will occur below the more heavily loaded central core portion of the mat foundation beneath the tower. Settlement on the perimeter edges of the mat foundation below the podium structure is expected to be between  $\frac{1}{4}$  to  $\frac{1}{2}$  inch.



### **Miscellaneous Foundations**

Foundations for small miscellaneous outlying structures, such as property line fence walls, planters, exterior canopies, and trash enclosures, which will not be tied-in to the proposed structure, may be supported on conventional foundations bearing in properly compacted fill and/or the native soils. Wall footings may be designed for a bearing value of 1,500 pounds per square foot, and should be a minimum of 12 inches in width, 24 inches in depth below the lowest adjacent grade and 24 inches into the recommended bearing material. No bearing value increases are recommended. All continuous foundations should be reinforced with a minimum of four #4 steel bars. Two should be placed near the top of the foundation, and two should be placed near the bottom.

Since the recommended bearing capacity is a net value, the weight of concrete in the foundations may be taken as 25 pounds per cubic foot and the weight of the soil backfill may be neglected when determining the downward load on the foundations.

### **Foundation Observations**

It is critical that all foundation excavations are observed by a representative of this firm to verify penetration into the recommended bearing materials. The observation should be performed prior to the placement of reinforcement. Foundations should be deepened to extend into satisfactory geologic materials, if necessary. Foundation excavations should be cleaned of all loose soils prior to placing steel and concrete. Any required foundation backfill should be mechanically compacted, flooding is not permitted.

### **RETAINING WALL DESIGN**

It is recommended that the proposed subterranean walls be designed for full hydrostatic pressure based on the existing ground surface due to presence of the presence of tar, methane, and the



historically highest groundwater level. As a result of the hydrostatic design, the subdrains behind the basement walls may be eliminated.

Cantilever retaining walls supporting a level backslope may be designed utilizing a triangular distribution of active earth pressure. Restrained retaining walls may be designed utilizing a triangular distribution of at-rest earth pressure. Retaining walls may be designed utilizing the following table:

| <b>Height of Retaining Wall (feet)</b> | <b>Cantilever Retaining Wall Triangular Distribution of Active Earth Pressure including Hydrostatic Pressure (pcf)</b> | <b>Restrained Retaining Wall Triangular Distribution of At-Rest Earth Pressure including Hydrostatic Pressure (pcf)</b> |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| 45 feet                                | 80 pcf                                                                                                                 | 100 pcf                                                                                                                 |

Additional active pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent structures.

In addition to the recommended earth pressure, the upper ten feet of the retaining wall adjacent to streets, driveways or parking areas should be designed to resist a uniform lateral pressure of 100 pounds per square foot, acting as a result of an assumed 300 pounds per square foot surcharge behind the walls due to normal street traffic. If the traffic is kept back at least ten feet from the retaining walls, the traffic surcharge may be neglected.

### **Dynamic (Seismic) Earth Pressure**

Retaining walls exceeding 6 feet in height shall be designed to resist the additional earth pressure caused by seismic ground shaking. A triangular pressure distribution should be utilized for the additional seismic loads, with an equivalent fluid pressure of 22 pounds per cubic foot. When using the code loading combination equations, the seismic earth pressure should be combined with the lateral active earth pressure for analyses of restrained basement walls under seismic loading condition.



### **Surcharge from Adjacent Structures**

As indicated herein, additional active pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent structures for retaining walls and shoring design.

The following surcharge equation provided in the LADBS Information Bulletin Document No. P/BC 2008-83, may be utilized to determine the surcharge loads on basement walls and shoring system for existing structures located within the 1:1 (h:v) surcharge influence zone of the excavation and basement.

Resultant lateral force: 
$$R = (0.3 * P * h^2) / (x^2 + h^2)$$

Location of lateral resultant: 
$$d = x * [(x^2 / h^2 + 1) * \tan^{-1}(h/x) - (x/h)]$$

where:

|                  |   |                                                                                                                          |
|------------------|---|--------------------------------------------------------------------------------------------------------------------------|
| R                | = | resultant lateral force measured in pounds per foot of wall width.                                                       |
| P                | = | resultant surcharge loads of continuous or isolated footings measured in pounds per foot of length parallel to the wall. |
| x                | = | distance of resultant load from back face of wall measured in feet.                                                      |
| h                | = | depth below point of application of surcharge loading to top of wall footing measured in feet.                           |
| d                | = | depth of lateral resultant below point of application of surcharge loading measure in feet.                              |
| $\tan^{-1}(h/x)$ | = | the angle in radians whose tangent is equal to h/x.                                                                      |

The structural engineer and shoring engineer may use this equation to determine the surcharge loads based on the loading of the adjacent structures located within the surcharge influence zone.

### **Waterproofing**

Moisture effecting retaining walls is one of the most common post-construction complaints. Poorly applied or omitted waterproofing can lead to efflorescence or standing water inside the building. Efflorescence is a process in which a powdery substance is produced on the surface of the concrete by the evaporation of water. The white powder usually consists of soluble salts



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such as gypsum, calcite, or common salt. Efflorescence is common to retaining walls and does not affect their strength or integrity.

It is recommended that retaining walls be waterproofed. Waterproofing design and inspection of its installation is not the responsibility of the geotechnical engineer. A waterproofing consultant should be retained in order to recommend a product or method which would provide protection to below grade walls.

### **Retaining Wall Backfill**

Any required backfill should be mechanically compacted in layers not more than 8 inches thick, to at least 90 percent of the maximum density obtainable by the ASTM D 1557. Flooding should not be permitted. Proper compaction of the backfill will be necessary to reduce settlement of overlying walks and paving. Some settlement of required backfill should be anticipated, and any utilities supported therein should be designed to accept differential settlement, particularly at the points of entry to the structure.

### **TEMPORARY EXCAVATIONS**

It is anticipated that excavations on the order of 51 to 57 feet in vertical height will be required for the proposed subterranean levels and foundation elements. The excavations are expected to expose fill and dense native soils, which are suitable for vertical excavations up to 5 feet where not surcharged by adjacent traffic or structures. Excavations which will be surcharged by adjacent traffic, public way, properties, or structures should be shored.

Where sufficient space is available, temporary unsurcharged embankments could be sloped back without shoring. Excavations over 5 feet in height should may be excavated at a uniform 1:1 (h:v) slope gradient in its entirety to a maximum height of 20 feet. A uniform sloped excavation does not have a vertical component.



Where sloped embankments are utilized, the tops of the slopes should be barricaded to prevent vehicles and storage loads within seven feet of the tops of the slopes. If the temporary construction embankments are to be maintained during the rainy season, berms are suggested along the tops of the slopes where necessary to prevent runoff water from entering the excavation and eroding the slope faces. The soils exposed in the cut slopes should be inspected during excavation by personnel from this office so that modifications of the slopes can be made if variations in the soil conditions occur.

It is critical that the soils exposed in the cut slopes are observed by a representative of this office during excavation so that modifications of the slopes can be made if variations in the earth material conditions occur. All excavations should be stabilized within 30 days of initial excavation. Water should not be allowed to pond on top of the excavation or to flow towards it.

### **Temporary Dewatering**

The proposed subterranean levels and foundation elements will extend up to a depth of 57 feet below existing site grades. Groundwater was encountered between 25½ and 28½ feet below the existing site grade during exploration. Therefore, it is anticipated that temporary dewatering consisting of wells or well-points and sump pumps will be required to lower the groundwater table prior to excavation of the subterranean level. The collected water should be pumped to an acceptable disposal area. The expected number and depths of well-points, expected flow rates, expected pre-pumping time frames, and treatment of groundwater should be determined during a dewatering test program conducted by a qualified dewatering consultant.

Once the temporary construction dewatering is discontinued, the water table will likely return to its current elevation. The hydrostatic forces on walls and foundations shall be mitigated by the structural design, since the historically highest groundwater level is higher than the proposed bottom of structure. Where the exposed subgrade is wet pumping may be encountered. Under these conditions please refer to the “Wet Soils” section of this report.



### **Excavation Observations**

It is critical that the soils exposed in the cut slopes are observed by a representative of Geotechnologies, Inc. during excavation so that modifications of the slopes can be made if variations in the geologic material conditions occur. Many building officials require that temporary excavations should be made during the continuous observations of the geotechnical engineer. All excavations should be stabilized within 30 days of initial excavation.

### **SHORING DESIGN**

The following information on the design and installation of the shoring is as complete as possible at this time. It is suggested that a review of the final shoring plans and specifications be made by this office prior to bidding or negotiating with a shoring contractor be made.

One method of shoring would consist of steel soldier piles, placed in drilled holes and backfilled with concrete. The soldier piles may be designed as cantilevers or laterally braced utilizing drilled tie-back anchors or raker braces.

### **Soldier Piles**

Drilled cast-in-place soldier piles should be placed no closer than 2 diameters on center. The minimum diameter of the piles is 18 inches. Structural concrete should be used for the soldier piles below the excavation; lean-mix concrete may be employed above that level. As an alternative, lean-mix concrete may be used throughout the pile where the reinforcing consists of a wideflange section. The slurry must be of sufficient strength to impart the lateral bearing pressure developed by the wideflange section to the earth materials. For design purposes, an allowable passive value for the earth materials below the bottom plane of excavation may be assumed to be 500 pounds per square foot per foot. To develop the full lateral value, provisions should be implemented to assure firm contact between the soldier piles and the undisturbed earth materials.



The frictional resistance between the soldier piles and retained earth material may be used to resist the vertical component of the anchor load. The coefficient of friction may be taken as 0.35 based on uniform contact between the steel beam and lean-mix concrete and retained earth. The portion of soldier piles below the plane of excavation may also be employed to resist the downward loads. The downward capacity may be determined using a frictional resistance of 450 pounds per square foot. The minimum depth of embedment for shoring piles is 5 feet below the bottom of the footing excavation, or 7 feet below the bottom of excavated plane, whichever is deeper.

Casing may be required should caving be experienced in the saturated earth materials. If casing is used, extreme care should be employed so that the pile is not pulled apart as the casing is withdrawn. At no time should the distance between the surface of the concrete and the bottom of the casing be less than 5 feet.

Piles placed below the water level will require the use of a tremie to place the concrete into the bottom of the hole. A tremie shall consist of a water-tight tube having a diameter of not less than 10 inches with a hopper at the top. The tube shall be equipped with a device that will close the discharge end and prevent water from entering the tube while it is being charged with concrete. The tremie shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of the work to prevent water entering the tube and shall be entirely sealed at all times, except when the concrete is being placed. The tremie tube shall be kept full of concrete. The flow shall be continuous until the work is completed and the resulting concrete seal shall be monolithic and homogeneous. The tip of the tremie tube shall always be kept about five feet below the surface of the concrete and definite steps and safeguards should be taken to insure that the tip of the tremie tube is never raised above the surface of the concrete.



A special concrete mix should be used for concrete to be placed below water. The design shall provide for concrete with a strength of 1,000 psi over the initial job specification. An admixture that reduces the problem of segregation of paste/aggregates and dilution of paste shall be included. The slump shall be commensurate to any research report for the admixture, provided that it shall also be the minimum for a reasonable consistency for placing when water is present.

### **Lagging**

Soldier piles and anchors should be designed for the full anticipated pressures. Due to the cohesionless nature of the underlying earth materials, lagging will be required throughout the entire depth of the excavation. Due to arching in the geologic materials, the pressure on the lagging will be less. It is recommended that the lagging should be designed for the full design pressure but be limited to a maximum of 400 pounds per square foot. It is recommended that a representative of this firm observe the installation of lagging to insure uniform support of the excavated embankment.

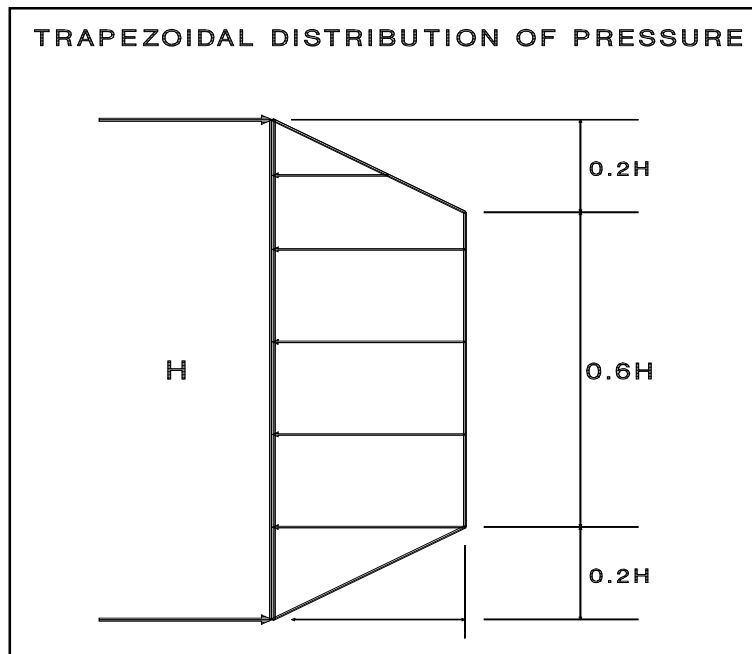
### **Lateral Pressures**

A triangular distribution of lateral earth pressure should be utilized for the design of cantilevered shoring system. A trapezoidal distribution of lateral earth pressure would be appropriate where shoring is to be restrained at the top by bracing or tie backs. The design of trapezoidal distribution of pressure is shown in the diagram below. Equivalent fluid pressures for the design of cantilevered and restrained shoring are presented in the following table:

| Height of Shoring<br>(feet) | Cantilever Shoring System<br>Equivalent Fluid Pressure (pcf)<br>Triangular Distribution of Pressure | Restrained Shoring System<br>Lateral Earth Pressure (psf)*<br>Trapezoidal Distribution of Pressure |
|-----------------------------|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Up to 57 feet               | 50 pcf                                                                                              | 32H psf                                                                                            |

\*Where H is the height of the shoring in feet.





Where a combination of sloped embankment and shoring is utilized, the pressure will be greater and must be determined for each combination. Additional active pressures should be applied where the shoring will be surcharged by adjacent traffic or structures.

The upper ten feet of the retaining wall adjacent to streets, driveways or parking areas should be designed to resist a uniform lateral pressure of 100 pounds per square foot, acting as a result of an assumed 300 pounds per square foot surcharge behind the walls due to normal street traffic. If the traffic is kept back at least ten feet from the retaining walls, the traffic surcharge may be neglected. Foundations may be designed using the allowable bearing capacities, friction, and passive earth pressure found in the "Foundation Design" section above.

### **Tied-Back Anchors**

Tied-back anchors may be used to resist lateral loads. Friction anchors are recommended. For design purposes, it may be assumed that the active wedge adjacent to the shoring is defined by a



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plane drawn 35 degrees with the vertical through the bottom plane of the excavation. Friction anchors should extend a minimum of 20 feet beyond the potentially active wedge.

Drilled friction anchors may be designed for a skin friction of 300 pounds per square foot. Pressure grouted anchor may be designed for a skin friction of 2,000 pounds per square foot. Where belled anchors are utilized, the capacity of belled anchors may be designed by assuming the diameter of the bonded zone is equivalent to the diameter of the bell. Only the frictional resistance developed beyond the active wedge would be effective in resisting lateral loads.

It is recommended that at least 3 of the initial anchors have their capacities tested to 200 percent of their design capacities for a 24-hour period to verify their design capacity. The total deflection during this test should not exceed 12 inches. The anchor deflection should not exceed 0.75 inches during the 24 hour period, measured after the 200 percent load has been applied.

All anchors should be tested to at least 150 percent of design load. The total deflection during this test should not exceed 12 inches. The rate of creep under the 150 percent test load should not exceed 0.1 inch over a 15 minute period in order for the anchor to be approved for the design loading.

After a satisfactory test, each anchor should be locked-off at the design load. This should be verified by rechecking the load in the anchor. The load should be within 10 percent of the design load. Where satisfactory tests are not attained, the anchor diameter and/or length should be increased or additional anchors installed until satisfactory test results are obtained. The installation and testing of the anchors should be observed by the geotechnical engineer. Minor caving during drilling of the anchors should be anticipated.



### **Anchor Installation**

Tied-back anchors may be installed between 20 and 40 degrees below the horizontal. Caving of the anchor shafts, particularly within sand deposits, should be anticipated and the following provisions should be implemented in order to minimize such caving. The anchor shafts should be filled with concrete by pumping from the tip out, and the concrete should extend from the tip of the anchor to the active wedge. In order to minimize the chances of caving, it is recommended that the portion of the anchor shaft within the active wedge be backfilled with sand before testing the anchor. This portion of the shaft should be filled tightly and flush with the face of the excavation. The sand backfill should be placed by pumping; the sand may contain a small amount of cement to facilitate pumping.

### **Deflection**

It is difficult to accurately predict the amount of deflection of a shored embankment. It should be realized that some deflection will occur. It is estimated that the deflection could be on the order of one inch at the top of the shored embankment. If greater deflection occurs during construction, additional bracing may be necessary to minimize settlement of adjacent buildings and utilities in adjacent street and alleys. If desired to reduce the deflection, a greater active pressure could be used in the shoring design. Where internal bracing is used, the rakers should be tightly wedged to minimize deflection. The proper installation of the raker braces and the wedging will be critical to the performance of the shoring.

The City of Los Angeles Department of Building and Safety requires limiting shoring deflection to  $\frac{1}{2}$  inch at the top of the shored embankment where a structure is within a 1:1 plane projected up from the base of the excavation. A maximum deflection of 1-inch has been allowed provided there are no structures within a 1:1 plane drawn upward from the base of the excavation.



## **Monitoring**

Because of the depth of the excavation, some mean of monitoring the performance of the shoring system is suggested. The monitoring should consist of periodic surveying of the lateral and vertical locations of the tops of all soldier piles and the lateral movement along the entire lengths of selected soldier piles. Also, some means of periodically checking the load on selected anchors will be necessary, where applicable.

Some movement of the shored embankments should be anticipated as a result of the relatively deep excavation. It is recommended that photographs of the existing buildings on the adjacent properties be made during construction to record any movements for use in the event of a dispute.

## **Shoring Observations**

It is critical that the installation of shoring is observed by a representative of Geotechnologies, Inc. Many building officials require that shoring installation should be performed during continuous observation of a representative of the geotechnical engineer. The observations insure that the recommendations of the geotechnical report are implemented and so that modifications of the recommendations can be made if variations in the geologic material or groundwater conditions warrant. The observations will allow for a report to be prepared on the installation of shoring for the use of the local building official, where necessary.

## **SLABS ON GRADE**

### **Concrete Slabs-on Grade**

Concrete floor slabs should be a minimum of 5 inches in thickness, and shall be reinforced with a minimum of #4 rebars spaced at 16 inches on center. Slabs-on-grade (where applicable) should



be cast over undisturbed natural geologic materials or properly controlled fill materials. Any geologic materials loosened or over-excavated should be wasted from the site or properly compacted to 90 percent (or 95 percent for cohesionless soils having less than 15 percent finer than 0.005 millimeters) of the maximum dry density.

Outdoor concrete flatwork should be a minimum of 4 inches in thickness, and shall be reinforced with a minimum of #3 rebars spaced at 12 inches on center. Outdoor concrete flatwork should be cast over undisturbed natural geologic materials or properly controlled fill materials. Any geologic materials loosened or over-excavated should be wasted from the site or properly compacted to 90 percent (or 95 percent for cohesionless soils having less than 15 percent finer than 0.005 millimeters) of the maximum dry density.

#### **Design of Slabs That Receive Moisture-Sensitive Floor Coverings**

Geotechnologies, Inc. does not practice in the field of moisture vapor transmission evaluation and mitigation. Therefore it is recommended that a qualified consultant be engaged to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. The qualified consultant should provide recommendations for mitigation of potential adverse impacts of moisture vapor transmission on various components of the structure.

The base of the proposed structure will extend below the historically highest groundwater level, therefore, it is recommended that waterproofing be provided below the proposed foundations and floor slabs.

#### **Concrete Crack Control**

The recommendations presented in this report are intended to reduce the potential for cracking of concrete slabs-on-grade due to settlement. However even where these recommendations have been implemented, foundations, stucco walls and concrete slabs-on-grade may display some



cracking due to minor soil movement and/or concrete shrinkage. The occurrence of concrete cracking may be reduced and/or controlled by limiting the slump of the concrete used, proper concrete placement and curing, and by placement of crack control joints at reasonable intervals, in particular, where re-entrant slab corners occur.

For standard control of concrete cracking, a maximum crack control joint spacing of 10 feet should not be exceeded. Lesser spacing would provide greater crack control. Joints at curves and angle points are recommended. The crack control joints should be installed as soon as practical following concrete placement. Crack control joints should extend a minimum depth of one-fourth the slab thickness. Construction joints should be designed by a structural engineer.

Complete removal of the existing fill soils beneath outdoor flatwork such as walkways or patio areas, is not required, however, due to the rigid nature of concrete, some cracking, a shorter design life and increased maintenance costs should be anticipated. In order to provide uniform support beneath the flatwork it is recommended that a minimum of 12 inches of the exposed subgrade beneath the flatwork be scarified and recompact to 90 percent (or 95 percent for cohesionless soils having less than 15 percent finer than 0.005 millimeters) relative compaction.

## **PAVEMENTS**

Prior to placing paving, the existing grade should be scarified to a depth of 12 inches, moistened as required to obtain optimum moisture content, and recompact to 95 percent of the maximum density as determined by the most recent revision of ASTM D 1557. The client should be aware that removal of all existing fill in the area of new paving is not required, however, pavement constructed in this manner will most likely have a shorter design life and increased maintenance costs. The following pavement sections are recommended:



| Service        | Asphalt Pavement Thickness<br>Inches | Base Course<br>Inches |
|----------------|--------------------------------------|-----------------------|
| Passenger Cars | 3                                    | 4                     |
| Moderate Truck | 4                                    | 6                     |
| Heavy Truck    | 6                                    | 9                     |

A subgrade modulus of 100 pounds per cubic inch may be assumed for design of concrete paving. Concrete paving for passenger cars and moderate truck traffic shall be a minimum of 6 inches in thickness, and shall be underlain by 4 inches of aggregate base. Concrete paving for heavy truck traffic shall be a minimum of 7½ inches in thickness, and shall be underlain by 6 inches of aggregate base. For standard crack control maximum expansion joint spacing of 15 feet should not be exceeded. Lesser spacing would provide greater crack control. Joints at curves and angle points are recommended.

Aggregate base should be compacted to a minimum of 95 percent of the most recent revision of ASTM D 1557 laboratory maximum dry density. Base materials should conform to Sections 200-2.2 or 200-2.4 of the “Standard Specifications for Public Works Construction”, (Green Book), latest edition.

### **SITE DRAINAGE**

Proper surface drainage is critical to the future performance of the project. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change in the designed engineering properties. Proper site drainage should be maintained at all times.

All site drainage should be collected and transferred to the street in non-erosive drainage devices. The proposed structure should be provided with roof drainage. Discharge from downspouts, roof drains and scuppers should not be permitted on unprotected soils within five feet of the building perimeter. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. Drainage should not be allowed to flow uncontrolled



over any descending slope. Planters which are located within a distance equal to the depth of a retaining wall should be sealed to prevent moisture adversely affecting the wall. Planters which are located within five feet of a foundation should be sealed to prevent moisture affecting the earth materials supporting the foundation.

### **STORMWATER DISPOSAL**

The proposed subterranean levels and foundation elements will extend up to a depth of 56 feet below existing site grades. Groundwater was encountered between 25½ and 28½ feet below the existing site grade during exploration. Temporary dewatering shall be installed as necessary. Due to the depth of the proposed subterranean levels and the groundwater level, it is the opinion of this firm that stormwater infiltration will not be feasible for the project.

### **DESIGN REVIEW**

Engineering of the proposed project should not begin until approval of the geotechnical report by the Building Official is obtained in writing. Significant changes in the geotechnical recommendations may result during the building department review process.

It is recommended that the geotechnical aspects of the project be reviewed by this firm during the design process. This review provides assistance to the design team by providing specific recommendations for particular cases, as well as review of the proposed construction to evaluate whether the intent of the recommendations presented herein are satisfied.

### **CONSTRUCTION MONITORING**

Geotechnical observations and testing during construction are considered to be a continuation of the geotechnical investigation. It is critical that this firm review the geotechnical aspects of the project during the construction process. Compliance with the design concepts, specifications or recommendations during construction requires review by this firm during the course of



construction. All foundations should be observed by a representative of this firm prior to placing concrete or steel. Any fill which is placed should be observed, tested, and verified if used for engineered purposes. Please advise Geotechnologies, Inc. at least twenty-four hours prior to any required site visit.

If conditions encountered during construction appear to differ from those disclosed herein, notify Geotechnologies, Inc. immediately so the need for modifications may be considered in a timely manner.

It is the responsibility of the contractor to ensure that all excavations and trenches are properly sloped or shored. All temporary excavations should be cut and maintained in accordance with applicable OSHA rules and regulations.

### **EXCAVATION CHARACTERISTICS**

The exploration performed for this investigation is limited to the geotechnical excavations described. Direct exploration of the entire site would not be economically feasible. The owner, design team and contractor must understand that differing excavation and drilling conditions may be encountered based on boulders, gravel, oversize materials, groundwater and many other conditions. Fill materials, especially when they were placed without benefit of modern grading codes, regularly contain materials which could impede efficient grading and drilling. Southern California sedimentary bedrock is known to contain variable layers which reflect differences in depositional environment. Such layers may include abundant gravel, cobbles and boulders. Similarly bedrock can contain concretions. Concretions are typically lenticular and follow the bedding. They are formed by mineral deposits. Concretions can be very hard. Excavation and drilling in these areas may require full size equipment and coring capability. The contractor should be familiar with the site and the geologic materials in the vicinity.



## **CLOSURE AND LIMITATIONS**

The purpose of this report is to aid in the design and completion of the described project. Implementation of the advice presented in this report is intended to reduce certain risks associated with construction projects. The professional opinions and geotechnical advice contained in this report are sought because of special skill in engineering and geology and were prepared in accordance with generally accepted geotechnical engineering practice. Geotechnologies, Inc. has a duty to exercise the ordinary skill and competence of members of the engineering profession. Those who hire Geotechnologies, Inc. are not justified in expecting infallibility, but can expect reasonable professional care and competence.

The scope of the geotechnical services provided did not include any environmental site assessment for the presence or absence of organic substances, hazardous/toxic materials in the soil, surface water, groundwater, or atmosphere, or the presence of wetlands.

Proper compaction is necessary to reduce settlement of overlying improvements. Some settlement of compacted fill should be anticipated. Any utilities supported therein should be designed to accept differential settlement. Differential settlement should also be considered at the points of entry to the structure.

## **GEOTECHNICAL TESTING**

### **Classification and Sampling**

The soil is continuously logged by a representative of this firm and classified by visual examination in accordance with the Unified Soil Classification system. The field classification is verified in the laboratory, also in accordance with the Unified Soil Classification System. Laboratory classification may include visual examination, Atterberg Limit Tests and grain size distribution. The final classification is shown on the excavation logs.



Samples of the geologic materials encountered in the exploratory excavations were collected and transported to the laboratory. Undisturbed samples of soil are obtained at frequent intervals. Unless noted on the excavation logs as an SPT sample, samples acquired while utilizing a hollow-stem auger drill rig are obtained by driving a thin-walled, California Modified Sampler with successive 30-inch drops of a 140-pound hammer. The soil is retained in brass rings of 2.50 inches outside diameter and 1.00 inch in height. The central portion of the samples are stored in close fitting, waterproof containers for transportation to the laboratory. Samples noted on the excavation logs as SPT samples are obtained in accordance with the most recent revision of ASTM D 1586. Samples are retained for 30 days after the date of the geotechnical report.

### **Moisture and Density Relationships**

The field moisture content and dry unit weight are determined for each of the undisturbed soil samples, and the moisture content is determined for SPT samples by the most recent revision of ASTM D 4959 or ASTM D 4643. This information is useful in providing a gross picture of the soil consistency between exploration locations and any local variations. The dry unit weight is determined in pounds per cubic foot and shown on the "Excavation Logs", A-Plates. The field moisture content is determined as a percentage of the dry unit weight.

### **Direct Shear Testing**

Shear tests are performed by the most recent revision of ASTM D 3080 with a strain controlled, direct shear machine manufactured by Soil Test, Inc. or a Direct Shear Apparatus manufactured by GeoMatic, Inc. The rate of deformation is approximately 0.025 inches per minute. Each sample is sheared under varying confining pressures in order to determine the Mohr-Coulomb shear strength parameters of the cohesion intercept and the angle of internal friction. Samples are generally tested in an artificially saturated condition. Depending upon the sample location and future site conditions, samples may be tested at field moisture content. The results are plotted on the "Shear Test Diagram," B-Plates.



The most recent revision of ASTM 3080 limits the particle size to 10 percent of the diameter of the direct shear test specimen. The sheared sample is inspected by the laboratory technician running the test. The inspection is performed by splitting the sample along the sheared plane and observing the soils exposed on both sides. Where oversize particles are observed in the shear plane, the results are discarded and the test run again with a fresh sample.

### **Consolidation Testing**

Settlement predictions of the soil's behavior under load are made on the basis of the consolidation tests using the most recent revision of ASTM D 2435. The consolidation apparatus is designed to receive a single one-inch high ring. Loads are applied in several increments in a geometric progression, and the resulting deformations are recorded at selected time intervals. Porous stones are placed in contact with the top and bottom of each specimen to permit addition and release of pore fluid. Samples are generally tested at increased moisture content to determine the effects of water on the bearing soil. The normal pressure at which the water is added is noted on the drawing. Results are plotted on the "Consolidation Test," C-Plates.

### **Expansion Index Testing**

The expansion tests performed on the remolded samples are in accordance with the Expansion Index testing procedures, as described in the most recent revision of ASTM D4829. The soil sample is compacted into a metal ring at a saturation degree of 50 percent. The ring sample is then placed in a consolidometer, under a vertical confining pressure of 1 lbf/square inch and inundated with distilled water. The deformation of the specimen is recorded for a period of 24 hour or until the rate of deformation becomes less than 0.0002 inches/hour, whichever occurs first. The expansion index, EI, is determined by dividing the difference between final and initial height of the ring sample by the initial height, and multiplied by 1,000.



### **Laboratory Compaction Characteristics**

The maximum dry unit weight and optimum moisture content of a soil are determined by use of the most recent revision of ASTM D 1557. A soil at a selected moisture content is placed in five layers into a mold of given dimensions, with each layer compacted by 25 blows of a 10 pound hammer dropped from a distance of 18 inches subjecting the soil to a total compactive effort of about 56,000 pounds per cubic foot. The resulting dry unit weight is determined. The procedure is repeated for a sufficient number of moisture contents to establish a relationship between the dry unit weight and the water content of the soil. The data when plotted represent a curvilinear relationship known as the compaction curve. The values of optimum moisture content and modified maximum dry unit weight are determined from the compaction curve.

### **Grain Size Distribution**

These tests cover the quantitative determination of the distribution of particle sizes in soils. Sieve analysis is used to determine the grain size distribution of the soil larger than the Number 200 sieve. The most recent revision of ASTM D 422 is used to determine particle sizes smaller than the Number 200 sieve. A hydrometer is used to determine the distribution of particle sizes by a sedimentation process. The grain size distributions are plotted on the E-Plates presented in the Appendix of this report.



## **REFERENCES**

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2. Bartlett, S.F. and Youd, T.L., 1992, "Empirical Analysis of Horizontal Ground Displacement Generated by Liquefaction-Induced Lateral Spreads," Technical Report NCEER-92-0021, National Center for Earthquake Engineering Research, SUNY-Buffalo, Buffalo, NY.
3. Bartlett, S.F. and Youd, T.L., 1995, "Empirical Prediction of Liquefaction-Induced lateral Spread," Journal of Geotechnical Engineering, Vol. 121, No.4, April.
4. Bowles, Joseph E., 1977, "Foundation Analysis and Design," 2nd Edition, McGraw-Hill, New York.
5. California Division of Mines and Geology, 1997, Seismic Hazard Zone Map, map scale 1:24,000.
6. California Division of Mines and Geology, 1998, Seismic Hazard Evaluation Report for the Hollywood 7.5-Minute Quadrangle, Los Angeles County, California, Seismic Hazard Zone Report 026.
7. California Geological Survey, 2008, "Guidelines for Evaluation and Mitigation of Seismic Hazards in California," CDMG Special Publication 117A.
8. City of Los Angeles, Department of Public Works, 2003, Methane and Methane Buffer Zones Map, Map Number A-20960.
9. Department of the Navy, NAVFAC Design Manual 7.1, 1982, "Soil Mechanics," Naval Facilities Engineering Command, May.
10. Department of the Navy, NAVFAC Design Manual 7.02, 1986, "Foundations and Earth Structures," Naval Facilities Engineering Command, September.
11. Dibblee, T.W., 1991, Geologic Map of the Hollywood and Burbank (South ½) 7.5-Minute Quadrangles, Map No DF-30, map scale 1: 24,000.
12. Leighton and Associates, Inc. (1990), Technical Appendix to the Safety Element of the Los Angeles County General Plan: Hazard Reduction in Los Angeles County.
13. Southern California Earthquake Center, 1999, "Recommended Procedures for Implementation of DMG Special Publication 117 - Guidelines for Analyzing and Mitigating Liquefaction in California," March.
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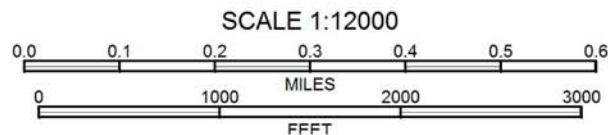
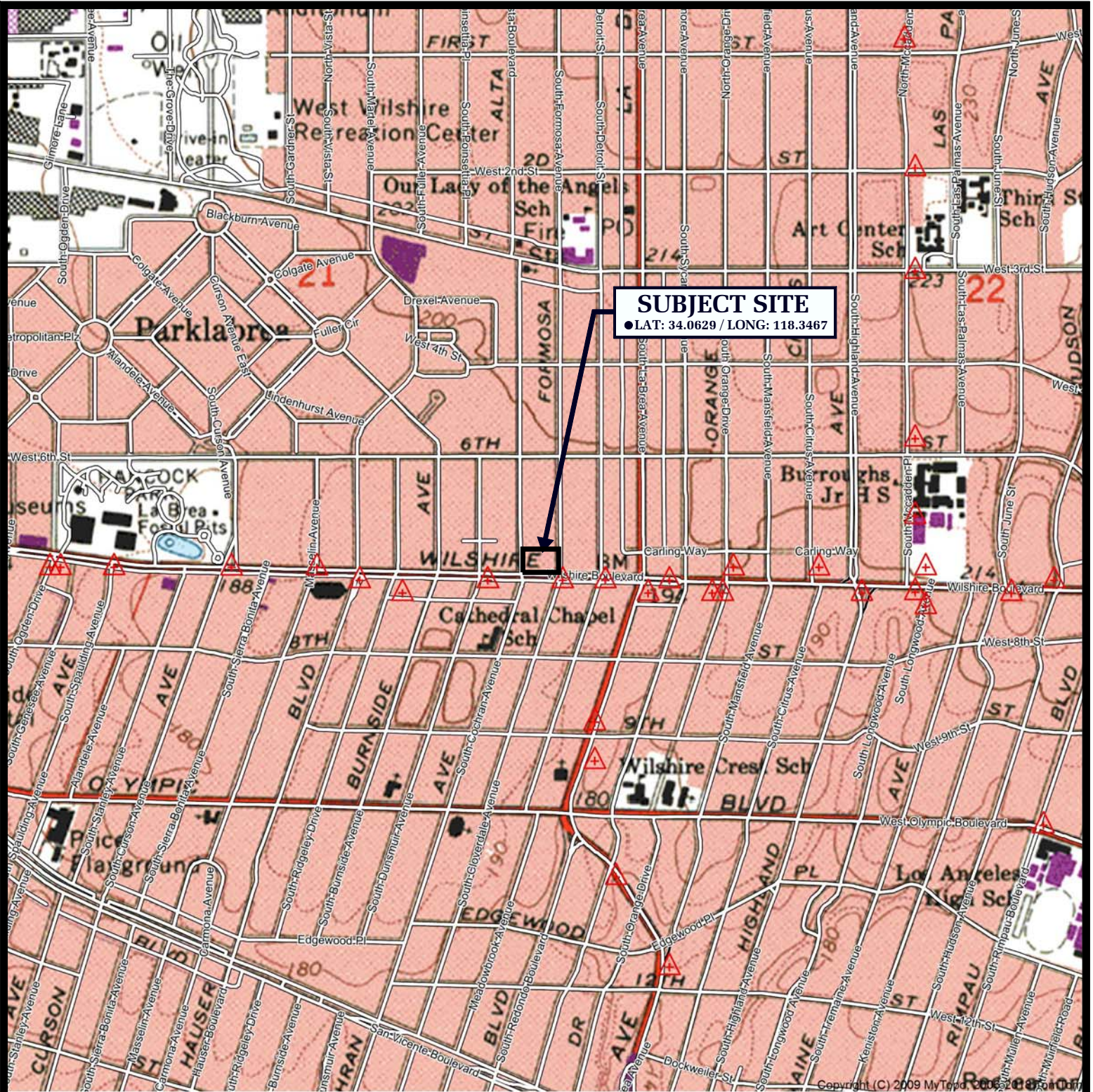
**Geotechnologies, Inc.**

439 Western Avenue, Glendale, California 91201-2837 • Tel: 818.240.9600 • Fax: 818.240.9675  
www.geotek.com

## **REFERENCES - continued**

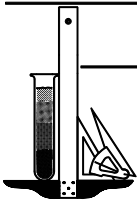
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REFERENCE: U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES,  
HOLLYWOOD, CA QUADRANGLE

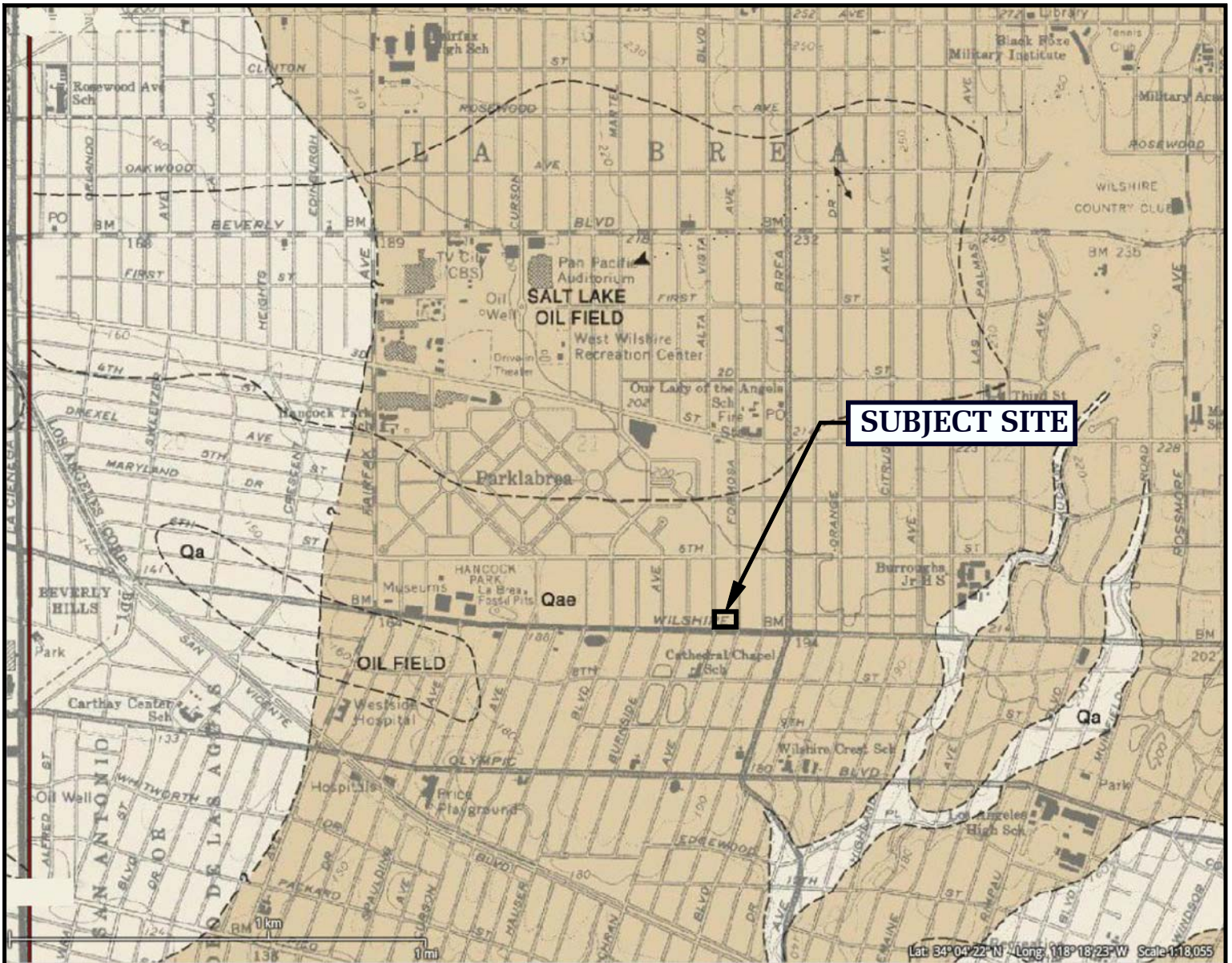
## VICINITY MAP



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**WALTER N. MARKS**  
5407 - 5425 WILSHIRE BLVD., LOS ANGELES

**FILE NO. 21644**

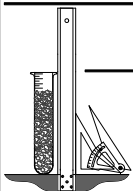


## LEGEND

- Qa: Surficial Sediments - alluvium: gravel, sand and clay  
 Qoa: Older Surficial Sediments - Older alluvium, gray to light brown pebble-gravel, sand, silt and clay of detritus

- +--- Folds - arrow on axial trace of fold indicates direction of plunge  
 -...- Fault - dashed where indefinite or inferred, dotted where concealed, queried where existence is doubtful

REFERENCE: DIBBLEE, T.W., (1991) GEOLOGIC MAP OF THE HOLLYWOOD AND BURBANK (SOUTH HALF) QUADRANGLES (#DF-30)

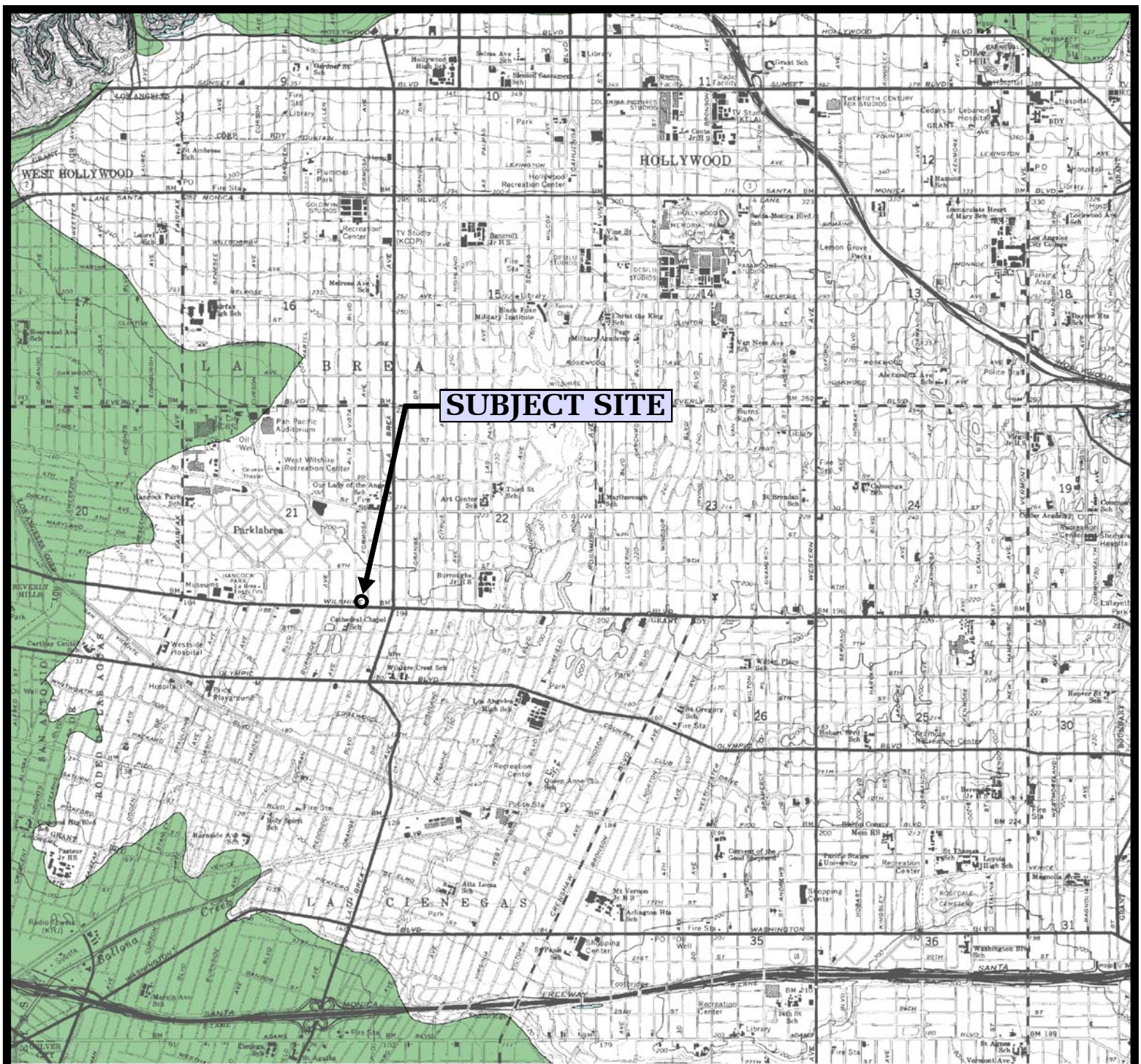


# LOCAL GEOLOGIC MAP - DIBBLEE

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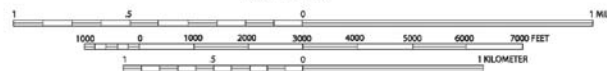
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FILE NO. 21644



**SUBJECT SITE**

SCALE 1:24,000



**LIQUEFACTION AREA**

**REFERENCE:** SEISMIC HAZARD ZONES, HOLLYWOOD QUADRANGLE OFFICIAL MAP (CDMG, 1999)

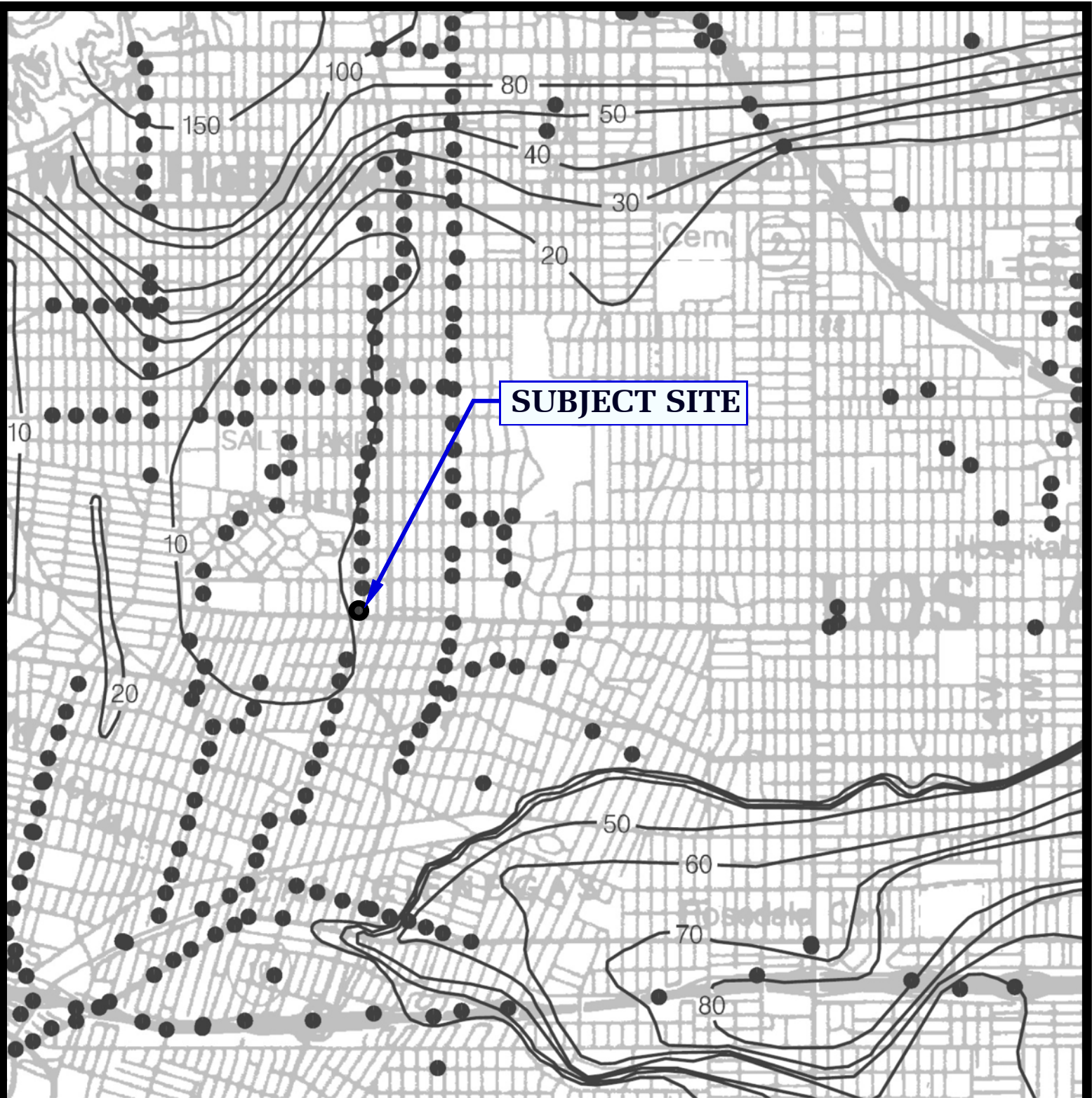
## SEISMIC HAZARD ZONE MAP

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**FILE NO. 21644**





20 Depth to groundwater in feet

ONE MILE

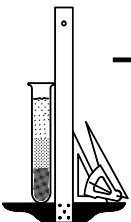
REFERENCE: CDMG, SEISMIC HAZARD ZONE REPORT, 026

SCALE

HOLLYWOOD 7.5 - MINUTE QUADRANGLE, LOS ANGELES COUNTY, CALIFORNIA (1998, REVISED 2006)



## HISTORICALLY HIGHEST GROUNDWATER LEVELS

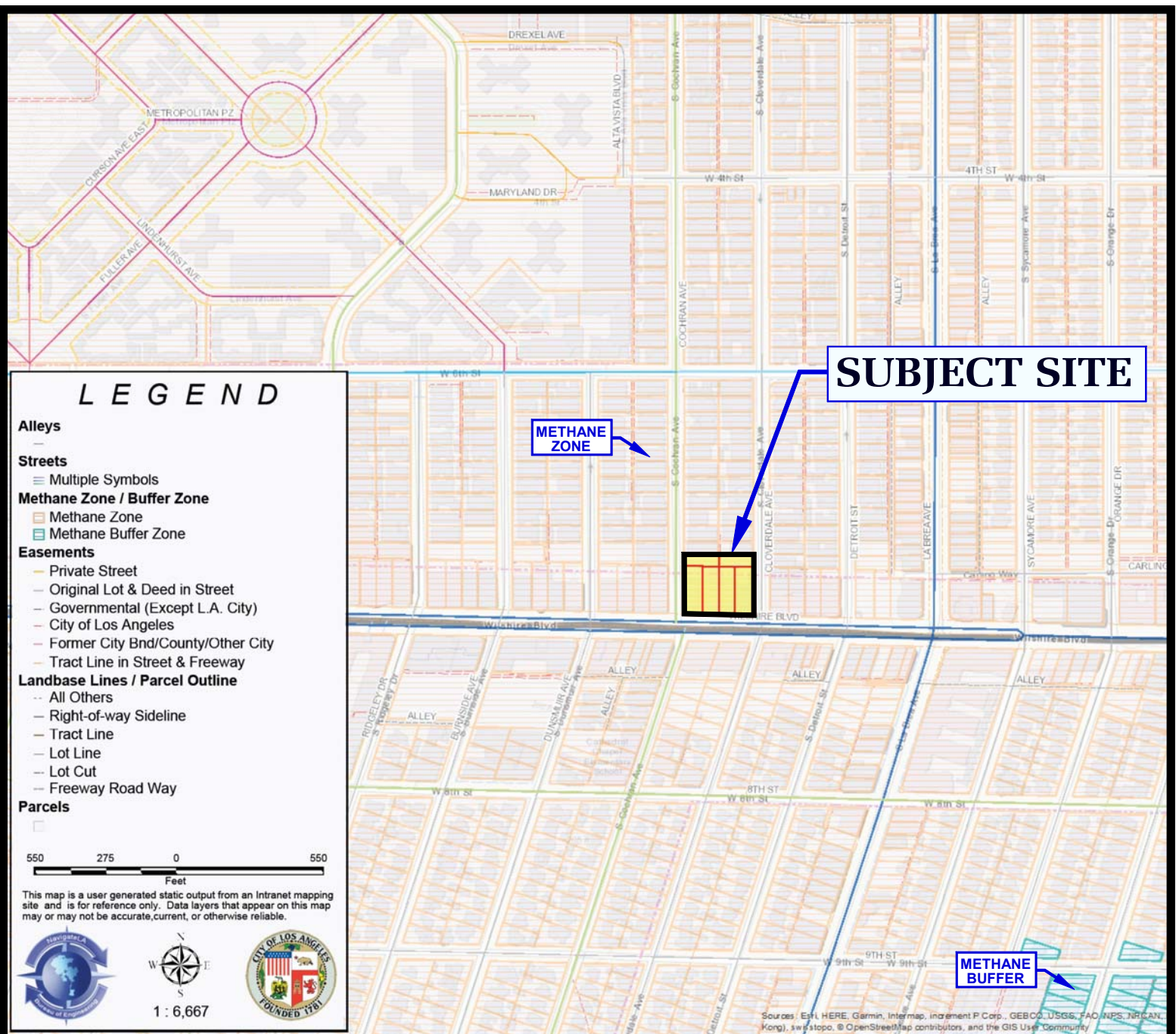


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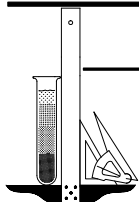
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**FILE NO. 21644**



REFERENCE: <http://navigate.lacity.org/NavigateLA/>

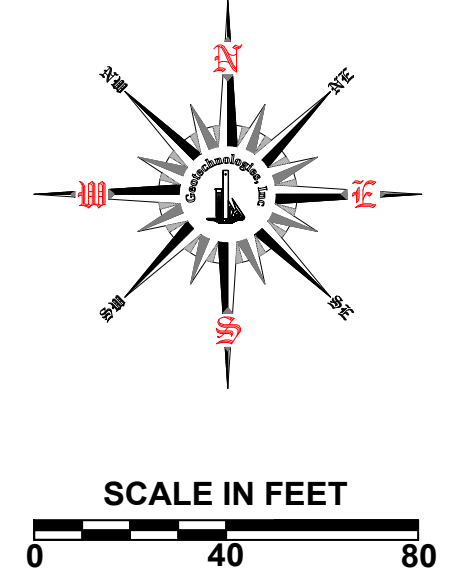
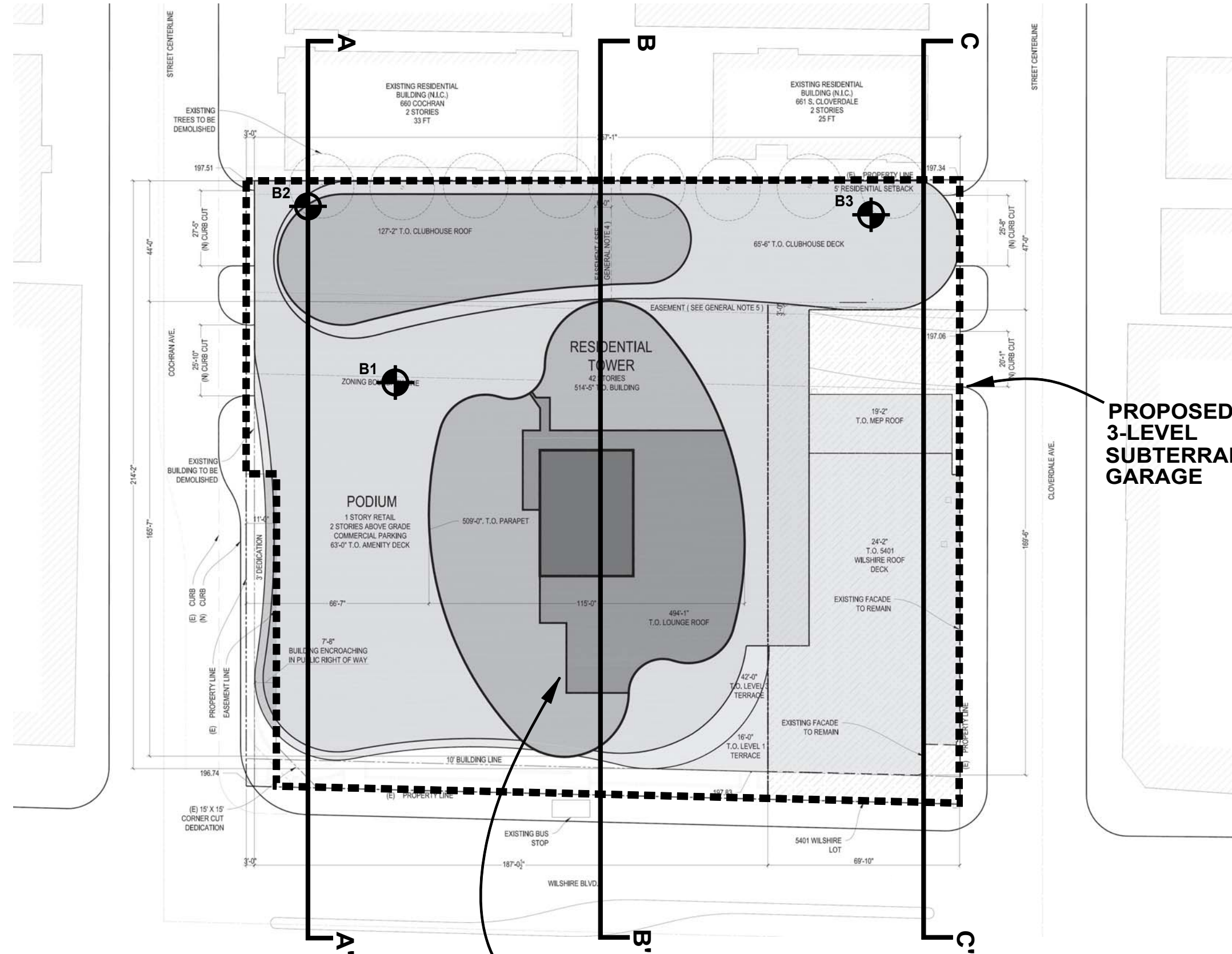
## METHANE ZONE RISK MAP



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FILE NO. 21644



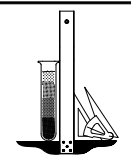
**LEGEND**

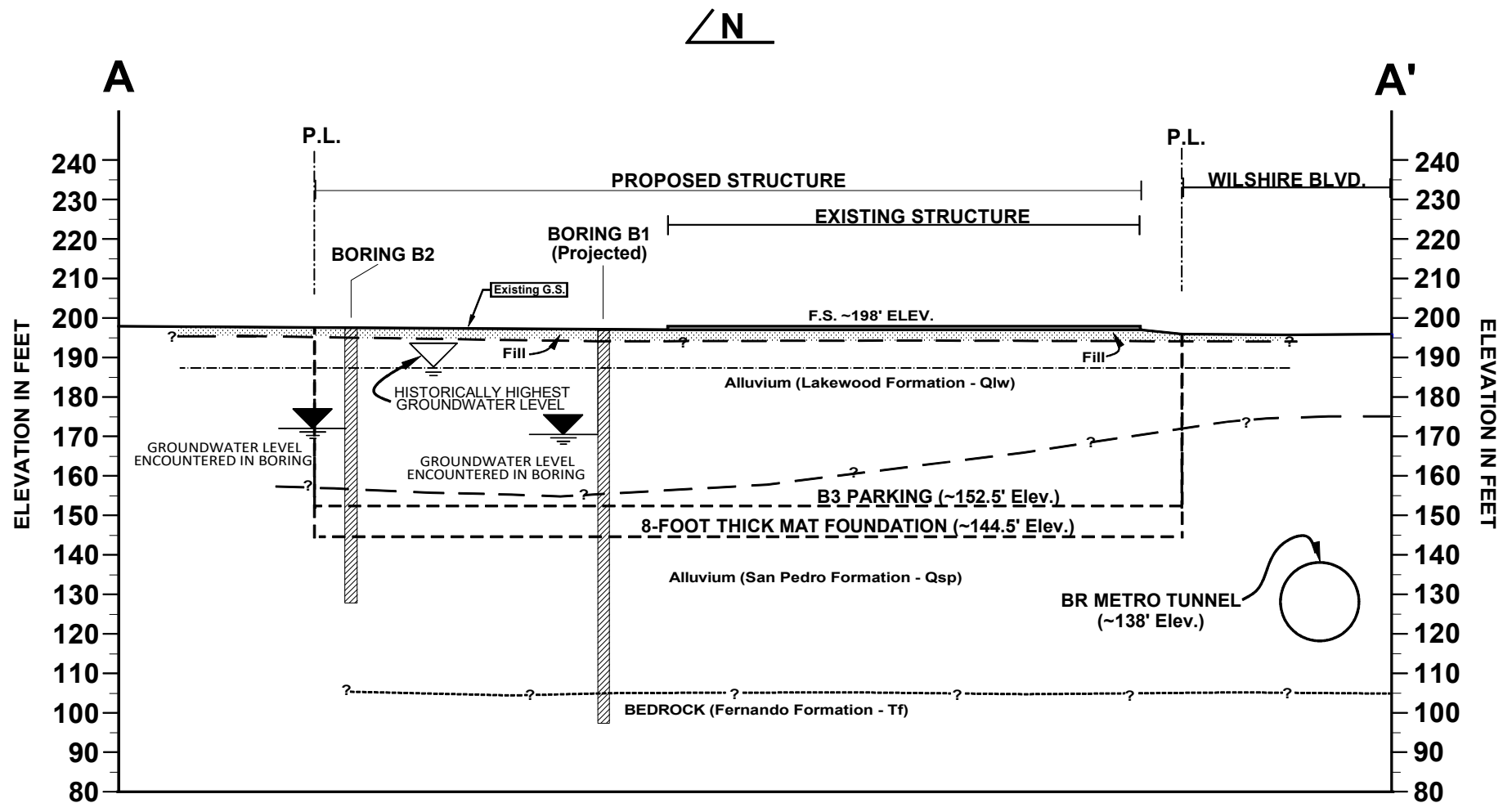
B3 LOCATION & NUMBER OF BORING

**PROPOSED 42-STORY  
RESIDENTIAL TOWER**

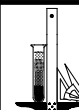
**PROPOSED  
3-LEVEL  
SUBTERRANEAN  
GARAGE**

REFERENCE: PLOT PLAN PROVIDED BY KEATING  
DATED FEBRUARY 11, 2019

|                                                                                                                                                                |                                                                   |                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|---------------------|
| <b>PLOT PLAN II</b>                                                                                                                                            |                                                                   |                     |
|  <b>Geotechnologies, Inc.</b><br><i>Consulting Geotechnical Engineers</i> | <b>WALTER N. MARKS</b><br>5407 - 5425 WILSHIRE BLVD., LOS ANGELES |                     |
|                                                                                                                                                                | <b>FILE No. 21644</b>                                             | <b>DRAWN BY: GN</b> |
|                                                                                                                                                                | <b>DATE: March 2019</b>                                           |                     |



### CROSS SECTION A-A'



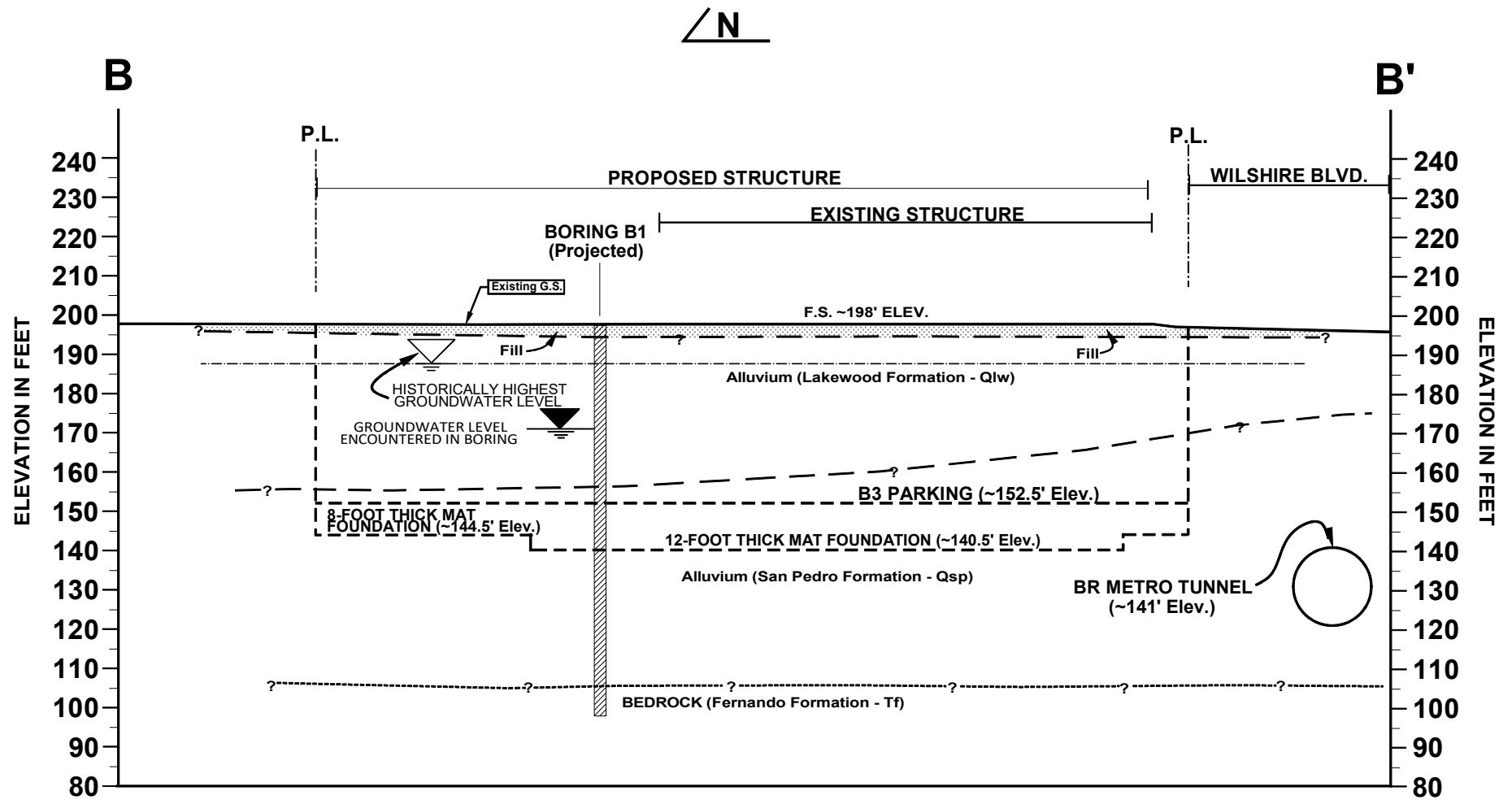
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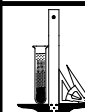
FILE No. 21644

DRAWN BY: AE

DATE: March '19



### CROSS SECTION B-B'



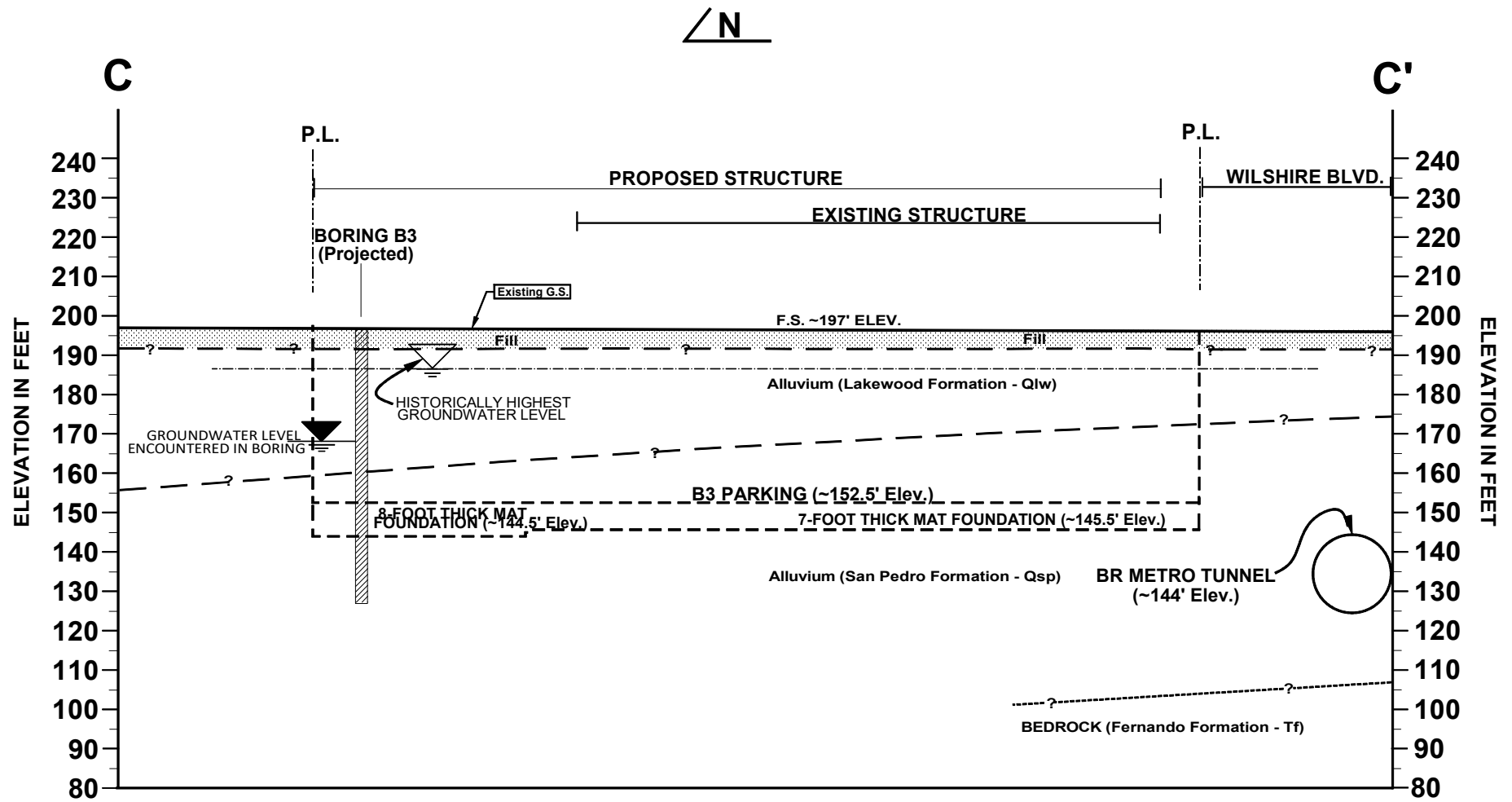
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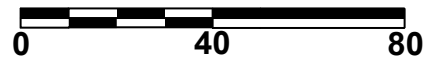
FILE No. 21644

DRAWN BY: AE

DATE: March '19



SCALE IN FEET



**CROSS SECTION C-C'**



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FILE No. 21644

DRAWN BY: AE

DATE: March '19

# BORING LOG NUMBER 1

Walter N. Marks, Inc.

Date: 09/11/18

Elevation: 197.5'

File No. 21644

Method: 5-inch diameter Rotary Wash Drill Rig

km

| Sample<br>Depth ft. | Blows<br>per ft. | Moisture<br>content % | Dry Density<br>p.c.f. | Depth in<br>feet | USCS<br>Class. | Description                                                          |
|---------------------|------------------|-----------------------|-----------------------|------------------|----------------|----------------------------------------------------------------------|
|                     |                  |                       |                       | 0 --             |                | Surface Conditions: Asphalt for Parking                              |
|                     |                  |                       |                       | -                |                | 3-inch Asphalt over 4-inch Base                                      |
|                     |                  |                       |                       | 1 --             |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
|                     |                  |                       |                       | 2 --             |                | FILL: Silty Clay, dark gray, moist, stiff                            |
|                     |                  |                       |                       | -                |                |                                                                      |
| 2.5                 | 13               | 19.4                  | 105.6                 | 3 --             |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
|                     |                  |                       |                       | 4 --             | CL             | Sandy Clay, dark brown, moist, stiff, some caliche                   |
|                     |                  |                       |                       | -                |                |                                                                      |
| 5                   | 20               | 22.3                  | SPT                   | 5 --             |                | -----                                                                |
|                     |                  |                       |                       | -                |                | Sandy Clay, yellowish brown, moist, stiff                            |
|                     |                  |                       |                       | 6 --             |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
| 7.5                 | 31               | 20.3                  | 106.6                 | 7 --             |                | -----                                                                |
|                     |                  |                       |                       | -                |                |                                                                      |
|                     |                  |                       |                       | 8 --             |                | Sandy Clay, olive brown, moist, stiff, fine grained                  |
|                     |                  |                       |                       | -                |                |                                                                      |
|                     |                  |                       |                       | 9 --             |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
| 10                  | 14               | 24.4                  | SPT                   | 10 --            |                | -----                                                                |
|                     |                  |                       |                       | -                |                | Silty Sand, dark brown, moist, medium dense, fine grained            |
|                     |                  |                       |                       | 11 --            |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
| 12.5                | 41               | 15.9                  | 116.5                 | 12 --            |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
|                     |                  |                       |                       | 13 --            | SM             | Silty Sand, grayish brown to brown, moist, dense, fine grained       |
|                     |                  |                       |                       | -                |                |                                                                      |
|                     |                  |                       |                       | 14 --            |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
| 15                  | 25               | 14.7                  | SPT                   | 15 --            |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
|                     |                  |                       |                       | 16 --            |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
| 17.5                | 27               | 29.5                  | 93.8                  | 17 --            |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
|                     |                  |                       |                       | 18 --            | CH             | Silty Clay, grayish to olive brown, moist, stiff, fine grained       |
|                     |                  |                       |                       | -                |                |                                                                      |
|                     |                  |                       |                       | 19 --            |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
| 20                  | 12               | 35.1                  | SPT                   | 20 --            |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
|                     |                  |                       |                       | 21 --            |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
| 22                  | 34               | 20.5                  | 104.4                 | 22 --            |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
|                     |                  |                       |                       | 23 --            | CL             | Sandy Clay, gray to dark brown, moist, stiff, with occasional gravel |
|                     |                  |                       |                       | -                |                |                                                                      |
|                     |                  |                       |                       | 24 --            |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |
| 25                  | 23               | 22.3                  | SPT                   | 25 --            |                |                                                                      |
|                     |                  |                       |                       | -                |                |                                                                      |

# BORING LOG NUMBER 1

Walter N. Marks, Inc.

File No. 21644

km

| Sample<br>Depth ft. | Blows<br>per ft. | Moisture<br>content % | Dry Density<br>p.c.f. | Depth in<br>feet | USCS<br>Class. | Description                                                              |
|---------------------|------------------|-----------------------|-----------------------|------------------|----------------|--------------------------------------------------------------------------|
|                     |                  |                       |                       | -                |                |                                                                          |
|                     |                  |                       |                       | 26 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |
|                     |                  |                       |                       | 27 --            |                |                                                                          |
| 27.5                | 25               | 23.7                  | 99.6                  | -                |                |                                                                          |
|                     |                  |                       |                       | 28 --            |                | Sandy Clay, gray to olive brown, moist, stiff                            |
|                     |                  |                       |                       | -                |                |                                                                          |
|                     |                  |                       |                       | 29 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |
| 30                  | 20               | 35.1                  | SPT                   | 30 --            |                |                                                                          |
|                     |                  |                       |                       | -                | CH             | Silty Clay, gray, moist, stiff                                           |
|                     |                  |                       |                       | 31 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |
|                     |                  |                       |                       | 32 --            |                |                                                                          |
| 32.5                | 23               | 32.9                  | 86.2                  | -                |                |                                                                          |
|                     |                  |                       |                       | 33 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |
|                     |                  |                       |                       | 34 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |
| 35                  | 27               | 23.7                  | SPT                   | 35 --            |                |                                                                          |
|                     |                  |                       |                       | -                | SC             | Clayey Sand, gray to olive brown, very moist to wet, dense, fine grained |
|                     |                  |                       |                       | 36 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |
|                     |                  |                       |                       | 37 --            |                |                                                                          |
| 37.5                | 29               | 30.8                  | 91.0                  | -                |                |                                                                          |
|                     |                  |                       |                       | 38 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |
|                     |                  |                       |                       | 39 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |
| 40                  | 27               | 25.8                  | SPT                   | 40 --            |                |                                                                          |
|                     |                  |                       |                       | -                | SM/SP          | Silty Sand to Sand, dark gray, wet, dense, fine grained                  |
|                     |                  |                       |                       | 41 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |
|                     |                  |                       |                       | 42 --            |                |                                                                          |
| 42.5                | 47               | 19.0                  | 109.5                 | -                |                |                                                                          |
|                     |                  |                       |                       | 43 --            | SP             | Sand, dark gray, wet, very dense, fine to medium grained                 |
|                     |                  |                       |                       | -                |                |                                                                          |
|                     |                  |                       |                       | 44 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |
| 45                  | 22               | 30.9                  | SPT                   | 45 --            |                |                                                                          |
|                     |                  |                       |                       | -                | CL             | Sandy Clay, dark gray to olive gray, very moist, very stiff              |
|                     |                  |                       |                       | 46 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |
|                     |                  |                       |                       | 47 --            |                |                                                                          |
| 47.5                | 43               | 31.7                  | 94.1                  | -                |                |                                                                          |
|                     |                  |                       |                       | 48 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |
|                     |                  |                       |                       | 49 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |
| 50                  | 27               | 22.9                  | SPT                   | 50 --            |                |                                                                          |
|                     |                  |                       |                       | -                |                |                                                                          |

# BORING LOG NUMBER 1

Walter N. Marks, Inc.

File No. 21644

km

| Sample<br>Depth ft. | Blows<br>per ft. | Moisture<br>content % | Dry Density<br>p.c.f. | Depth in<br>feet | USCS<br>Class. | Description                                                                             |
|---------------------|------------------|-----------------------|-----------------------|------------------|----------------|-----------------------------------------------------------------------------------------|
|                     |                  |                       |                       | -                |                |                                                                                         |
|                     |                  |                       |                       | 51 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
|                     |                  |                       |                       | 52 --            |                |                                                                                         |
| 52.5                | 57               | 16.4                  | 111.5                 | -                |                |                                                                                         |
|                     |                  |                       |                       | 53 --            | SM/ML          | Silty Sand to Sandy Silt, dark gray, moist, very dense to very stiff                    |
|                     |                  |                       |                       | -                |                |                                                                                         |
|                     |                  |                       |                       | 54 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
| 55                  | 18               | 32.4                  | SPT                   | 55 --            |                |                                                                                         |
|                     |                  |                       |                       | -                | CH             | Silty Clay, dark gray, very moist, very stiff                                           |
|                     |                  |                       |                       | 56 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
| 57.5                | 41               | 23.7                  | 99.5                  | 57 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
|                     |                  |                       |                       | 58 --            | SM/ML          | Silty Sand to Sandy Silt, dark gray, moist, very dense to very very stiff, fine grained |
|                     |                  |                       |                       | -                |                |                                                                                         |
|                     |                  |                       |                       | 59 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
| 60                  | 74               | 19.4                  | SPT                   | 60 --            |                |                                                                                         |
|                     |                  |                       |                       | -                | SP             | Sand, dark gray, wet, very dense, fine grained                                          |
|                     |                  |                       |                       | 61 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
|                     |                  |                       |                       | 62 --            |                |                                                                                         |
| 62.5                | 34               | 20.2                  | 101.4                 | -                |                |                                                                                         |
|                     | 50/5.5"          |                       |                       | 63 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
|                     |                  |                       |                       | 64 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
| 65                  | 67               | 20.7                  | SPT                   | 65 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
|                     |                  |                       |                       | 66 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
|                     |                  |                       |                       | 67 --            |                |                                                                                         |
| 67.5                | 37               | 22.6                  | 106.5                 | -                |                |                                                                                         |
|                     | 50/4"            |                       |                       | 68 --            |                | Sand, dark gray, wet, very dense, fine grained                                          |
|                     |                  |                       |                       | -                |                |                                                                                         |
|                     |                  |                       |                       | 69 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
| 70                  | 85               | 19.8                  | SPT                   | 70 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
|                     |                  |                       |                       | 71 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
|                     |                  |                       |                       | 72 --            |                |                                                                                         |
| 72.5                | 35               | 22.2                  | 105.8                 | -                |                |                                                                                         |
|                     | 50/4"            |                       |                       | 73 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
|                     |                  |                       |                       | 74 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |
| 75                  | 55/6"            | 11.7                  | SPT                   | 75 --            |                |                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                         |

# BORING LOG NUMBER 1

Walter N. Marks, Inc.

File No. 21644

km

| Sample<br>Depth ft. | Blows<br>per ft. | Moisture<br>content % | Dry Density<br>p.c.f. | Depth in<br>feet | USCS<br>Class. | Description                                                                                                           |
|---------------------|------------------|-----------------------|-----------------------|------------------|----------------|-----------------------------------------------------------------------------------------------------------------------|
|                     |                  |                       |                       | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 76 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 77 --            |                |                                                                                                                       |
| 77.5                | 46<br>50/5"      | 29.6                  | 96.1                  | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 78 --            |                | Sand, dark gray, wet, very dense, fine grained                                                                        |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 79 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
| 80                  | 38<br>50/5.5"    | 23.6                  | SPT                   | 80 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 81 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
| 82.5                | 39<br>50/5"      | 19.0                  | 104.5                 | 82 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 83 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 84 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
| 85                  | 50/5"            | 13.5                  | SPT                   | 85 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                | Sand, dark gray, wet, very dense, fine to medium grained                                                              |
|                     |                  |                       |                       | 86 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 87 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
| 87.5                | 47<br>50/3"      | 22.1                  | 101.8                 | 88 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 89 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
| 90                  | 38<br>50/3"      | 24.9                  | SPT                   | 90 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                | Sand, dark gray, wet, very dense, fine grained                                                                        |
|                     |                  |                       |                       | 91 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 92 --            |                |                                                                                                                       |
| 92.5                | 82               | 47.2                  | 74.6                  | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 93 --            |                | BEDROCK: Siltstone to Shale, dark gray, moist, moderately hard                                                        |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 94 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
| 95                  | 48               | 49.9                  | SPT                   | 95 --            |                | NOTE: The stratification lines represent the approximate boundary between earth types; the transition may be gradual. |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 96 --            |                | Used 5-inch diameter Rotary Wash Drill Rig                                                                            |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 97 --            |                |                                                                                                                       |
| 97.5                | 31<br>50/5"      | 68.7                  | 58.1                  | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 98 --            |                | Shale, dark gray, moist, hard                                                                                         |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
|                     |                  |                       |                       | 99 --            |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                |                                                                                                                       |
| 100                 | 36<br>50/4"      | 40.1                  | SPT                   | 100 --           |                |                                                                                                                       |
|                     |                  |                       |                       | -                |                | Total Depth 100 feet<br>Water at 26½ feet<br>Fill to 3 feet                                                           |

# BORING LOG NUMBER 2

Walter N. Marks, Inc.

Date: 09/12/18

Elevation: 197.5'

File No. 21644

Method: 8-inch diameter Hollow Stem Auger

km

| Sample<br>Depth ft. | Blows<br>per ft. | Moisture<br>content % | Dry Density<br>p.c.f. | Depth in<br>feet | USCS<br>Class. | Description                                                |
|---------------------|------------------|-----------------------|-----------------------|------------------|----------------|------------------------------------------------------------|
|                     |                  |                       |                       | 0 --             |                | Surface Conditions: Asphalt for Parking                    |
|                     |                  |                       |                       | -                |                | 3-inch Asphalt over 7-inch Base                            |
|                     |                  |                       |                       | 1 --             |                |                                                            |
|                     |                  |                       |                       | -                |                | FILL: Silty Clay, dark brown, moist, stiff                 |
|                     |                  |                       |                       | 2 --             |                |                                                            |
| 2.5                 | 35               | 17.6                  | 110.3                 | -                |                |                                                            |
|                     |                  |                       |                       | 3 --             | CL             | Sandy Clay, dark brown to gray, moist, stiff               |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 4 --             |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
| 5                   | 29               | 19.0                  | 109.7                 | 5 --             |                | -----                                                      |
|                     |                  |                       |                       | -                |                | Sandy Clay, dark brown, moist, stiff, minor caliche        |
|                     |                  |                       |                       | 6 --             |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 7 --             |                | -----                                                      |
| 7.5                 | 27               | 25.1                  | 101.8                 | -                |                |                                                            |
|                     |                  |                       |                       | 8 --             |                | Sandy Clay, dark brown, moist, stiff, fine grained         |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 9 --             |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
| 10                  | 32               | 27.1                  | 90.0                  | 10 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 11 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 12 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 13 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 14 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
| 15                  | 60               | 11.3                  | 117.9                 | 15 --            |                |                                                            |
|                     |                  |                       |                       | -                | SM/SP          | Silty Sand, dark grayish brown, moist, dense, fine grained |
|                     |                  |                       |                       | 16 --            |                | grained                                                    |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 17 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 18 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 19 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
| 20                  | 35               | 32.3                  | 88.7                  | 20 --            |                |                                                            |
|                     |                  |                       |                       | -                | CH             | Silty Clay, dark gray to olive gray, very moist, stiff     |
|                     |                  |                       |                       | 21 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 22 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 23 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 24 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
| 25                  | 42               | 23.7                  | 99.8                  | 25 --            |                |                                                            |
|                     |                  |                       |                       | -                | CL             | Sandy Clay, dark gray to olive gray, moist, stiff          |

# BORING LOG NUMBER 2

Walter N. Marks, Inc.

File No. 21644

km

| Sample<br>Depth ft. | Blows<br>per ft. | Moisture<br>content % | Dry Density<br>p.c.f. | Depth in<br>feet | USCS<br>Class. | Description                                                |
|---------------------|------------------|-----------------------|-----------------------|------------------|----------------|------------------------------------------------------------|
| 30                  | 15               | 25.0                  | 97.7                  | -                |                |                                                            |
|                     |                  |                       |                       | 26 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 27 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 28 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 29 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 30 --            |                |                                                            |
| 35                  | 44               | 22.7                  | 105.8                 | -                |                | Sandy Clay, gray to olive gray, moist, stiff, some caliche |
|                     |                  |                       |                       | 31 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 32 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 33 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 34 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 35 --            |                |                                                            |
| 40                  | 47               | 18.7                  | 106.2                 | -                | SP             | Sand, gray, wet, dense, fine to medium grained             |
|                     |                  |                       |                       | 36 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 37 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 38 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 39 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 40 --            |                |                                                            |
| 45                  | 73               | 15.9                  | 112.6                 | -                |                |                                                            |
|                     |                  |                       |                       | 41 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 42 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 43 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 44 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 45 --            |                |                                                            |
| 50                  | 72               | 19.1                  | 109.4                 | -                |                |                                                            |
|                     |                  |                       |                       | 46 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 47 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 48 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 49 --            |                |                                                            |
|                     |                  |                       |                       | -                |                |                                                            |
|                     |                  |                       |                       | 50 --            |                |                                                            |
| 50                  | 72               | 19.1                  | 109.4                 | -                | CL             | Sandy Clay, dark gray to olive gray, moist, stiff          |
|                     |                  |                       |                       | -                |                |                                                            |

# BORING LOG NUMBER 2

Walter N. Marks, Inc.

File No. 21644

km

| Sample<br>Depth ft. | Blows<br>per ft. | Moisture<br>content % | Dry Density<br>p.c.f. | Depth in<br>feet | USCS<br>Class. | Description                                                                                                                                 |
|---------------------|------------------|-----------------------|-----------------------|------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 55                  | 67               | 27.9                  | 97.7                  | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 51 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 52 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 53 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 54 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 55 --            |                |                                                                                                                                             |
| 60                  | 25<br>50/5"      | 17.2                  | 118.6                 | -                |                | Sandy Clay, dark gray, moist, stiff                                                                                                         |
|                     |                  |                       |                       | 56 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 57 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 58 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 59 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 60 --            |                |                                                                                                                                             |
| 65                  | 30<br>50/5"      | 19.8                  | 108.1                 | -                | SM/SP          | Silty Sand to Sand, gray to dark gray, wet, very dense, fine grained                                                                        |
|                     |                  |                       |                       | 61 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 62 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 63 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 64 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 65 --            |                |                                                                                                                                             |
| 70                  | 100/6"           | 20.8                  | 98.5                  | -                | SP             | Sand, gray to dark gray, wet, very dense, fine grained                                                                                      |
|                     |                  |                       |                       | 66 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 67 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 68 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 69 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 70 --            |                |                                                                                                                                             |
| 75                  |                  |                       |                       | -                |                | Total Depth 70 feet<br>Water at 25½ feet<br>Fill to 2½ feet                                                                                 |
|                     |                  |                       |                       | 71 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 72 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 73 --            |                | NOTE: The stratification lines represent the approximate<br>boundary between earth types; the transition may be gradual.                    |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 74 --            |                |                                                                                                                                             |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |
|                     |                  |                       |                       | 75 --            |                | Used 8-inch diameter Hollow-Stem Auger<br>140-lb. Automatic Hammer, 30-inch drop<br>Modified California Sampler used unless otherwise noted |
|                     |                  |                       |                       | -                |                |                                                                                                                                             |

# BORING LOG NUMBER 3

Walter N. Marks, Inc.

Date: 09/14/18

Elevation: 197.5'

File No. 21644

Method: 8-inch diameter Hollow Stem Auger

km

| Sample<br>Depth ft. | Blows<br>per ft. | Moisture<br>content % | Dry Density<br>p.c.f. | Depth in<br>feet | USCS<br>Class. | Description                                                                      |
|---------------------|------------------|-----------------------|-----------------------|------------------|----------------|----------------------------------------------------------------------------------|
|                     |                  |                       |                       | 0 --             |                | Surface Conditions: Asphalt for Parking                                          |
|                     |                  |                       |                       | -                |                | 3-inch Asphalt over 3-inch Base                                                  |
|                     |                  |                       |                       | 1 --             |                | FILL: Silty Clay, dark brown, moist, stiff                                       |
|                     |                  |                       |                       | -                |                |                                                                                  |
| 2.5                 | 9                | 19.1                  | 102.4                 | 2 --             |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 3 --             |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 4 --             |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
| 5                   | 19               | 15.9                  | 114.1                 | 5 --             | SM/ML          | Sandy Silt to Silty Sand, dark brown, moist, medium dense to stiff, fine grained |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 6 --             |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
| 7.5                 | 49               | 12.0                  | 123.5                 | 7 --             |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 8 --             | SP             | Sand, reddish brown, moist, dense, fine grained                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 9 --             |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
| 10                  | 48               | 16.4                  | 114.6                 | 10 --            |                |                                                                                  |
|                     |                  |                       |                       | -                | SM             | Silty Sand, reddish brown, moist, dense, fine grained                            |
|                     |                  |                       |                       | 11 --            |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 12 --            |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 13 --            |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 14 --            |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
| 15                  | 49               | 9.0                   | 109.8                 | 15 --            |                |                                                                                  |
|                     |                  |                       |                       | -                | SP             | Sand, dark to yellowish brown, slightly moist, dense, fine grained               |
|                     |                  |                       |                       | 16 --            |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 17 --            |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 18 --            |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 19 --            |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
| 20                  | 40               | 27.0                  | 94.4                  | 20 --            |                |                                                                                  |
|                     |                  |                       |                       | -                | CL             | Sandy Clay, dark brown to olive brown, moist, stiff                              |
|                     |                  |                       |                       | 21 --            |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 22 --            |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 23 --            |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
|                     |                  |                       |                       | 24 --            |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |
| 25                  | 46               | 26.1                  | 99.3                  | 25 --            |                |                                                                                  |
|                     |                  |                       |                       | -                |                |                                                                                  |

# BORING LOG NUMBER 3

Walter N. Marks, Inc.

File No. 21644

km

| Sample<br>Depth ft. | Blows<br>per ft. | Moisture<br>content % | Dry Density<br>p.c.f. | Depth in<br>feet | USCS<br>Class. | Description                                             |
|---------------------|------------------|-----------------------|-----------------------|------------------|----------------|---------------------------------------------------------|
| 30                  | 72               | 18.2                  | 110.2                 | -                |                |                                                         |
|                     |                  |                       |                       | 26 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 27 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 28 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 29 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 30 --            |                |                                                         |
| 35                  | 47               | 28.5                  | 95.3                  | -                | SM             | Silty Sand, dark gray, wet, very dense, fine grained    |
|                     |                  |                       |                       | 31 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 32 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 33 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 34 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 35 --            |                |                                                         |
| 40                  | 52               | 30.1                  | 90.6                  | -                | CH             | Silty Clay, dark gray to olive gray, very moist, stiff  |
|                     |                  |                       |                       | 36 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 37 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 38 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 39 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 40 --            |                |                                                         |
| 45                  | 86               | 28.9                  | 89.5                  | -                |                |                                                         |
|                     |                  |                       |                       | 41 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 42 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 43 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 44 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 45 --            |                |                                                         |
| 50                  | 63               | 22.3                  | 106.3                 | -                | SM/SP          | Silty Sand to Sand, dark gray, wet, dense, fine grained |
|                     |                  |                       |                       | 46 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 47 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 48 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 49 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |
|                     |                  |                       |                       | 50 --            |                |                                                         |
|                     |                  |                       |                       | -                |                |                                                         |

# BORING LOG NUMBER 3

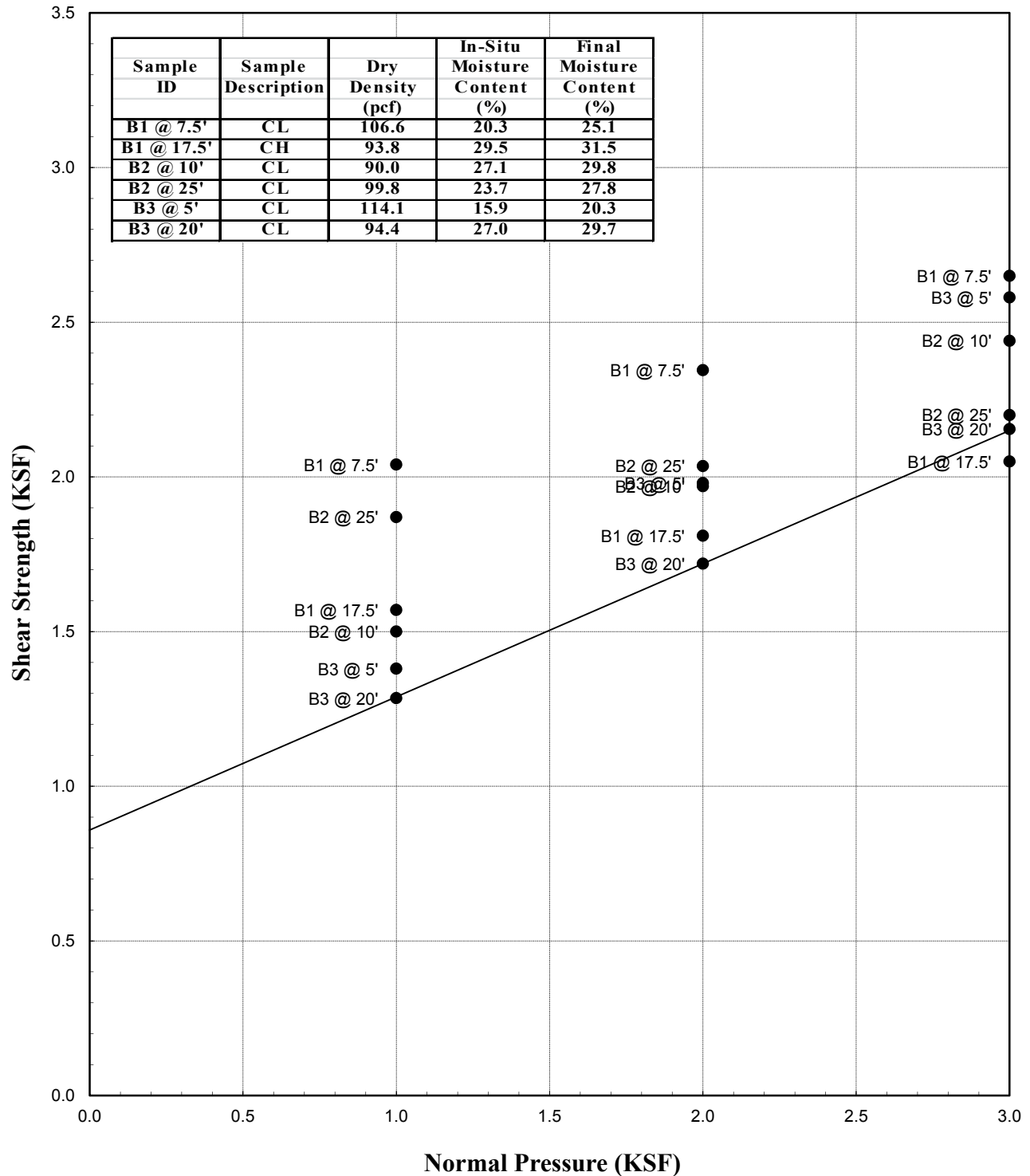
Walter N. Marks, Inc.

File No. 21644

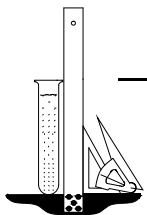
km

| Sample<br>Depth ft. | Blows<br>per ft. | Moisture<br>content % | Dry Density<br>p.c.f. | Depth in<br>feet | USCS<br>Class. | Description                                                                                                                                                                                                                                                                                                                                   |
|---------------------|------------------|-----------------------|-----------------------|------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 55                  | 51               | 25.2                  | 101.6                 | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 51 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 52 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 53 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 54 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 55 --            |                |                                                                                                                                                                                                                                                                                                                                               |
| 60                  | 82               | 16.5                  | 114.9                 | -                | CL             | Sandy Clay, gray to dark gray, moist, stiff                                                                                                                                                                                                                                                                                                   |
|                     |                  |                       |                       | 56 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 57 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 58 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 59 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 60 --            |                |                                                                                                                                                                                                                                                                                                                                               |
| 65                  | 34<br>50/5"      | 19.7                  | 106.9                 | -                | SM             | Silty Sand, dark gray, wet, very dense, fine grained                                                                                                                                                                                                                                                                                          |
|                     |                  |                       |                       | 61 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 62 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 63 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 64 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 65 --            |                |                                                                                                                                                                                                                                                                                                                                               |
| 70                  | 40<br>50/5"      | 21.9                  | 101.2                 | -                | SP             | Sand, gray to dark gray, wet, very dense, fine grained                                                                                                                                                                                                                                                                                        |
|                     |                  |                       |                       | 66 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 67 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 68 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 69 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 70 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                | Total Depth 70 feet<br>Water at 28½ feet<br>Fill to 5 feet<br><br>NOTE: The stratification lines represent the approximate<br>boundary between earth types; the transition may be gradual.<br><br>Used 8-inch diameter Hollow-Stem Auger<br>140-lb. Automatic Hammer, 30-inch drop<br>Modified California Sampler used unless otherwise noted |
|                     |                  |                       |                       | 71 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 72 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 73 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 74 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | 75 --            |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |
|                     |                  |                       |                       | -                |                |                                                                                                                                                                                                                                                                                                                                               |

## Saturated Shear



## SHEAR TEST DIAGRAM



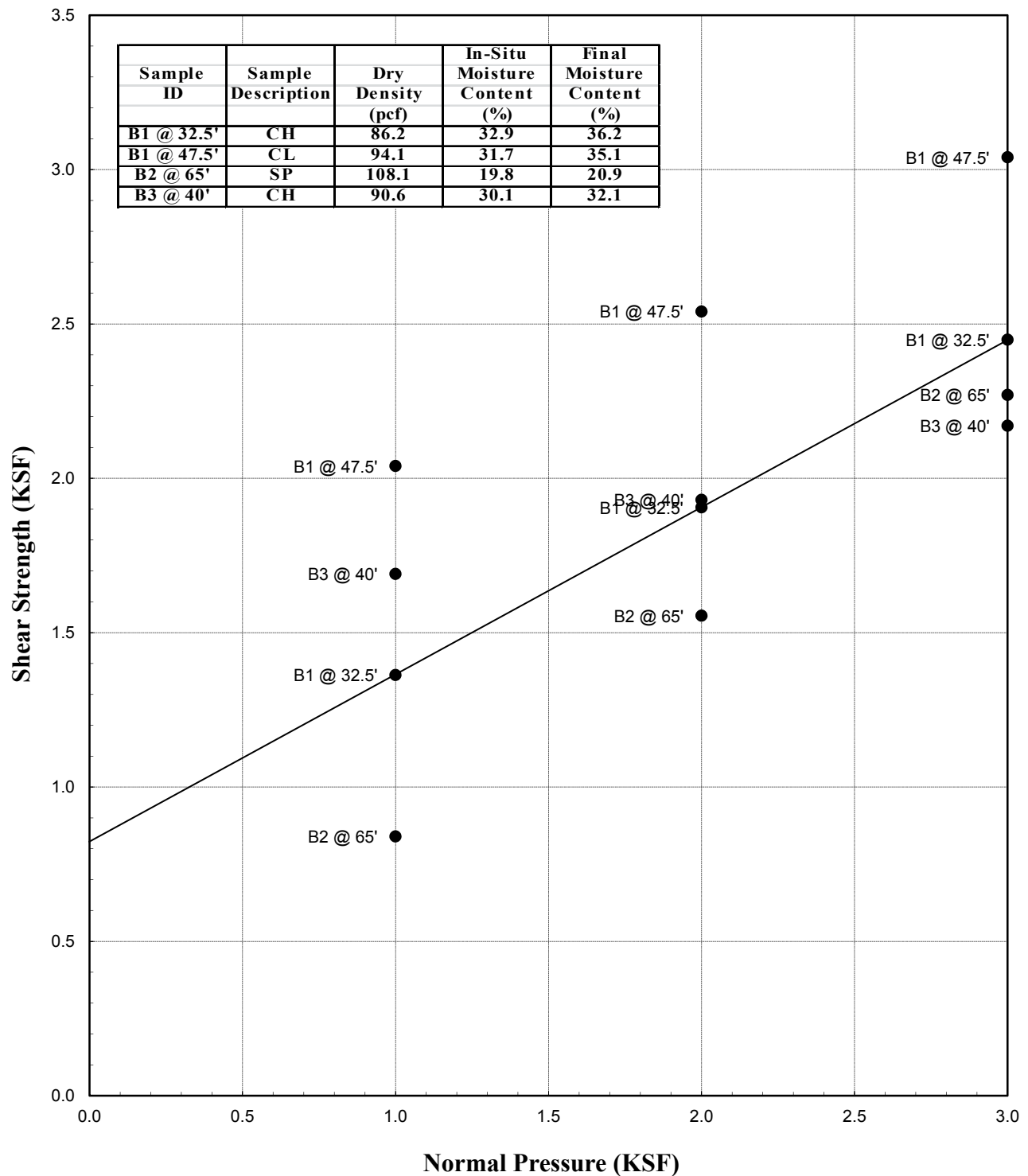
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FILE NO.: 21644

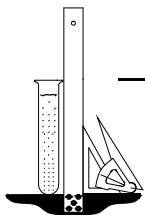
PLATE: B-1

## Saturated Shear



$\phi$ : 28.5 degrees  
 $c$ : 820.0 psf

## SHEAR TEST DIAGRAM

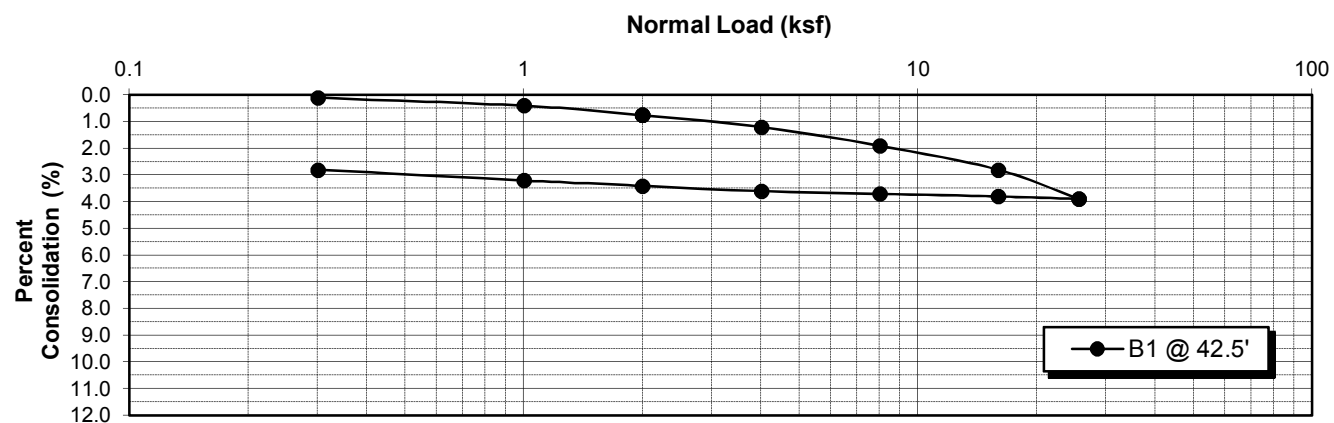
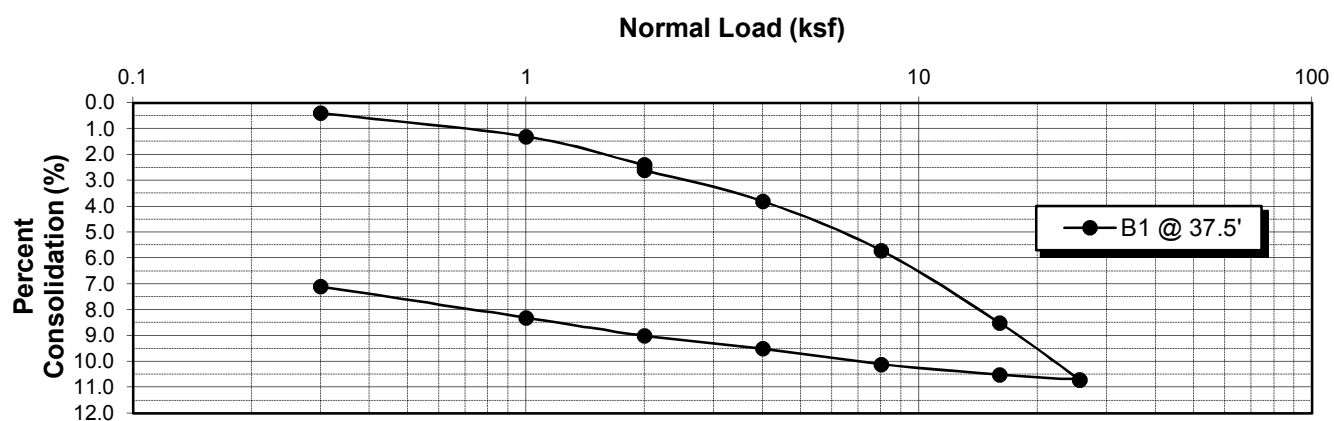
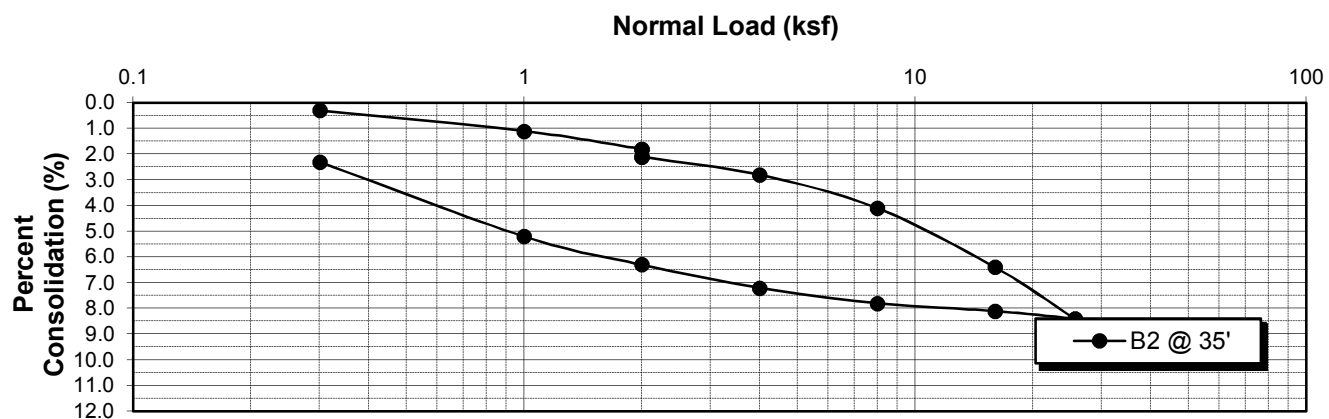


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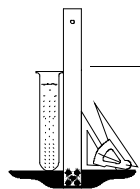
PROJECT: WALTER N. MARKS

FILE NO.: 21644

PLATE: B-2



Water added at 2 KSF



## CONSOLIDATION

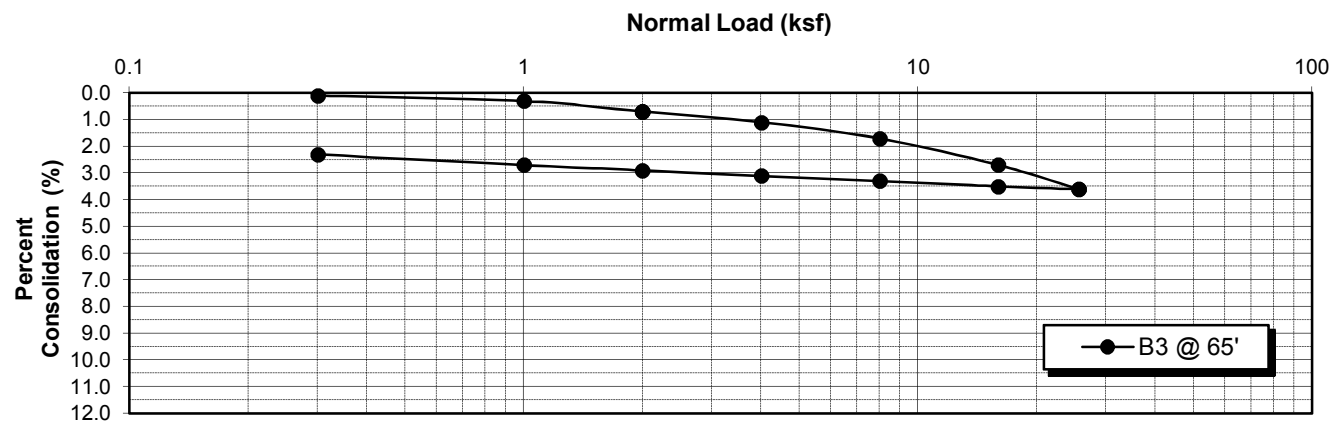
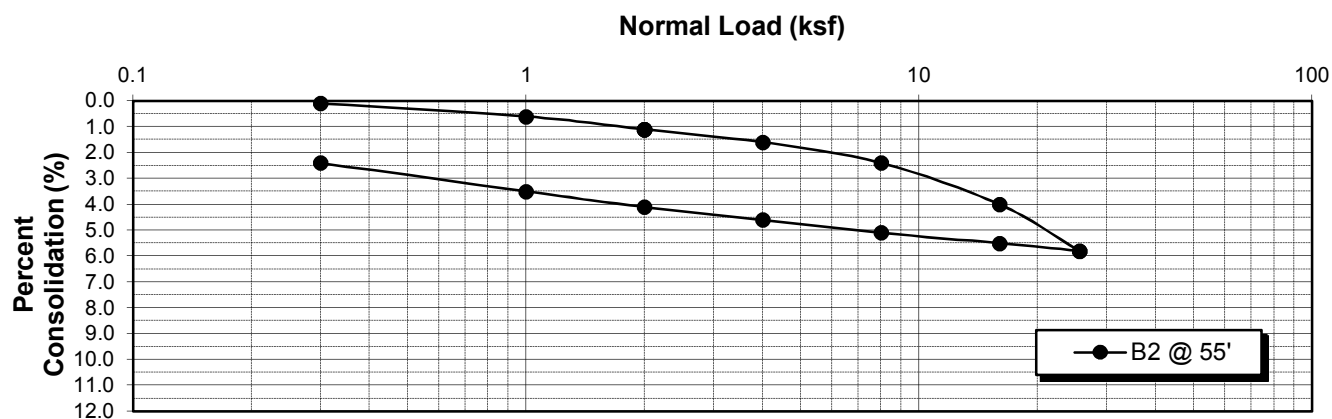
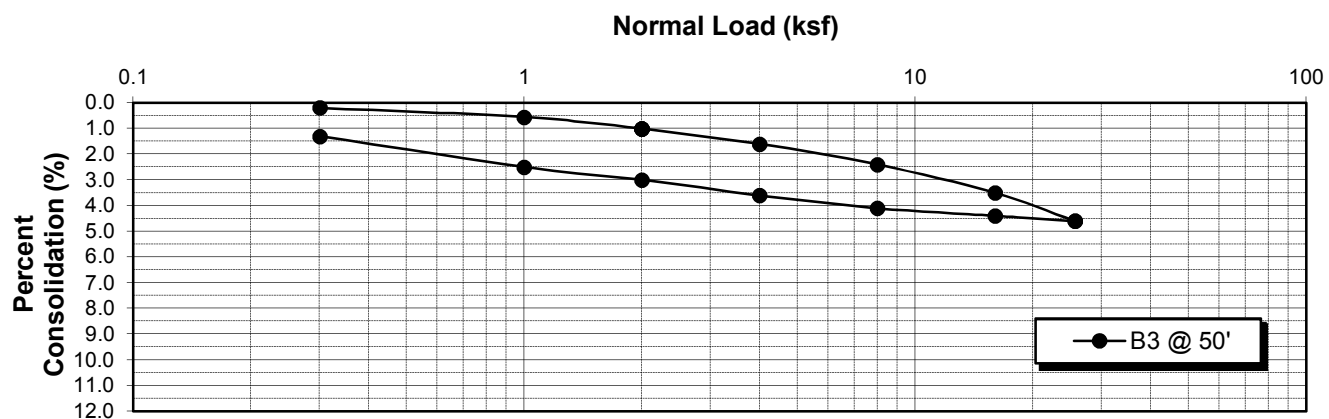
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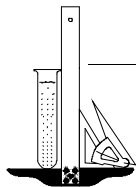
FILE NO. 21644

PLATE: C-1



Water added at 2 KSF

## CONSOLIDATION



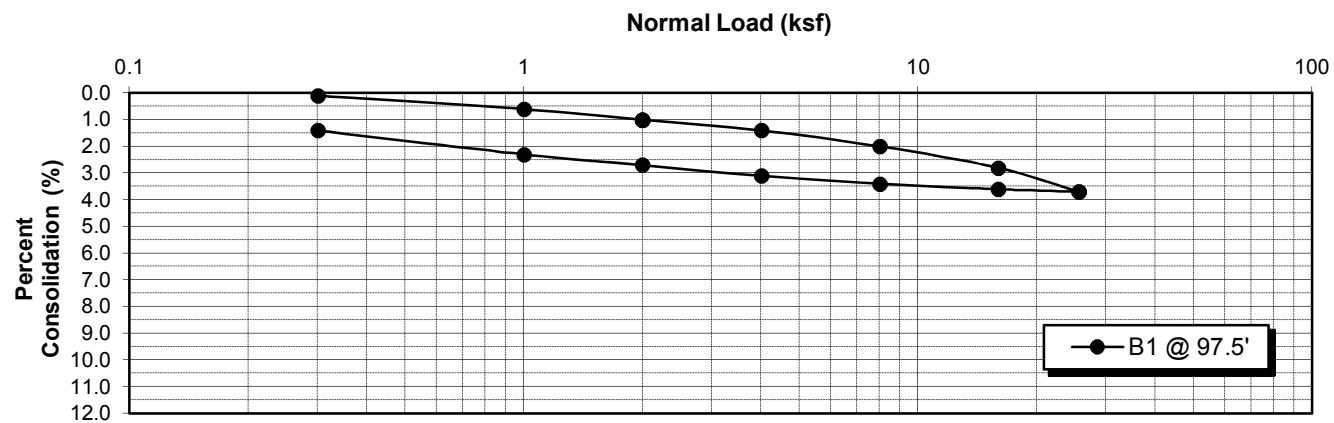
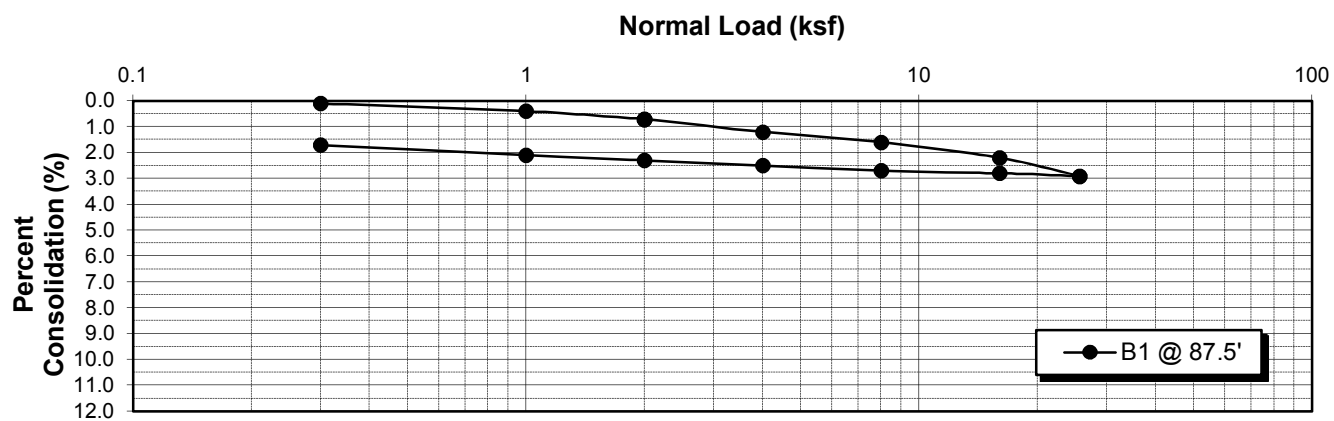
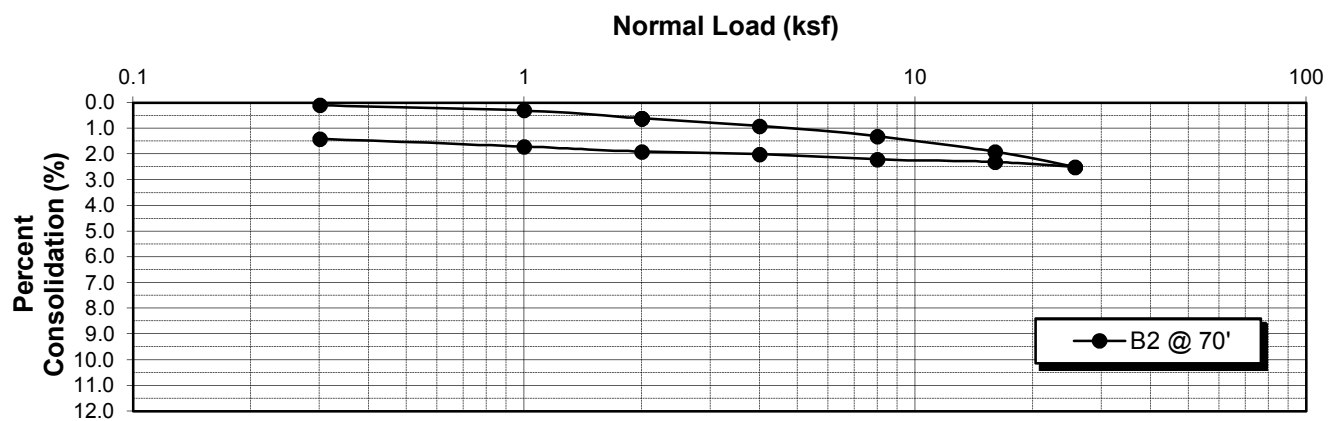
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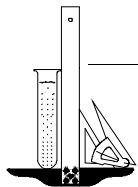
FILE NO. 21644

PLATE: C-2



Water added at 2 KSF

## CONSOLIDATION



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PROJECT: WALTER N. MARKS

FILE NO. 21644

PLATE: C-3



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Walter N. Marks

File No. 21644

## COMPACTION/EXPANSION/SULFATE DATA SHEET

### ASTM D-1557

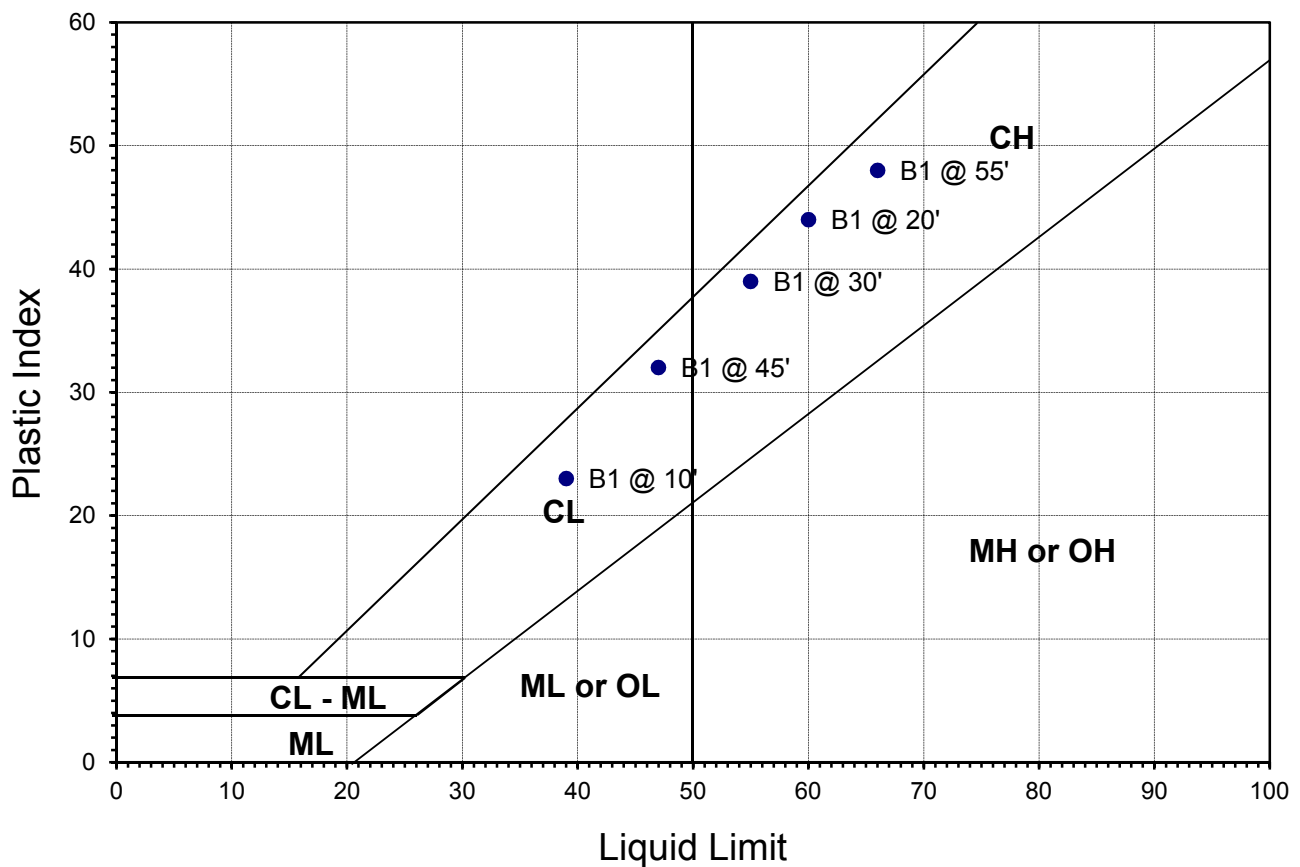
| Sample                               | B2 @ 1' – 5' | B3 @ 1' – 5' |
|--------------------------------------|--------------|--------------|
| Soil Type                            | CL           | CL           |
| Maximum Density (pcf)                | 123.5        | 123.5        |
| Optimum Moisture Content (percent)   | 12.5         | 12.0         |
| Percent finer than 0.005mm (percent) | >15%         | >15%         |

### EXPANSION INDEX

| Sample                              | B2 @ 1' – 5' | B3 @ 1' – 5' |
|-------------------------------------|--------------|--------------|
| Soil Type                           | CL           | CL           |
| Expansion Index – UBC Standard 18-2 | 118          | 124          |
| Expansion Characteristic            | High         | High         |

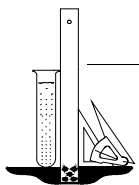
### SULFATE CONTENT

| Sample                | B2 @ 1' – 5' | B3 @ 1' – 5' |
|-----------------------|--------------|--------------|
| Sulfate Content (ppm) | 1,000        | >2,000       |



| Sample ID | Descriptions | Passing #200 | Liquid Limit | Plastic Limit | Plastic Index |
|-----------|--------------|--------------|--------------|---------------|---------------|
| B1 @ 10'  | CL           | 52.9         | 39.0         | 16.0          | 23.0          |
| B1 @ 15'  | SM           | 17.7         |              |               |               |
| B1 @ 20'  | CH           | 95.7         | 60.0         | 16.0          | 44.0          |
| B1 @ 30'  | CH           | 61.1         | 55.0         | 16.0          | 39.0          |
| B1 @ 45'  | CL           | 66.0         | 47.0         | 15.0          | 32.0          |
| B1 @ 55'  | CH           | 81.7         | 66.0         | 18.0          | 48.0          |
|           |              |              |              |               |               |
|           |              |              |              |               |               |
|           |              |              |              |               |               |
|           |              |              |              |               |               |

## ATTERBERG LIMITS



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FILE NO. 21644

PLATE: F



## LEGEND

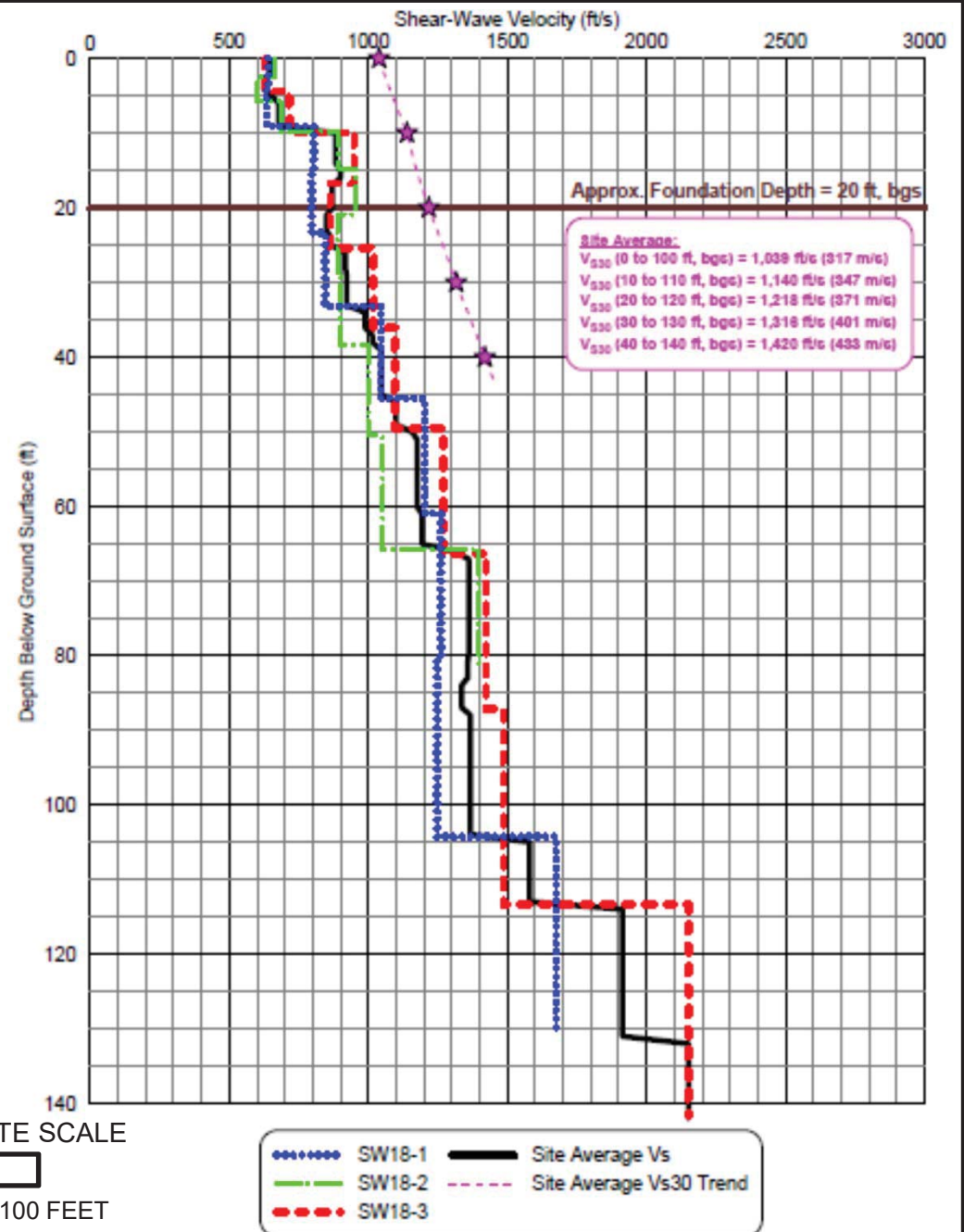
— Location of Surface Wave Geophysical Measurement



APPROXIMATE SCALE



0 100 FEET



## SHEAR-WAVE VELOCITY PROFILES LOCATIONS AND RESULTS

Date: OCT 2018

Project No.: 18054A

Project: 5407 WILSHIRE BLVD. GROUND MOTIONS

Figure 1b