CITY OF LOS ANGELES
CALIFORNIA

ERIC GARCETTI
MAYOR

DEPARTMENT OF
BUILDING AND SAFETY
201 NORTH FIGUEROA STREET
LOS ANGELES, CA 90012

OSAMA YOUNAN, P.E.
GENERAL MANAGER
SUPERINTENDENT OF BUILDING

JOHN WEIGHT
EXECUTIVE OFFICER

GEOLOGY AND SOILS REPORT APPROVAL LETTER

September 30, 2021

LOG # 118925
SOILS/GEOLOGY FILE - 2

Standard Southern Corporation
400 S. Central Avenue
Los Angeles, CA 90013

TRACT:	Wolfskill Orchard (MR 30-9/13) / Joseph W. Wolfskill Homestead Property (DM 1625-96)
LOT(S):	-- (VAC ORD 111966) / FR Unnumbered LT (Arbs. 1 & 2)
LOCATION:	715 E. 4th Street & 364 C. Central Avenue (North Site)

CURRENT REFERENCE REPORT/LETTER(S)	REPORT No.	DATE OF DOCUMENT	PREPARED BY
Geology/Soils Report	W1041-06-02	09/13/2021	Geocon West, Inc.

The Grading Division of the Department of Building and Safety has reviewed the referenced report that provides recommendations for the proposed multistory, mixed-use high-rise building and subterranean parking levels. According to the report, the subject property, identified as the "North Site", will be developed in conjunction with two additional, nearby development sites identified as the "South Site" and the "West Site". The three development sites are separated by Central Avenue and 4th Street. The subject property (North Site) will be developed with a 44-story structure over four levels of subterranean parking (48-stories total). The existing 6-story structure will remain and will be remodeled. Retaining walls ranging up to 64 feet in height are proposed for the subterranean parking structures.

The subject site consists of consecutive adjacent lots and are relatively flat with very little topography. Subsurface exploration performed by the consultant, in conjunction with the two other development sites, consisted of four hollowstem-auger borings to a maximum depth of 42 feet and one mud-rotary boring to a maximum depth of 100½ feet. The earth materials at the subsurface exploration locations consist of up to 8 feet of uncertified fill underlain by alluvium. No groundwater was encountered within the borings. The historically high groundwater table is estimated at a depth of about 75 feet. The consultants recommend to support the proposed structures on conventional and/or mat-type foundations bearing on native undisturbed alluvium.

The referenced report is acceptable, provided the following conditions are complied with during site development:

(Note: Numbers in parenthesis ( ) refer to applicable sections of the 2020 City of LA Building Code. P/BC numbers refer the applicable Information Bulletin. Information Bulletins can be accessed on the internet at LADBS.ORG.)

1. Stormwater infiltration is not approved. In the event that stormwater infiltration is proposed, a supplemental report shall be submitted to the Grading Division for review. The report shall include, at a minimum, an updated map and cross-sections showing the location and type of infiltration system.

2. Secure necessary approval from the Subdivision Section of the Department of City Planning for the proposed subdivision prior to recordation of the map and issuance of any permits.

   201 N. Figueroa Street 4th Floor, LA (213) 482-7077

3. Conformance with the Zoning Code Section 12.21 C8, which limits the heights and number of retaining walls, will be determined during structural plan check.

4. Approval shall be obtained from the Department of Public Works, Bureau of Engineering, Development Services and Permits Program for the proposed removal of support and/or retaining of slopes adjoining to a public way (3307.3.2).

   201 N. Figueroa Street 3rd Floor, LA (213) 482-7045

5. Provide a notarized letter from all adjoining property owners allowing tie-back anchors on their property (7006.6).

6. The geologist and soils engineer shall review and approve the detailed plans prior to issuance of any permits. This approval shall be by signature on the plans that clearly indicates the geologist and soils engineer have reviewed the plans prepared by the design engineer and that the plans include the recommendations contained in their reports (7006.1).

7. All recommendations of the report that are in addition to or more restrictive than the conditions contained herein shall be incorporated into the plans.

8. A copy of the subject and appropriate referenced reports and this approval letter shall be attached to the District Office and field set of plans. Submit one copy of the above reports to the Building Department Plan Checker prior to issuance of the permit. (7006.1)

9. A grading permit shall be obtained for all structural fill and retaining wall backfill (106.1.2).

10. All graded, brushed or bare slopes shall be planted with low-water consumption, native-type plant varieties to protect slopes against erosion (7012).

11. All new graded slopes shall be no steeper than 2H:1V (7010.2 & 7011.2).

12. All man-made fill shall be compacted to a minimum 90 percent of the maximum dry density of the fill material per the latest version of ASTM D 1557. Where cohesionless soil having less than 15 percent finer than 0.005 millimeters is used for fill, it shall be compacted to a minimum of 95 percent relative compaction based on maximum dry

density. Placement of gravel in lieu of compacted fill is only allowed if complying with LAMC Section 91.7011.3.

13. Existing uncertified fill shall not be used for support of footings, concrete slabs or new fill (1809.2, 7011.3).

14. Drainage in conformance with the provisions of the Code shall be maintained during and subsequent to construction (7013.12).

15. Grading shall be scheduled for completion prior to the start of the rainy season, or detailed temporary erosion control plans shall be filed in a manner satisfactory to the Grading Division of the Department and the Department of Public Works, Bureau of Engineering, B-Permit Section, for any grading work in excess of 200 cubic yards (7007.1).

    201 N. Figueroa Street 3rd Floor, LA (213) 482-7045

16. Controlled Low Strength Material, CLSM (slurry) proposed to be used for backfill shall satisfy the requirements specified in P/BC 2020-121.

17. The applicant is advised that the approval of this report does not waive the requirements for excavations contained in the General Safety Orders of the California Department of Industrial Relations (3301.1).

18. Temporary excavations that remove lateral support to the public way, adjacent property, or adjacent structures shall be supported by shoring. Note: Lateral support shall be considered to be removed when the excavation extends below a plane projected downward at an angle of 45 degrees from the bottom of a footing of an existing structure, from the edge of the public way or an adjacent property. (3307.3.1)

19. Where any excavation, not addressed in the approved reports, would remove lateral support (as defined in 3307.3.1) from a public way, adjacent property or structures, a supplemental report shall be submitted to the Grading Division of the Department containing recommendations for shoring, underpinning, and sequence of construction. Shoring recommendations shall include the maximum allowable lateral deflection of shoring system to prevent damage to adjacent structures, properties and/or public ways. Report shall include a plot plan and cross-section(s) showing the construction type, number of stories, and location of adjacent structures, and analysis incorporating all surcharge loads that demonstrate an acceptable factor of safety against failure. (7006.2 & 3307.3.2)

20. Prior to the issuance of any permit that authorizes an excavation where the excavation is to be of a greater depth than are the walls or foundation of any adjoining building or structure and located closer to the property line than the depth of the excavation, the owner of the subject site shall provide the Department with evidence that the adjacent property owner has been given a 30-day written notice of such intent to make an excavation (3307.1).

21. The soils engineer shall review and approve the shoring plans prior to issuance of the permit (3307.3.2).

22. Prior to the issuance of the permits, the soils engineer and/or the structural designer shall evaluate the surcharge loads used in the report calculations for the design of the retaining walls and shoring. If the surcharge loads used in the calculations do not conform to the

actual surcharge loads, the soil engineer shall submit a supplementary report with revised recommendations to the Department for approval.

23. Unsurcharged temporary excavations may be cut vertical up to 5 feet. Excavations between 5 feet and 12 feet shall be trimmed back at a uniform gradient not exceeding 1½:1, from top to bottom of excavation, as recommended.

24. Shoring shall be designed for the lateral earth pressures specified on page 33 of the 09/13/2021 report. All surcharge loads shall be included into the design. Total lateral load on shoring piles shall be determined by multiplying the recommended EFP by the pile spacing.

25. Shoring shall be designed for a maximum lateral deflection of 1 inch, provided there are no structures within a 1:1 plane projected up from the base of the excavation. Where a structure is within a 1:1 plane projected up from the base of the excavation, shoring shall be designed for a maximum lateral deflection of ½ inch, or to a lower deflection determined by the consultant that does not present any potential hazard to the adjacent structure.

26. A shoring monitoring program shall be implemented to the satisfaction of the soils engineer.

27. All foundations shall derive entire support from native undisturbed alluvium, as recommended and approved by the geologist and soils engineer by inspection.

28. Footings supported on approved compacted fill or expansive soil shall be reinforced with a minimum of four (4), ½-inch diameter (#4) deformed reinforcing bars. Two (2) bars shall be placed near the bottom and two (2) bars placed near the top of the footing.

29. Slabs placed on approved compacted fill shall be at least 3½ inches thick and shall be reinforced with ½-inch diameter (#4) reinforcing bars spaced a maximum of 16 inches on center each way.

30. Concrete floor slabs placed on expansive soil shall be placed on a 4-inch fill of coarse aggregate or on a moisture barrier membrane. The slabs shall be at least 3½ inches thick and shall be reinforced with ½-inch diameter (#4) reinforcing bars spaced a maximum of 16 inches on center each way.

31. The seismic design shall be based on a Site Class D, as recommended. All other seismic design parameters shall be reviewed by LADBS building plan check. According to ASCE 7-16 Section 11.4.8, the long period coefficient (Fv) may be selected per Table 11.4-2 in ASCE 7-16, provided that the value of the Seismic Response Coefficient (Cs) is determined by Equation 12.8-2 for values of the fundamental period of the building (T) less than or equal to 1.5Ts, and taken as 1.5 times the value computed in accordance with either Equation 12.8-3 for T greater than 1.5Ts and less than or equal to TL or Equation 12.8-4 for T greater than TL. Alternatively, a supplemental report containing a site-specific ground motion hazard analysis in accordance with ASCE 7-16 Section 21.2 shall be submitted for review and approval.

32. Retaining walls shall be designed for the lateral earth pressures specified in the section titled "Retaining Walls" starting on page 25 of the 09/13/2021 report. All surcharge loads shall be included into the design.

33. Retaining walls higher than 6 feet shall be designed for lateral earth pressure due to earthquake motions as specified on page 27 of the 09/13/2021 report (1803.5.12).

    Note: Lateral earth pressure due to earthquake motions shall be in addition to static lateral earth pressures and other surcharge pressures. The height of a stacked retaining wall shall be considered as the summation of the heights of each wall.

34. Basement walls and other walls in which horizontal movement is restricted at the top shall be designed for at-rest pressure as specified on page 25 of the 09/13/2021 report (1610.1). All surcharge loads shall be included into the design.

35. All retaining walls shall be provided with a standard surface backdrain system and all drainage shall be conducted in a non-erosive device to the street in an acceptable manner (7013.11).

36. With the exception of retaining walls designed for hydrostatic pressure, all retaining walls shall be provided with a subdrain system to prevent possible hydrostatic pressure behind the wall. Prior to issuance of any permit, the retaining wall subdrain system recommended in the soils report shall be incorporated into the foundation plan which shall be reviewed and approved by the soils engineer of record (1805.4).

37. Installation of the subdrain system shall be inspected and approved by the soils engineer of record and the City grading/building inspector (108.9).

38. Basement walls and floors shall be waterproofed/damp-proofed with an LA City approved "Below-grade" waterproofing/damp-proofing material with a research report number (104.2.6).

39. Prefabricated drainage composites (Miradrain, Geotextiles) may be only used in addition to traditionally accepted methods of draining retained earth.

40. Where the ground water table is lowered and maintained at an elevation not less than 6 inches below the bottom of the lowest floor, or where hydrostatic pressures will not occur, the floor and basement walls shall be damp-proofed. Where a hydrostatic pressure condition exists, and the design does not include a ground-water control system, basement walls and floors shall be waterproofed. (1803.5.4, 1805.1.3, 1805.2, 1805.3)

41. The structure shall be connected to the public sewer system per P/BC 2020-027.

42. All concentrated drainage shall be conducted in an approved device and disposed of in a manner approved by the LADBS (7013.10).

43. Any recommendations prepared by the geologist and/or the soils engineer for correction of geological hazards found during grading shall be submitted to the Grading Division of the Department for approval prior to use in the field (7008.2, 7008.3).

44. The geologist and soils engineer shall inspect all excavations to determine that conditions anticipated in the report have been encountered and to provide recommendations for the correction of hazards found during grading (7008, 1705.6, & 1705.8).

45. Prior to pouring concrete, a representative of the consulting soils engineer shall inspect and approve the footing excavations. The representative shall post a notice on the job site for

the LADBS Inspector and the Contractor stating that the work inspected meets the conditions of the report. No concrete shall be poured until the LADBS Inspector has also inspected and approved the footing excavations. A written certification to this effect shall be filed with the Grading Division of the Department upon completion of the work. (108.9 & 7008.2)

46. Prior to excavation an initial inspection shall be called with the LADBS Inspector. During the initial inspection, the sequence of construction, shoring, protection fences, and dust and traffic control will be scheduled (108.9.1).

47. Installation of shoring shall be performed under the inspection and approval of the soils engineer and deputy grading inspector (1705.6, 1705.8).

48. The installation and testing of tie-back anchors shall comply with the recommendations included in the report or the standard sheets titled "Requirement for Tie-back Earth Anchors", whichever is more restrictive. (Research Report #23835)

49. Prior to the placing of compacted fill, a representative of the soils engineer shall inspect and approve the bottom excavations. The representative shall post a notice on the job site for the LADBS Inspector and the Contractor stating that the soil inspected meets the conditions of the report. No fill shall be placed until the LADBS Inspector has also inspected and approved the bottom excavations. A written certification to this effect shall be included in the final compaction report filed with the Grading Division of the Department. All fill shall be placed under the inspection and approval of the soils engineer. A compaction report together with the approved soil report and Department approval letter shall be submitted to the Grading Division of the Department upon completion of the compaction. In addition, an Engineer's Certificate of Compliance with the legal description as indicated in the grading permit and the permit number shall be included (7011.3).

EDMOND LEE
Engineering Geologist Associate III

DAN L. STOICA
Geotechnical Engineer I

Log No. 118925
213-482-0480

cc: Geocon West, Inc., Project Consultant
LA District Office

CITY OF LOS ANGELES
DEPARTMENT OF BUILDING AND SAFETY
Grading Division

District

Log No. 118925

APPLICATION FOR REVIEW OF TECHNICAL REPORTS

INSTRUCTIONS

A. Address all communications to the Grading Division, LADBS, 201 N. Figueroa St., 3rd Fl., Los Angeles, CA 90012 Telephone No. (213)482-0480.

B. Submit two copies (three for subdivisions) of reports, one "pdf" copy of the report on a CD-Rom or flash drive, and one copy of application with items "1" through "10" completed.

C. Check should be made to the City of Los Angeles.

1. LEGAL DESCRIPTION JOSEPH W. WOLFSKILL HOMESTEAD
Tract: PROPERTY, WOLFSKILL ORCHARD TRACT (DM 1625-96)
Block:
Lots: FR "UNNUMBERED LT", VAC ORD 1119666 ARB: 1-2

2. PROJECT ADDRESS: 715 East 4th Street and 364 South Central Avenue

3. OWNER: Standard Southern Corporation
Address: 400 S. Central Avenue
City: Los Angeles Zip: 90013
Phone (Daytime):

4. APPLICANT Geocon West Inc.
Address: 3303 N. San Fernando Blvd.
City: Burbank Zip: 91504
Phone (Daytime): 818-841-8388
E-mail address: berliner@geoconinc.com

5. Report(s) Prepared by: Geocon West, Inc. No. W1041-06-02 (North Site)

6. Report Date(s): September 13, 2021

7. Status of project: ☑ Proposed ☐ Under Construction ☐ Storm Damage

8. Previous site reports? ☐ YES if yes, give date(s) of report(s) and name of company who prepared report(s)
Geocon West, Inc. W1041-06-02 dated 01/31/20

9. Previous Department actions? ☑ YES if yes, provide dates and attach a copy to expedite processing.
Dates: Log No. 113079 (05/19/20)

10. Applicant Signature: (Kelsey Filban) Position: Admin

(DEPARTMENT USE ONLY)

REVIEW REQUESTED	FEES	REVIEW REQUESTED		FEES
☐ Soils Engineering		No. of Lots		
☐ Geology	726.00	No. of Acres		
☐ Combined Soils Engr. & Geol.		☐ Division of Land		
☐ Supplemental		Other		
☐ Combined Supplemental		☐ Expedite		363.00
☐ Import-Export Route		☐ Response to Correction		
Cubic Yards:		☐ Expedite ONLY		
		Sub-total		1089.00
		One-Stop Surcharge		249.58
		TOTAL FEE		1338.58

Fee Due: 1338.58
Fee Verified By: Date: 9.17.21
(Cashier Use Only)

Los Angeles Department of Building and Safety
Metro 4th Floor 09/20/2021 8:20:01 AM
User ID: jbitanscol
Receipt Ref Nbr: 2021263001-18
Transaction ID: 2021263001-18-1
PLAN APPROVAL FEE $363.00
SYSTEMS DEV SURCH $65.34
GEN PLAN MAINT SURCH $76.23
DEV SERV CENTER SURCH $32.67
CITY PLAN SURCH $65.34
GRADING REPORT $726.00
MISC OTHER $10.00
Amount Paid: $1,338.58
PCIS Number: NA
Job Address: 715 E. 4TH STREET & 364 S. CENTRAL AVENUE
Owners Name: STANDARD SOUTHERN CORPORATION

ACTION BY:

THE REPORT IS: ☐ NOT APPROVED

☐ APPROVED WITH CONDITIONS ☐ BELOW ☐ ATTACHED

For Geology Date

For Soils Date

GEOCON
WEST, INC.

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED MIXED-USE AND HIGH-RISE DEVELOPMENT
"410 SOUTH CENTRAL AVENUE"
NORTH SITE
715 EAST 4TH STREET
364 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

TRACTS: JOSEPH W. WOLFSKILL HOMESTEAD PROPERTY,
WOLFSKILL ORCHARD TRACT
LOTS: FR "UNNUMBERED LT", VAC ORD 111966
ARB: 1-2

PREPARED FOR

STANDARD SOUTHERN CORPORATION
LOS ANGELES, CALIFORNIA

PROJECT NO. W1041-06-02

REVISED SEPTEMBER 13, 2021

GEOCON
WEST, INC.
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. W1041-06-02
Revised September 13, 2021

Mr. Larry Rauch
Standard Southern Corporation
400 S. Central Avenue
Los Angeles, CA 90013

Subject: PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED MIXED-USE AND HIGH-RISE DEVELOPMENT
"410 SOUTH CENTRAL AVENUE" – NORTH SITE
715 EAST 4TH STREET
364 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

Dear Mr. Rauch:

In accordance with your authorization of our proposal dated November 7, 2019, we have performed a preliminary geotechnical investigation for the proposed mixed-use and high-rise development located at 715 East 4th Street and 364 South Central Avenue in the City of Los Angeles, California. The accompanying report presents the findings of our study, and our conclusions and recommendations pertaining to the geotechnical aspects of proposed design and construction. Based on the results of our investigation, it is our opinion that the site can be developed as proposed, provided the recommendations of this report are followed and implemented during design and construction.

The primary intent of this report is to address the potential geologic hazards and geotechnical conditions that could impact site development and to provide preliminary recommendations. Additional analyses will be required in order to provide comprehensive geotechnical recommendations for design and construction.

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

Very truly yours,

GEOCON WEST, INC.

Petrina Zen

PETRINA ZEN
C87489

GERALD KASMAN
NO. 2251

JELISA THOMAS ADAMS
GE3092

Petrina Zen
PE 87489

Gerald A. Kasman
CEG 2251

Jelisa Adams
GE 3092

(EMAIL) Addressee

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

PRELIMINARY GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a geotechnical investigation for the proposed mixed-use and high-rise development located at 715 East 4th Street and 364 South Central Avenue in the City of Los Angeles, California (see Vicinity Map, Figure 1). The purpose of the investigation was to evaluate subsurface soil and geologic conditions underlying the site and, based on conditions encountered, to provide conclusions and recommendations pertaining to the geotechnical aspects of design and construction. Due to the preliminary nature of the project at this time, the primary intent of this report is to address the potential geologic hazards and geotechnical conditions that could impact site development and to provide preliminary recommendations. Additional analyses will be required in order to provide comprehensive geotechnical recommendations for design and construction.

The scope of this investigation included a site reconnaissance, field exploration, laboratory testing, engineering analysis, and the preparation of this report. The site was explored as a part of a larger parcel of land, which is shown on the Site Plan (see Figure 2A). The larger site was explored on November 23, 2019 by excavating four 8-inch diameter borings to depths between approximately 20 and 42 feet below the existing ground surface using a truck-mounted hollow-stem auger drilling machine. Additional site exploration was performed on December 28, 2019 by excavating one 4⅞-inch diameter boring to a depth of approximately 100½ feet below the existing ground surface using a truck-mounted mud-rotary drilling machine. The approximate locations of the exploratory borings are depicted on the Site Plan (see Figure 2A). A detailed discussion of the field investigation, including boring logs, is presented in Appendix A.

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

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

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

2. SITE AND PROJECT DESCRIPTION

The subject site is located at 715 East 4th Street and 364 South Central Avenue in the City of Los Angeles, California. The property is currently occupied by a six-story structure, a single-story warehouse structure, and associated loading yards and parking lots. The property is bounded by a three-story warehouse structure to the north, East 4th Street to the south, by a four-story parking structure and parking lot to the east, and by South Central Avenue to the west. The site is relatively flat, with no pronounced changes in elevation. Surface water drainage at the site appears to be by sheet flow along the existing ground contours to the city streets or area drains within the paving. Vegetation is nonexistent due to the paved nature of the site.

Based on the information provided by the Client, the entire project consists of a larger parcel of land, which can be divided into 3 portions: the North, South, and West sites. For the North site, the existing structures occupying the site will be demolished for the proposed new development, with the exception of the six-story structure. It is anticipated that the new construction will consists of an adaptive reuse of the existing six-story structure, as well as construction of a new 44-story structure over 4 levels of subterranean parking. Based in input provided by the project civil engineer, is anticipated that the proposed subterranean levels will extend to depths of approximately 57feet below the existing ground surface. Deeper excavations, up to an additional 7 feet, may be locally required for proposed elevator pits. The proposed site conditions are depicted on the Site Plan and Cross Sections (see Figures 2A and 2B).

Based on the preliminary nature of the design at this time, wall and column loads were not available. It is estimated that wall loads may be up to 20 kips per linear foot and column loads may be up to 2,000 kips.

Due to the preliminary nature of the project at this time, the primary intent of this report is to address the potential geologic hazards and geotechnical conditions that could impact site development and to provide preliminary recommendations. As the project proceeds, additional analyses will be required in order to provide comprehensive geotechnical recommendations for design and construction. Any changes in the design, location or elevation of any structure, as outlined in this report, should be reviewed by this office.

3. GEOLOGIC SETTING

The site is located in the northern portion of the Los Angeles Basin, within the limits of the ancestral flood plain of the Los Angeles River (located approximately 0.6 mile to the east). The Los Angeles Basin is a coastal plain, bounded by the Santa Monica Mountains, the Elysian Hills, and the Repetto Hills to the north, the Puente Hills to the northeast, the Whittier Fault to the east, the Palos Verdes Peninsula and Pacific Ocean to the south and west, and the Santa Ana Mountains and San Joaquin Hills to the southeast.

Regionally, the site is located within the northern portion of the Peninsular Ranges geomorphic province, near the boundary of the Transverse Ranges geomorphic province. The Peninsular Ranges is characterized by northwest-trending geologic structures in contrast to the Transverse Ranges, characterized by east-west geologic structures. The boundary between the two geomorphic provinces in the vicinity of the site is the Hollywood Fault located approximately 5.2 miles to the north (CGS, 2020b).

4. SOIL AND GEOLOGIC CONDITIONS

Based on our field investigation and published geologic maps of the area, the site is underlain by artificial fill over Holocene age alluvial deposits consisting predominately of sand with gravel and silt (Lamar, 1970). Detailed stratigraphic profiles of the materials encountered at the site are provided on the boring logs in Appendix A.

4.1 Artificial Fill

Artificial fill was encountered in our field explorations to a maximum depth of 8 feet below the existing ground surface. The artificial fill generally consists of brown to dark brown sand with varying amounts of silt. The artificial fill is characterized as slightly moist to moist and medium dense to dense. Fill soils encountered were generally fine to medium grained with trace amounts of debris and fine gravel. The fill is likely the result of past grading or construction activities at the site. Deeper fill may exist between excavations and in other portions of the site that were not directly explored.

4.2 Alluvial Deposits

Holocene are alluvial deposits were encountered directly beneath the fill. The alluvial deposits generally consist of light brown to brown to yellowish brown interbedded sand with varying amounts of silt and gravel. The alluvial deposits are generally characterized as dry to moist and loose to very dense, increasing in density with depth. The sand is generally poorly to well graded, with trace cobbles and boulders (up to 16 inches in size).

5. GROUNDWATER

Based on a review of the Seismic Hazard Zone Report for the Los Angeles Quadrangle (California Division of Mines and Geology [CDMG], 1998), the historically highest groundwater level in the area is approximately 75 feet beneath the ground surface. Groundwater information presented in this document is generated from data collected in the early 1900's to the late 1990s. Based on current groundwater basin management practices, it is unlikely that groundwater levels will ever exceed the historic high levels.

Groundwater was not encountered in our borings, drilled to a maximum depth of 100½ feet below the existing ground surface. Based on the historic high groundwater levels in the site vicinity (CDMG, 1998) and the depth of proposed construction, static groundwater is neither expected to be encountered during construction, nor have a detrimental effect on the project. However, it is not uncommon for groundwater levels to vary seasonally or for groundwater seepage conditions to develop where none previously existed, especially in impermeable fine-grained soils which are heavily irrigated or after seasonal rainfall. In addition, recent requirements for stormwater infiltration could result in shallower seepage conditions in the immediate site vicinity. Proper surface drainage of irrigation and precipitation will be critical for future performance of the project. Recommendations for drainage are provided in the S*urface Drainage* section of this report (see Section 7.26).

6. GEOLOGIC HAZARDS

6.1 Surface Fault Rupture

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

The site is not within a state-designated Alquist-Priolo Earthquake Fault Zone (CGS, 2020a and 2020b; CDMG, 2017). No active or potentially active faults with the potential for surface fault rupture are known to pass directly beneath the site. Therefore, the potential for surface rupture due to faulting occurring beneath the site during the design life of the proposed development is considered low. However, the site is located in the seismically active Southern California region, and could be subjected to moderate to strong ground shaking in the event of an earthquake on one of the many active Southern California faults. The faults in the vicinity of the site are shown in Figure 3, Regional Fault Map.

The closest active fault to the site is the Hollywood Fault located approximately 5.2 miles to the north-northwest (Ziony and Jones, 1989). Other nearby active faults are the Raymond Fault, the Newport-Inglewood Fault Zone, and the Whittier Fault, located approximately 5.3 miles north, 7.3 miles west-southwest, and 11.0 miles east of the property, respectively (Ziony and Jones, 1989). The active San Andreas Fault Zone is located approximately 36 miles northeast of the site (Ziony and Jones, 1989).

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

6.2 Seismicity

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

LIST OF HISTORIC EARTHQUAKES

Earthquake (Oldest to Youngest)	Date of Earthquake	Magnitude	Distance to Epicenter (Miles)	Direction to Epicenter
Near Redlands	July 23, 1923	6.3	57	E
Long Beach	March 10, 1933	6.4	33	SE
Tehachapi	July 21, 1952	7.5	79	NW
San Fernando	February 9, 1971	6.6	27	NNW
Whittier Narrows	October 1, 1987	5.9	9	E
Sierra Madre	June 28, 1991	5.8	20	NE
Landers	June 28, 1992	7.3	104	E
Big Bear	June 28, 1992	6.4	81	E
Northridge	January 17, 1994	6.7	21	WNW
Hector Mine	October 16, 1999	7.1	119	ENE
Ridgecrest	July 5, 2019	7.1	124	NNE

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

6.3 Seismic Design Criteria

The following table summarizes the site-specific design criteria obtained from the 2019 California Building Code (CBC; Based on the 2018 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The data was calculated using the online application *Seismic Design Maps*, provided by OSHPD. The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2019 CBC and Table 20.3-1 of ASCE 7-16. The values presented below are for the risk-targeted maximum considered earthquake (MCE_R).

2019 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2019 CBC Reference
Site Class	D	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	1.946g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.693g	Figure 1613.2.1(2)
Site Coefficient, F_A	1	Table 1613.2.3(1)
Site Coefficient, F_V	1.7*	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.946g	Section 1613.2.3 (Eqn 16-36)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	1.179g*	Section 1613.2.3 (Eqn 16-37)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	1.297g	Section 1613.2.4 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.786g*	Section 1613.2.4 (Eqn 16-39)

Note:

*Per Section 11.4.8 of ASCE/SEI 7-16, a ground motion hazard analysis shall be performed for projects for Site Class "E" sites with Ss greater than or equal to 1.0g and for Site Class "D" and "E" sites with S1 greater than 0.2g. Section 11.4.8 also provides exceptions which indicates that the ground motion hazard analysis may be waived provided the exceptions are followed. Using the code based values presented in the table above, in lieu of a performing a ground motion hazard analysis, requires the exceptions outlined in ASCE 7-16 Section 11.4.8 be followed.

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

ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.834g	Figure 22-9
Site Coefficient, F_{PGA}	1.1	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.917g	Section 11.8.3 (Eqn 11.8-1)

The Maximum Considered Earthquake Ground Motion (MCE) is the level of ground motion that has a 2 percent chance of exceedance in 50 years, with a statistical return period of 2,475 years. According to the 2019 California Building Code and ASCE 7-16, the MCE is to be utilized for the evaluation of liquefaction, lateral spreading, seismic settlements, and it is our understanding that the intent of the Building code is to maintain “Life Safety” during a MCE event. The Design Earthquake Ground Motion (DE) is the level of ground motion that has a 10 percent chance of exceedance in 50 years, with a statistical return period of 475 years.

Deaggregation of the MCE peak ground acceleration was performed using the USGS online Unified Hazard Tool, 2014 Conterminous U.S. Dynamic edition (v4.2.0). The result of the deaggregation analysis indicates that the predominant earthquake contributing to the MCE peak ground acceleration is characterized as a 6.85 magnitude event occurring at a hypocentral distance of 9.73 kilometers from the site.

Deaggregation was also performed for the Design Earthquake (DE) peak ground acceleration, and the result of the analysis indicates that the predominant earthquake contributing to the DE peak ground acceleration is characterized as a 6.72 magnitude occurring at a hypocentral distance of 13.29 kilometers from the site.

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

6.4 Liquefaction Potential

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

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

The State of California Seismic Hazard Zone Map for the Los Angeles Quadrangle (CDMG, 1999) indicates that the site is not located within an area identified as having a potential for liquefaction. As stated in Section 5, the historically highest groundwater level in the area is approximately 75 feet beneath the ground surface. Based on this consideration, as well as the density of the soils at depth, it is our opinion that the potential for liquefaction to occur beneath the site is considered low.

6.5 Slope Stability

The topography at the property is relatively level. The immediate vicinity of the project slopes gently to the south. The site is not located within a City of Los Angeles Hillside Grading Area or Hillside Grading Ordinance Area (City of Los Angeles, 2018). According to the County of Los Angeles Safety Element (Leighton, 1990), the site is not within a hillside area or landslide area. Additionally, the site is not within zone of required investigation for earthquake-induced landslides (CDMG, 1999). There are no known landslides near the site, nor is the site in the path of any known or potential landslides. Therefore, the potential for slope stability hazards to adversely affect the proposed development is considered low.

6.6 Earthquake-Induced Flooding

Earthquake-induced flooding is inundation caused by failure of dams or other water-retaining structures due to earthquakes. The Los Angeles County Safety Element (Leighton, 1990) indicates that the site is located within the dam or debris basin inundation area or flood boundary for the Hansen Dam. Therefore, there is potential for inundation at the site to occur as a result of an earthquake-induced dam failure. However, these reservoirs, as well as others in California, are continually monitored by various governmental agencies (such as the State of California Division of Safety of Dams and the U.S. Army Corps of Engineers) to guard against the threat of dam failure. Current design, construction practices, and ongoing programs of review, modification, or total reconstruction of existing dams are intended to ensure that all dams are capable of withstanding the maximum considered earthquake (MCE) for the site.

6.7 Tsunamis, Seiches, and Flooding

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

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

The site is within a Flood Zone X as defined by the Federal Emergency Management Agency (FEMA, 2020: LACDPW, 2020).

6.8 Oil Fields & Methane Potential

Based on a review of the California Geologic Energy Management Division (CalGEM) Well Finder Website, the site is not located within the limits of an oilfield and oil or gas wells are not located in the immediate site vicinity (CalGEM, 2020). However, due to the voluntary nature of record reporting by the oil well drilling companies, wells may be improperly located or not shown on the location map and undocumented wells could be encountered during construction. Any wells encountered during construction will need to be properly abandoned in accordance with the current requirements of the DOGGR.

Should it be determined that a methane study is required for the proposed development it is recommended that a qualified methane consultant be retained to perform the study and provide mitigation measures as necessary.

6.9 Subsidence

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

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 General

7.1.1 It is our opinion that neither soil nor geologic conditions were encountered during the investigation that would preclude the construction of the proposed development provided the recommendations presented herein are followed and implemented during design and construction. The geotechnical design parameters presented herein should be reviewed and updated once proposed building elevations are finalized and structural loads are available.

7.1.2 Up to 8 feet of existing artificial fill was encountered during the site investigation. The existing fill encountered is believed to be the result of past grading and construction activities at the site. Deeper fill may exist in other areas of the site that were not directly explored. It is our opinion that the existing fill, in its present condition, is not suitable for direct support of proposed foundations or slabs. The existing fill and site soils are suitable for re-use as engineered fill provided the recommendations in the Grading section of this report are followed (see Section 7.4).

7.1.3 Excavations for the subterranean levels are anticipated to penetrate through the existing artificial fill and expose undisturbed alluvial soils throughout the excavation bottom.

7.1.4 Based on our observations onsite and our knowledge of the geologic setting, cobbles should be anticipated during earthwork at the subject site. Additionally, boulders are common in this geologic environment and may be encountered in the alluvial soils. The contractor should be prepared for difficult excavation conditions as well as caving. The presence of these materials and their impact on construction methods and equipment selection should be considered by both the owner and contractor prior to construction.

7.1.5 It is anticipated that the tower cores will be supported on reinforced concrete mat foundations, and that elsewhere conventional spread foundations may be used. Recommendations for mat foundations and conventional spread foundations are provided herein in Sections 7.6 through 7.8. All foundations should derive support in competent alluvial soils found below a depth of 10 feet below the ground surface. Foundations should be deepened as necessary to extend into satisfactory soils and must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.).

7.1.6 Where new footings are required for support of the proposed improvements within the existing structure, it is anticipated that conventional foundations deriving support in the undisturbed, competent alluvial soils may be used. Based on the boring performed outside of the footprint of the existing structure, the depth to competent alluvial soils may be on the order of 8 feet below the existing ground surface. Additional exploration within the footprint of the existing structure is recommended in order to further evaluate the depth to competent alluvial soils and provide recommendations for new footings within the existing structure.

7.1.7 Where new foundations are constructed immediately adjacent to existing foundations, the new foundation should be deepened to match the depth of the existing foundation to prevent a surcharge on the existing foundation.

7.1.8 Where proposed foundations will be deeper than an existing foundation, the new foundation must be designed to resist the surcharge imposed by the existing foundation. The surcharge area may be defined by a 1:1 projection down and away from the bottom of the existing foundation.

7.1.9 Allowable bearing pressures and anticipated settlements will be highly influenced by the proposed foundation dimensions and loads. Once proposed building loads become available and elevations are established, additional analyses will be required to evaluate the anticipated total and differential settlements between the foundation elements to check if the settlements are in conformance with the City of Los Angeles policy or provide updated foundation design recommendations.

7.1.10 Excavations up to 64 feet in vertical height are anticipated for construction of the subterranean levels, including foundation depths. Due to the depth of the excavation and the proximity to the property lines, city streets and adjacent offsite structures and improvements, excavation of the proposed subterranean levels will require sloping and/or shoring in order to provide a stable excavation. Where shoring is required it is recommended that a soldier pile shoring system be utilized. In addition, where the proposed excavation will be deeper than and adjacent to an offsite structure, the proposed shoring should be designed to resist the surcharge imposed by the adjacent offsite structure. Recommendations for shoring are provided in Section 7.20 of this report.

7.1.11 Due to the nature of the proposed design and intent for a subterranean level, waterproofing of subterranean walls and slabs is suggested. Particular care should be taken in the design and installation of waterproofing to avoid moisture problems, or actual water seepage into the structure through any normal shrinkage cracks which may develop in the concrete walls, floor slab, foundations and/or construction joints. The design and inspection of the waterproofing 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 subterranean walls, floor slabs and foundations.

7.1.12 Where new paving is to be placed, it is recommended that all existing fill and soft alluvial soils be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing fill and soft alluvial soils in the area of new paving is not required; however, paving constructed over existing uncertified fill or unsuitable alluvial soil may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of subgrade soil should be scarified and properly compacted for paving support. Paving recommendations are provided in *Preliminary Pavement Recommendations* section of this report (see Section 7.13).

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

7.1.14 Based on the results of percolation testing performed at the site, a stormwater infiltration system is considered feasible for this project. Recommendations for infiltration are provided in the *Stormwater Infiltration* section of this report (see Section 7.25).

7.1.15 Once the foundation loading configuration and design elevations for the existing and proposed structures proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, as necessary. Based on the final foundation loading configurations and building elevations, the potential for settlement should be reevaluated by this office.

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

7.2 Soil and Excavation Characteristics

7.2.1 The in-situ soils can be excavated with moderate effort using conventional excavation equipment. Due to the presence of granular soils, excessive caving should be anticipated in unshored vertical excavations and the contractor should be prepared for caving conditions. Formwork may be required to prevent caving of foundation excavations. In addition, due to the presence of cobbles and the potential for boulders, the contractor should be prepared for difficult excavation conditions during drilling and earthwork activities.

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

7.2.3 All onsite excavations must be conducted in such a manner that potential surcharges from existing structures, construction equipment, and vehicle loads are resisted. The surcharge area may be defined by a 1:1 projection down and away from the bottom of an existing foundation or vehicle load. Penetrations below this 1:1 projection will require special excavation measures such as sloping or shoring. Excavation recommendations are provided in the *Temporary Excavations* section of this report (see Section 7.19).

7.2.4 The upper 5 feet of existing site soils encountered during this investigation are considered to have a “very low” expansive potential (EI = 0); and are classified as “non-expansive” based on the 2019 California Building Code (CBC) Section 1803.5.3. The soils encountered at the subterranean levels are primarily granular in nature and anticipated to be “non-expansive” in accordance with the 2019 California Building Code (CBC) Section 1803.5.3. Recommendations presented herein assume that proposed foundations and slabs will derive support in these materials.

7.3 Minimum Resistivity, pH and Water-Soluble Sulfate

7.3.1 Potential of Hydrogen (pH) and resistivity testing as well as chloride content testing were performed on representative samples of soil to generally evaluate the corrosion potential to surface utilities. The tests were performed in accordance with California Test Method Nos. 643 and 422 and indicate that the soils are considered “mildly corrosive” to “moderately corrosive” with respect to corrosion of buried ferrous metals on site. The results are presented in Appendix B (Figure B28) and should be considered for design of underground structures.

7.3.2 Laboratory tests were performed on representative samples of the on-site soil to measure the percentage of water-soluble sulfate content. Results from the laboratory water-soluble sulfate tests are presented in Appendix B (Figure B28) and indicate that the on-site materials possess a sulfate exposure class of “S0” to concrete structures as defined by 2019 CBC Section 1904 and ACI 318-14 Table 19.3.1.1.

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

7.4 Grading

7.4.1 Grading is anticipated to include excavation of site soils for the subterranean levels, foundations, and utility trenches, as well as placement of backfill for walls, ramps, and trenches.

7.4.2 Earthwork should be observed, and compacted fill tested by representatives of Geocon West, Inc. The existing fill encountered during exploration is suitable for re-use as an engineered fill, provided any encountered oversize material (greater than 6 inches) and any encountered deleterious debris is removed.

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

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

7.4.5 The City of Los Angeles Department of Building and Safety requires a minimum compactive effort of 95 percent of the laboratory maximum dry density in accordance with ASTM D 1557 (latest edition) where the soils to be utilized in the fill have less than 15 percent finer than 0.005 millimeters. Soils with more than 15 percent finer than 0.005 millimeters may be compacted to 90 percent of the laboratory maximum dry density in accordance with ASTM D 1557 (latest edition).

7.4.6 Based on the soils encountered during this investigation, it is anticipated that 95 percent relative compaction will be required. All fill and backfill soils should be placed in horizontal loose layers approximately 6 to 8 inches thick, moisture conditioned to near optimum moisture content, and properly compacted to the required degree of compaction in accordance with ASTM D 1557 (latest edition).

7.4.7. Where new paving is to be placed, it is recommended that all existing fill and soft soils be excavated and properly compacted for paving support. As a minimum, the upper 12 inches of soil should be scarified, moisture conditioned to near optimum moisture content, and compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Paving recommendations are provided in *Preliminary Pavement Recommendations* section of this report (see Section 7.13).

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

7.4.9 All imported fill shall be observed, tested and approved by Geocon West, Inc. prior to bringing soil to the site. Rocks larger than 6 inches in diameter shall not be used in the fill. Imported soils should have an expansion index less than 20 and soils corrosivity properties that are equally or less detrimental to that of the existing onsite soils (see Figure B28).

7.4.10 Utility trenches should be properly backfilled in accordance with the requirements of the Green Book (latest edition). The pipe should be bedded with clean sands (Sand Equivalent greater than 30) to a depth of at least 1 foot over the pipe, and the bedding material must be inspected and approved in writing by the Geotechnical Engineer (a representative of Geocon). The use of gravel is not acceptable unless used in conjunction with filter fabric to prevent the gravel from having direct contact with soil. If gravel is used for trench bedding and shading (typical when seepage is present) it must be 3/16-inch rounded birds-eye rock in accordance with the City of LA plumbing department requirements. The remainder of the trench backfill may be derived from onsite soil or approved import soil, compacted as necessary, until the required compaction is obtained. The use of minimum 2-sack slurry as backfill is also acceptable (see Section 7.5). Prior to placing any bedding materials or pipes, the excavation bottom must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

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

7.5 Controlled Low Strength Material (CLSM)

7.5.1 Controlled Low Strength Material (CLSM) may be utilized in lieu of compacted soil as engineered fill where approved in writing by the Geotechnical Engineer. Where utilized within the City of Los Angeles use of CLSM is subject to the following requirements:

Standard Requirements

1. CLSM shall be ready-mixed by a City of Los Angeles approved batch plant;
2. CLSM shall not be placed on uncertified fill, on incompetent natural soil, nor below water;
3. CLSM shall not be placed on a sloping surface with a gradient steeper than 5:1 (horizontal to vertical);
4. Placement of the CLSM shall be under the continuous inspection of a concrete deputy inspector;
5. The excavation bottom shall be accepted by the soil engineer and the City Inspector prior to placing CLSM.

Requirements for CLSM that will be used for support of footings

1. The cement content of the CLSM shall not be less than 188 pounds per cubic yard (min. 2 sacks);
2. The excavation bottom must be level, cleaned of loose soils and approved in writing by Geocon prior to placement of the CLSM;
3. The ultimate compressive strength of the CLSM shall be no less than 100 pounds per square inch (psi) when tested on the 28th-day per ASTM D4832 (latest edition), Standard Test Method for Preparation and Testing of Controlled Low Strength Material Test Cylinders. Compression testing will be performed in accordance with ASTM C39 and City of Los Angeles requirements;
4. Samples of the CLSM will be collected during placement, a minimum of one test (two cylinders) for each 50 cubic yards or fraction thereof;
5. Overexcavation for CLSM placement shall extend laterally beyond the footprint of any proposed footings as required for placement of compacted fill, unless justified otherwise by the soil engineer that footings will have adequate vertical and horizontal bearing capacity.

7.6 Foundation Design

7.6.1 It is anticipated that the tower cores will be supported on reinforced concrete mat foundations, and that elsewhere conventional spread foundations may be used. If additional capacity is required for overturning considerations, supplemental recommendations for deepened pile foundations can also be considered and should be discussed with the project team. All foundations for proposed structures should derive support in competent alluvial soils found below a depth of 10 feet below the ground surface. Foundations should be deepened as necessary to extend into satisfactory soils and must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.).

7.6.2 Once proposed foundation depths and building loads are available, additional analyses may be required to evaluate the anticipated total and differential settlements between the foundation elements for verification that the settlements are within tolerance as evaluated by the project structural engineer. Updated foundation design recommendations will be provided as necessary in an addendum report.

7.6.3 No special subgrade presaturation is required prior to placement of concrete. However, the slab and foundation subgrade should be sprinkled as necessary; to maintain a moist condition as would be expected in any concrete placement.

7.6.4 Waterproofing of subterranean walls and slabs is recommended for this project for any portions of the structure that will be constructed below the groundwater table. Particular care should be taken in the design and installation of waterproofing to avoid moisture problems, or actual water seepage into the structure through any normal shrinkage cracks which may develop in the concrete walls, floor slab, foundations and/or construction joints. The design and inspection of the waterproofing 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 subterranean walls, floor slabs and foundations.

7.6.5 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of the methane system, reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.

7.6.6 This office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.

7.7 Conventional Foundation Design

7.7.1 The bearing capacities presented herein are preliminary and are considered a reasonable pressure for initial evaluation. Higher bearing capacities are feasible; however, the use of higher bearing capacities will require coordination with the structural engineer and will be based on the structural tolerance for allowable total and differential settlements.

7.7.2 Continuous footings may be designed for an allowable bearing capacity of 3,000 pounds per square foot (psf), and should be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing material.

7.7.3 Isolated spread foundations may be designed for an allowable bearing capacity of 3,500 psf, and should be a minimum of 24 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing material.

7.7.4 The allowable soil bearing pressure above may be increased by 250 psf and 500 psf for each additional foot of foundation width and depth, respectively, up to a maximum allowable soil bearing pressure of 6,500 psf.

7.7.5 The allowable bearing pressures may be increased by one-third for transient loads due to wind or seismic forces.

7.7.6 If depth increases are utilized for the perimeter foundations, this office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.

7.7.7 Continuous footings should be reinforced with four No. 4 steel reinforcing bars, two placed near the top of the footing and two near the bottom. Reinforcement for spread footings should be designed by the project structural engineer.

7.7.8 The above foundation dimensions and minimum reinforcement recommendations are based on soil conditions and building code requirements only, and are not intended to be used in lieu of those required for structural purposes.

7.8 Mat Foundation Design – Tower Core

7.8.1 The recommended maximum allowable bearing value is 6,500 psf for the design of a mat foundation system deriving support in the undisturbed alluvial soils found below a depth of 10 feet. The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.

7.8.2 The recommended maximum allowable bearing value is 10,000 psf for the design of a mat foundation system deriving support in the undisturbed alluvial soils found below a depth of 40 feet. The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.

7.8.3 A vertical modulus of subgrade reaction of 150 pounds per cubic inch (pci) may be used in the design of mat foundations deriving support in competent alluvial soils found at or below a depth of 10 feet below the ground surface. This value is a unit value for use with a 1-foot square footing. The modulus should be reduced in accordance with the following equation when used with larger foundations:

$$K_R = K\left[\frac{B+1}{2B}\right]^2$$

where: K_R = reduced subgrade modulus
K = unit subgrade modulus
B = foundation width (in feet)

7.8.4 The thickness of and reinforcement for the mat foundation should be designed by the project structural engineer.

7.8.5 For seismic design purposes, a coefficient of friction of 0.35 may be utilized between the concrete mat and subgrade soils without a moisture barrier, and 0.15 for slabs underlain by a moisture barrier.

7.9 Foundation Settlement

7.9.1 The anticipated settlements indicated below are preliminary and should be verified once the project structural engineer can provide a final diagram of the anticipated foundation bearing pressures.

7.9.2 The maximum static settlement for conventional foundations deriving support in the undisturbed alluvial soils found below a depth of 40 feet and designed with a maximum bearing pressure of 6,500 psf is estimated to be less than ½ inch and occur below the heaviest loaded structural element. Settlement of the foundation system is expected to occur on initial application of loading. Differential settlement is expected to be less than ½ inch over a distance of 20 feet.

7.9.3 The maximum expected static settlement for an assumed 40-foot by 30-foot mat foundation deriving support in the undisturbed alluvial soils found below a depth of 40 feet and utilizing a maximum allowable bearing pressure of 10,000 psf is estimated to be less than 1 inch and occur below the central portion of the mat. The differential settlement between the center and corner of the mat is estimated to be less than ½ inch.

7.9.4 Differential settlement between the mat foundations and conventional foundations is expected to be less than ¾ inch.

7.9.5 Once the design and foundation loading configurations for the proposed structures proceeds to a more finalized plan, the estimated settlements presented in this report should be reviewed and revised, if necessary. If the final foundation loading configurations are greater than the assumed loading conditions, the potential for settlement should be reevaluated by this office.

7.10 Miscellaneous Foundations

7.10.1 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures which will not be tied to the proposed structure may be supported on conventional foundations bearing on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed or is undesirable, such as adjacent to property lines, foundations may derive support in the undisturbed alluvial soils, and should be deepened as necessary to maintain a minimum 12 inch embedment into the recommended bearing materials.

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

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

7.11 Lateral Design

7.11.1 Resistance to lateral loading may be provided by friction acting at the base of foundations, slabs and by passive earth pressure. An allowable coefficient of friction of 0.35 may be used with the dead load forces in the competent alluvial soils or newly placed engineered fill.

7.11.2 Passive earth pressure for the sides of foundations and slabs poured against competent alluvial soils or newly placed engineered fill may be computed as an equivalent fluid having a density of 250 pcf with a maximum earth pressure of 2,500 psf. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third.

7.12 Concrete Slabs-on-Grade

7.12.1 Concrete slabs-on-grade subject to vehicle loading should be designed in accordance with the recommendations in the *Pavement Recommendations* section of this report (Section 7.13).

7.12.2 Subsequent to the recommended grading, concrete slabs-on-grade for structures, not subject to vehicle loading, should be a minimum of 4 inches thick and minimum slab reinforcement should consist of No. 4 steel reinforcing bars placed 16 inches on center in both horizontal directions. Steel reinforcing should be positioned vertically near the slab midpoint.

7.12.3 Slabs-on-grade at the ground surface that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder placed directly beneath the slab. The vapor retarder and acceptable permeance should be specified by the project architect or developer based on the type of floor covering that will be installed. The vapor retarder design should be consistent with the guidelines presented in Section 9.3 of the American Concrete Institute's (ACI) Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials (ACI 302.2R-06) and should be installed in general conformance with ASTM E 1643 (latest edition) and the manufacturer's recommendations. A minimum thickness of 15 mils extruded polyolefin plastic is recommended; vapor retarders which contain recycled content or woven materials are not recommended. The vapor retarder should have a permeance of less than 0.01 perms demonstrated by testing before and after mandatory conditioning. The vapor retarder should be installed in direct contact with the concrete slab with proper perimeter seal. If the California Green Building Code requirements apply to this project, the vapor retarder should be underlain by 4 inches of clean aggregate. It is important that the vapor retarder be puncture resistant since it will be in direct contact with angular gravel. As an alternative to the clean aggregate suggested in the Green Building Code, it is our opinion that the concrete slab-on-grade may be underlain by a vapor retarder over 4 inches of clean sand (sand equivalent greater than 30), since the sand will serve a capillary break and will minimize the potential for punctures and damage to the vapor barrier.

7.12.4 For seismic design purposes, a coefficient of friction of 0.35 may be utilized between concrete slabs and subgrade soils without a moisture barrier, and 0.15 for slabs underlain by a moisture barrier.

7.12.5 Exterior slabs for walkways or flatwork, not subject to traffic loads, should be at least 4 inches thick and reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions, positioned near the slab midpoint. Prior to construction of slabs, the upper 12 inches of subgrade should be moistened to near optimum moisture content and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Crack control joints should be spaced at intervals not greater than 10 feet and should be constructed using saw-cuts or other methods as soon as practical following concrete placement. Crack control joints should extend a minimum depth of one-fourth the slab thickness. The project structural engineer should design construction joints as necessary.

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

7.13 Preliminary Pavement Recommendations

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

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

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

PRELIMINARY PAVEMENT DESIGN SECTIONS

Location	Estimated Traffic Index (TI)	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
Automobile Parking And Driveways	4.0	3.0	4.0
Trash Truck & Fire Lanes	7.0	4.0	9.0

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

7.13.5 Unless specifically designed and evaluated by the project structural engineer, where exterior concrete paving will be utilized for support of vehicles, it is recommended that the concrete be a minimum of 6 inches of concrete reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Concrete paving supporting vehicular traffic should be underlain by a minimum of 4 inches of aggregate base and a properly compacted subgrade. The subgrade and base material should be compacted to 95 percent relative compaction as determined by ASTM Test Method D 1557 (latest edition).

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

7.14 Retaining Wall Design

7.14.1 The recommendations presented below are generally applicable to the design of rigid concrete or masonry retaining walls having a maximum height of 64 feet. In the event that walls significantly higher than 64 feet are planned, Geocon should be contacted for additional recommendations.

7.14.2 Retaining wall foundations may be designed in accordance with the recommendations provided in the *Foundation Design* sections of this report (see Sections 7.6 through 7.8).

7.14.3 Retaining walls with a level backfill surface that are not restrained at the top should be designed utilizing a triangular distribution of pressure (active pressure). Restrained walls are those that are not allowed to rotate more than 0.001H (where H equals the height of the retaining portion of the wall in feet) at the top of the wall. Where walls are restrained from movement at the top, walls may be designed utilizing a triangular distribution of pressure (at-rest pressure). The table below presents recommended pressures to be used in retaining wall design, assuming that proper drainage will be maintained. Calculations of the recommended retaining wall pressures are provided as Figures 5 through 8.

RETAINING WALL WITH LEVEL BACKFILL SURFACE

HEIGHT OF RETAINING WALL (Feet)	ACTIVE PRESSURE EQUIVALENT FLUID PRESSURE (Pounds Per Cubic Foot)	AT-REST PRESSURE EQUIVALENT FLUID PRESSURE (Pounds Per Cubic Foot)
Up to 12	39	61
13-25	48	61
26-45	52	61
46-64	54	61

7.14.4 The wall pressures provided above assume that the proposed retaining walls will support undisturbed soils. If sloping techniques are to be utilized for construction of proposed walls, which would result in a wedge of engineered fill behind the retaining walls, revised earth pressures may be required to account for the expansive potential of the soil placed as engineered fill. This should be evaluated once the use of sloping measures is established and once the geotechnical characteristics of the engineered backfill soils can be further evaluated.

7.14.5 The wall pressures provided above assume that the retaining wall will be properly drained preventing the buildup of hydrostatic pressure. If retaining wall drainage is not implemented, the equivalent fluid pressure to be used in design of undrained walls is 91 pcf. The value includes hydrostatic pressures plus buoyant lateral earth pressures.

7.14.6 Additional active pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent structures and should be designed for each condition as the project progresses.

7.14.7 It is recommended that line-load surcharges from adjacent wall footings, use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.20 \times \left(\frac{z}{H}\right)}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

and

$$For\ {}^{x}/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.28 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

where x is the distance from the face of the excavation or wall to the vertical line-load, H is the distance from the bottom of the footing to the bottom of excavation or wall, z is the depth at which the horizontal pressure is desired, Q_L is the vertical line-load and $\sigma_H(z)$ is the horizontal pressure at depth z.

7.14.8 It is recommended that vertical point-loads, from construction equipment outriggers or adjacent building columns use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.28 \times \left(\frac{z}{H}\right)^2}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

and

$$For\ {}^{x}/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.77 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)^2}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

then

$$\sigma'_H\,(z) = \sigma_H(z)cos^2(1.1\theta)$$

where x is the distance from the face of the excavation/wall to the vertical point-load, H is distance from the outrigger/bottom of column footing to the bottom of excavation, z is the depth at which the horizontal pressure is desired, Q_P is the vertical point-load, $\sigma_H(z)$ is the horizontal pressure at depth z, θ is the angle between a line perpendicular to the excavation/wall and a line from the point-load to location on the excavation/wall where the surcharge is being evaluated, and $\sigma_H(z)$ is the horizontal pressure at depth z.

7.14.9 In addition to the recommended earth pressure, the upper 10 feet of the subterranean wall adjacent to the street or driveway areas should be designed to resist a uniform lateral pressure of 100 psf, acting as a result of an assumed 300 psf surcharge behind the wall due to normal street traffic. If the traffic is kept back at least 10 feet from the subterranean walls, the traffic surcharge may be neglected.

7.14.10 Seismic lateral forces should be incorporated into the design as necessary, and recommendations for seismic lateral forces are presented below.

7.15 Dynamic (Seismic) Lateral Forces

7.15.1 The structural engineer should determine the seismic design category for the project in accordance with Section 1613 of the CBC. If the project possesses a seismic design category of D, E, or F, proposed retaining walls in excess of 6 feet in height should be designed with seismic lateral pressure (Section 1803.5.12 of the 2019 CBC).

7.15.2 A seismic load of 15 pcf should be used for design on walls that support more than 6 feet of backfill in accordance with Section 1803.5.12 of the 2019 CBC. The seismic load is applied as an equivalent fluid pressure along the height of the wall and the calculated loads result in a maximum load exerted at the base of the wall and zero at the top of the wall. This seismic load should be applied in addition to the active earth pressure. The earth pressure is based on half of two thirds of PGA_M calculated from ASCE 7-16 Section 11.8.3.

7.16 Retaining Wall Drainage

7.16.1 Retaining walls not designed for hydrostatic pressures should be provided with a drainage system. At the base of the drain system, a subdrain covered with a minimum of 12 inches of gravel should be installed, and a compacted fill blanket or other seal placed at the surface (see Figure 9). The clean bottom and subdrain pipe, behind a retaining wall, should be observed by the Geotechnical Engineer (a representative of Geocon), prior to placement of gravel or compacting backfill.

7.16.2 As an alternative, a plastic drainage composite such as Miradrain or equivalent may be installed in continuous, 4-foot wide columns along the entire back face of the wall, at 8 feet on center. The top of these drainage composite columns should terminate approximately 18 inches below the ground surface, where either hardscape or a minimum of 18 inches of relatively cohesive material should be placed as a cap (see Figure 10). These vertical columns of drainage material would then be connected at the bottom of the wall to a collection panel or a 1-cubic-foot rock pocket drained by a 4-inch subdrain pipe.

7.16.3 Subdrainage pipes at the base of the retaining wall drainage system should outlet to an acceptable location via controlled drainage structures.

7.16.4 Moisture affecting below grade walls is one of the most common post-construction complaints. Poorly applied or omitted waterproofing can lead to efflorescence or standing water. Particular care should be taken in the design and installation of waterproofing to avoid moisture problems, or actual water seepage into the structure through any normal shrinkage cracks which may develop in the concrete walls, floor slab, foundations and/or construction joints. The design and inspection of the waterproofing 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 subterranean walls, floor slabs and foundations.

7.17 Elevator Pit Design

7.17.1 The elevator pit slab and retaining wall should be designed by the project structural engineer. Elevator pit walls may be designed in accordance with the recommendations in the *Foundation Design* and *Retaining Wall Design* sections of this report (see Sections 7.6 through 7.8 and 7.14).

7.17.2 Additional active pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent foundations and should be designed for each condition as the project progresses.

7.17.3 If retaining wall drainage is to be provided, the drainage system should be designed in accordance with the *Retaining Wall Drainage* section of this report (see Section 7.16).

7.17.4 It is suggested that the elevator pit walls and slab be waterproofed to prevent excessive moisture inside of the elevator pit. Waterproofing design and installation is not the responsibility of the geotechnical engineer.

7.18 Elevator Piston

7.18.1 If a plunger-type elevator piston is installed for this project, a deep drilled excavation will be required. It is important to verify that the drilled excavation is not situated immediately adjacent to a foundation or shoring pile, or the drilled excavation could compromise the existing foundation or pile support, especially if the drilling is performed subsequent to the foundation or pile construction.

7.18.2 Casing may be required if caving is experienced in the drilled excavation. The contractor should be prepared to use casing and should have it readily available at the commencement of drilling activities. The contractor should be prepared to mitigate the buoyant forces on the casing due to groundwater seepage, if encountered. Continuous observation of the drilling and installation of the elevator piston by the Geotechnical Engineer (a representative of Geocon West, Inc.) is required.

7.18.3 The annular space between the piston casing and drilled excavation wall should be filled with a minimum of 1½-sack slurry pumped from the bottom up. As an alternative, pea gravel may be utilized. The use of soil to backfill the annular space is not acceptable.

7.19 Temporary Excavations

7.19.1 Excavations up to 64 feet in height may be required for excavation and construction of the proposed subterranean level and foundations. The excavations are expected to expose fill and alluvial soils, which may be subject to caving. Due to the presence of cobbles and boulders, the contractor should be prepared for difficult excavation conditions. Vertical excavations up to 5 feet in height may be attempted where not surcharged; however, the contractor should be prepared for caving, sloughing, and raveling in open excavations. Due to the granular nature of soils and potential for caving, the contractor should also be prepared to form foundation excavations at the excavation bottom.

7.19.2 Vertical excavations greater than 5 feet or where surcharged by existing structures or traffic loads will require sloping or shoring measures to provide a stable excavation. Where sufficient space is available, temporary unsurcharged embankments could be sloped back at a uniform 1½:1 (H:V) slope gradient or flatter up to a maximum height of 12 feet. A uniform slope does not have a vertical portion. Where space is limited, shoring measures will be required and shoring recommendations are provided in Section 7.20 of this report.

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

7.20 Shoring – Soldier Pile Design and Installation

7.20.1 The following information on the design and installation of shoring is preliminary. Review of the final shoring plans and specifications should be made by this office prior to bidding or negotiating with a shoring contractor.

7.20.2 One method of shoring would consist of steel soldier piles, placed in drilled holes and backfilled with concrete. It is also allowable to install steel soldier piles utilizing high frequency vibration. Where maximum excavation heights are less than 12 feet the soldier piles are typically designed as cantilevers. Where excavations exceed 12 feet or are surcharged, soldier piles may require lateral bracing utilizing drilled tie-back anchors or raker braces to maintain an economical steel beam size and prevent excessive deflection. The size of the steel beam, the need for lateral bracing, and the acceptable shoring deflection should be determined by the project shoring engineer.

7.20.3 The design embedment of the shoring pile toes must be maintained during excavation activities. The toes of the perimeter shoring piles should be deepened to take into account any required excavations necessary for grading, foundations, and/or adjacent drainage systems.

7.20.4 The proposed soldier piles may also be designed as permanent piles. The required pile depths, dimensions, and spacing should be determined and designed by the project structural and shoring engineers. All piles utilized for shoring can also be incorporated into a permanent retaining wall system (shotcrete wall) and should be designed in accordance with the earth pressure provided in the *Retaining Wall Design* section of this report (see Section 7.14).

7.20.5 Drilled cast-in-place soldier piles should be placed no closer than 3 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 soil. For design purposes, an allowable passive value for the soils below the bottom plane of excavation may be assumed to be 300 psf per foot. Where piles are installed by vibration techniques, the passive pressure may be assumed to mobilize across a width equal to the two times the dimension of the beam flange. The allowable passive value may be doubled for isolated piles spaced a minimum of three the pile diameter. To develop the full lateral value, provisions should be implemented to assure firm contact between the soldier piles and the undisturbed soils.

7.20.6 Groundwater was not encountered during site exploration, and the groundwater table is sufficiently deep that it is not expected to be encountered during pile installation. However, local seepage may be encountered during excavations for the proposed soldier piles, especially if conducted during the rainy season. If more than 6 inches of water is present in the bottom of the excavation, a tremie is required to place the concrete into the bottom of the hole. A tremie should consist of a rigid, water-tight tube having a diameter of not less than 6 inches with a hopper at the top. The tube should 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 should 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 should be closed at the start of the work to prevent water entering the tube and should be entirely sealed at all times, except when the concrete is being placed. The tremie tube should be kept full of concrete. The flow should be continuous until the work is completed and the resulting concrete seal should be monolithic and homogeneous. The tip of the tremie tube should always be kept about 5 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.

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

7.20.8 Due to the presence of cobbles and the potential for boulders, the contractor should be prepared for difficult drilling conditions. Casing will likely be required since excessive caving is anticipated, and the contractor should have casing available prior to commencement of pile excavation. When 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. As an alternative, piles may be vibrated into place; however, there is always a risk that excessive vibrations in sandy soils could induce settlements and distress to adjacent offsite improvements. Continuous observation of the drilling and pouring of the piles by the Geotechnical Engineer (a representative of Geocon West, Inc.), is required.

7.20.9 If a vibratory method of solider pile installation is utilized, predrilling must be performed and should terminate at depth equal with the level of the basement. If predrilling is performed, it is recommended that the bore diameter be at least 2 inches smaller than the largest dimension of the pile to prevent any significant loss in capacity. Due to the presence of cobbles and the potential for boulders, the contractor should be prepared for difficult conditions.

7.20.10 If a vibratory method is utilized, the owner should be aware of the potential risks associated with vibratory efforts, which typically involve inducing settlement within the vicinity of the pile which could result in a potential for damage to existing improvements in the area.

7.20.11 The level of vibration that results from the installation of the piles should not exceed a threshold where occupants of nearby structures are disturbed, despite higher vibration tolerances that a building may endure without deformation or damage. The main parameter used for vibration assessment is peak particle velocity in units of inch per second (in/sec). The acceptable range of peak particle velocity should be evaluated based on the age and condition of adjacent structures, as well as the tolerance of human response to vibration. Based on Table 19 of the *Transportation and Construction Induced Vibration Guidance Manual* (Caltrans 2004), a continuous source of vibrations (ex. vibratory pile driving) which generates a maximum peak particle velocity of 0.5 in/sec is considered tolerable for modern industrial/commercial buildings and new residential structures. The Client should be aware that a lower value may be necessary if older or fragile structures are in the immediate vicinity of the site.

7.20.12 Vibrations should be monitored and recorded with seismographs during pile installation to detect the magnitude of vibration and oscillation experienced by adjacent structures. If the vibrations exceed the acceptable range during installation, the shoring contractor should modify the installation procedure to reduce the values to within the acceptable range. Vibration monitoring is not the responsibility of the Geotechnical Engineer.

7.20.13 Geocon does not practice in the field of vibration monitoring. If construction techniques will be implemented, it is recommended that qualified consultant be retained to provide site specific recommendations for vibration thresholds and monitoring.

7.20.14 The frictional resistance between the soldier piles and retained earth may be used to resist a vertical component 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 500 psf.

7.20.15 Due to the nature of the site soils, it is expected that continuous lagging between soldier piles will be required. However, it is recommended that the exposed soils be observed by the Geotechnical Engineer (a representative of Geocon West, Inc.), to verify the presence of any cohesive soils and the areas where lagging may be omitted.

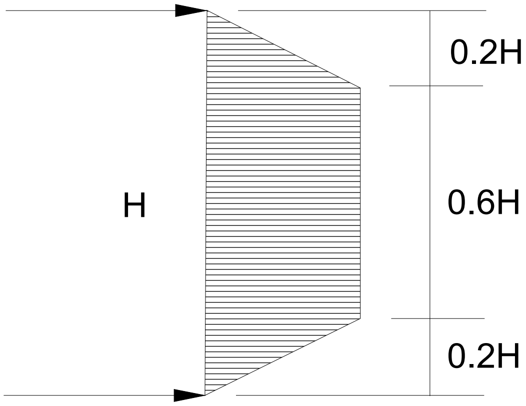
7.20.16 The time between lagging excavation and lagging placement should be as short as possible. Soldier piles should be designed for the full-anticipated pressures. Due to arching in the soils, the pressure on the lagging will be less. It is recommended that the lagging be designed for the full design pressure but be limited to a maximum of 400 psf.

7.20.17 For the design of unbraced shoring, it is recommended that an equivalent fluid pressure be utilized for design. A trapezoidal distribution of lateral earth pressure may be used where shoring will be restrained by bracing or tie backs. The recommended active and trapezoidal pressure are provided in the following table. A diagram depicting the trapezoidal pressure distribution of lateral earth pressure is provided below the table. Calculation of the recommended shoring wall pressures are provided as Figures 11 through 14.

SHORING WITH LEVEL BACKFILL SURFACE

HEIGHT OF SHORING (FEET)	**EQUIVALENT FLUID PRESSURE (Pounds Per Cubic Foot) (ACTIVE PRESSURE)**	**EQUIVALENT FLUID PRESSURE (Pounds Per Square Foot per Foot) Trapezoidal –Active (Where H is the height of the shoring in feet)**
Up to 14	33	21H
15-25	40	25H
26-45	44	28H
46-64	45	28H

Trapezoidal Distribution of Pressure



7.20.18 Where a combination of sloped embankment and shoring is utilized, the pressure will be greater and must be determined for each combination. Additional active pressure should be added for a surcharge condition due to sloping ground, vehicular traffic, or adjacent structures and must be determined for each combination.

7.20.19 It is recommended that line-load surcharges from adjacent wall footings, use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.20 \times \left(\frac{z}{H}\right)}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

and

$$For\ {}^{x}/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.28 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

where x is the distance from the face of the excavation or wall to the vertical line-load, H is the distance from the bottom of the footing to the bottom of excavation or wall, z is the depth at which the horizontal pressure is desired, Q_L is the vertical line-load and $\sigma_H(z)$ is the horizontal pressure at depth z.

7.20.20 It is recommended that vertical point-loads, from construction equipment outriggers or adjacent building columns use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}\!/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.28 \times \left(\frac{z}{H}\right)^2}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

and

$$For\ {}^{x}\!/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.77 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)^2}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

then

$$\sigma'_H\ (z) = \sigma_H(z)cos^2(1.1\theta)$$

where x is the distance from the face of the excavation/wall to the vertical point-load, H is distance from the outrigger/bottom of column footing to the bottom of excavation, z is the depth at which the horizontal pressure is desired, Q_P is the vertical point-load, $\sigma_H(z)$ is the horizontal pressure at depth z, θ is the angle between a line perpendicular to the excavation/wall and a line from the point-load to location on the excavation/wall where the surcharge is being evaluated, and $\sigma_H(z)$ is the horizontal pressure at depth z.

7.20.21 In addition to the recommended earth pressure, the upper 10 feet of the shoring adjacent to the street or driveway areas should be designed to resist a uniform lateral pressure of 100 psf, acting as a result of an assumed 300 psf surcharge behind the shoring due to normal street traffic. If the traffic is kept back at least 10 feet from the shoring, the traffic surcharge may be neglected.

7.20.22 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 recommended that the deflection be minimized to prevent damage to existing structures and adjacent improvements. Where public right-of-ways are present or adjacent offsite structures do not surcharge the shoring excavation, the shoring deflection should be limited to less than 1 inch at the top of the shored embankment. Where offsite structures are within the shoring surcharge area it is recommended that the beam deflection be limited to less than ½ inch at the elevation of the adjacent offsite foundation, and no deflection at all if deflections will damage existing structures. The allowable deflection is dependent on many factors, such as the presence of structures and utilities near the top of the embankment, and will be assessed and designed by the project shoring engineer.

7.20.23 Because of the depth of the excavation, some means 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.

7.20.24 Due to the depth of the excavation and proximity to adjacent structures, it is suggested that prior to excavation the existing improvements be inspected to document the present condition. For documentation purposes, photographs should be taken of preconstruction distress conditions and level surveys of adjacent grade and pavement should be considered. During excavation activities, the adjacent structures and pavement should be periodically inspected for signs of distress. In the event that distress or settlement is noted, an investigation should be performed and corrective measures taken so that continued or worsened distress or settlement is mitigated. Documentation and monitoring of the offsite structures and improvements is not the responsibility of the geotechnical engineer.

7.21 Temporary Tie-Back Anchors

7.21.1 Temporary tie-back anchors may be used with the solider pile wall system to resist lateral loads. Post-grouted friction anchors are recommended. For design purposes, it may be assumed that the active wedge adjacent to the shoring is defined by a 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 and to greater lengths if necessary to develop the desired capacities. The locations and depths of all offsite utilities should be thoroughly checked and incorporated into the drilling angle design for the tie-back anchors.

7.21.2 The capacities of the anchors should be determined by testing of the initial anchors as outlined in a following section. Only the frictional resistance developed beyond the active wedge would be effective in resisting lateral loads. Anchors should be placed at least 6 feet on center to be considered isolated. For preliminary design purposes, it is estimated that drilled friction anchors constructed without utilizing post-grouting techniques will develop average skin frictions as follows:

- 7 feet below the top of the excavation – 1,000 pounds per square foot
- 15 feet below the top of the excavation – 1,900 pounds per square foot
- 25 feet below the top of the excavation – 2,600 pounds per square foot
- 35 feet below the top of the excavation – 3,200 pounds per square foot
- 45 feet below the top of the excavation – 4,000 pounds per square foot

7.21.3 Depending on the techniques utilized, and the experience of the contractor performing the installation, a maximum allowable friction capacity of 5.0 kips per linear foot for post-grouted anchors (for a minimum 20-foot length beyond the active wedge) may be assumed for design purposes. Only the frictional resistance developed beyond the active wedge should be utilized in resisting lateral loads.

7.22 Anchor Installation

7.22.1 Tied-back anchors are typically installed between 20 and 40 degrees below the horizontal; however, occasionally alternative angles are necessary to avoid existing improvements and utilities. The locations and depths of all offsite utilities should be thoroughly checked prior to design and installation of the tie-back anchors. Caving of the anchor shafts, particularly within sand and gravel deposits or seepage zones, should be anticipated during installation and provisions should be implemented in order to minimize such caving. It is suggested that hollow-stem auger drilling equipment be used to install the anchors. 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.

7.23 Anchor Testing

7.23.1 All of the 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.

7.23.2 At least 10 percent of the anchors should be selected for "quick" 200 percent tests and three additional anchors should be selected for 24-hour 200 percent tests. The purpose of the 200 percent tests is to verify the friction value assumed in design. The anchors should be tested to develop twice the assumed friction value. These tests should be performed prior to installation of additional tiebacks. Where satisfactory tests are not achieved on the initial anchors, the anchor diameter and/or length should be increased until satisfactory test results are obtained.

7.23.3 The total deflection during the 24-hour 200 percent test should not exceed 12 inches. During the 24-hour tests, the anchor deflection should not exceed 0.75 inches measured after the 200 percent test load is applied.

7.23.4 For the "quick" 200 percent tests, the 200 percent test load should be maintained for 30 minutes. The total deflection of the anchor during the 200 percent quick tests should not exceed 12 inches; the deflection after the 200 percent load has been applied should not exceed 0.25 inch during the 30-minute period.

7.23.5 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. A representative of this firm should observe the installation and testing of the anchors.

7.24 Internal Bracing

7.24.1 Rakers may be utilized to brace the soldier piles in lieu of tieback anchors. The raker bracing could be supported laterally by temporary concrete footings (deadmen) or by the permanent, interior footings. For design of such temporary footings or deadmen, poured with the bearing surface normal to rakers inclined at 45 degrees, a bearing value of 2,000 psf may be used, provided the shallowest point of the footing is at least 1 foot below the lowest adjacent grade. The structural engineer should review the shoring plans to determine if raker footings conflict with the structural foundation system. The client should be aware that the utilization of rakers could significantly impact the construction schedule due to their intrusion into the construction site and potential interference with equipment.

7.25 Stormwater Infiltration

7.25.1 During the November 23, 2019 site exploration, borings B3 and B4 were utilized to perform percolation testing. The borings were advanced to the depth listed in the table below. Slotted casing was placed in the borings, and the annular space between the casing and excavation was filled with gravel. The borings were then filled with water to pre-saturate the soils. The casing was refilled with water and percolation test readings were performed after repeated flooding of the cased excavation. Based on the test results, the measured percolation rate and design infiltration rate, for the earth materials encountered, are provided in the following table. These values have been calculated in accordance with the Boring Percolation Test Procedure in the County of Los Angeles Department of Public Works GMED *Guidelines for Geotechnical Investigation and Reporting, Low Impact Development Stormwater Infiltration* (June 2017). Percolation test field data and calculation of the measured percolation rate and design infiltration rate are provided on Figures 15 and 16.

Boring	Soil Type	Infiltration Depth (ft)	Measured Percolation Rate (in / hour)	Design Infiltration Rate (in / hour)
B3	Sand (SP)	29-34	10.0	5.0
B4	Sand (SP)	30-40	7.9	3.9

7.25.2 Based on the test method utilized (Boring Percolation Test), the reduction factor RF_t may be taken as 2.0 in the infiltration system design. Based on the number of tests performed and consistency of the soils throughout the site, it is suggested that the reduction factor RF_v be taken as 1.0. In addition, provided proper maintenance is performed to minimize long-term siltation and plugging, the reduction factor RF_s may be taken as 1.0. Additional reduction factors may be required and should be applied by the engineer in responsible charge of the design of the stormwater infiltration system and based on applicable guidelines.

7.25.3 The results of the percolation testing indicate that the soils at depths in the above table are conductive to infiltration. It is our opinion that the soil zone encountered at the depth and location as listed in the table above are suitable for infiltration of stormwater.

7.25.4 It is our further opinion that infiltration of stormwater and will not induce excessive hydro-consolidation (see Figures B13 through B25), will not create a perched groundwater condition, will not affect soil structure interaction of existing or proposed foundations due to expansive soils, will not saturate soils supported by existing or proposed retaining walls, and will not increase the potential for liquefaction. Resulting settlements are anticipated to be less than ¼ inch, if any.

7.25.5 The infiltration system must be located such that the closest distance between an adjacent foundation is at least 10 feet in all directions from the zone of saturation. The zone of saturation may be assumed to project downward from the discharge of the infiltration facility at a gradient of 1:1. Additional property line or foundation setbacks may be required by the governing jurisdiction and should be incorporated into the stormwater infiltration system design as necessary.

7.25.6 Where the 10-foot horizontal setback cannot be maintained between the infiltration system and an adjacent footing, and the infiltration system penetrates below the foundation influence line, the proposed stormwater infiltration system must be designed to resist the surcharge from the adjacent foundation. The foundation surcharge line may be assumed to project down away from the bottom of the foundation at a 1:1 gradient. The stormwater infiltration system must still be sufficiently deep to maintain the 10-foot vertical offset between the bottom of the footing and the zone of saturation.

7.25.7 Subsequent to the placement of the infiltration system, it is acceptable to backfill the resulting void space between the excavation sidewalls and the infiltration system with minimum two-sack slurry provided the slurry is not placed in the infiltration zone. It is recommended that pea gravel be utilized adjacent to the infiltration zone so communication of water to the soil is not hindered.

7.25.8 Due to the preliminary nature of the project at this time, the type of stormwater infiltration system and location of the stormwater infiltration systems has not yet been determined. The design drawings should be reviewed and approved by the Geotechnical Engineer. The installation of the stormwater infiltration system should be observed and approved by the Geotechnical Engineer (a representative of Geocon).

7.26 Surface Drainage

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

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

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

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

7.27 Plan Review

7.27.1 Grading, foundation, and shoring plans should be reviewed by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to finalization to verify that the plans have been prepared in substantial conformance with the recommendations of this report and to provide additional analyses or recommendations.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon West, Inc. should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon West, Inc.

2. This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the date of this report. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

4. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

LIST OF REFERENCES

California Division of Mines and Geology, 1999, *State of California Seismic Hazard Zones, Los Angeles Quadrangle,* Official Map, Released: March 25, 1999.

California Division of Mines and Geology, 1998, *Seismic Hazard Evaluation of the Los Angeles 7.5-Minute Quadrangle, Los Angeles County, California,* Open File Report 98-20.

California Geologic Energy Management Division, 2020, Geologic Energy Management Division Well Finder, http://maps.conservation.ca.gov.doggr/index.html#close.

California Geological Survey, 2020a, CGS Information Warehouse, Regulatory Map Portal, http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps.

California Geological Survey, 2020b, Earthquake Zones of Required Investigation, https://maps.conservation.ca.gov/cgs/EQZApp/app/.

California Geological Survey, 2018, *Earthquake Fault Zones, A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California,* Special Publication 42, Revised 2018.

California Geological Survey, 2017, *Earthquake Fault Zones, Los Angeles Quadrangle*, Revised Official Map, released: June 15, 2017

FEMA, 2020, Online Flood Hazard Maps, http://www.esri.com/hazards/index.html.

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

Lamar, D.L., 1970, *Geologic Map of the Elysian Park – Repetto Hills Area, Los Angeles County, California*, California Division of Mines and Geology Special Report 101.

Leighton and Associates, Inc., 1990, *Technical Appendix to the Safety Element of the Los Angeles County General Plan, Hazard Reduction in Los Angeles County*.

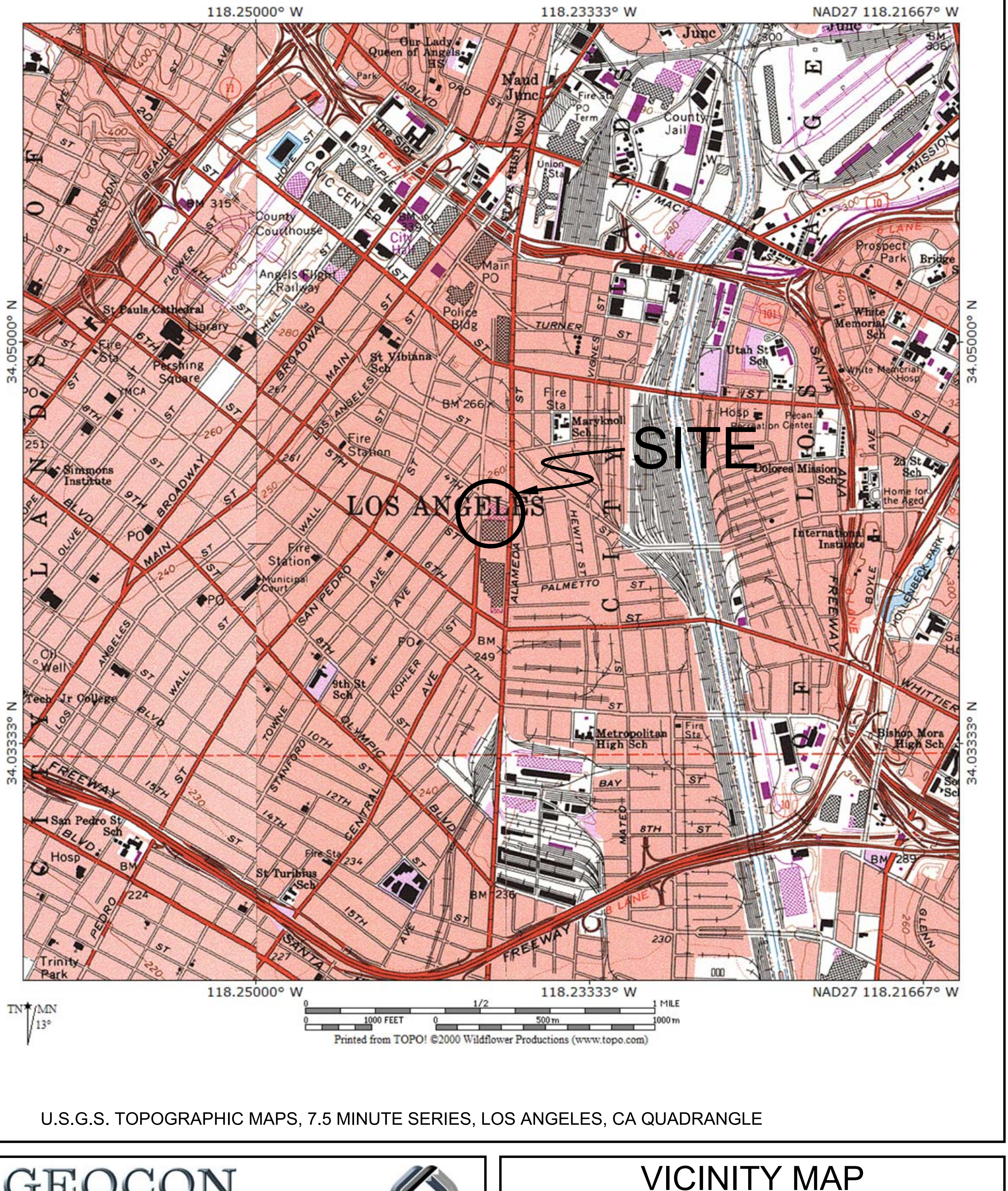
Los Angeles, City of, 2020, NavigateLA website, http://navigatela.lacity.org.

Los Angeles, City of, 1996, Seismic Safety Element of the General Plan

Los Angeles County Department of Public Works, 2020, Flood Zone Determination Website, http://dpw.lacounty.gov/apps/wmd/floodzone/map.htm.

Toppozada, T., Branum, D., Petersen, M, Hallstrom, C., and Reichle, M., 2000, *Epicenters and Areas Damaged by M> 5 California Earthquakes, 1800 – 1999,* California Geological Survey, Map Sheet 49.

Ziony, J. I., and Jones, L. M., 1989, *Map Showing Late Quaternary Faults and 1978–1984 Seismicity of the Los Angeles Region, California*, U.S. Geological Survey Miscellaneous Field Studies Map MF-1964.



Printed from TOPO! ©2000 Wildflower Productions (www.topo.com)

U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, LOS ANGELES, CA QUADRANGLE

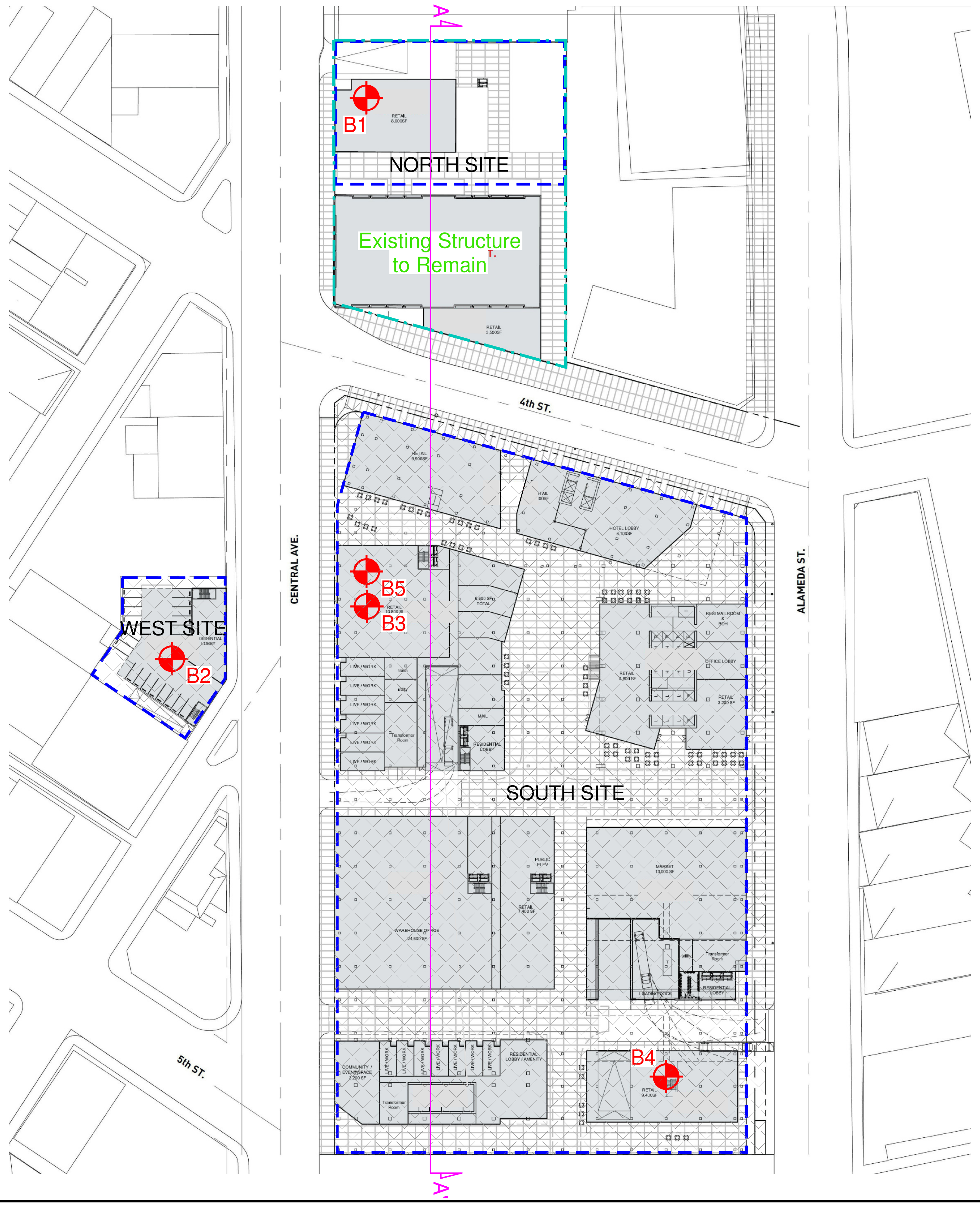
GEOCON
W E S T, I N C.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

VICINITY MAP

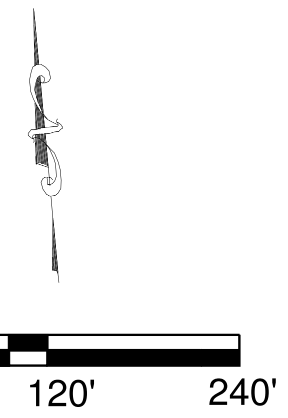
410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

DRAFTED BY: CB	CHECKED BY: GAK	SEPT. 2021	PROJECT NO. W1041-06-02	FIG. 1



LEGEND

⊕ B5	Approximate Location of Boring
▭	Approximate Location of Property Line
▭	Approximate Limits of Subterranean Levels Below
▨	Not a Part / Addressed in Separate Report



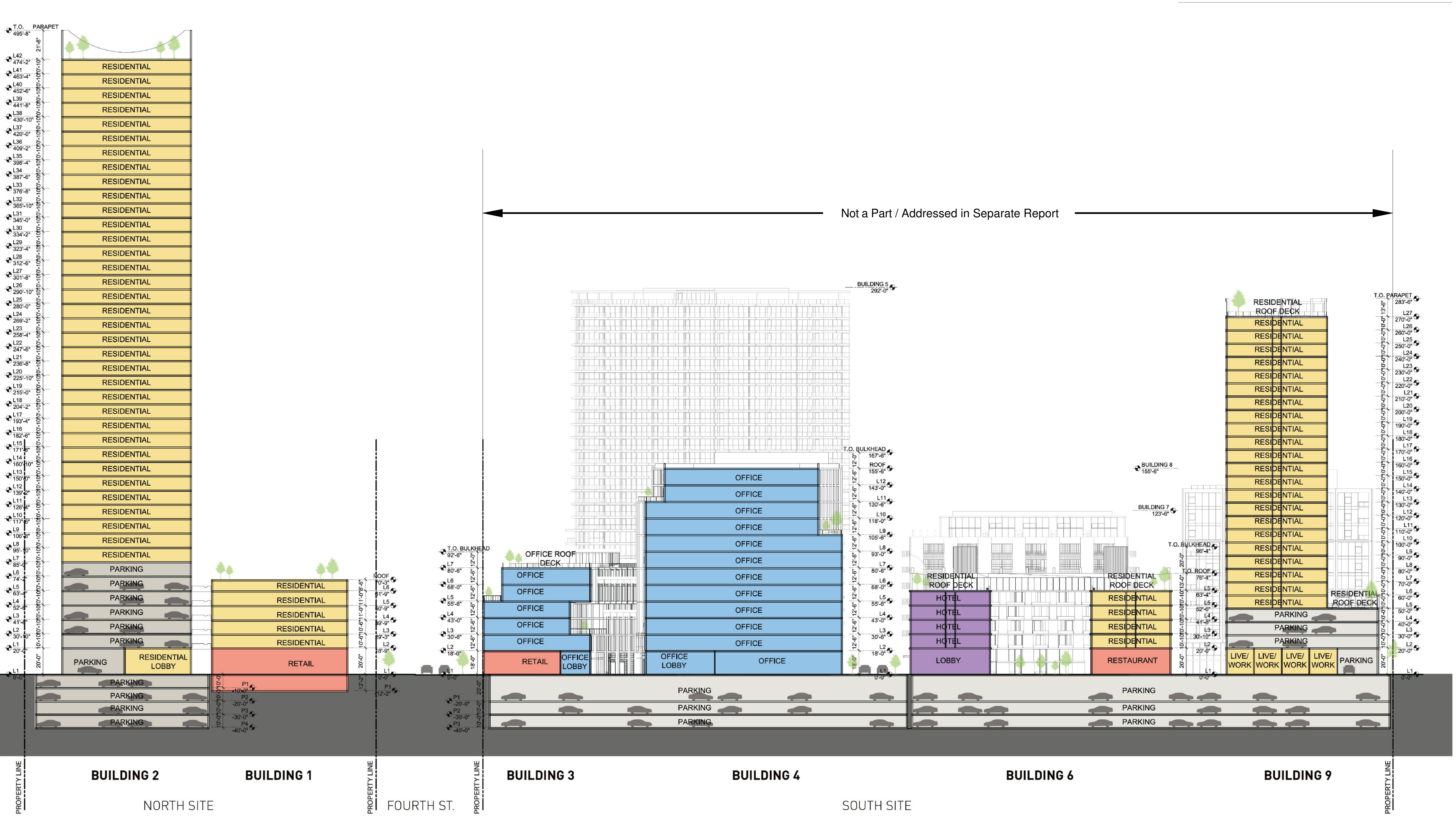
GEOCON
WEST, INC.
ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

DRAFTED BY: PZ
CHECKED BY: JTA

SITE PLAN

410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

SEPT. 2021
PROJECT NO. W1041-06-02
FIG. 2A



GEOCON
WEST, INC.
ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

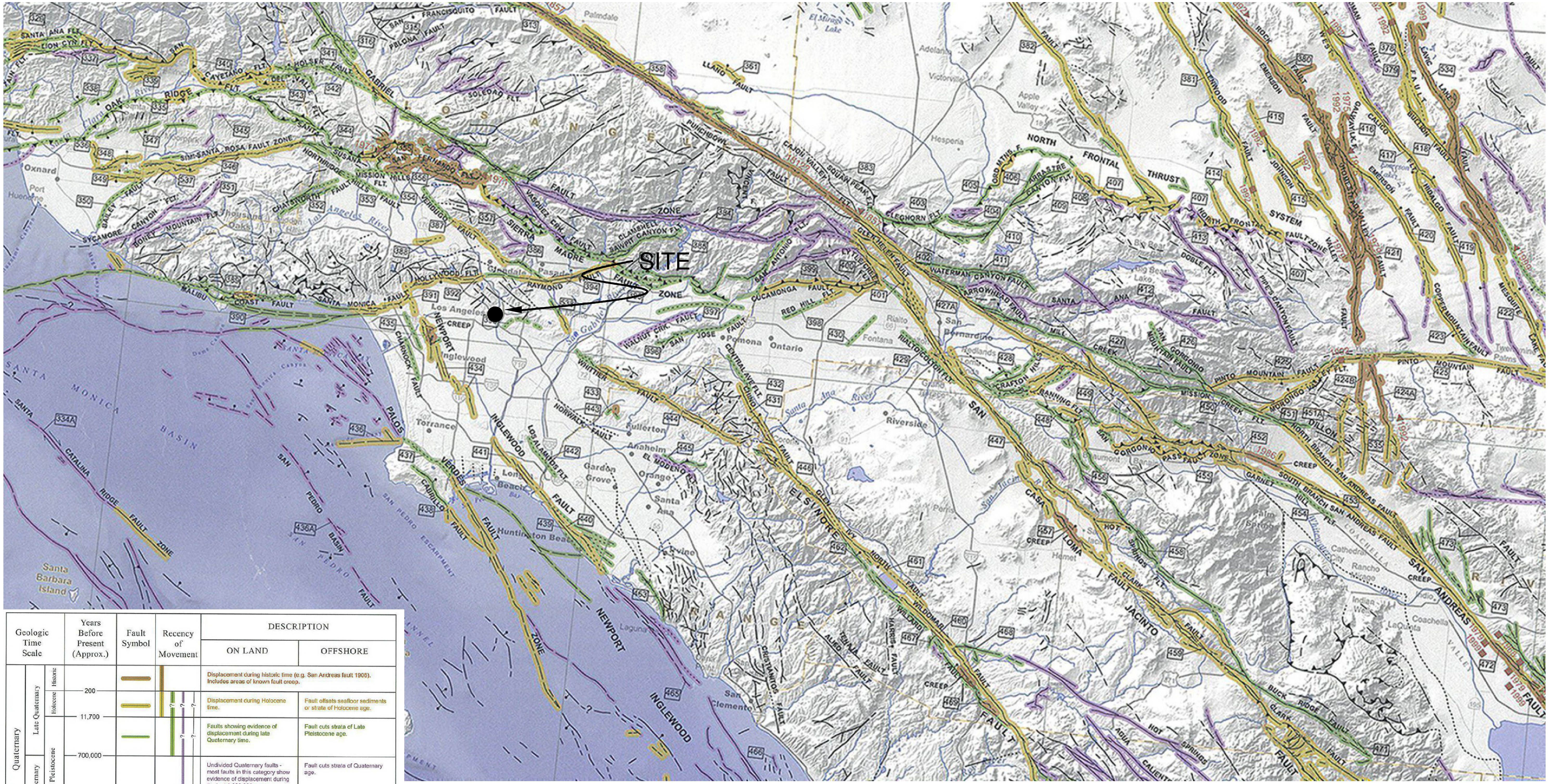
DRAFTED BY: PZ CHECKED BY: JTA

CROSS SECTION A-A'

410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

SEPT. 2021 PROJECT NO. W1041-06-02 FIG. 2B

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



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

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

0 12 24 Miles

GEOCON
W E S T, I N C.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

DRAFTED BY: CB
CHECKED BY: GAK

REGIONAL FAULT MAP

410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

SEPT. 2021
PROJECT NO. W1041-06-02
FIG. 3

Reference: Toppozada, T., Branum, D., Petersen, M., Hallstrom, C., Cramer, C., and Reichle, M., 2000, Epicenters and Areas Damaged by M>5 California Earthquakes, 1800 - 1999, California Geological Survey, Map Sheet 49.

GEOCON
W E S T, I N C.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

DRAFTED BY: CB
CHECKED BY: GAK

REGIONAL SEISMICITY MAP

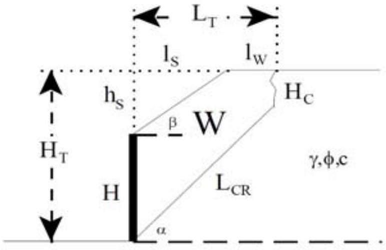
410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

SEPT. 2021
PROJECT NO. W1041-06-02
FIG.4

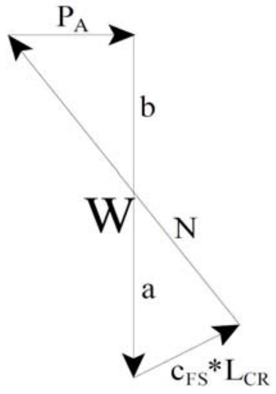
Retaining Wall Design with Transitioned Backfill
(Vector Analysis)

Input:

Retaining Wall Height	(H)	12.00 feet
Slope Angle of Backfill	(b)	0.0 degrees
Height of Slope above Wall	(h_s)	0.0 feet
Horizontal Length of Slope	(l_s)	0.0 feet
Total Height (Wall + Slope)	(H_T)	12.0 feet
Unit Weight of Retained Soils	(g)	125.0 pcf
Friction Angle of Retained Soils	(f)	31.0 degrees
Cohesion of Retained Soils	(c)	130.0 psf
Factor of Safety	(FS)	1.50
Factored Parameters:	(f_{FS})	21.8 degrees
	(c_{FS})	86.7 psf



Failure Angle (a) degrees	Height of Tension Crack (H_C) feet	Area of Wedge (A) feet^2	Weight of Wedge (W) lbs/lineal foot	Length of Failure Plane (L_{CR}) feet	a lbs/lineal foot	b lbs/lineal foot	Active Pressure (P_A) lbs/lineal foot
45	2.3	69	8665.5	13.7	2801.1	5864.5	2509.9
46	2.3	67	8382.1	13.5	2659.7	5722.4	2568.2
47	2.2	65	8105.7	13.4	2529.8	5575.8	2620.3
48	2.2	63	7836.0	13.2	2410.2	5425.7	2666.3
49	2.1	61	7572.8	13.1	2299.8	5273.0	2706.5
50	2.1	59	7316.0	12.9	2197.7	5118.3	2741.0
51	2.1	57	7065.2	12.7	2103.1	4962.2	2769.9
52	2.1	55	6820.3	12.6	2015.2	4805.1	2793.3
53	2.1	53	6580.9	12.4	1933.4	4647.5	2811.3
54	2.1	51	6346.8	12.3	1857.2	4489.7	2824.0
55	2.1	49	6117.8	12.1	1785.9	4331.9	2831.5
56	2.0	47	5893.5	12.0	1719.3	4174.2	2833.7
57	2.1	45	5673.8	11.9	1656.8	4017.0	2830.6
58	2.1	44	5458.4	11.7	1598.1	3860.3	2822.3
59	2.1	42	5247.1	11.6	1542.9	3704.2	2808.6
60	2.1	40	5039.6	11.5	1490.7	3548.9	2789.7
61	2.1	39	4835.7	11.3	1441.5	3394.2	2765.3
62	2.1	37	4635.3	11.2	1394.8	3240.4	2735.5
63	2.2	36	4438.0	11.1	1350.6	3087.5	2700.1
64	2.2	34	4243.8	10.9	1308.4	2935.4	2658.9
65	2.2	32	4052.4	10.8	1268.2	2784.2	2611.8
66	2.3	31	3863.5	10.6	1229.6	2633.9	2558.7
67	2.3	29	3677.2	10.5	1192.6	2484.6	2499.4
68	2.4	28	3493.0	10.4	1156.9	2336.1	2433.5
69	2.4	26	3310.9	10.2	1122.3	2188.6	2361.0
70	2.5	25	3130.6	10.1	1088.6	2042.0	2281.5



Design Equations (Vector Analysis):

$a = c_{FS} * L_{CR} * \sin(90+f_{FS}) / \sin(a-f_{FS})$

$b = W-a$

$P_A = b * \tan(a-f_{FS})$

$EFP = 2 * P_A / H^2$

Maximum Active Pressure Resultant

$P_{A,\ max}$ 2833.7 lbs/lineal foot

Equivalent Fluid Pressure (per lineal foot of wall) At-Rest= γ*(1-sin(ϕ))

$EFP = 2 * P_A / H^2$

EFP 39.4 pcf 60.6 pcf

Design Wall for an Equivalent Fluid Pressure: 39 pcf 61 pcf

GEOCON
WEST, INC.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

RETAINING WALL PRESSURE CALCULATION

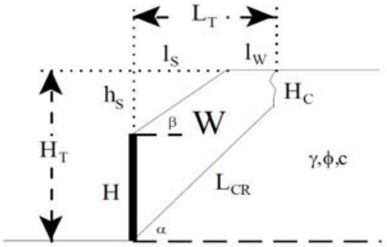
410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

DRAFTED BY: PZ	CHECKED BY: NDB	SEPT. 2021	PROJECT NO. W1041-06-02	FIG. 5

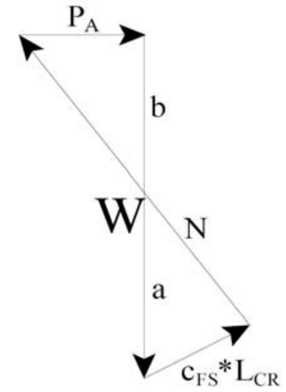
Retaining Wall Design with Transitioned Backfill
(Vector Analysis)

Input:

Retaining Wall Height	(H)	25.00	feet
Slope Angle of Backfill	(b)	0.0	degrees
Height of Slope above Wall	(h_s)	0.0	feet
Horizontal Length of Slope	(l_s)	0.0	feet
Total Height (Wall + Slope)	(H_T)	25.0	feet
Unit Weight of Retained Soils	(g)	125.0	pcf
Friction Angle of Retained Soils	(f)	31.0	degrees
Cohesion of Retained Soils	(c)	130.0	psf
Factor of Safety	(FS)	1.50	
Factored Parameters:	(f_{FS})	21.8	degrees
	(c_{FS})	86.7	psf



Failure Angle (a) degrees	Height of Tension Crack (H_C) feet	Area of Wedge (A) $feet^2$	Weight of Wedge (W) lbs/lineal foot	Length of Failure Plane (L_{CR}) feet	a lbs/lineal foot	b lbs/lineal foot	Active Pressure (P_A) lbs/lineal foot
45	2.3	310	38728.0	32.1	6560.2	32167.8	13767.4
46	2.3	299	37413.2	31.6	6210.7	31202.5	14003.5
47	2.2	289	36139.4	31.1	5892.2	30247.2	14214.1
48	2.2	279	34904.4	30.7	5601.2	29303.1	14400.0
49	2.1	270	33705.7	30.3	5334.6	28371.1	14562.2
50	2.1	260	32541.4	29.9	5089.7	27451.7	14701.1
51	2.1	251	31409.4	29.5	4864.2	26545.2	14817.5
52	2.1	242	30307.7	29.1	4656.1	25651.6	14911.8
53	2.1	234	29234.6	28.7	4463.6	24771.0	14984.3
54	2.1	226	28188.5	28.4	4285.2	23903.3	15035.4
55	2.1	217	27167.8	28.0	4119.5	23048.2	15065.3
56	2.0	209	26171.0	27.7	3965.4	22205.5	15074.0
57	2.1	202	25196.6	27.4	3821.8	21374.8	15061.7
58	2.1	194	24243.6	27.1	3687.7	20555.8	15028.2
59	2.1	186	23310.5	26.8	3562.4	19748.1	14973.5
60	2.1	179	22396.2	26.5	3444.9	18951.3	14897.3
61	2.1	172	21499.7	26.2	3334.7	18164.9	14799.3
62	2.1	165	20619.8	25.9	3231.1	17388.6	14679.1
63	2.2	158	19755.6	25.6	3133.7	16622.0	14536.2
64	2.2	151	18906.3	25.4	3041.7	15864.5	14370.1
65	2.2	145	18070.7	25.1	2954.9	15115.9	14180.0
66	2.3	138	17248.2	24.9	2872.7	14375.6	13965.1
67	2.3	132	16437.9	24.6	2794.7	13643.3	13724.6
68	2.4	125	15639.0	24.4	2720.5	12918.5	13457.3
69	2.4	119	14850.8	24.2	2649.9	12200.9	13162.1
70	2.5	113	14072.5	23.9	2582.3	11490.2	12837.6



Design Equations (Vector Analysis):

$a = c_{FS}*L_{CR}*\sin(90+f_{FS})/\sin(a-f_{FS})$

$b = W-a$

$P_A = b*\tan(a-f_{FS})$

$EFP = 2*P_A/H^2$

Maximum Active Pressure Resultant

$P_{A,\ max}$ 15074.0 lbs/lineal foot

Equivalent Fluid Pressure (per lineal foot of wall) At-Rest= γ*(1-sin(ϕ))

$EFP = 2*P_A/H^2$

EFP 48.2 pcf 60.6 pcf

Design Wall for an Equivalent Fluid Pressure: **48 pcf** **61** pcf

GEOCON
W E S T, I N C.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

RETAINING WALL PRESSURE CALCULATION

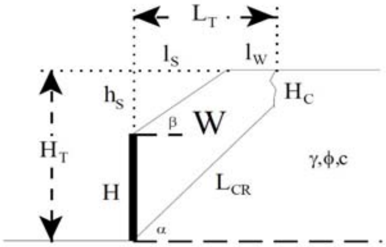
410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

DRAFTED BY: PZ	CHECKED BY: NDB	SEPT. 2021	PROJECT NO. W1041-06-02	FIG. 6

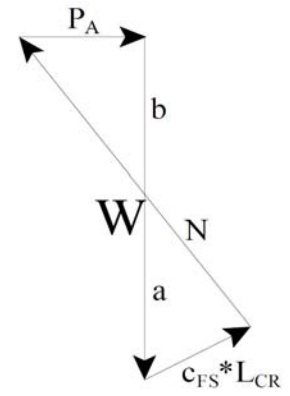
Retaining Wall Design with Transitioned Backfill
(Vector Analysis)

Input:

Retaining Wall Height	(H)	45.00 feet
Slope Angle of Backfill	(b)	0.0 degrees
Height of Slope above Wall	(h_s)	0.0 feet
Horizontal Length of Slope	(l_s)	0.0 feet
Total Height (Wall + Slope)	(H_T)	45.0 feet
Unit Weight of Retained Soils	(g)	125.0 pcf
Friction Angle of Retained Soils	(f)	31.0 degrees
Cohesion of Retained Soils	(c)	130.0 psf
Factor of Safety	(FS)	1.50
Factored Parameters:	(f_{FS})	21.8 degrees
	(c_{FS})	86.7 psf



Failure Angle (a) degrees	Height of Tension Crack (H_C) feet	Area of Wedge (A) $feet^2$	Weight of Wedge (W) lbs/lineal foot	Length of Failure Plane (L_{CR}) feet	a lbs/lineal foot	b lbs/lineal foot	Active Pressure (P_A) lbs/lineal foot
45	2.3	1010	126228.0	60.4	12343.5	113884.5	48741.0
46	2.3	975	121910.9	59.4	11673.7	110237.2	49473.8
47	2.2	942	117734.5	58.5	11065.1	106669.4	50127.2
48	2.2	910	113689.7	57.6	10510.5	103179.2	50704.0
49	2.1	878	109768.3	56.8	10003.5	99764.8	51206.7
50	2.1	848	105962.6	56.0	9538.9	96423.7	51637.5
51	2.1	818	102265.5	55.2	9112.1	93153.4	51998.2
52	2.1	789	98670.2	54.5	8719.0	89951.2	52290.4
53	2.1	761	95170.6	53.8	8356.2	86814.4	52515.1
54	2.1	734	91761.0	53.1	8020.6	83740.4	52673.4
55	2.1	707	88435.9	52.4	7709.7	80726.2	52765.9
56	2.0	682	85190.4	51.8	7421.0	77769.4	52793.0
57	2.1	656	82019.8	51.2	7152.6	74867.2	52754.8
58	2.1	631	78919.6	50.6	6902.6	72017.1	52651.1
59	2.1	607	75885.8	50.1	6669.3	69216.5	52481.6
60	2.1	583	72914.3	49.6	6451.3	66463.0	52245.4
61	2.1	560	70001.7	49.0	6247.4	63754.3	51941.7
62	2.1	537	67144.4	48.6	6056.2	61088.1	51569.1
63	2.2	515	64339.1	48.1	5876.9	58462.2	51126.2
64	2.2	493	61582.9	47.6	5708.4	55874.5	50611.1
65	2.2	471	58872.7	47.2	5549.8	53322.8	50021.4
66	2.3	450	56205.7	46.8	5400.4	50805.3	49354.7
67	2.3	429	53579.5	46.4	5259.4	48320.1	48608.1
68	2.4	408	50991.3	46.0	5126.2	45865.2	47778.1
69	2.4	388	48438.9	45.6	5000.0	43438.9	46861.0
70	2.5	367	45919.9	45.2	4880.3	41039.6	45852.3



Design Equations (Vector Analysis):

$a = c_{FS}*L_{CR}*\sin(90+f_{FS})/\sin(a-f_{FS})$

$b = W-a$

$P_A = b*\tan(a-f_{FS})$

$EFP = 2*P_A/H^2$

Maximum Active Pressure Resultant

$P_{A, max}$ 52793.0 lbs/lineal foot

Equivalent Fluid Pressure (per lineal foot of wall) At-Rest= γ*(1-sin(ϕ))

$EFP = 2*P_A/H^2$

EFP 52.1 pcf 60.6 pcf

Design Wall for an Equivalent Fluid Pressure: **52** pcf **61** pcf

GEOCON
WEST, INC.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

RETAINING WALL PRESSURE CALCULATION

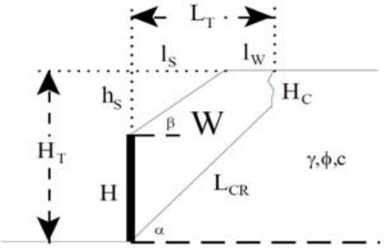
410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

DRAFTED BY: PZ	CHECKED BY: NDB	SEPT. 2021	PROJECT NO. W1041-06-02	FIG. 7

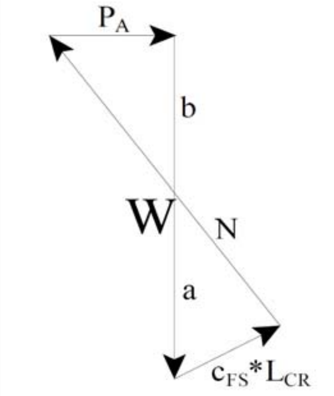
Retaining Wall Design with Transitioned Backfill
(Vector Analysis)

Input:

Retaining Wall Height	(H)	64.00	feet
Slope Angle of Backfill	(b)	0.0	degrees
Height of Slope above Wall	(h_s)	0.0	feet
Horizontal Length of Slope	(l_s)	0.0	feet
Total Height (Wall + Slope)	(H_T)	64.0	feet
Unit Weight of Retained Soils	(g)	125.0	pcf
Friction Angle of Retained Soils	(f)	31.0	degrees
Cohesion of Retained Soils	(c)	130.0	psf
Factor of Safety	(FS)	1.50	
Factored Parameters:	(f_{FS})	21.8	degrees
	(c_{FS})	86.7	psf



Failure Angle (a) degrees	Height of Tension Crack (H_C) feet	Area of Wedge (A) $feet^2$	Weight of Wedge (W) lbs/lineal foot	Length of Failure Plane (L_{CR}) feet	a lbs/lineal foot	b lbs/lineal foot	Active Pressure (P_A) lbs/lineal foot
45	2.3	2045	255665.5	87.2	17837.7	237827.9	101787.1
46	2.3	1975	246907.3	85.8	16863.6	230043.7	103242.2
47	2.2	1907	238436.9	84.5	15979.4	222457.5	104539.5
48	2.2	1842	230235.8	83.2	15174.3	215061.5	105684.7
49	2.1	1778	222286.6	82.0	14439.0	207847.6	106682.8
50	2.1	1717	214573.6	80.8	13765.7	200807.9	107538.1
51	2.1	1657	207081.9	79.7	13147.6	193934.3	108254.1
52	2.1	1598	199797.8	78.6	12578.8	187219.1	108834.0
53	2.1	1542	192708.8	77.5	12054.1	180654.6	109280.2
54	2.1	1486	185802.8	76.6	11569.3	174233.5	109594.4
55	2.1	1433	179069.1	75.6	11120.3	167948.7	109778.1
56	2.0	1380	172497.1	74.7	10703.9	161793.3	109831.9
57	2.1	1329	166077.5	73.9	10316.9	155760.7	109756.0
58	2.1	1278	159801.2	73.0	9956.6	149844.5	109550.2
59	2.1	1229	153659.7	72.3	9620.9	144038.8	109213.6
60	2.1	1181	147645.1	71.5	9307.4	138337.7	108744.8
61	2.1	1134	141750.1	70.8	9014.4	132735.7	108141.9
62	2.1	1088	135967.5	70.1	8740.1	127227.4	107402.4
63	2.2	1042	130290.8	69.4	8483.0	121807.9	106523.1
64	2.2	998	124713.7	68.8	8241.7	116472.0	105500.3
65	2.2	954	119230.4	68.2	8015.0	111215.3	104329.6
66	2.3	911	113835.0	67.6	7801.8	106033.3	103005.8
67	2.3	868	108522.4	67.0	7600.9	100921.5	101523.1
68	2.4	826	103287.5	66.5	7411.5	95876.0	99874.7
69	2.4	785	98125.3	65.9	7232.6	90892.7	98053.1
70	2.5	744	93031.3	65.4	7063.4	85967.9	96049.4



Design Equations (Vector Analysis):

$a = c_{FS}*L_{CR}*\sin(90+f_{FS})/\sin(a-f_{FS})$

$b = W-a$

$P_A = b*\tan(a-f_{FS})$

$EFP = 2*P_A/H^2$

Maximum Active Pressure Resultant

$P_{A,\ max}$ 109831.9 lbs/lineal foot

Equivalent Fluid Pressure (per lineal foot of wall) At-Rest= γ*(1-sin(ϕ))

$EFP = 2*P_A/H^2$

EFP 53.6 pcf 60.6 pcf

Design Wall for an Equivalent Fluid Pressure: 54 pcf 61 pcf

GEOCON
WEST, INC.

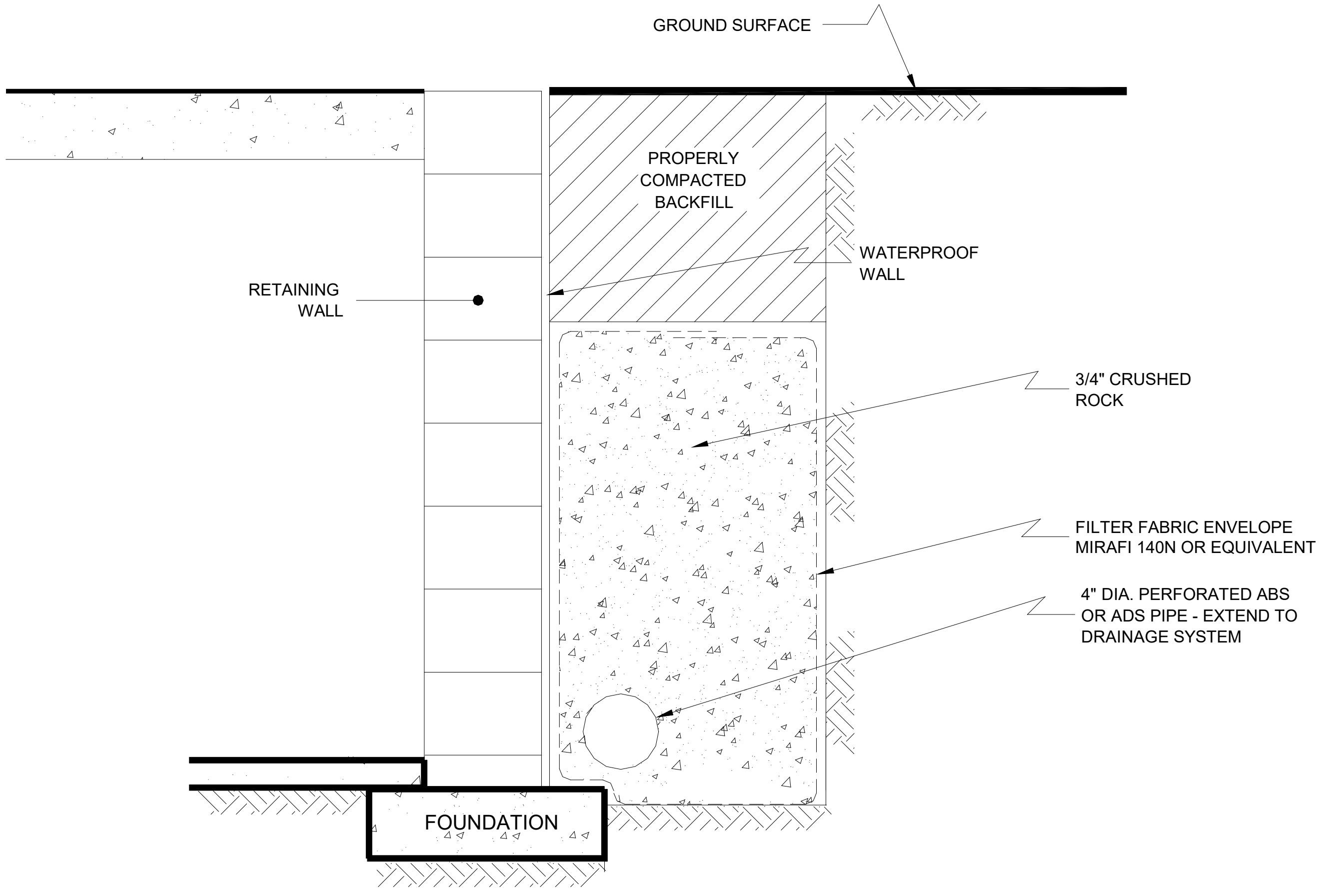
ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

DRAFTED BY: PZ | CHECKED BY: NDB

RETAINING WALL PRESSURE CALCULATION

410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

SEPT. 2021 | PROJECT NO. W1041-06-02 | FIG. 8



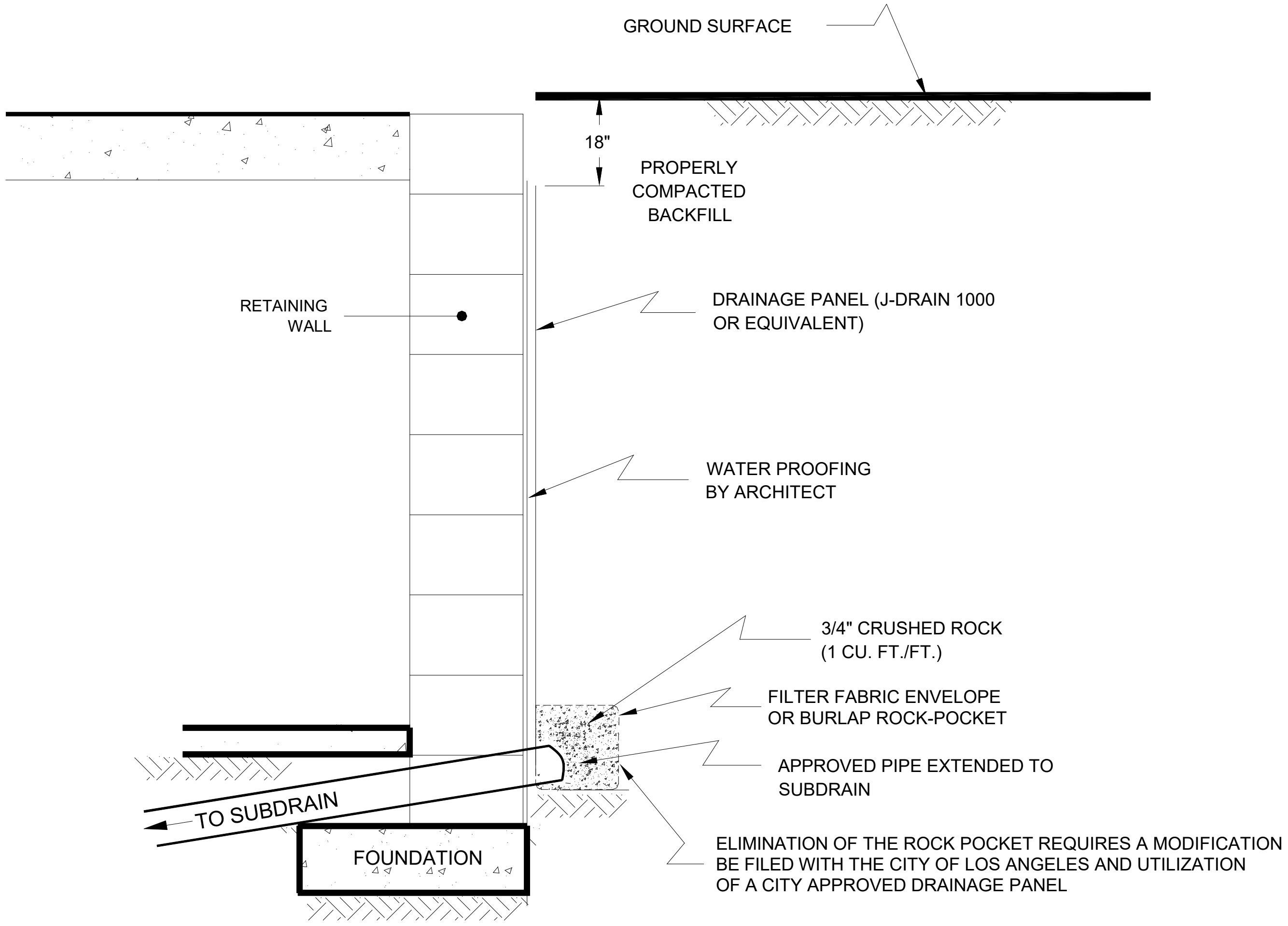
NO SCALE

GEOCON
WEST, INC.
ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

RETAINING WALL DRAIN DETAIL

410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

DRAFTED BY: PZ	CHECKED BY: NDB	SEPT. 2021	PROJECT NO. W1041-06-02	FIG. 9



NO SCALE

GEOCON
WEST, INC.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

RETAINING WALL DRAIN DETAIL

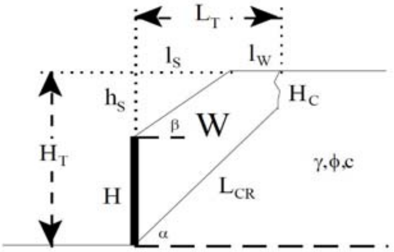
410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

DRAFTED BY: PZ	CHECKED BY: NDB	SEPT. 2021	PROJECT NO. W1041-06-02	FIG. 10

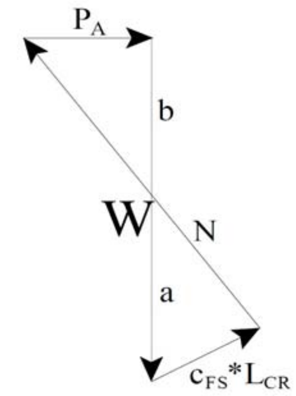
Shoring Design with Transitioned Backfill
(Vector Analysis)

Input:

Shoring Height	(H)	14.00	feet
Slope Angle of Backfill	(b)	0.0	degrees
Height of Slope above Shoring	(h_s)	0.0	feet
Horizontal Length of Slope	(l_s)	0.0	feet
Total Height (Shoring + Slope)	(H_T)	14.0	feet
Unit Weight of Retained Soils	(g)	125.0	pcf
Friction Angle of Retained Soils	(f)	31.0	degrees
Cohesion of Retained Soils	(c)	130.0	psf
Factor of Safety	(FS)	1.25	
Factored Parameters:	(f_{FS})	25.7	degrees
	(c_{FS})	104.0	psf



Failure Angle (a) degrees	Height of Tension Crack (H_C) feet	Area of Wedge (A) feet^2	Weight of Wedge (W) lbs/lineal foot	Length of Failure Plane (L_{CR}) feet	a lbs/lineal foot	b lbs/lineal foot	Active Pressure (P_A) lbs/lineal foot
45	3.2	93	11608.3	15.3	4324.0	7284.3	2554.8
46	3.1	90	11246.9	15.1	4085.9	7161.0	2652.8
47	3.0	87	10890.6	15.0	3868.2	7022.4	2741.7
48	2.9	84	10540.2	14.9	3668.8	6871.4	2822.0
49	2.9	82	10196.1	14.7	3485.7	6710.4	2893.7
50	2.8	79	9858.4	14.6	3317.3	6541.1	2957.1
51	2.8	76	9527.2	14.4	3161.9	6365.3	3012.5
52	2.7	74	9202.5	14.3	3018.3	6184.1	3060.0
53	2.7	71	8884.1	14.1	2885.4	5998.7	3099.7
54	2.7	69	8571.9	14.0	2761.9	5810.0	3131.9
55	2.7	66	8265.7	13.8	2647.1	5618.6	3156.5
56	2.7	64	7965.4	13.7	2540.2	5425.2	3173.7
57	2.6	61	7670.6	13.5	2440.2	5230.4	3183.5
58	2.6	59	7381.2	13.4	2346.7	5034.4	3186.0
59	2.6	57	7096.8	13.2	2259.0	4837.8	3181.1
60	2.7	55	6817.3	13.1	2176.6	4640.7	3168.9
61	2.7	52	6542.4	12.9	2099.0	4443.4	3149.3
62	2.7	50	6271.8	12.8	2025.7	4246.2	3122.2
63	2.7	48	6005.4	12.7	1956.3	4049.1	3087.6
64	2.8	46	5742.8	12.5	1890.5	3852.3	3045.3
65	2.8	44	5483.8	12.4	1827.8	3656.0	2995.3
66	2.8	42	5228.2	12.2	1768.0	3460.2	2937.3
67	2.9	40	4975.7	12.1	1710.7	3265.1	2871.1
68	3.0	38	4726.2	11.9	1655.6	3070.6	2796.7
69	3.0	36	4479.2	11.7	1602.3	2876.9	2713.6
70	3.1	34	4234.7	11.6	1550.6	2684.1	2621.7



Design Equations (Vector Analysis):

$a = c_{FS}*L_{CR}*\sin(90+f_{FS})/\sin(a-f_{FS})$

$b = W-a$

$P_A = b*\tan(a-f_{FS})$

$EFP = 2*P_A/H^2$

Maximum Active Pressure Resultant

$P_{A,\ max}$ 3186.0 lbs/lineal foot

Equivalent Fluid Pressure (per lineal foot of shoring)

$EFP = 2*P_A/H^2$

EFP 32.5 pcf

Design Shoring for an Equivalent Fluid Pressure: 33 pcf

GEOCON
WEST, INC.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

DRAFTED BY: PZ | CHECKED BY: NDB

SHORING PRESSURE CALCULATION

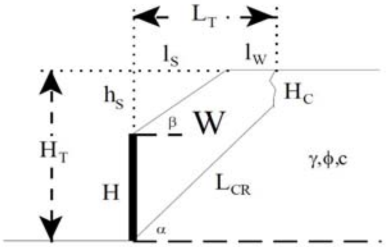
410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

SEPT. 2021 | PROJECT NO. W1041-06-02 | FIG. 11

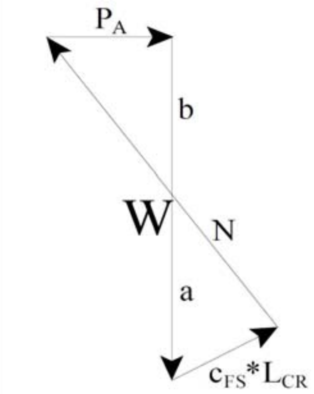
Shoring Design with Transitioned Backfill
(Vector Analysis)

Input:

Shoring Height	(H)	25.00 feet
Slope Angle of Backfill	(b)	0.0 degrees
Height of Slope above Shoring	(h_s)	0.0 feet
Horizontal Length of Slope	(l_s)	0.0 feet
Total Height (Shoring + Slope)	(H_T)	25.0 feet
Unit Weight of Retained Soils	(g)	125.0 pcf
Friction Angle of Retained Soils	(f)	31.0 degrees
Cohesion of Retained Soils	(c)	130.0 psf
Factor of Safety	(FS)	1.25
Factored Parameters:	(f_{FS})	25.7 degrees
	(c_{FS})	104.0 psf



Failure Angle (a) degrees	Height of Tension Crack (H_C) feet	Area of Wedge (A) feet²	Weight of Wedge (W) lbs/lineal foot	Length of Failure Plane (L_{CR}) feet	a lbs/lineal foot	b lbs/lineal foot	Active Pressure (P_A) lbs/lineal foot
45	3.2	307	38420.8	30.8	8729.9	29690.9	10413.3
46	3.1	297	37139.4	30.4	8212.1	28927.3	10716.0
47	3.0	287	35893.7	30.0	7744.6	28149.1	10990.1
48	2.9	277	34682.3	29.7	7321.0	27361.3	11236.7
49	2.9	268	33503.8	29.3	6935.9	26568.0	11456.8
50	2.8	259	32356.7	28.9	6584.6	25772.1	11651.2
51	2.8	250	31239.5	28.6	6263.3	24976.2	11820.6
52	2.7	241	30150.7	28.2	5968.7	24182.0	11965.7
53	2.7	233	29088.7	27.9	5697.7	23391.1	12087.0
54	2.7	224	28052.3	27.6	5447.8	22604.5	12185.0
55	2.7	216	27040.1	27.3	5217.0	21823.1	12260.0
56	2.7	208	26050.7	27.0	5003.2	21047.4	12312.4
57	2.6	201	25082.9	26.7	4804.8	20278.0	12342.3
58	2.6	193	24135.5	26.4	4620.3	19515.1	12349.8
59	2.6	186	23207.4	26.1	4448.4	18759.0	12335.0
60	2.7	178	22297.5	25.8	4287.9	18009.6	12297.8
61	2.7	171	21404.8	25.5	4137.7	17267.1	12238.0
62	2.7	164	20528.3	25.3	3996.9	16531.4	12155.5
63	2.7	157	19667.0	25.0	3864.7	15802.3	12049.9
64	2.8	151	18820.1	24.7	3740.3	15079.8	11920.9
65	2.8	144	17986.7	24.5	3622.9	14363.8	11767.9
66	2.8	137	17165.9	24.2	3512.0	13653.9	11590.4
67	2.9	131	16357.0	24.0	3406.9	12950.1	11387.7
68	3.0	124	15559.1	23.8	3307.0	12252.1	11159.1
69	3.0	118	14771.6	23.5	3211.9	11559.7	10903.6
70	3.1	112	13993.6	23.3	3120.9	10872.7	10620.2



Design Equations (Vector Analysis):

$a = c_{FS}*L_{CR}*\sin(90+f_{FS})/\sin(a-f_{FS})$

$b = W-a$

$P_A = b*\tan(a-f_{FS})$

$EFP = 2*P_A/H^2$

Maximum Active Pressure Resultant

$P_{A,\ max}$ 12349.8 lbs/lineal foot

Equivalent Fluid Pressure (per lineal foot of shoring)

$EFP = 2*P_A/H^2$

EFP 39.5 pcf

Design Shoring for an Equivalent Fluid Pressure: 40 pcf

GEOCON
WEST, INC.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

SHORING PRESSURE CALCULATION

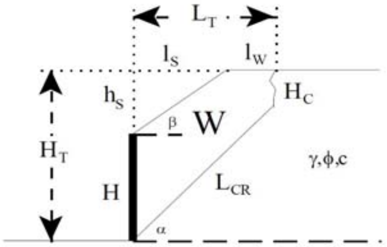
410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

DRAFTED BY: PZ	CHECKED BY: NDB	SEPT. 2021	PROJECT NO. W1041-06-02	FIG. 12

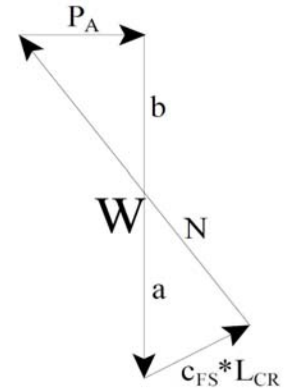
Shoring Design with Transitioned Backfill
(Vector Analysis)

Input:

Shoring Height	(H)	45.00	feet
Slope Angle of Backfill	(b)	0.0	degrees
Height of Slope above Shoring	(h_s)	0.0	feet
Horizontal Length of Slope	(l_s)	0.0	feet
Total Height (Shoring + Slope)	(H_T)	45.0	feet
Unit Weight of Retained Soils	(g)	125.0	pcf
Friction Angle of Retained Soils	(f)	31.0	degrees
Cohesion of Retained Soils	(c)	130.0	psf
Factor of Safety	(FS)	1.25	
Factored Parameters:	(f_{FS})	25.7	degrees
	(c_{FS})	104.0	psf



Failure Angle (a) degrees	Height of Tension Crack (H_C) feet	Area of Wedge (A) feet^2	Weight of Wedge (W) lbs/lineal foot	Length of Failure Plane (L_{CR}) feet	a lbs/lineal foot	b lbs/lineal foot	Active Pressure (P_A) lbs/lineal foot
45	3.2	1007	125920.8	59.1	16740.5	109180.3	38292.1
46	3.1	973	121637.2	58.2	15714.3	105922.9	39238.7
47	3.0	940	117488.7	57.4	14792.6	102696.1	40095.2
48	2.9	908	113467.7	56.6	13961.4	99506.3	40865.2
49	2.9	877	109566.4	55.8	13208.8	96357.6	41551.9
50	2.8	846	105778.0	55.0	12525.3	93252.7	42158.0
51	2.8	817	102095.6	54.3	11902.3	90193.3	42686.1
52	2.7	788	98513.2	53.6	11332.9	87180.3	43138.2
53	2.7	760	95024.7	52.9	10810.9	84213.8	43516.1
54	2.7	733	91624.8	52.3	10331.3	81293.5	43821.4
55	2.7	706	88308.2	51.7	9889.5	78418.7	44055.0
56	2.7	681	85070.2	51.1	9481.6	75588.6	44218.1
57	2.6	655	81906.0	50.5	9104.1	72801.9	44311.2
58	2.6	630	78811.6	49.9	8754.2	70057.4	44334.6
59	2.6	606	75782.7	49.4	8429.1	67353.6	44288.4
60	2.7	583	72815.7	48.9	8126.5	64689.1	44172.5
61	2.7	559	69906.9	48.4	7844.5	62062.4	43986.5
62	2.7	536	67052.9	47.9	7581.0	59471.9	43729.5
63	2.7	514	64250.5	47.4	7334.6	56916.0	43400.6
64	2.8	492	61496.7	47.0	7103.6	54393.1	42998.6
65	2.8	470	58788.6	46.6	6886.8	51901.8	42521.9
66	2.8	449	56123.4	46.1	6683.0	49440.5	41968.5
67	2.9	428	53498.5	45.7	6490.9	47007.6	41336.3
68	3.0	407	50911.4	45.3	6309.7	44601.7	40622.8
69	3.0	387	48359.7	44.9	6138.4	42221.3	39824.9
70	3.1	367	45841.0	44.5	5976.0	39865.1	38939.3



Design Equations (Vector Analysis):

$a = c_{FS} * L_{CR} * \sin(90+f_{FS}) / \sin(a-f_{FS})$

$b = W-a$

$P_A = b * \tan(a-f_{FS})$

$EFP = 2 * P_A / H^2$

Maximum Active Pressure Resultant

$P_{A,\ max}$ 44334.6 lbs/lineal foot

Equivalent Fluid Pressure (per lineal foot of shoring)

$EFP = 2*P_A/H^2$

EFP 43.8 pcf

Design Shoring for an Equivalent Fluid Pressure: **44 pcf**

GEOCON
W E S T, I N C.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

DRAFTED BY: PZ
CHECKED BY: NDB

SHORING PRESSURE CALCULATION

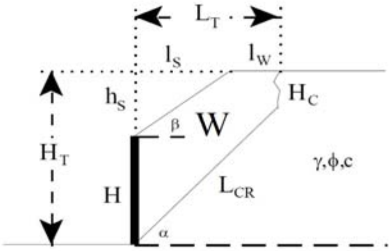
410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

SEPT. 2021
PROJECT NO. W1041-06-02
FIG. 13

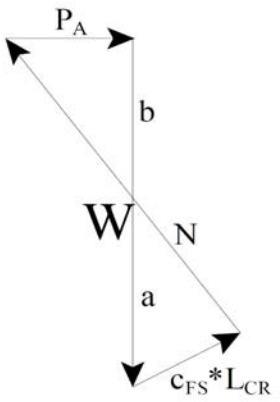
Shoring Design with Transitioned Backfill
(Vector Analysis)

Input:

Shoring Height	(H)	64.00	feet
Slope Angle of Backfill	(b)	0.0	degrees
Height of Slope above Shoring	(h_s)	0.0	feet
Horizontal Length of Slope	(l_s)	0.0	feet
Total Height (Shoring + Slope)	(H_T)	64.0	feet
Unit Weight of Retained Soils	(g)	125.0	pcf
Friction Angle of Retained Soils	(f)	31.0	degrees
Cohesion of Retained Soils	(c)	130.0	psf
Factor of Safety	(FS)	1.25	
Factored Parameters:	(f_{FS})	25.7	degrees
	(c_{FS})	104.0	psf



Failure Angle (a) degrees	Height of Tension Crack (H_C) feet	Area of Wedge (A) $feet^2$	Weight of Wedge (W) lbs/lineal foot	Length of Failure Plane (L_{CR}) feet	a lbs/lineal foot	b lbs/lineal foot	Active Pressure (P_A) lbs/lineal foot
45	3.2	2043	255358.3	86.0	24350.5	231007.8	81019.7
46	3.1	1973	246633.5	84.7	22841.4	223792.1	82902.9
47	3.0	1906	238191.2	83.4	21488.2	216703.0	84606.4
48	2.9	1840	230013.7	82.2	20269.7	209744.0	86137.5
49	2.9	1777	222084.7	81.0	19168.2	202916.6	87502.8
50	2.8	1715	214388.9	79.8	18168.9	196220.1	88707.9
51	2.8	1655	206912.0	78.8	17259.3	189652.8	89757.6
52	2.7	1597	199640.8	77.7	16428.8	183212.0	90656.2
53	2.7	1541	192562.9	76.7	15668.5	176894.3	91407.3
54	2.7	1485	185666.6	75.8	14970.6	170696.1	92013.9
55	2.7	1432	178941.3	74.9	14328.3	164613.0	92478.3
56	2.7	1379	172376.8	74.0	13736.0	158640.9	92802.3
57	2.6	1328	165963.7	73.2	13188.4	152775.3	92987.3
58	2.6	1278	159693.1	72.3	12681.3	147011.8	93033.8
59	2.6	1228	153556.6	71.6	12210.7	141345.9	92942.1
60	2.7	1180	147546.4	70.8	11773.3	135773.2	92711.8
61	2.7	1133	141655.2	70.1	11365.9	130289.3	92342.0
62	2.7	1087	135876.0	69.4	10985.9	124890.1	91831.4
63	2.7	1042	130202.2	68.8	10630.9	119571.3	91177.8
64	2.8	997	124627.6	68.1	10298.8	114328.9	90378.8
65	2.8	953	119146.3	67.5	9987.5	109158.8	89431.2
66	2.8	910	113752.7	66.9	9695.4	104057.3	88331.2
67	2.9	868	108441.5	66.4	9420.8	99020.7	87074.3
68	3.0	826	103207.6	65.8	9162.3	94045.3	85655.5
69	3.0	784	98046.1	65.3	8918.5	89127.6	84068.7
70	3.1	744	92952.4	64.8	8688.3	84264.2	82307.3



Design Equations (Vector Analysis):

$a = c_{FS}*L_{CR}*\sin(90+f_{FS})/\sin(a-f_{FS})$

$b = W-a$

$P_A = b*\tan(a-f_{FS})$

$EFP = 2*P_A/H^2$

Maximum Active Pressure Resultant

$P_{A,\ max}$ 93033.8 lbs/lineal foot

Equivalent Fluid Pressure (per lineal foot of shoring)

$EFP = 2*P_A/H^2$

EFP 45.4 pcf

Design Shoring for an Equivalent Fluid Pressure: 45 pcf

GEOCON
W E S T, I N C.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

DRAFTED BY: PZ | CHECKED BY: NDB

SHORING PRESSURE CALCULATION

410 SOUTH CENTRAL AVENUE
LOS ANGELES, CALIFORNIA

SEPT. 2021 | PROJECT NO. W1041-06-02 | FIG. 14

BORING PERCOLATION TEST FIELD LOG

Date: 11/23/2019
Project Number: W1041-06-02
Project Location: 410 S Central Ave
Earth Description: SP
Tested By: JAO
Liquid Description: Clear Clean Tap Water
Measurement Method: Sounder

Boring/Test Number: B1
Diameter of Boring: 8 inches
Diameter of Casing: 2 inches
Depth of Boring: 34 feet
Depth to Invert of BMP: feet
Depth to Water Table: > 75 feet
Depth to Initial Water Depth (d_1): 348 inches

Start Time for Pre-Soak: 9:00 AM
Start Time for Standard: 10:00 AM

Water Remaining in Boring (Y/N): Yes
Standard Time Interval Between Readings: 10 min

Reading Number	Time Start (hh:mm)	Time End (hh:mm)	Elapsed Time Δtime (min)	Water Drop During Standard Time Interval, Δd (in)	Soil Description Notes Comments
1	10:05 AM	10:15 AM	10	59.8	
2	10:19 AM	10:29 AM	10	57.0	
3	10:35 AM	10:45 AM	10	55.7	
4	10:48 AM	10:58 AM	10	55.3	
5	11:02 AM	11:12 AM	10	53.6	
6	11:16 AM	11:26 AM	10	52.7	Stabilized Readings
7	11:30 AM	11:40 AM	10	51.8	Achieved with Readings
8	11:44 AM	11:54 AM	10	51.1	6, 7, and 8

MEASURED PERCOLATION RATE & DESIGN INFILTRATION RATE CALCULATIONS*

* Calculations Below Based on Stabilized Readings Only

Boring Radius, r: 4 inches
Test Section Height, h: 60.0 inches

$$Test\ Section\ Surface\ Area, A = 2\pi rh + \pi r^2$$

A = **1558** in^2

$$Discharged\ Water\ Volume, V = \pi r^2 \Delta d$$

$$Percolation\ Rate = \left(\frac{V/A}{\Delta T}\right)$$

Reading 6 V = **2648** in^3
Reading 7 V = **2606** in^3
Reading 8 V = **2570** in^3

Percolation Rate = **10.20** inches/hour
Percolation Rate = **10.03** inches/hour
Percolation Rate = **9.89** inches/hour

Measured Percolation Rate = **10.0** inches/hour

Reduction Factors

Boring Percolation Test, RF_t = 2
Site Variability, RF_v = 1
Long Term Siltation, RF_s = 1

$$Total\ Reduction\ Factor, RF = RF_t \times RF_v \times RF_s$$

Total Reduction Factor = 2

Design Infiltration Rate

$$Design\ Infiltration\ Rate = Measured\ Percolation\ Rate\ /RF$$

Design Infiltration Rate = **5.0** inches/hour

FIGURE 15

BORING PERCOLATION TEST FIELD LOG

Date: 11/23/2019
Project Number: W1041-06-02
Project Location: 410 S Central Ave
Earth Description: SP
Tested By: JAO
Liquid Description: Clear Clean Tap Water
Measurement Method: Sounder

Boring/Test Number: B4
Diameter of Boring: 8 inches
Diameter of Casing: 2 inches
Depth of Boring: 40 feet
Depth to Invert of BMP: feet
Depth to Water Table: > 75 feet
Depth to Initial Water Depth (d_1): 360 inches

Start Time for Pre-Soak: 12:00 PM
Start Time for Standard: 1:00 PM

Water Remaining in Boring (Y/N): Yes
Standard Time Interval Between Readings: 10 min

Reading Number	Time Start (hh:mm)	Time End (hh:mm)	Elapsed Time Δtime (min)	Water Drop During Standard Time Interval, Δd (in)	Soil Description Notes Comments
1	1:00 PM	1:10 PM	10	98.4	
2	1:14 PM	1:24 PM	10	93.7	
3	1:27 PM	1:37 PM	10	92.4	
4	1:45 PM	1:55 PM	10	89.3	
5	2:00 PM	2:10 PM	10	85.2	
6	2:13 PM	2:23 PM	10	82.3	Stabilized Readings
7	2:27 PM	2:37 PM	10	79.4	Achieved with Readings
8	2:40 PM	2:50 PM	10	79.2	6, 7, and 8

MEASURED PERCOLATION RATE & DESIGN INFILTRATION RATE CALCULATIONS*

* Calculations Below Based on Stabilized Readings Only

Boring Radius, r: 4 inches
Test Section Height, h: 120.0 inches

$$Test\ Section\ Surface\ Area, A = 2\pi rh + \pi r^2$$

A = **3066** in^2

$$Discharged\ Water\ Volume, V = \pi r^2 \Delta d$$

$$Percolation\ Rate = \left(\frac{V/A}{\Delta T}\right)$$

Reading 6	V =	**4138**	in^3	Percolation Rate =	**8.10**	inches/hour
Reading 7	V =	**3993**	in^3	Percolation Rate =	**7.81**	inches/hour
Reading 8	V =	**3981**	in^3	Percolation Rate =	**7.79**	inches/hour

Measured Percolation Rate = **7.9** inches/hour

Reduction Factors

Boring Percolation Test, RF_t = 2
Site Variability, RF_v = 1
Long Term Siltation, RF_s = 1

$$Total\ Reduction\ Factor, RF = RF_t \times RF_v \times RF_s$$

Total Reduction Factor = 2

Design Infiltration Rate

$$Design\ Infiltration\ Rate = Measured\ Percolation\ Rate\ / RF$$

Design Infiltration Rate = **3.9** inches/hour

FIGURE 16

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

The site was explored as a part of a larger parcel of land, which is shown on the Site Plan (see Figure 2A). The larger site was explored on November 23, 2019 by excavating four 8-inch diameter borings to depths between approximately 20 and 42 feet below the existing ground surface using a truck-mounted hollow-stem auger drilling machine. Additional site exploration was performed on December 28, 2019 by excavating one 4⅞-inch diameter boring to a depth of approximately 100½ feet below the existing ground surface using a truck-mounted mud-rotary drilling machine. Representative and relatively undisturbed samples were obtained by driving a 3 inch, O. D., California Modified Sampler into the "undisturbed" soil mass with blows from a 140-pound auto-hammer falling 30 inches. The California Modified Sampler was equipped with 1-inch high by 2⅜-inch diameter brass sampler rings to facilitate soil removal and testing. Bulk samples were also obtained.

The soil conditions encountered in the borings were visually examined, classified and logged in general accordance with the Unified Soil Classification System (USCS). The logs of the borings are presented on Figures A1 through A5. The logs depict the soil and geologic conditions encountered and the depth at which samples were obtained. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the logs using visual observations, penetration rates, excavation characteristics and other factors. The transition between materials may be abrupt or gradual. Where applicable, the logs were revised based on subsequent laboratory testing. The locations of the borings are provided on the Site Plan (Figure 2A).

PROJECT NO. W1041-06-01

BORING 1

ELEV. (MSL.) **--** DATE COMPLETED **11/23/19**

EQUIPMENT **HOLLOW STEM AUGER** BY: **JS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**CONCRETE: 4.5"** **ARTIFICIAL FILL** Silty Sand, medium dense, moist, brown, fine-grained.			
2					Sand, poorly graded, dense, moist, dark brown, fine- to medium-grained, trace fine gravel, clay pipe fragment.			
4								
	B1@5'					55	118.1	11.1
6								
8					**ALLUVIUM** Sand, poorly graded, medium dense, moist, light brown, fine-grained, trace medium-grained.			
10	B1@10'			SP		52	102.1	7.5
12								
14					Sand, well graded, medium dense, slightly moist, light brown, fine- to coarse-grained, some fine gravel.			
	B1@15'			SW		45	107.9	2.8
16								
18					Sand with Gravel, poorly graded, medium dense, moist, light brown, fine-grained, fine gravel.			
20	B1@20'				- decreased in gravel	49	98.5	9.6
22				SP				
	B1@22.5'					52	100.9	4.5
24								
	B1@25'				- dense	74	97.9	10.6
26					Sand with Gravel, well graded, dense, slightly moist, light brown, fine- to coarse-grained, fine gravel, some cobble fragments (to 4").			
28	B1@27.5'			SW		74	83.8	2.0

W1041-06-02 BORING LOGS.GPJ

Figure A1,
Log of Boring 1, Page 1 of 2

SAMPLE SYMBOLS

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

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

GEOCON

PROJECT NO. W1041-06-01

BORING 1

ELEV. (MSL.) **--** DATE COMPLETED **11/23/19**

EQUIPMENT **HOLLOW STEM AUGER** BY: **JS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B1@30' ■					50 (5")	105.6	8.6
32				SW				
34					- refusal			

Total depth of boring: 34 feet
Fill to 8 feet.
No groundwater encountered.
Backfilled with soil cuttings and tamped.
Concrete patched.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

W1041-06-02 BORING LOGS.GPJ

Figure A1,
Log of Boring 1, Page 2 of 2

SAMPLE SYMBOLS

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

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

GEOCON

PROJECT NO. W1041-06-01

BORING 2

ELEV. (MSL.) **--** DATE COMPLETED **11/23/19**

EQUIPMENT **HOLLOW STEM AUGER** BY: **CB**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**AC: 3"** **ARTIFICIAL FILL**			
2					Sand with Silt, poorly graded, medium dense, slightly moist, dark brown, fine-grained, trace coarse-grained and fine gravel.			
4								
	B2@5'				**ALLUVIUM** Sand, poorly graded, medium dense, slightly moist, fine- to medium-grained, yellowish brown, trace coarse-grained sand.	32	107.1	11.6
6								
8					- interbeds of well-graded sand, 2" thick			
10	B2@10'					21	87.8	13.7
12	B2@12'			SP	- light yellowish brown	37	97.9	7.3
14								
	B2@15'				- dense, trace fine gravel	72	94.5	0.8
16	BULK 15-20'							
	B2@17'				- very dense	50 (5")	112.1	3.0
18					- increase in gravel size			
20	B2@20'					50 (6")	101.6	1.3

Total depth of boring: 20.5 feet
Fill to 4.5 feet.
No groundwater encountered.
Backfilled with soil cuttings and tamped.
Asphalt patched.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

W1041-06-02 BORING LOGS.GPJ

Figure A2,
Log of Boring 2, Page 1 of 1

SAMPLE SYMBOLS

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

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

PROJECT NO. W1041-06-01

BORING 3

ELEV. (MSL.) **--** DATE COMPLETED **11/23/19**

EQUIPMENT **HOLLOW STEM AUGER** BY: **CB**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**AC: 3" BASE: 3"** **ARTIFICIAL FILL** Sand, poorly graded, medium dense, dry, dark brown, fine-grained, debris, some silt, trace medium-grained sand and fine gravel.			
2								
4								
	B3@5'			SP	**ALLUVIUM** Sand, poorly graded, loose, slightly moist, light grayish brown, fine- to medium-grained interbeds with well-graded sand, trace fine gravel.	14	103.9	4.6
6								
8								
10	B3@10'				- medium dense, increase in gravel size	25	109.5	3.0
12								
14								
	B3@15'					43	88.6	11.0
16								
18								
20	B3@20'				- dense, gravel (to 2.5")	83	120.1	3.2
22								
24								
	B3@25'					83	116.4	2.8
26								
28								

W1041-06-02 BORING LOGS.GPJ

Figure A3,
Log of Boring 3, Page 1 of 2

SAMPLE SYMBOLS

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

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

GEOCON

BORING 3

ELEV. (MSL.) **--** DATE COMPLETED **11/23/19**

EQUIPMENT **HOLLOW STEM AUGER** BY: **CB**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B3@30' ☐				- very dense	50 (5")	116.4	4.9
32								
34	B3@34' ■			SP	- some coarse gravel and cobbles	50 (2")	107.8	5.7
36								
38					- refusal			

Total depth of boring: 38 feet
Fill to 5 feet.
No groundwater encountered.
Backfilled with soil cuttings and tamped.
Asphalt patched.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

Figure A3,
Log of Boring 3, Page 2 of 2

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

PROJECT NO. W1041-06-01

BORING 4

ELEV. (MSL.) **--** DATE COMPLETED **11/23/19**

EQUIPMENT **HOLLOW STEM AUGER** BY: **JS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**AC: 5" BASE: 3.5"** **ARTIFICIAL FILL** Silty Sand, loose, moist, dark brown, fine-grained.			
2								
4					**ALLUVIUM** Sand, poorly graded, loose, moist, light brown, fine-grained.			
	B4@5'			SP		8	107.8	5.7
6								
					Sand, well graded, medium dense, moist, light brown to brown, fine- to coarse-grained.			
8								
10	B4@10'			SW		31	97.2	5.4
12								
					Sand, poorly graded, medium dense, moist, brown, fine-grained.			
14								
	B4@15'					44	106.1	5.2
16								
18				SP				
20	B4@20'				- very dense, some fine gravel	50 (6")	101.3	8.4
22								
					Silty Sand, dense, moist, brown, fine-grained.			
24								
	B4@25'			SM		64	99.8	19.1
26								
28								
				SW	Sand with Gravel, well graded, very dense, moist, brown, fine- to coarse-grained, coarse gravel, cobble fragments.			

W1041-06-02 BORING LOGS.GPJ

Figure A4,
Log of Boring 4, Page 1 of 2

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

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

PROJECT NO. W1041-06-01

BORING 4

ELEV. (MSL.) -- DATE COMPLETED **11/23/19**

EQUIPMENT **HOLLOW STEM AUGER** BY: **JS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B4@30' BULK 30-35'					50 (2")	99.8	7.4
32								
34								
	B4@35'			SW		50 (3")		
36								
38								
40	B4@40'					50 (5.5")		
42					- refusal			

Total depth of boring: 42 feet
Fillto 3.5 feet.
No groundwater encountered.
Backfilled with soil cuttings and tamped.
Asphalt patched.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

**Figure A4,
Log of Boring 4, Page 2 of 2**

SAMPLE SYMBOLS

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

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

PROJECT NO. W1041-06-01

BORING 5

ELEV. (MSL.) -- DATE COMPLETED 12/28/19

EQUIPMENT **MUD ROTARY** BY: **JS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ARTIFICIAL FILL** Sand, medium dense, moist, dark brown, fine-grained.			
2					- some brick fragments			
4					**ALLUVIUM**			
	B5@5	■			Sand, poorly graded, medium dense, moist, dark brown, fine-grained, some medium-grained.	20	115.4	7.9
6								
8				SP				
10	B5@10	■			- light brown	33	105.3	7.2
12								
				SM	Silty Sand, medium dense, moist, olive brown, fine-grained.			
14								
	B5@15	■		SP	Sand, poorly graded, medium dense, moist, light brown to brown, fine- to medium-grained, fine gravel.	47	119.7	9.5
16								
					Sand with Gravel, well graded, dense, moist, brown, fine- to coarse-grained, fine gravel.			
18								
20	B5@20	■				86	133.2	6.0
22				SW				
24								
	B5@25	■			- very dense	50 (6")	123.5	8.1
26								
28					Silty Clay with Sand, firm, moist, brown, fine-grained.			
				CL				

Figure A5,
Log of Boring 5, Page 1 of 4

W1041-06-02 BORING LOGS.GPJ

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

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

BORING 5

ELEV. (MSL.) -- DATE COMPLETED 12/28/19

EQUIPMENT **MUD ROTARY** BY: **JS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B5@30 ■			SW	Sand with Gravel, well graded, dense, moist, light brown to brown, fine- to coarse-grained, fine gravel.	55	130.0	7.7
32								
34					Sand with Cobbles, well graded, very dense, moist, brown, fine- to coarse-grained, cobble fragments.			
	B5@35 ■					50 (5")		8.5
36								
38								
40	B5@40 ■					50 (5")	101.6	26.0
42				SW				
	B5@42.5 ■					60 (6")	117.4	8.4
44								
	B5@45 ■					59 (6")		9.8
46								
	B5@47.5 ■					50 (4.5")		8.2
48								
50	B5@50 ☐					50 (3")		
52					Sand with Gravel and Cobbles, well graded, very dense, moist, brown, fine- to coarse-grained, fine to coarse gravel.			
	B5@52.5 ■					50 (5")	127.7	10.6
54								
	B5@55 ■					50 (5")	123.4	13.9
56				SW				
	B5@57.5 ■					50 (3")	125.3	15.9
58								

W1041-06-02 BORING LOGS.GPJ

**Figure A5,
Log of Boring 5, Page 2 of 4**

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

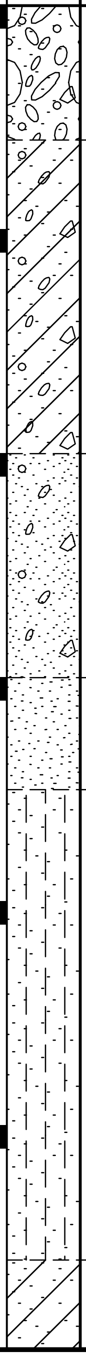
NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. W1041-06-01

BORING 5

ELEV. (MSL.) -- DATE COMPLETED **12/28/19**

EQUIPMENT **MUD ROTARY** BY: **JS**



DEPTH IN FEET	SAMPLE NO.	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	B5@60		SW		50 (5")	120.8	6.9
62							
64			SP-SC	Sand with Clay and Gravel, poorly graded, very dense, moist, yellowish brown, fine- to medium-grained, fine gravel.			
66	B5@65				50 (4.5")	116.0	18.1
68							
70	B5@70		SW	Sand with Gravel, well graded, very dense, moist, brown, fine- to coarse-grained, fine to coarse gravel.	50 (5")	125.3	12.3
72							
74							
76	B5@75		SP	- decrease in cobbles and gravel Sand, poorly graded, dense, moist, olive brown, fine- to medium-grained, some fine gravel.	59	94.8	24.1
78			SM	Silty Sand, very dense, moist, olive brown to brown, fine-grained.			
80	B5@80				50 (4")	105.9	16.9
82							
84							
86	B5@85			- brown, fine- to medium-grained	50 (4")	116.6	20.6
88			SP-SC	Sand with Clay, very dense, moist, dark yellowish brown, fine-grained.			

Figure A5,
Log of Boring 5, Page 3 of 4

W1041-06-02 BORING LOGS.GPJ

SAMPLE SYMBOLS

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

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

GEOCON

PROJECT NO. W1041-06-01

BORING 5

ELEV. (MSL.) -- DATE COMPLETED **12/28/19**

EQUIPMENT **MUD ROTARY** BY: **JS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
90	■ B5@90			SP-SC		50 (5")	117.0	18.0
92								
94				SP	Sand, poorly graded, very dense, moist, medium- to coarse-grained.			
	☐ B5@95					50 (3")		
96								
98								
100	☐ B5@100					50 (2")		

Total depth of boring: 100.5 feet
Fill to 4 feet.
No groundwater encountered.
Backfilled with grout.
Surface restored.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

W1041-06-02 BORING LOGS.GPJ

Figure A5,
Log of Boring 5, Page 4 of 4

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

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

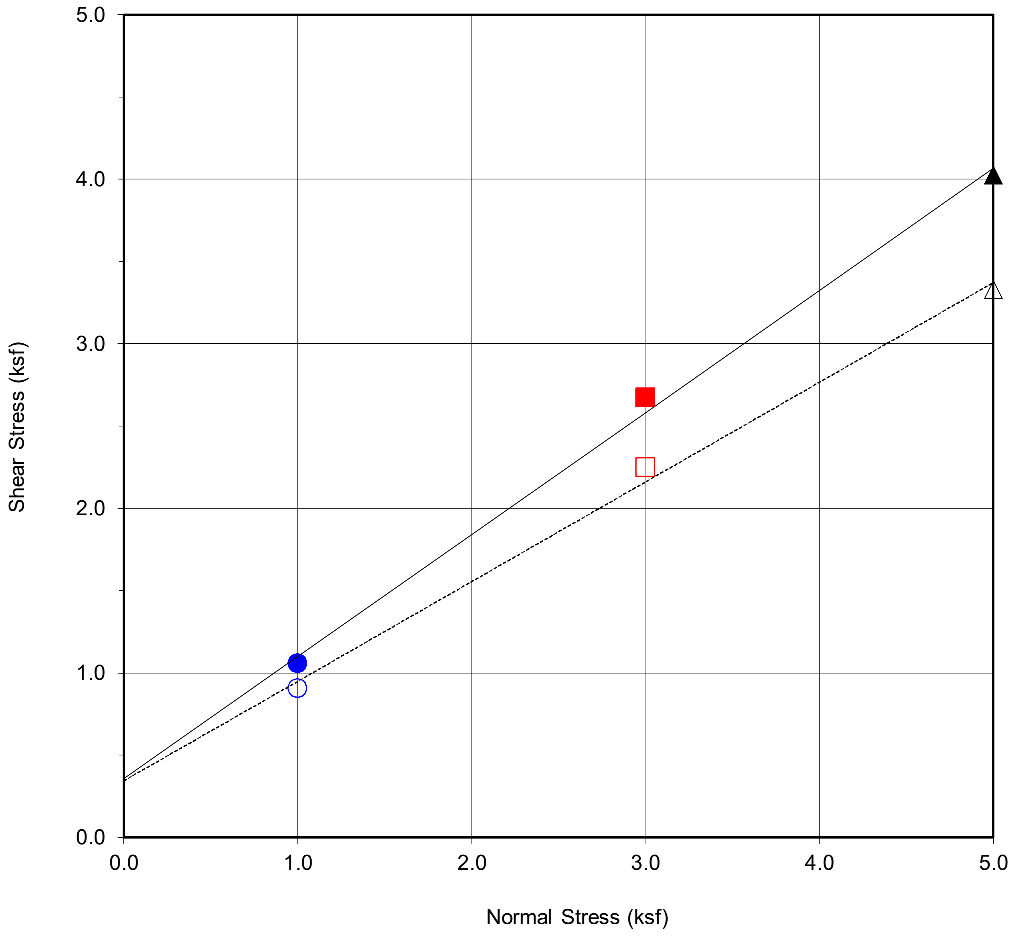
GEOCON

APPENDIX B

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the "American Society for Testing and Materials (ASTM)", or other suggested procedures. Selected samples were tested for direct shear strength, consolidation and expansion characteristics, corrosivity, corrosivity, in-place dry density and moisture content. The results of the laboratory tests are summarized in Figures B1 through B28. The in-place dry density and moisture content of the samples tested are presented on the boring logs, Appendix A.



Boring No.	**B2**
Sample No.	**B2@5'**
Depth (ft)	**5**
Sample Type:	Ring

Soil Identification:
Yellowish Brown Poorly Graded Sand (SP)

Strength Parameters

	C (psf)	ϕ (°)
Peak	357	36.6
Ultimate	344	31.2

Normal Stress (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.06	■ 2.67	▲ 4.02
Shear Stress @ End of Test (ksf)	○ 0.91	□ 2.25	△ 3.33
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	11.6	11.5	12.0
Initial Dry Density (pcf)	107.3	108.5	104.6
Initial Degree of Saturation (%)	54.8	55.8	52.9
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	17.5	16.9	17.2

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

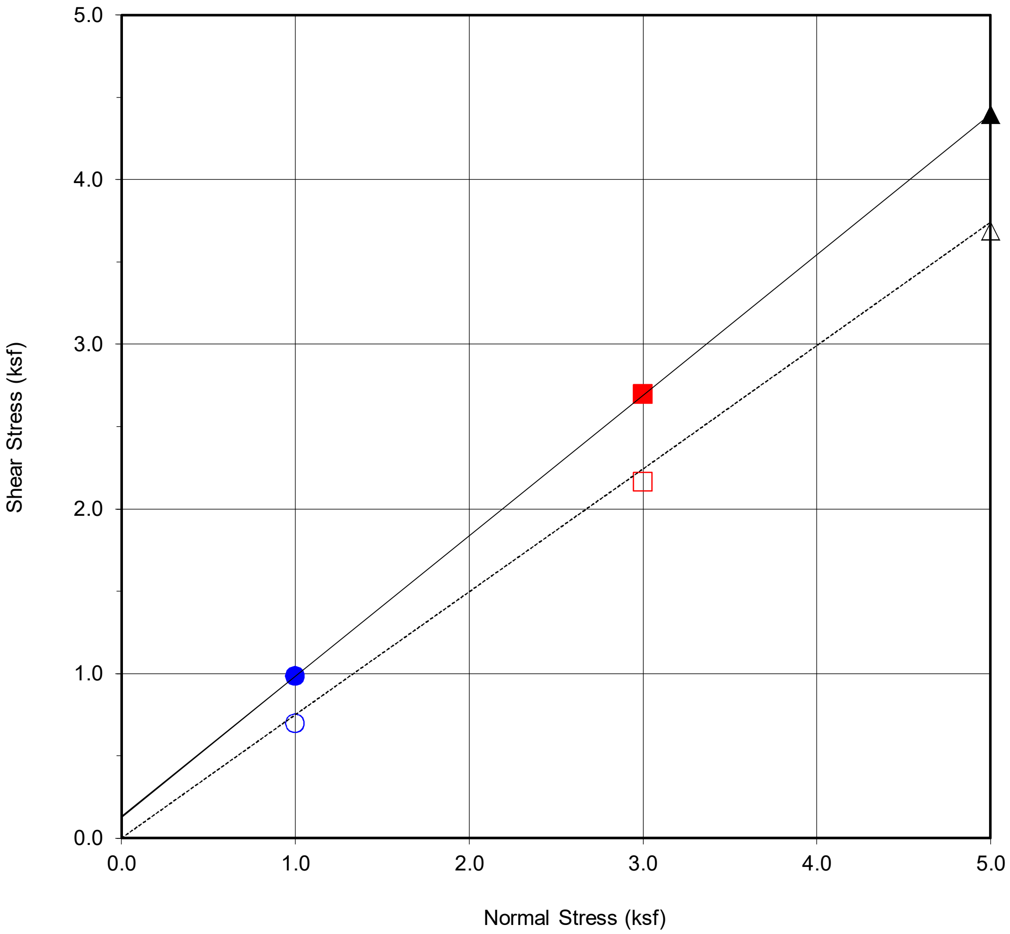
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B1



Boring No.	**B1**
Sample No.	**B1@10'**
Depth (ft)	**10**
Sample Type:	Ring

Soil Identification:		
Light Brown Poorly Graded Sand (SP)		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	129	40.5
Ultimate	0	36.8

Normal Stress (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.98	■ 2.70	▲ 4.40
Shear Stress @ End of Test (ksf)	○ 0.70	□ 2.16	△ 3.69
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	6.1	4.9	7.5
Initial Dry Density (pcf)	100.6	97.5	106.5
Initial Degree of Saturation (%)	24.4	18.2	34.8
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	18.8	18.8	16.1

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

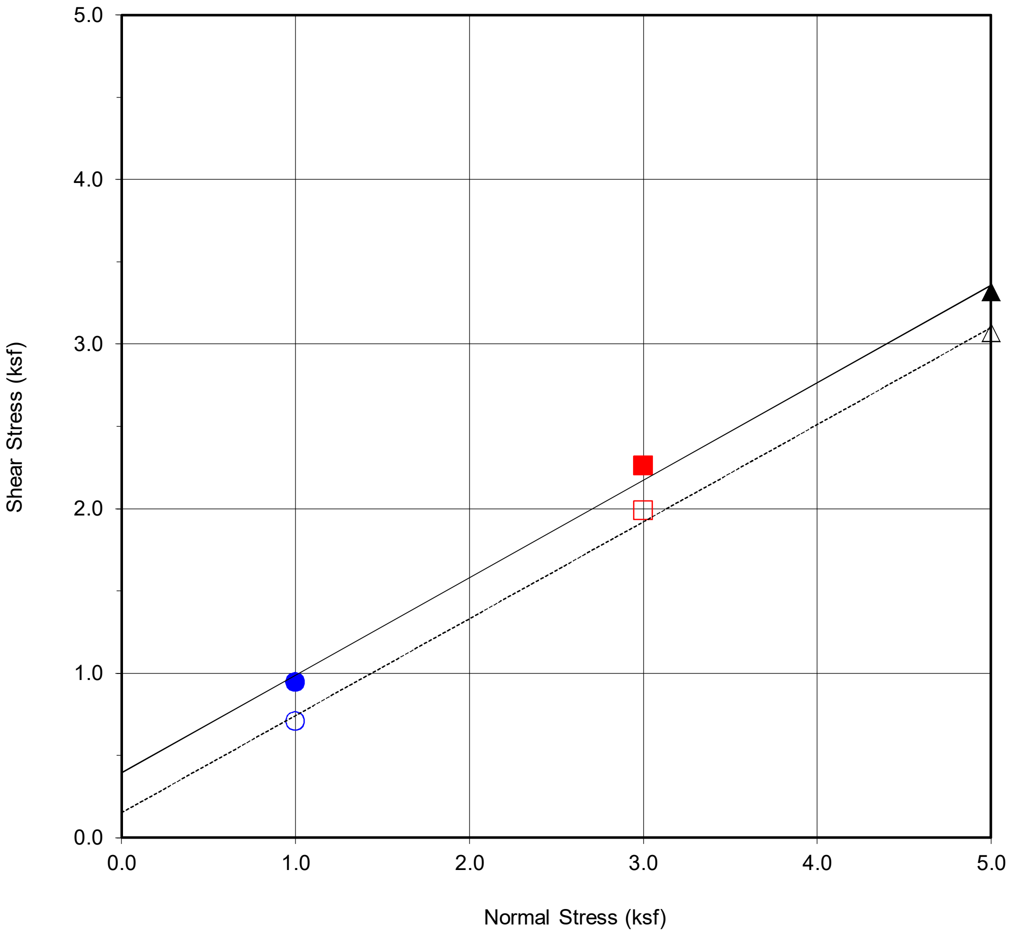
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B2



Boring No.	**B2**
Sample No.	**B2@10'**
Depth (ft)	**10**
Sample Type:	Ring

Soil Identification:		
Yellowish Brown Poorly Graded Sand (SP)		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	395	30.7
Ultimate	151	30.5

Normal Stress (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.94	■ 2.26	▲ 3.32
Shear Stress @ End of Test (ksf)	○ 0.71	□ 1.99	△ 3.07
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	11.0	13.7	7.5
Initial Dry Density (pcf)	87.0	88.5	92.3
Initial Degree of Saturation (%)	31.6	41.0	24.6
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	30.0	29.9	27.5

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

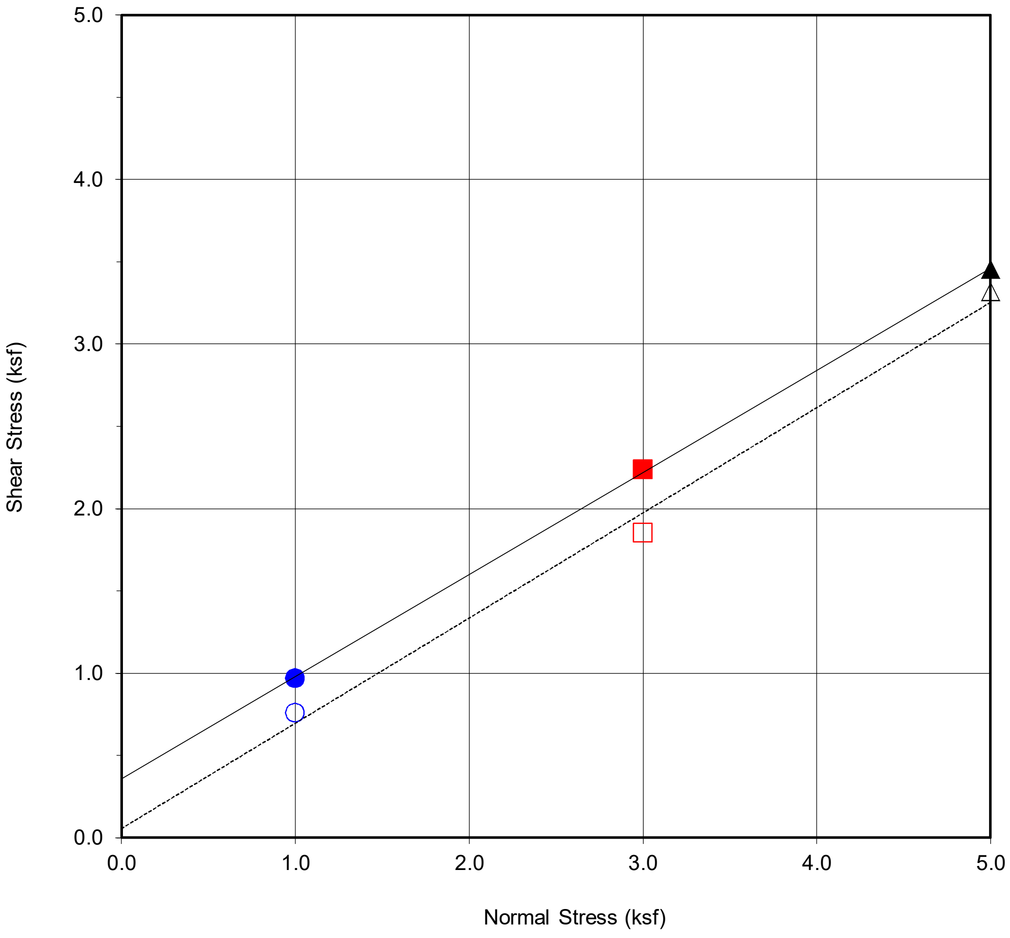
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B3



Boring No.	**B3**
Sample No.	**B3@10**
Depth (ft)	**10**
Sample Type:	Ring

Soil Identification:		
Light Grayish Brown Poorly Graded Sand (SP)		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	356	31.8
Ultimate	55	32.6

Normal Stress (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.97	■ 2.24	▲ 3.45
Shear Stress @ End of Test (ksf)	○ 0.76	□ 1.85	△ 3.32
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	16.0	16.3	15.9
Initial Dry Density (pcf)	115.5	114.5	116.2
Initial Degree of Saturation (%)	93.9	93.5	95.5
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	17.6	17.4	-57.4

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

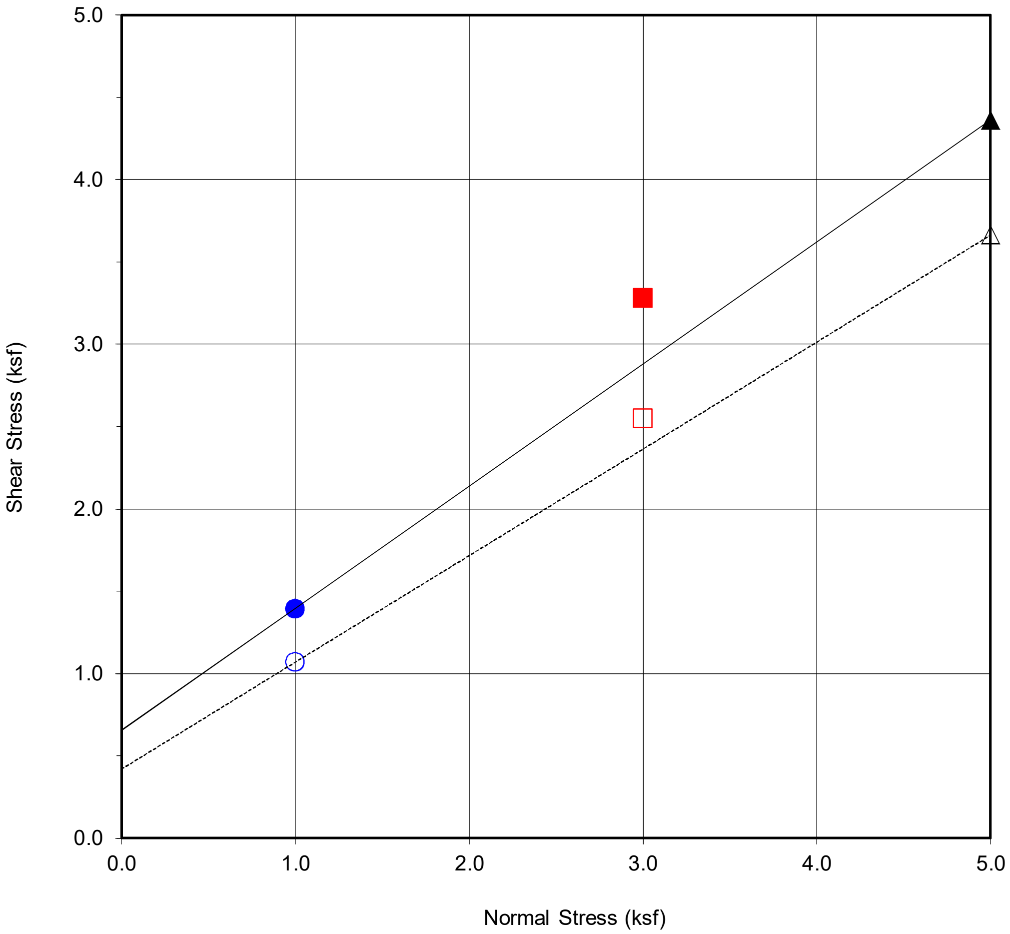
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B4



Boring No.	**B4**
Sample No.	**B4@10'**
Depth (ft)	**10'**
Sample Type:	Ring

Soil Identification:		
Light Brown Well Graded Sand (SW)		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	654	36.6
Ultimate	419	33.0

Normal Stress (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.39	■ 3.28	▲ 4.36
Shear Stress @ End of Test (ksf)	○ 1.07	□ 2.55	△ 3.66
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	5.4	7.4	6.0
Initial Dry Density (pcf)	97.1	95.2	93.3
Initial Degree of Saturation (%)	19.8	25.9	20.2
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	17.3	18.8	19.4

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

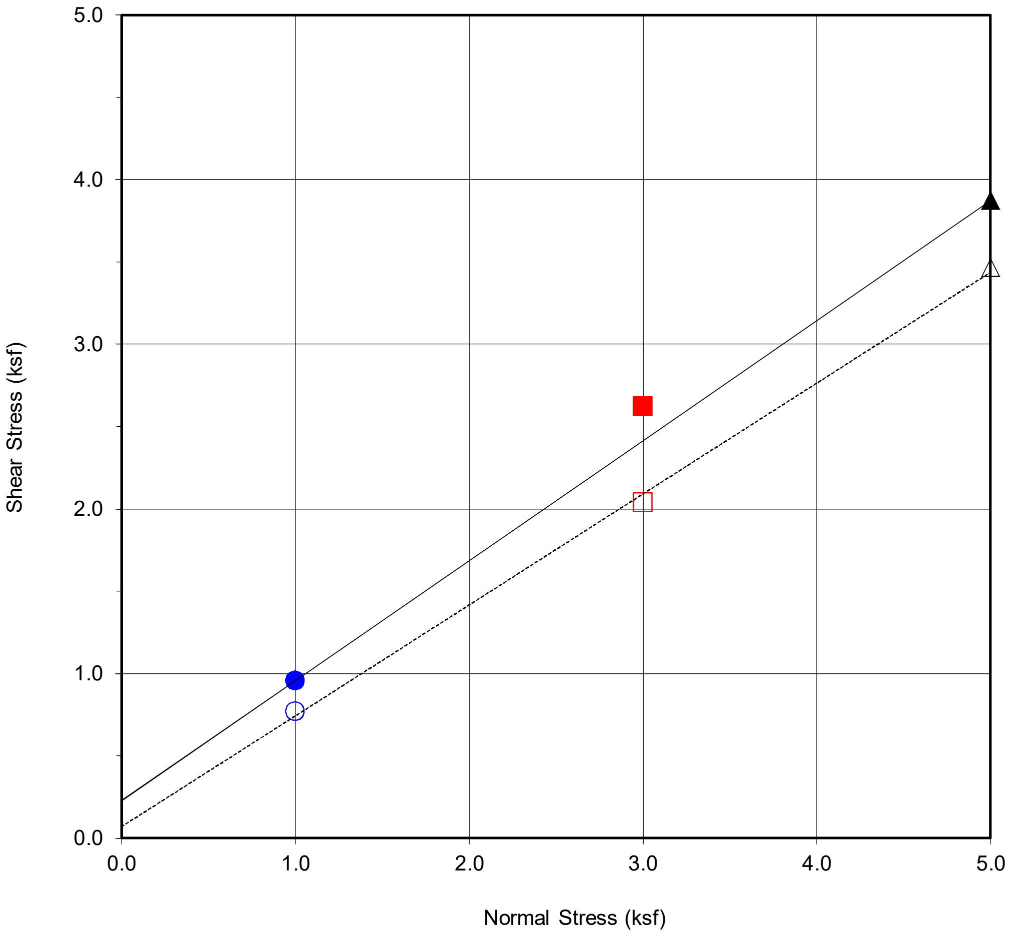
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B5



Boring No.	**B2**
Sample No.	**B2@12'**
Depth (ft)	**12'**
Sample Type:	Ring

Soil Identification:

Light Yellowish Brown Poorly Graded Sand (SP)

Strength Parameters

	C (psf)	ϕ (°)
Peak	225	36.1
Ultimate	69	34.0

Normal Stress (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.96	■ 2.62	▲ 3.87
Shear Stress @ End of Test (ksf)	○ 0.77	□ 2.04	△ 3.46
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	6.9	7.8	7.3
Initial Dry Density (pcf)	97.1	95.0	98.6
Initial Degree of Saturation (%)	25.2	27.1	27.8
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	20.9	20.3	27.6

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

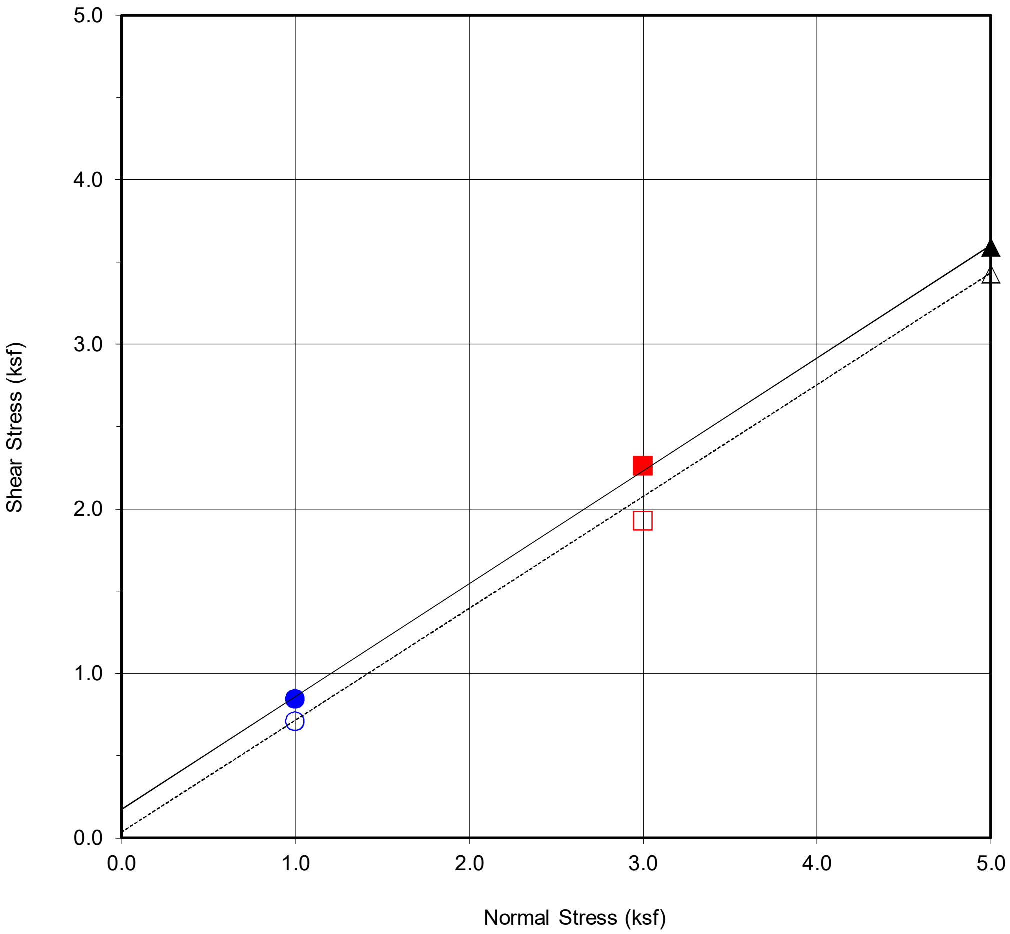
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B6



Boring No.	**B3**
Sample No.	**B3@15'**
Depth (ft)	**Ring**
Sample Type:	Ring

Soil Identification:		
Light Grayish Brown Poorly Graded Sand (SP)		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	172	34.5
Ultimate	35	34.2

Normal Stress (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.84	■ 2.26	▲ 3.59
Shear Stress @ End of Test (ksf)	○ 0.71	□ 1.93	△ 3.43
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	9.1	11.0	10.1
Initial Dry Density (pcf)	86.9	90.5	87.5
Initial Degree of Saturation (%)	26.1	34.3	29.3
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	22.6	20.8	21.9

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

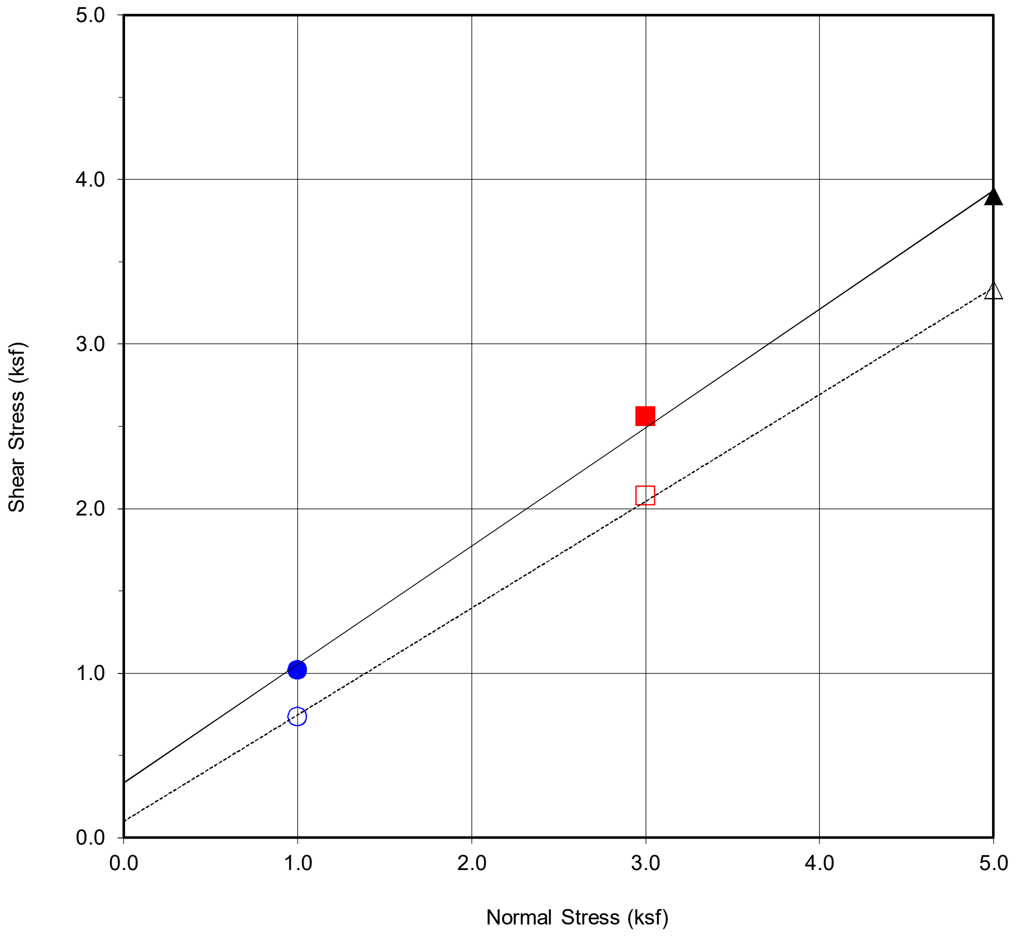
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B7



Boring No.	**B1**
Sample No.	**B1@20'**
Depth (ft)	**20**
Sample Type:	Ring

Normal Stress (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.02	■ 2.56	▲ 3.90
Shear Stress @ End of Test (ksf)	○ 0.73	□ 2.07	△ 3.33
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	8.4	9.3	9.6
Initial Dry Density (pcf)	99.1	96.4	97.4
Initial Degree of Saturation (%)	32.5	33.7	35.4
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	20.2	20.3	18.3

Soil Identification:

Light Brown Poorly Graded Sand (SP)

Strength Parameters

	C (psf)	ϕ (°)
Peak	331	35.8
Ultimate	99	33.0

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

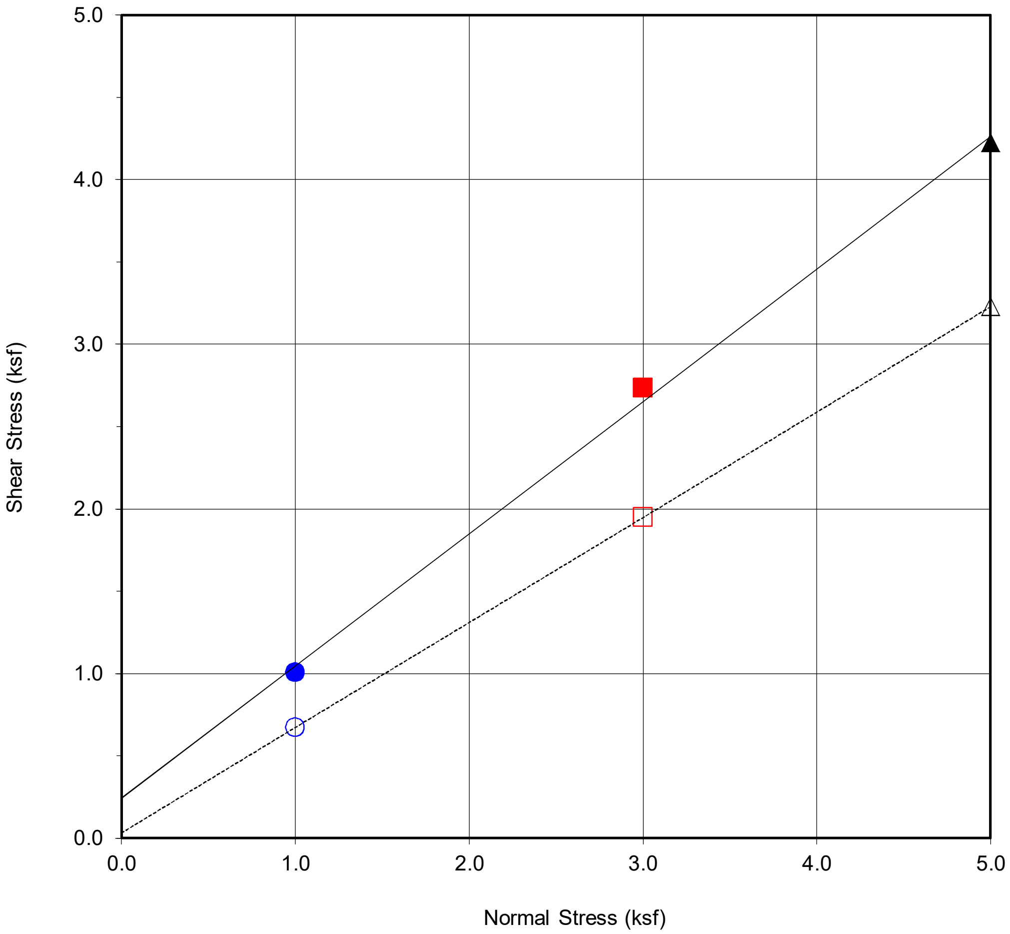
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B8



Boring No.	**B1**
Sample No.	**B1@25'**
Depth (ft)	**25**
Sample Type:	Ring

Normal Stress (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.01	■ 2.73	▲ 4.22
Shear Stress @ End of Test (ksf)	○ 0.67	□ 1.95	△ 3.23
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	7.6	9.5	10.6
Initial Dry Density (pcf)	99.8	98.5	97.9
Initial Degree of Saturation (%)	30.0	36.2	39.7
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	21.8	21.7	21.4

Soil Identification:

Light Brown Poorly Graded Sand (SP)

Strength Parameters

	C (psf)	ϕ (°)
Peak	241	38.8
Ultimate	32	32.6

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

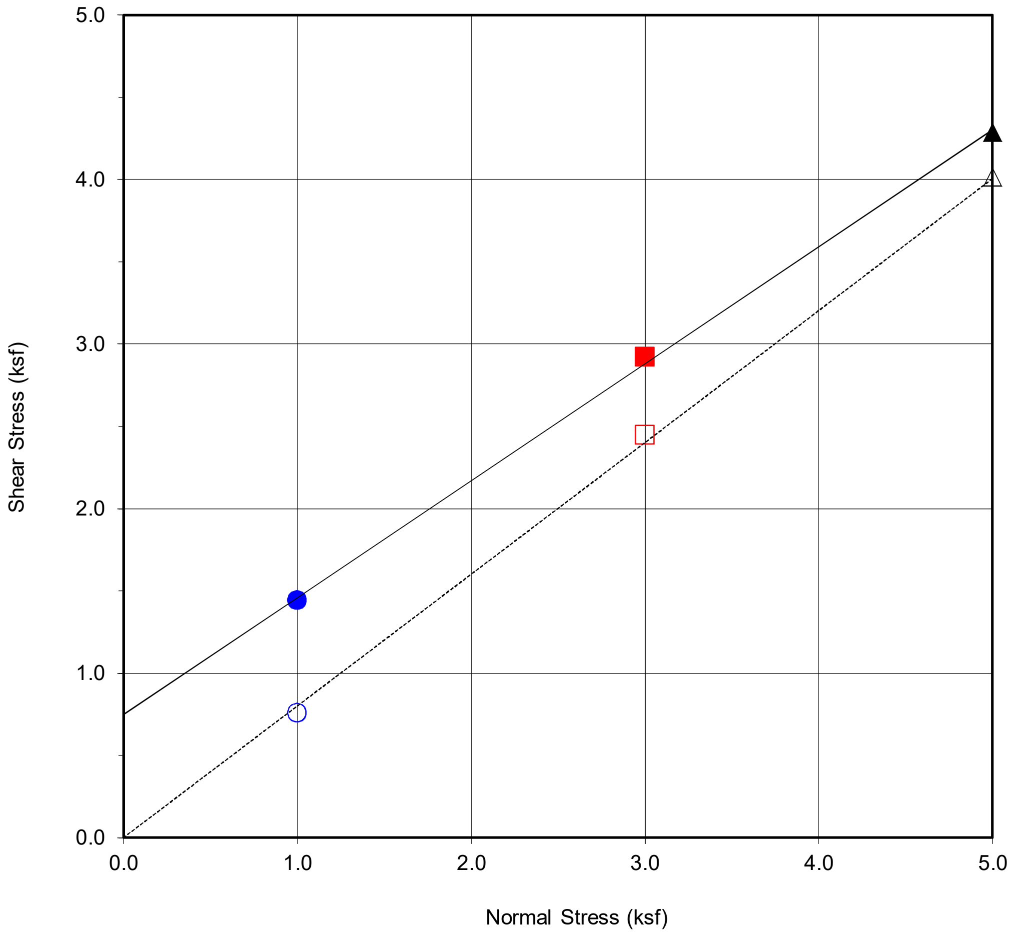
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B9



Boring No.	**B5**
Sample No.	**B5@40**
Depth (ft)	**40**
Sample Type:	Ring

Soil Identification:		
Brown Well Graded Sand (SP)		
Strength Parameters		
	C (psf)	ϕ (°)
Peak	748	35.4
Ultimate	0	38.7

Normal Stress (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.44	■ 2.92	▲ 4.28
Shear Stress @ End of Test (ksf)	○ 0.76	□ 2.45	△ 4.01
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	21.8	26.0	27.4
Initial Dry Density (pcf)	104.5	101.4	98.8
Initial Degree of Saturation (%)	96.0	106.1	104.8
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	25.9	25.0	27.1

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

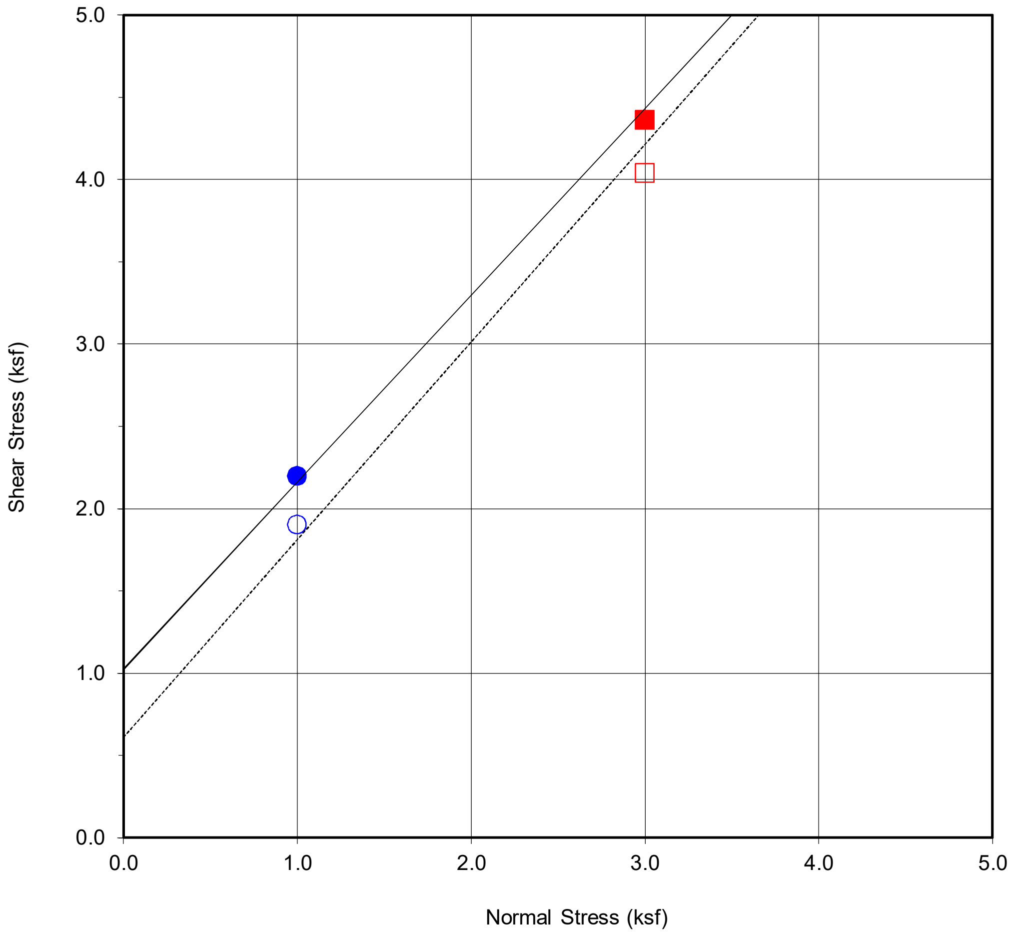
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B10



Boring No.	**B5**
Sample No.	**B5@57.5**
Depth (ft)	**57.5**
Sample Type:	Ring

Soil Identification:

Brown Well Graded Sand w/Gravel (SW)

Strength Parameters

	C (psf)	ϕ (°)
Peak	1024	48.6
Ultimate	610	50.2

Normal Stress (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 2.20	■ 4.36	▲ 6.74
Shear Stress @ End of Test (ksf)	○ 1.90	□ 4.04	△ 6.71
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	16.6	16.9	15.9
Initial Dry Density (pcf)	124.8	122.1	124.3
Initial Degree of Saturation (%)	127.5	120.2	121.1
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	14.2	14.5	13.9

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

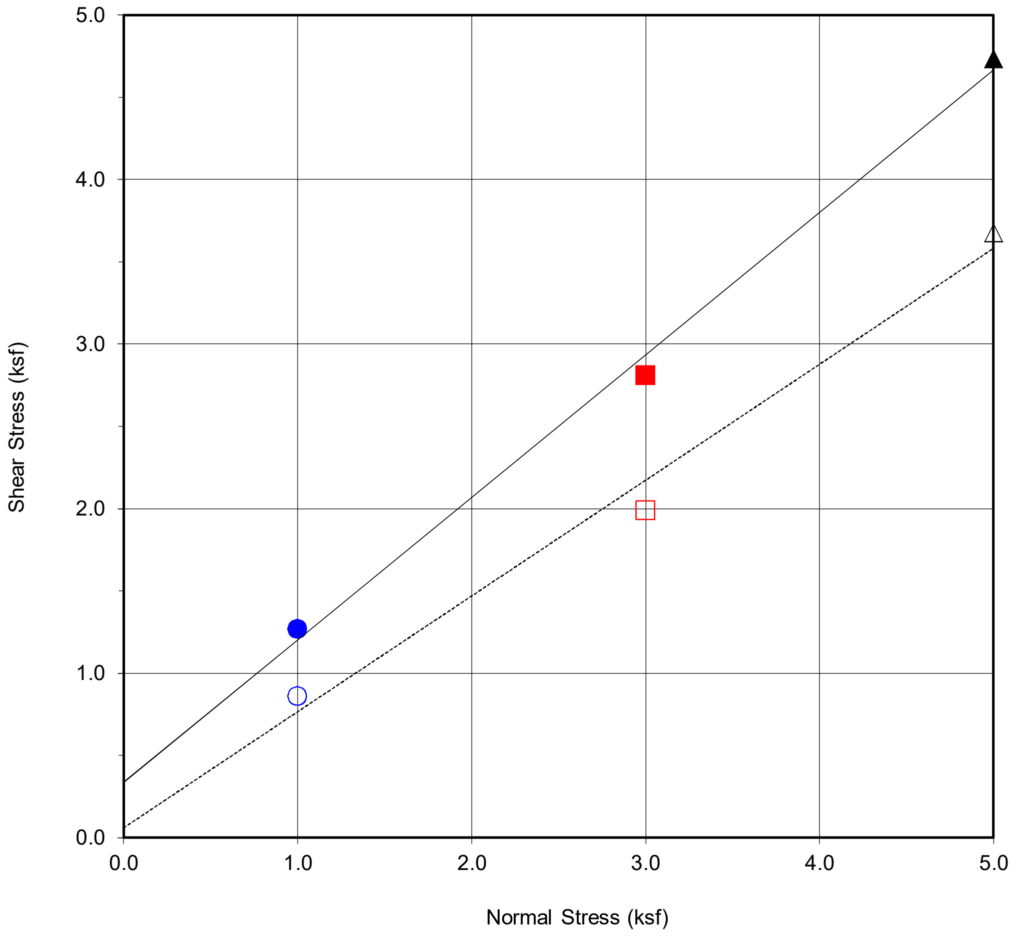
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B11



Boring No.	**B5**
Sample No.	**B5@65**
Depth (ft)	**65**
Sample Type:	Ring

Soil Identification:

Yellowish Brown Clayey Sand (SC)

Strength Parameters

	C (psf)	ϕ (°)
Peak	337	40.9
Ultimate	60	35.2

Normal Stress (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.27	■ 2.81	▲ 4.73
Shear Stress @ End of Test (ksf)	○ 0.86	□ 1.99	△ 3.68
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	18.1	18.3	17.2
Initial Dry Density (pcf)	115.5	114.8	116.2
Initial Degree of Saturation (%)	106.5	105.4	103.3
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	19.4	18.9	18.6

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

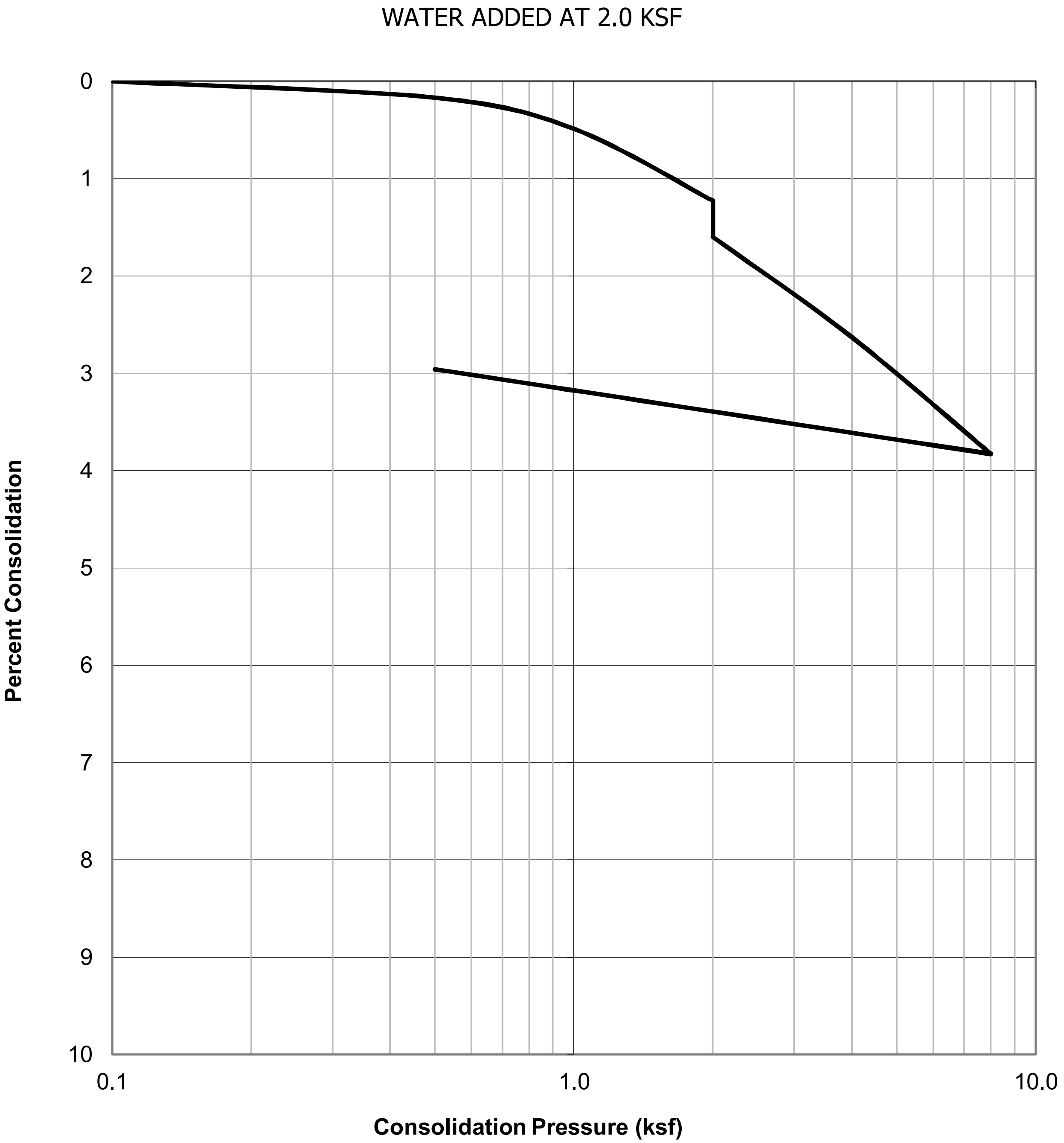
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B12



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B2@10	Yellowish Brown Poorly Graded Sand (SP)	88.9	7.7	27.5

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

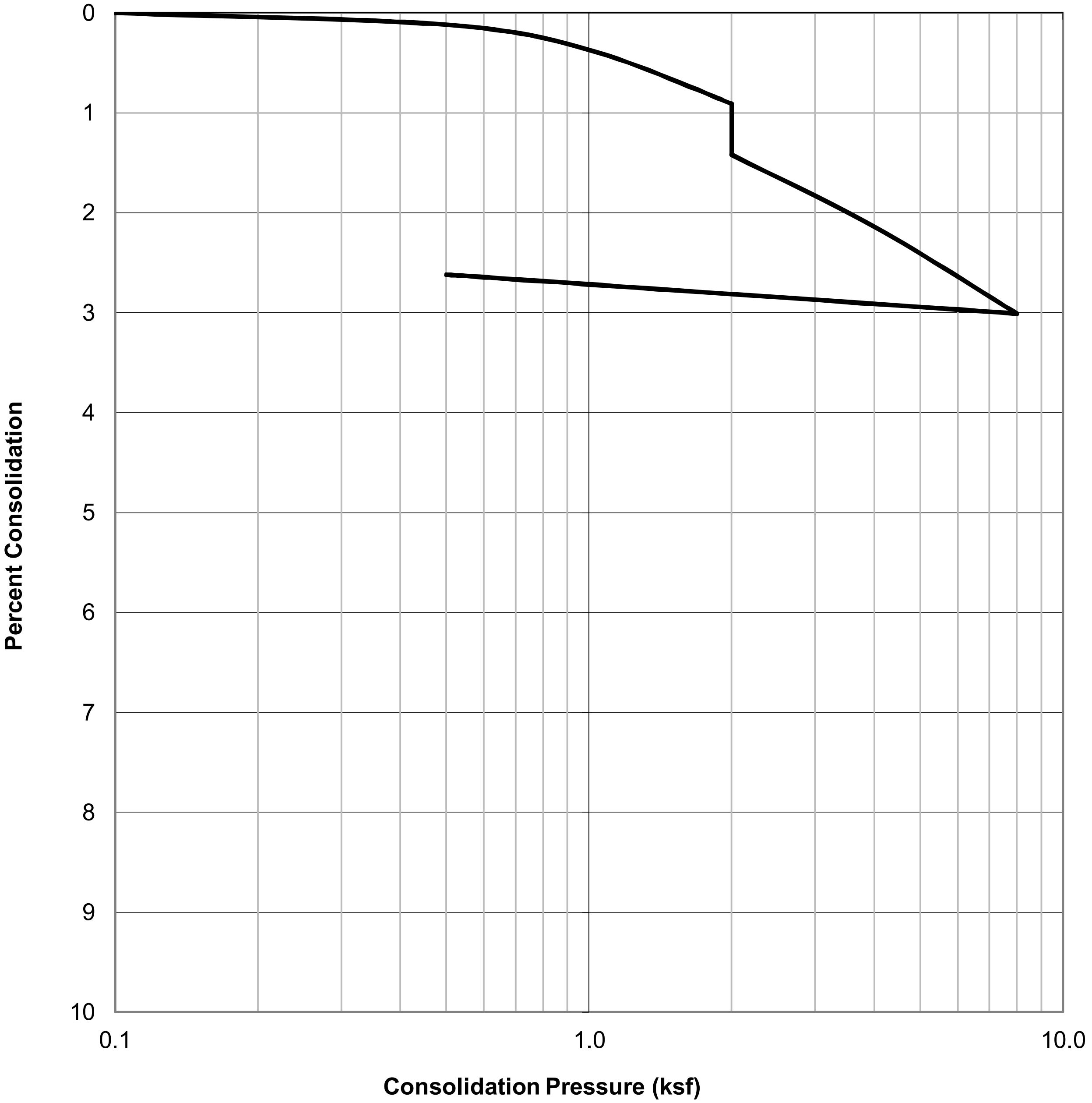
Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B13

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B2@12	Light Yellowish Brown Poorly Graded Sand (SP)	100.7	3.1	19.4

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

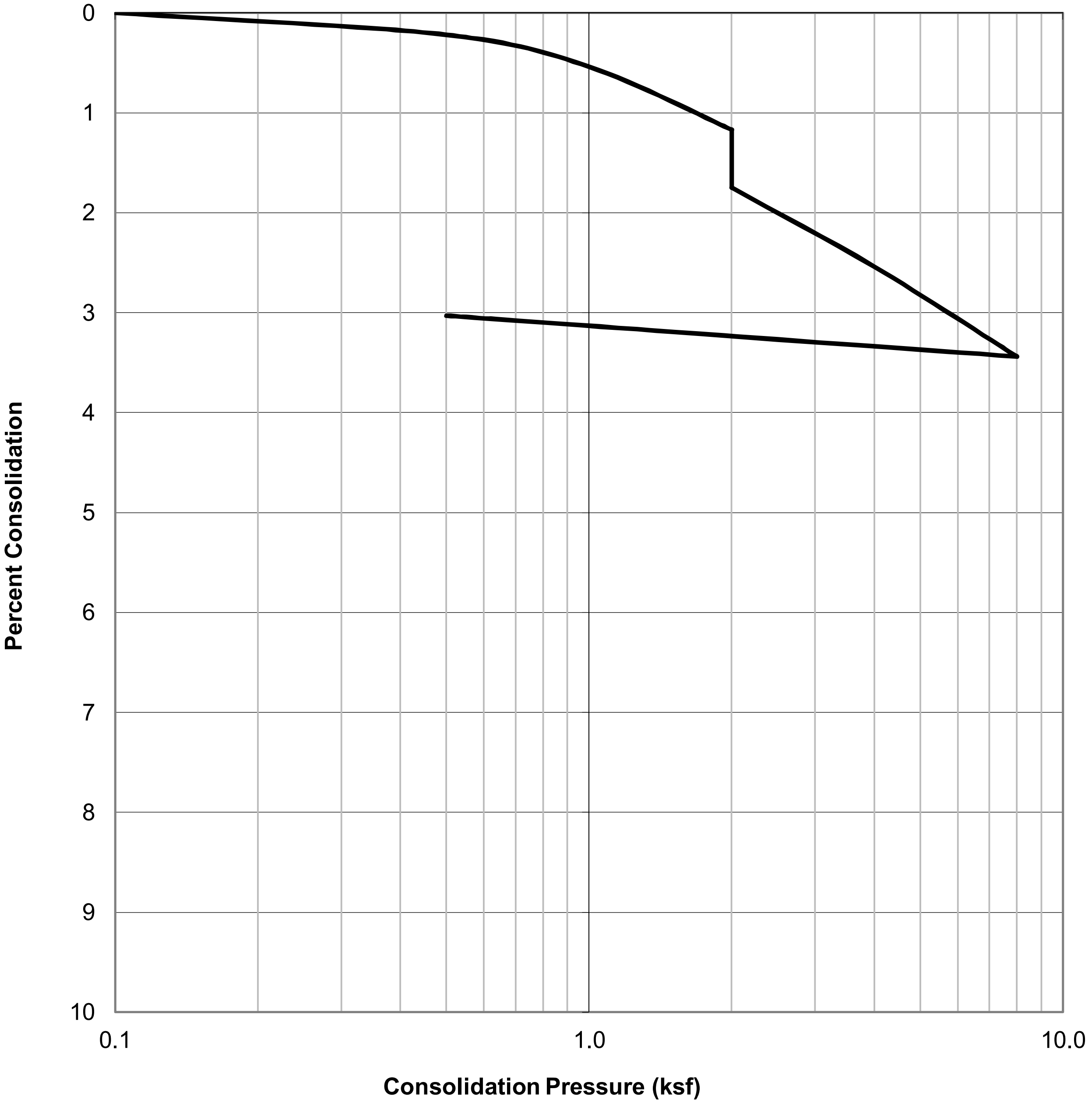
Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B14

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B2@17	Light Yellowish Brown Poorly Graded Sand (SP)	105.4	3.0	16.6

GEOCON

CONSOLIDATION TEST RESULTS

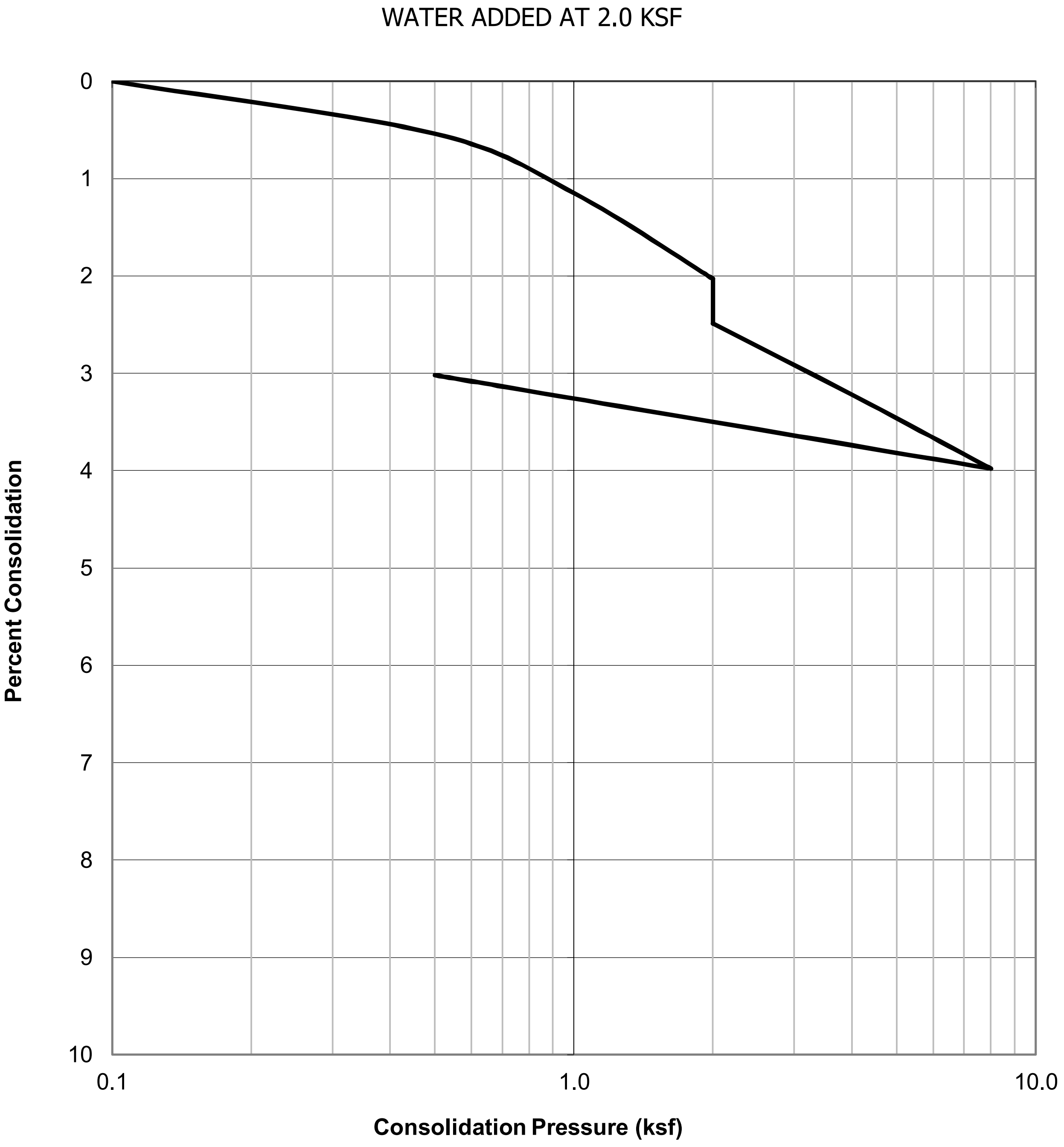
ASTM D-2435

Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@22.5	Light Brown Poorly Graded Sand (SP)	98.2	4.5	20.4

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

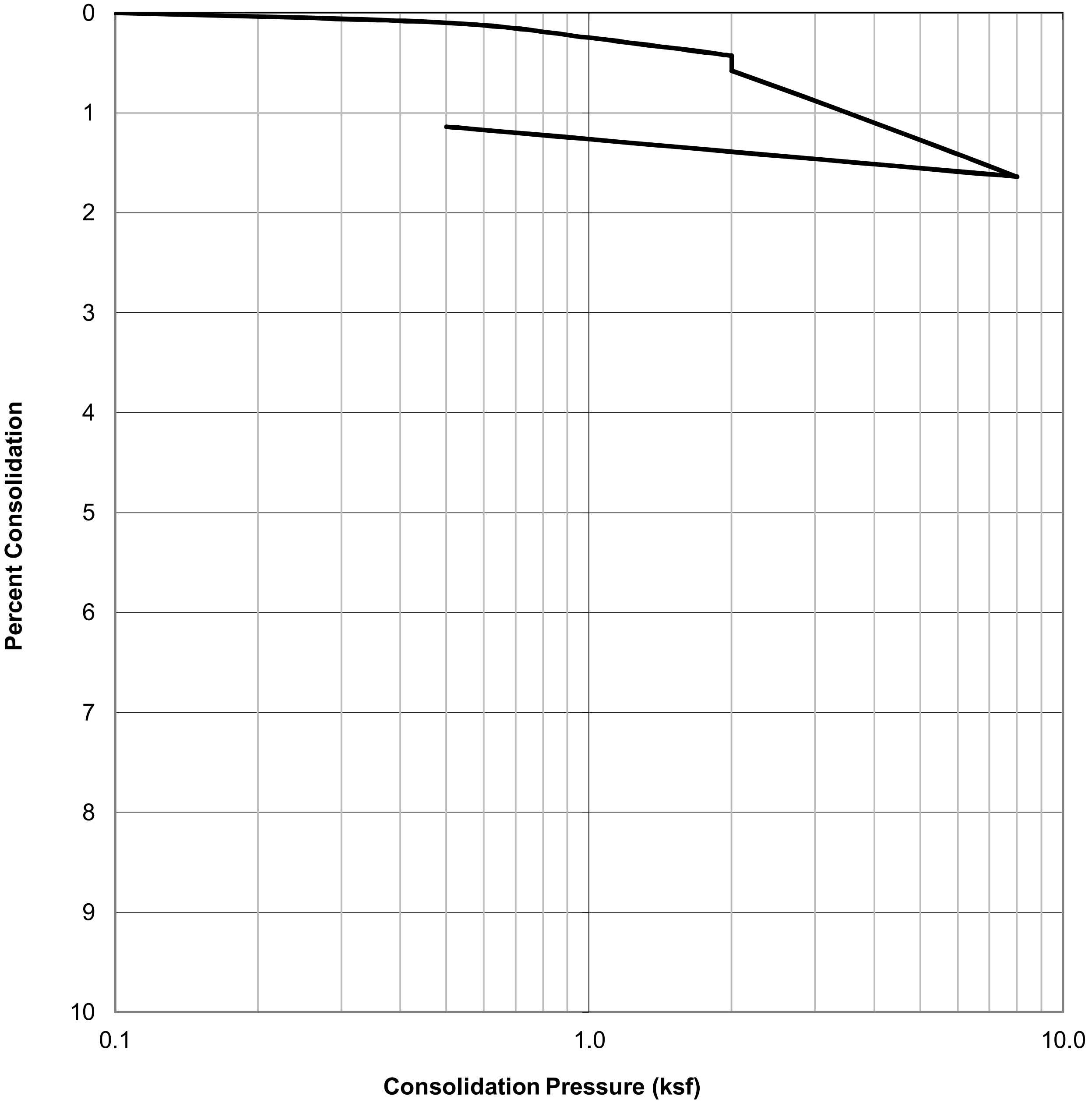
Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B16

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@25	Light Brown Poorly Graded Sand (SP)	101.0	5.1	19.3

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

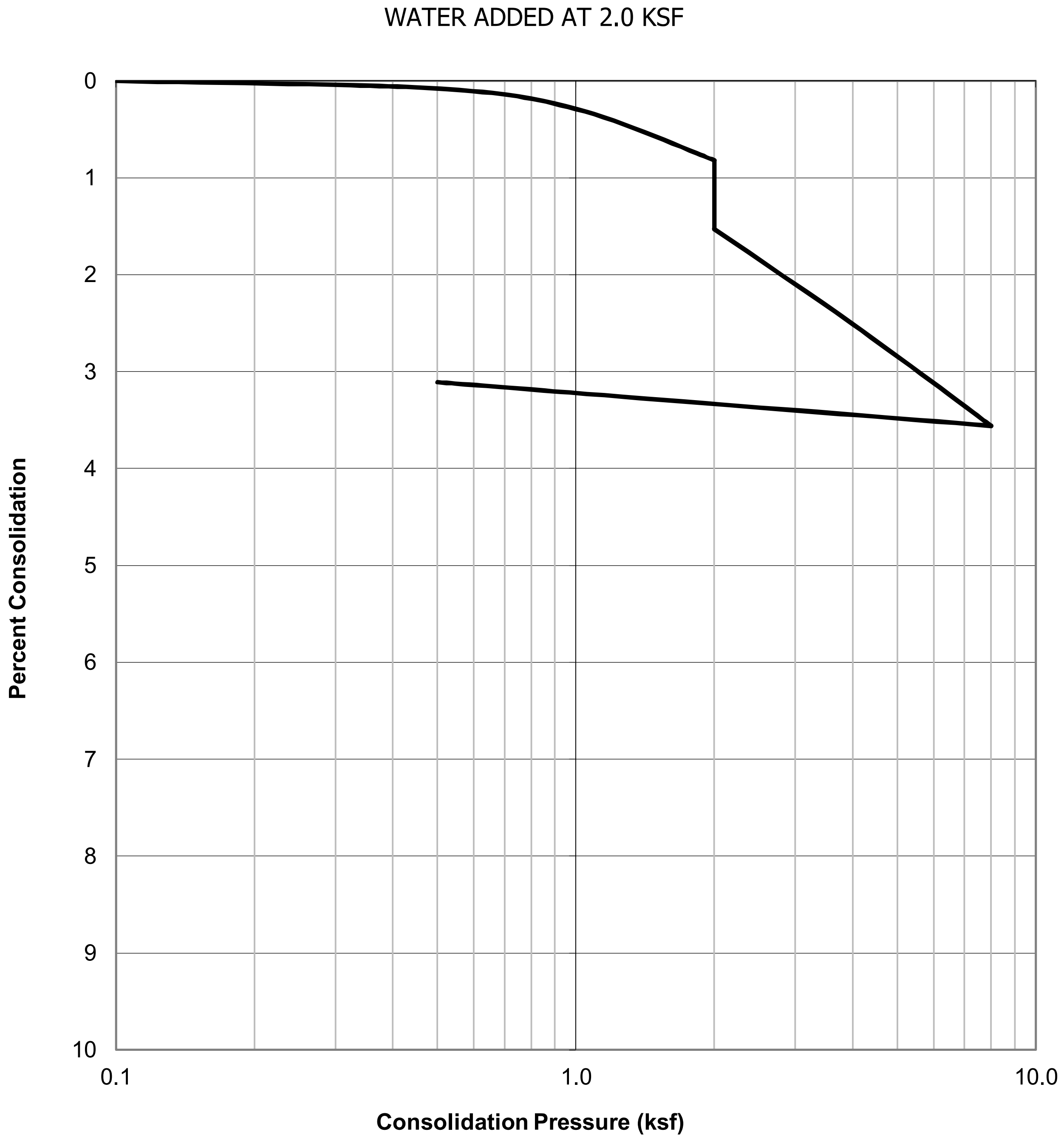
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B17



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@30	Light Brown Well Graded Sand w/Gravel (SW)	104.9	3.3	16.2

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

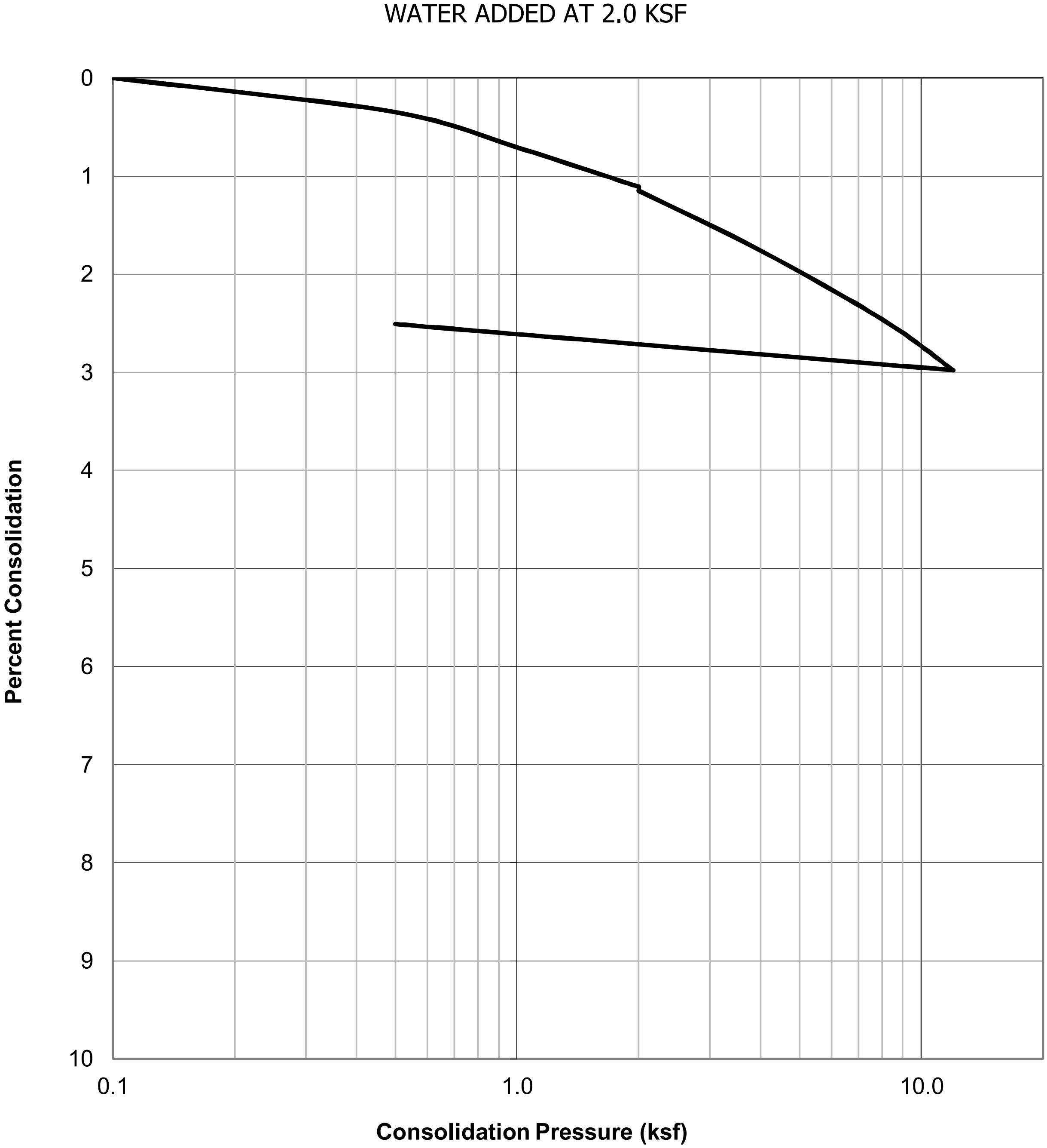
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B18



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@40	Brown Well Graded Sand w/Gravel (SW)	124.2	8.0	13.0

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

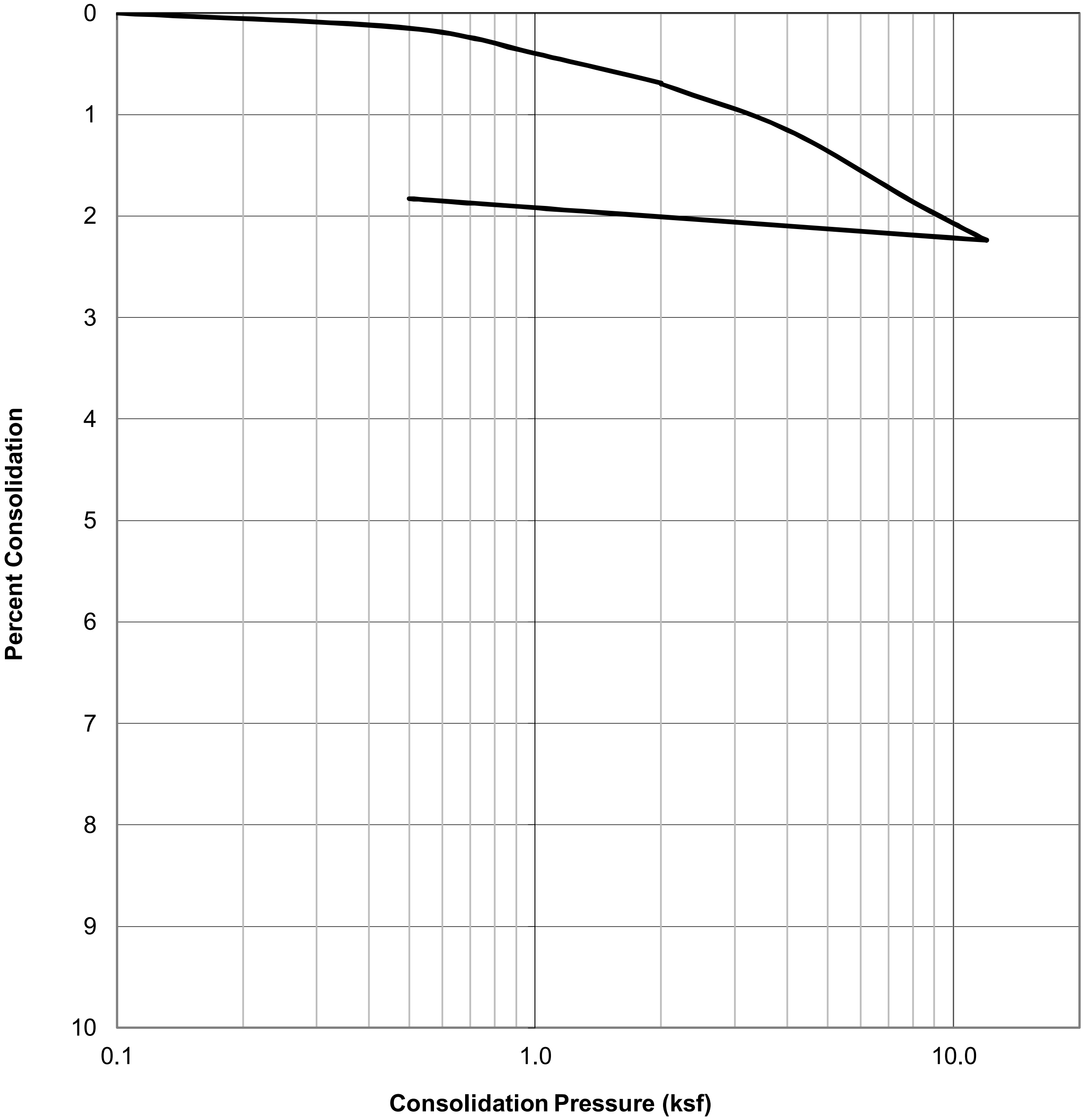
Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B19

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@42.5	Brown Well Graded Sand w/Gravel (SW)	134.1	11.2	11.3

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

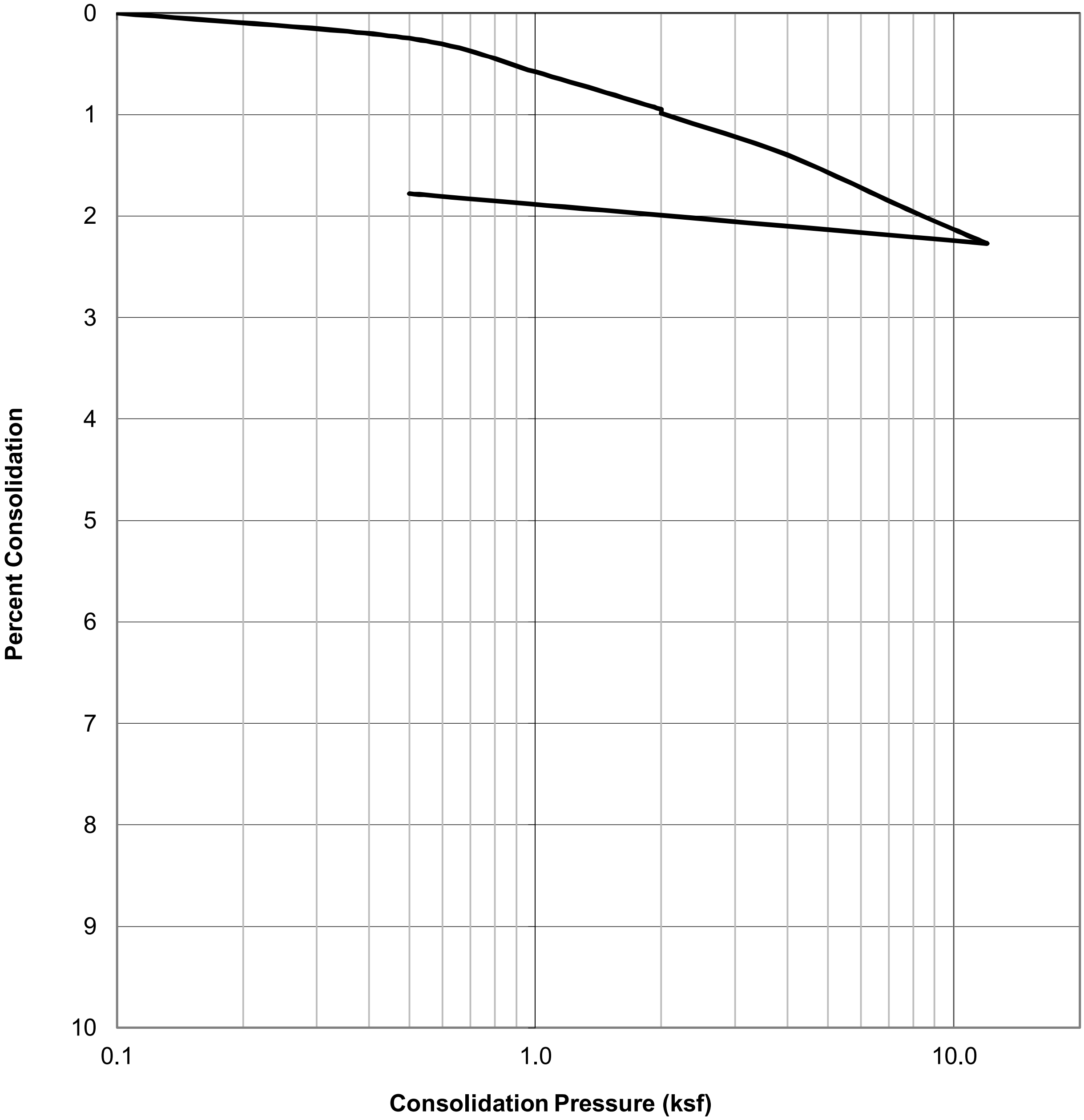
Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B20

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@52.5	Brown Well Graded Sand w/Gravel (SW)	120.7	14.0	15.1

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

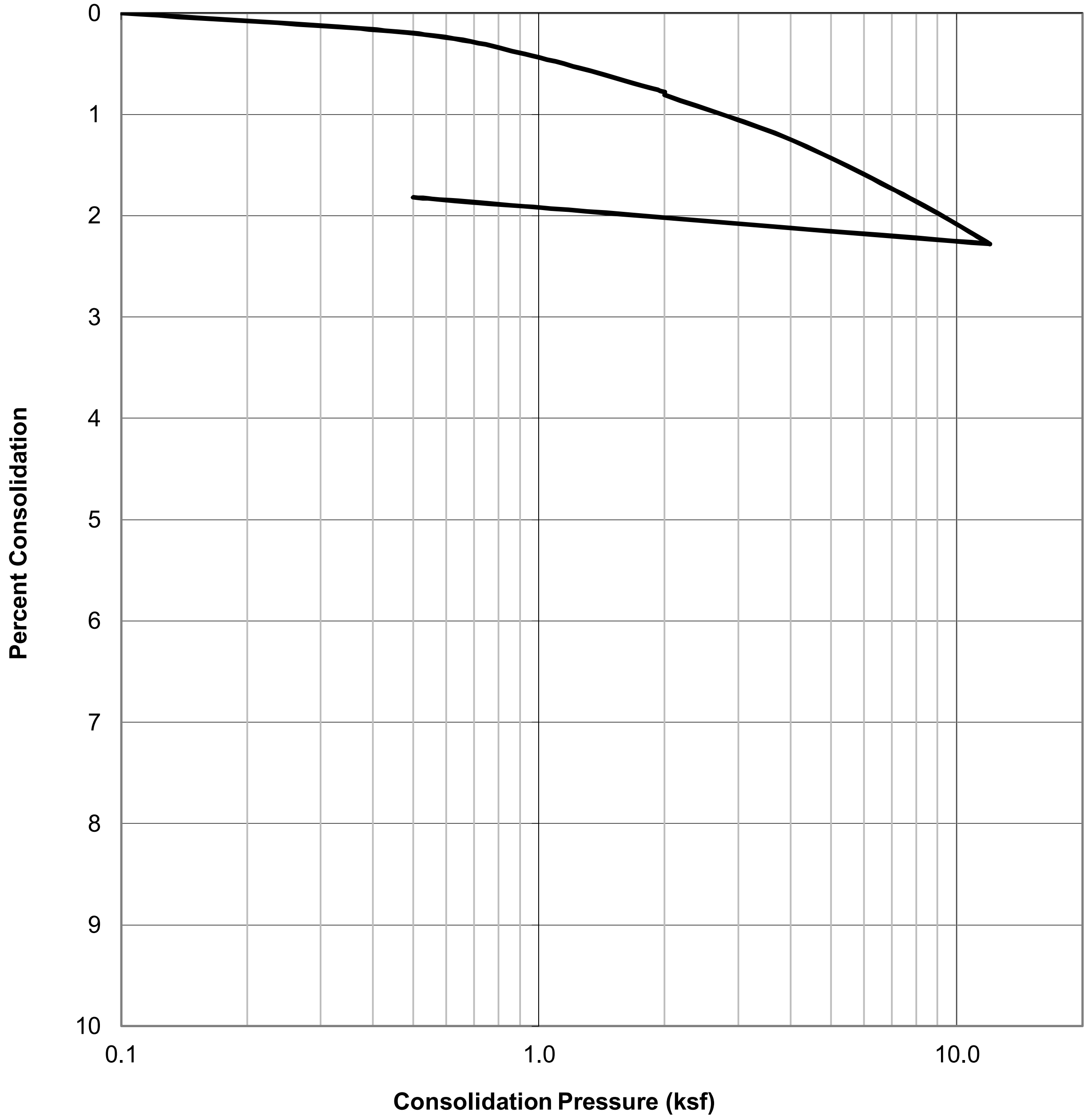
Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B21

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@55	Brown Well Graded Sand w/Gravel (SW)	122.6	13.9	13.7

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

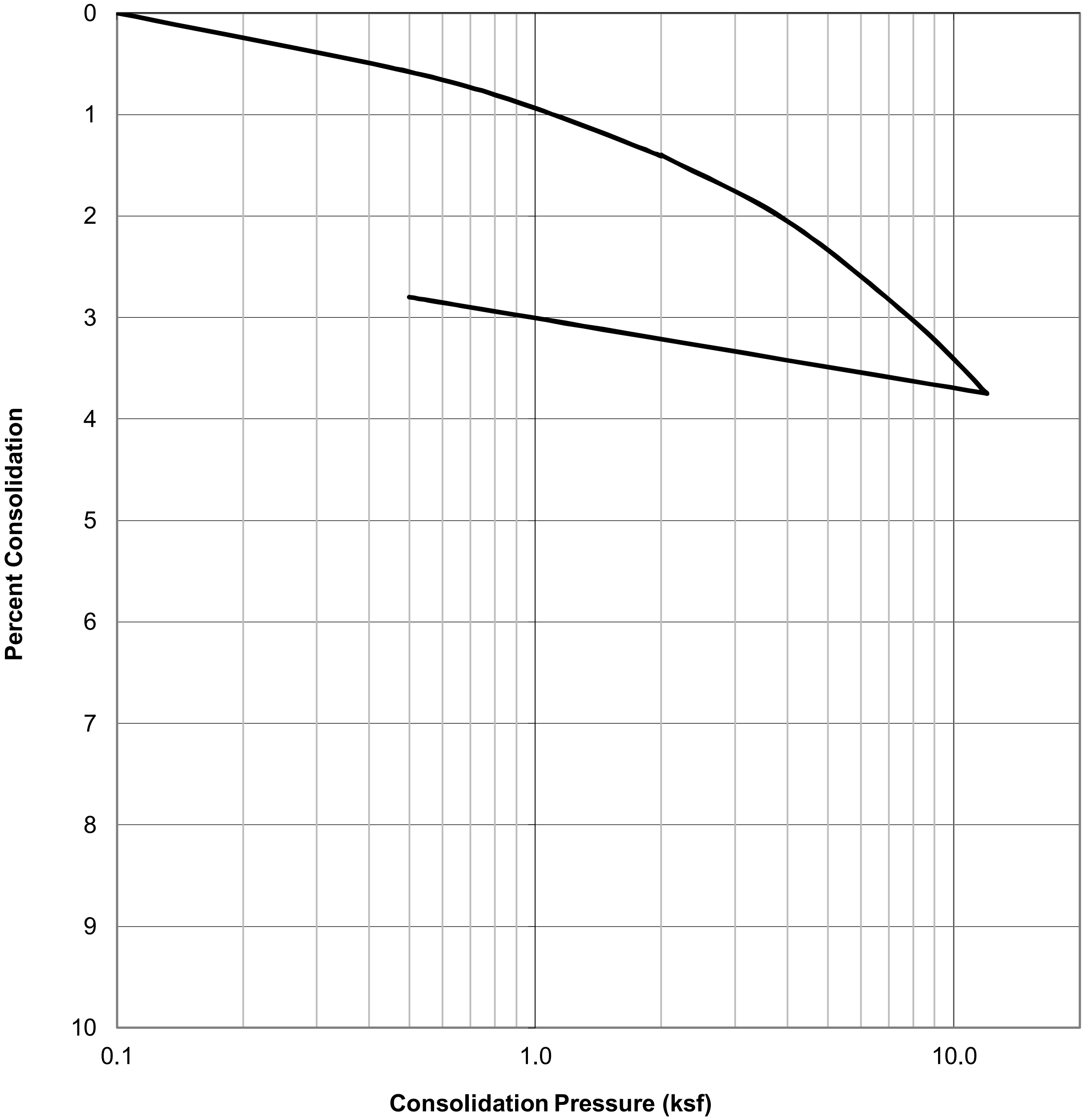
Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B22

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@65	Brown Clayey Sand w/Gravel (SC)	114.0	18.3	18.5

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

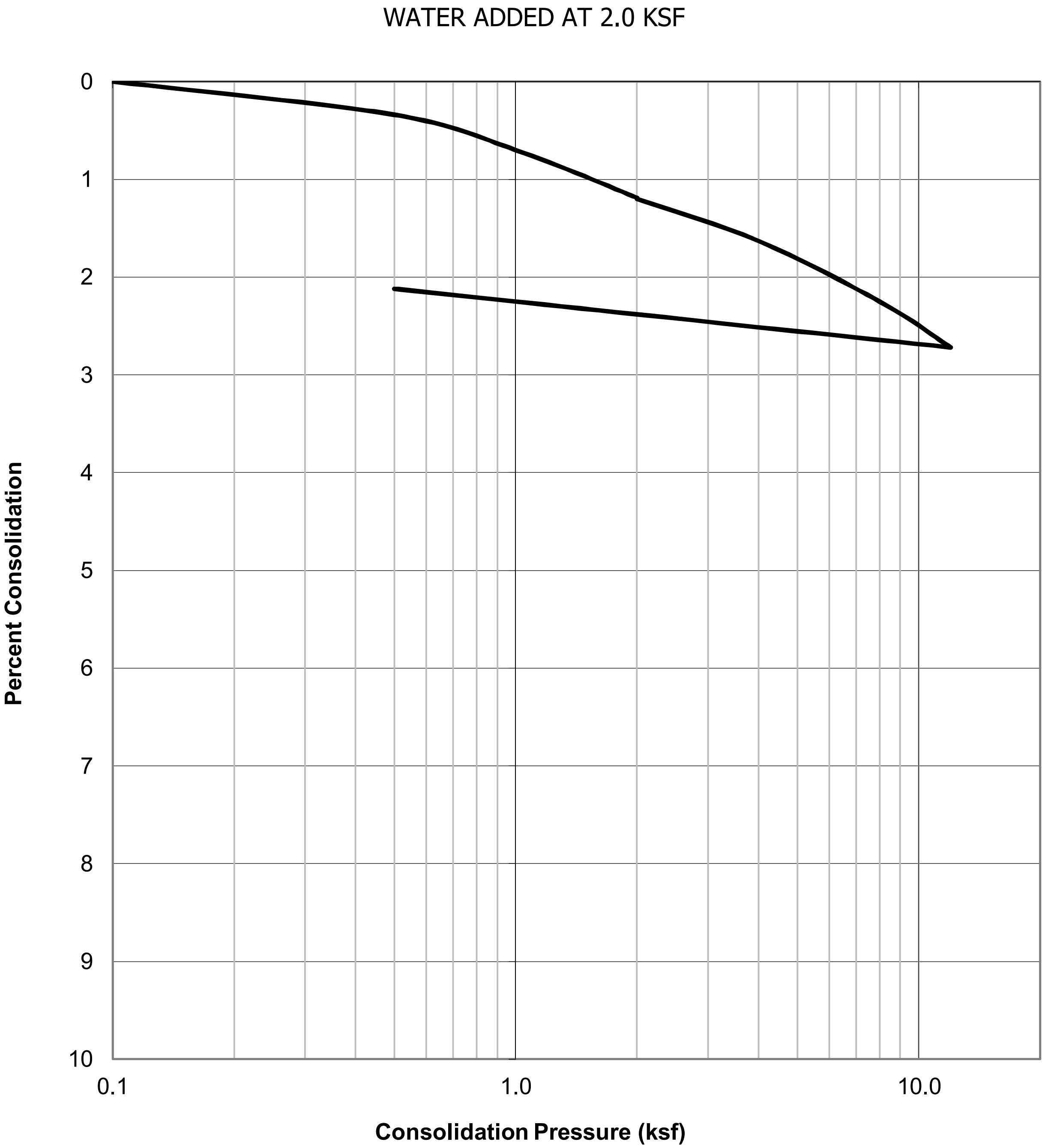
Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B23



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@70	Brown Well Graded Sand w/Gravel (SW)	129.9	6.7	12.2

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

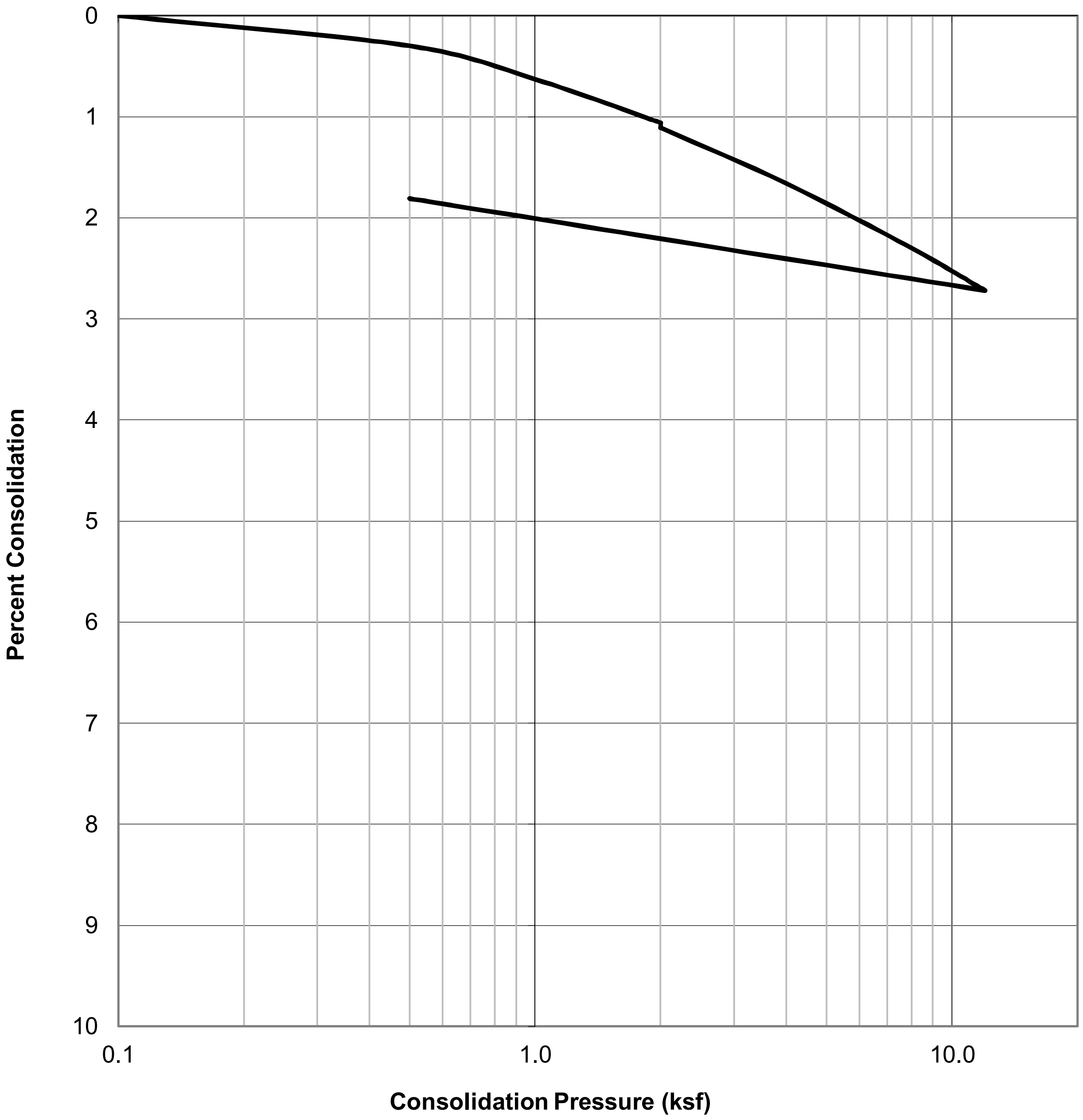
Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B24

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@80	Olive Brown Silty Sand (SM)	105.8	20.0	23.8

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B25

B1@0-5'

MOLDED SPECIMEN		BEFORE TEST	AFTER TEST
Specimen Diameter	(in.)	4.0	4.0
Specimen Height	(in.)	1.0	1.0
Wt. Comp. Soil + Mold	(gm)	779.9	801.3
Wt. of Mold	(gm)	368.6	368.6
Specific Gravity	(Assumed)	2.7	2.7
Wet Wt. of Soil + Cont.	(gm)	487.0	801.3
Dry Wt. of Soil + Cont.	(gm)	463.8	379.4
Wt. of Container	(gm)	187.0	368.6
Moisture Content	(%)	8.4	14.0
Wet Density	(pcf)	124.1	130.3
Dry Density	(pcf)	114.5	114.3
Void Ratio		0.5	0.5
Total Porosity		0.3	0.3
Pore Volume	(cc)	66.5	66.2
Degree of Saturation	(%) [S_{meas}]	48.4	80.5

Date	Time	Pressure (psi)	Elapsed Time (min)	Dial Readings (in.)
12/9/2019	10:00	1.0	0	0.198
12/9/2019	10:10	1.0	10	0.198
Add Distilled Water to the Specimen				
12/10/2019	10:00	1.0	1430	0.1965
12/10/2019	11:00	1.0	1490	0.1965

Expansion Index (EI meas) =	-1.5
Expansion Index (Report) =	**0**

Expansion Index, EI_{50}	CBC CLASSIFICATION *	UBC CLASSIFICATION **
0-20	Non-Expansive	Very Low
21-50	Expansive	Low
51-90	Expansive	Medium
91-130	Expansive	High
>130	Expansive	Very High

* Reference: 2016 California Building Code, Section 1803.5.3

** Reference: 1997 Uniform Building Code, Table 18-I-B.

GEOCON

EXPANSION INDEX TEST RESULTS

ASTM D-4829

Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B26

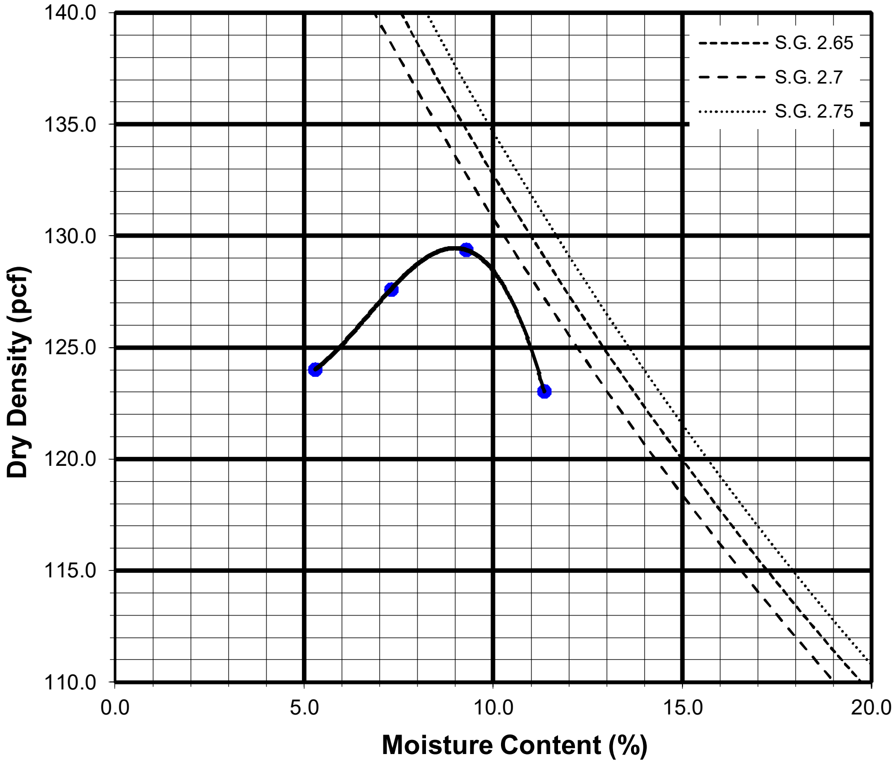
Sample No:

B1@0-5	Brown Poorly Graded Sand with Gravel (SP)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6117	6212	6279	6213		
Weight of Mold	(g)	4150	4150	4150	4150		
Net Weight of Soil	(g)	1967	2062	2129	2063		
Wet Weight of Soil + Cont.	(g)	643.3	764.0	753.3	682.9		
Dry Weight of Soil + Cont.	(g)	617.2	721.9	701.8	627.1		
Weight of Container	(g)	124.2	144.8	147.4	135.3		
Moisture Content	(%)	5.3	7.3	9.3	11.3		
Wet Density	(pcf)	130.6	136.9	141.4	137.0		
Dry Density	(pcf)	124.0	127.6	129.4	123.0		

Maximum Dry Density (pcf)	**129.5**
Bulk Specific Gravity (dry)	**2.65**
Corrected Maximum Dry Density (pcf)	**136.5**

Optimum Moisture Content (%)	**9.5**
Oversized Fraction (%)	**14.0**
Corrected Moisture Content (%)	**8.0**



Preparation Method: A

MODIFIED COMPACTION TEST OF SOILS

ASTM D-1557

Checked by: PZ

GEOCON

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B27

SUMMARY OF LABORATORY POTENTIAL OF HYDROGEN (pH) AND RESISTIVITY TEST RESULTS
CALIFORNIA TEST NO. 643

Sample No.	**pH**	**Resistivity (ohm centimeters)**
B1 @ 20-25	8.3	4000 (Moderately Corrosive)
B2 @ 15-20	8.1	5000 (Moderately Corrosive)
B4 @ 30-35	8.5	110000 (Mildly Corrosive)

SUMMARY OF LABORATORY CHLORIDE CONTENT TEST RESULTS
EPA NO. 325.3

Sample No.	Chloride Ion Content (%)
B1@20-25	0.008
B2@15-20	0.006
B4@35-40	0.005

SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS
CALIFORNIA TEST NO. 417

Sample No.	**Water Soluble Sulfate (% SQ_4)**	**Sulfate Exposure***
B1@20-25	0.014	S0
B2@15-20	0.009	S0
B4@35-40	0.000	S0

GEOCON

CORROSIVITY TEST RESULTS

Checked by: PZ

Project No.: W1041-06-02

410 S. Central Avenue
Los Angeles, California

Sept. 2021

Figure B28