Leighton
a verdantas company

GEOTECHNICAL DESIGN UPDATE
PROPOSED WAREHOUSING FACILITY
3041± DEL AMO BOULEVARD
TORRANCE, LOS ANGELES COUNTY, CALIFORNIA
APN: 7352-015-004, 5 AND 6
PROLOGIS PROJECT ID: LAX12490

Prepared For:

PROLOGIS, INC.
3546 Concours Street, Suite 100
Ontario, California 91764-5584

Project No. 12452.004

October 25, 2023

Leighton
a verdantas company

Leighton Consulting, Inc.

Wednesday, October 25, 2023

Project No. 12452.004

Prologis, Inc.
3546 Concours Street, Suite 100
Ontario, California 91764-5584

Attention: Mr. Andrew Resurreccion
Development Manager

Subject: Geotechnical Design Update
Proposed Warehousing Facility
3041± Del Amo Boulevard
Torrance, Los Angeles County, California
APN: 7352-015-004, 5 and 6
Prologis Project ID: LAX 12490

In accordance with our September 28, 2023 proposal, authorized on October 2, 2023 (Prologis Contract Change Order 8), Leighton Consulting, Inc. has completed this *Geotechnical Design Update* for your use in design and permitting of a warehouse to be constructed north of Del Amo Boulevard and east of Prairie Avenue, within the City of Torrance, Los Angeles County, California.

We have relied on geotechnical and geoenvironmental exploration and testing by others, augmented by our subsurface explorations. Based on these current and prior subsurface explorations and geotechnical laboratory testing, this report summarizes our findings, conclusions and recommendations regarding geotechnical aspects of filling in the borrow pit at the center of this site with compacted fill to support a new warehouse.

This report updates and revises our prior geotechnical work on this site, based on the assumption that all undocumented fill under the proposed warehouse footprint can (regardless of elevation) be over-excavated and recompacted to support this new warehouse. It was previously assumed that over-excavation could not extend below elevation 60 feet, which would require leaving some existing fill in place (previously recommended to be surcharged, to reduce compressibility).

This 31.3-acre site is located southwest of the Torrance Refinery (previously ExxonMobil Refinery), separated by BNSF's five-track railway right-of-way. Reportedly, there is no known evidence of past oil production and/or refining activities having occurred on this site. However, this site has reportedly been both (1) an earth borrow source with a pit excavated at the center of this site and (2) used as a disposal site for catalyst beads and other hydrocarbon-impacted soils predominantly placed in the northwestern portion of the site. This site is geologically and geotechnically characterized as older stabilized dune sands (Dibblee's "Qos" and CGS's "Qoe"), and site topography is consistent with undulating dunes. The 1934 USGS "Torrance" Quadrangle shows a depression at and below the 75-foot elevation contour (NGVD29), filled by the railway at the northeast-center portion of the site; with the eastern, southern and western portions of the site roughly at elevation 100-feet. Psomas's March 16, 2018 (flown November 18, 2015) ALTA topographic survey for this site shows the lowest survey point within the borrow pit area at elevation 59.6 feet above mean sea level.

Based on extrapolation and interpolation of prior reported subsurface conditions, a clayey fill mass in the borrow pit extended down to elevation 50 feet (at boring LB-8). Encountered fill was highly variable but consisted predominantly of a dark-brown to black "fat" (high plasticity, CL to CH) clay that was expansive. Some small amounts of encountered fill contained trace organics, which measured no-higher-than (≤) 3.1% by loss-on-ignition weight. Rubble fills exceeding 20-feet-deep were also encountered west of the borrow pit. Tested rubble fill was found to be corrosive with high sulfate content.

Best standard geotechnical practice is to remove all undocumented fill from under proposed building footprints, which would extend down to elevation 50 feet above mean sea level in the central portion of the existing borrow pit. Now that this is allowable, this is what we recommend.

Site sands are non-expansive and have desirable consolidation characteristics (compared to clay) when properly compacted. Therefore, we recommend that site finish grades be lowered to provide more balanced earthwork requiring less import. Torrance is known to have undesirable highly expansive clays not far from this site. Such clays are undesirable due to adverse expansion and consolidation characteristics, and will consolidate slower over time relative to sand. If it is absolutely unavoidable to import clays to the site, then clays should be placed within the pit at least 15 feet below finish grade. Even with this design, clay consolidation will need to be evaluated specific to the grading scheme and structural requirements for differential settlement.

Although conventional tilt-up structures with conventional shallow spread footings are the likely structure alternative, differential settlement of new fill soils (presumably 35- to 40-feet-deep) needs to be evaluated relative to cut zones in older eolian (stabilized) sands. Compaction to 95% relative compaction in deeper fills (>15 feet thick) is recommended (in more detail) in this report.

We understand that in-situ solidification/stabilization (ISS) is proposed/promulgated by others to cement hazardous materials in-place, which was recommended and is to be permitted by others to mitigate impact to groundwater. This report does not address hazardous materials except to the extent that hazardous material remediation may impact our geotechnical recommendations. Therefore, as an alternative to excavating and hauling off site fill soils containing hazardous materials, ISS may be used as deep soil mixing (DSM) with Portland cement, to "fix" (or cement) soils with Portland cement in-situ. Within building footprint areas, we recommend that this DSM achieve a minimum 28-day-cured unconfined compressive strength of at least 50 pounds-per-square-inch (psi), and that any DSM zone be capped with at least 5-feet of new properly compacted fill. DSM must treat all existing fill soils down to undisturbed native soils within the proposed warehouse footprint. DSM strength must be verified during remediation by in-process (molded) quality control (QC) testing and post-cored quality assurance (QA) testing.

We appreciate the opportunity to be of additional service to Prologis and hope to see this project through construction. If you have any questions, or if we can be of further service, please call us at your convenience at **(866) *LEIGHTON***, directly at the phone extension and/or e-mail address listed below.

Respectfully submitted,

LEIGHTON CONSULTING, INC.



Thomas C. Benson, Jr., GE 2091
Senior Principal Geotechnical Engineer
Extension 8771, tbenson@leightonconsulting.com

TCB:tcb

Distribution: (1) addressee (PDF via e-mail)

TABLE OF CONTENTS

Section **Page**

1.0 INTRODUCTION 1
1.1 Site Description 1
1.2 Proposed Warehouse 1
1.3 Purpose and Scope of Work 2

2.0 FINDINGS 3
2.1 Regional Geology 3
2.2 Past and Existing Surface Conditions 3
2.3 Prior Geotechnical Exploration 4

3.0 CONCLUSIONS AND RECOMMENDATIONS 5
3.1 Conclusions and Findings Summary 5
3.2 Warehouse Foundation Recommendations Summary 6
3.3 Earthwork 7
3.3.1. Clearing and Site Preparation: 7
3.3.2. Subgrade Preparation: 7
3.3.3. Material for Fill: 8
3.3.4. Compaction: 8
3.3.5. Construction Observation: 9
3.4 Optional Deep Soil Mixing (DSM) for Hazardous Materials Mitigation 9
3.5 Seismic Design Parameters 10
3.6 Shallow Spread Footing Foundations (Overlying Compacted Fill) 11
3.6.1. Spread Footings Minimum Embedment and Width: 11
3.6.2. Spread Footings Allowable Bearing Pressure: 11
3.6.3. Spread Footing Lateral Load Resistance: 12
3.6.4. Uplift Load Resistance: 12
3.6.5. Spread Footing Settlement Estimates: 12
3.7 Loading Dock Retaining Walls 13
3.7.1. Lateral Earth Pressures: 13
3.7.2. Retaining Wall Surcharges: 13
3.7.3. Retaining Wall Sliding and Overturning: 13
3.7.4. Retaining Wall Drainage: 14
3.7.5. Retaining Wall Incremental Seismic Loads: 14
3.8 Concrete Slab-On-Grade 15
3.9 Sulfate Attack and Ferrous Corrosion Protection 16
3.9.1. Sulfate Exposure: 16
3.9.2. Ferrous Corrosivity: 16
3.9.3. Corrosivity Test Results: 17
3.10 Pavements 18
3.10.1. Asphalt Concrete Pavements: 18
3.10.2. Portland Cement Concrete (PCC) Pavements: 19

4.0 CONSTRUCTION CONSIDERATIONS 20
4.1 Plans, Specifications, and Construction Review 20
4.2 Temporary Excavations 20

5.0 LIMITATIONS 20
REFERENCES

LIST OF TABLES

Table **Page**
Table 1. Proposed Warehouse Column and Bearing-Wall Loads 2
Table 2. March 22, 2022 Borings Summary 5
Table 3. 2022 CBC Site-Specific Seismic Parameters 11
Table 4. Retaining Wall Design Earth Pressures 13
Table 5. Sulfate Concentration and Exposure 16
Table 6. Soil Resistivity and Soil Corrosivity 16
Table 7. Results of Corrosivity Testing 17
Table 8. Asphalt Pavement Section Thickness 18
Table 9. Rigid Pavement Design Alternatives 19

List of Figures

Figure 1 – *Site Location Map*
Plate 1 – *Location of Explorations* (in pocket)
Plate 2 – *Cross Sections A-A' and B-B''* (in pocket)

List of Appendices

Appendix A – Subsurface Exploration
Appendix B – Geotechnical Laboratory Testing
Appendix C – Kleinfelder Review and Response Matrix
Appendix D – Earthwork and Grading Guide Specifications
Appendix E – GBA's Important Information About This Geotechnical-Engineering Report

1.0 INTRODUCTION

1.1 Site Description

As depicted on Figure 1, *Site Location Map*, this relatively flat, gentle rolling dunes, site is roughly a triangular parcel (Los Angeles County APN: 7352-015-004, 5 and 6) covering on the order of 31.3 acres, bound by a "Santa Fe Railroad" (BNSF) right-of-way and the Torrance Refinery to the northeast, Del Amo Boulevard to the south and Prairie Avenue to the west; generally within north-central Torrance; within the Los Angeles Basin. This is an industrial area with the five-track active BNSF railway and Torrance Refinery oil tank farm to the northeast, vacant land and warehousing facility to the south, and offices and hotels to the west.

1.2 Proposed Warehouse

Our understanding of this project was derived solely from Kimley-Horn's August 24, 2023 "*Preliminary Grading Plan*" (Version 23). Grading concepts are depicted on Plate 1, *Location of Explorations* (in pocket). As depicted on Plate 1 (in pocket), we understand that a 441,048-square-foot warehouse is proposed, with a finish-floor elevation at 94.2-feet. Semi-trailer parking is proposed to be located in the northwest portion of this site. Earthwork quantities were estimated as follows:

Cut:	63,800 cubic-yards
Fill:	294,700 cubic-yards
Import:	230,900 cubic-yards

A roughly 42-foot-high relatively-lightweight tilt-up warehouse structure is proposed, with a conventional concrete slab-on-grade designed for a stacked-product live-load of 1,000 pounds-per-square-foot (psf). Interior column and perimeter bearing wall loads are expected to be as follows:

Table 1. Proposed Warehouse Column and Bearing-Wall Loads

Load Location	Load Type (kips)		
	Dead	Live	Seismic
Interior Columns	57	41	120
Perimeter Bearing Walls (per foot)	8	0.6	-0-

1.3 Purpose and Scope of Work

Purposes of this geotechnical design update were to: (1) evaluate geotechnical conditions in the vicinity of this proposed larger warehouse footprint, (2) revise geotechnical recommendations based on elimination of the elevation restriction (elevation 60 feet) for earthwork, and (3) provide augmented/updated geotechnical recommendations for design and construction of this proposed warehouse and appurtenant site improvements. In accordance with our September 28, 2023 proposal, authorized on October 2, 2023 (Prologis Contract Change Order 8), Leighton Consulting, Inc. has completed this *Geotechnical Design Update* specific to this site for your use in final design and permitting of this larger warehouse. Scope of our evaluation has included the following tasks:

- **Document Review**: We reviewed available and provided geologic literature, reports, and historical topographic maps and aerial photographs relevant to this site. Pertinent geotechnical documents are referenced at the end of this report text.

- **Subsurface Exploration**: Currently, our Certified Engineering Geologist (CEG) revisited this site to observe exposed geologic conditions in more detail west of the borrow pit. On October 4, 2023, four test pits were excavated with a backhoe, logged and sampled to depths ranging from 11- to 21-feet below existing grades. In-situ soil moisture and density was determined as shown on the logs, using a nuclear soil density gauge in accordance with ASTM D6938. Bulk soil samples were collected from these test pits. Approximate prior and current subsurface exploration locations are depicted on Plate 1, *Location of Explorations* (in pocket). A description of our three sets of subsurface explorations and logs are presented in Appendix A, *Subsurface Exploration*.

- **Geotechnical Laboratory Testing**: In 2019, 2022 and October 2023, geotechnical laboratory tests were conducted on recovered bulk and driven ring-lined soil samples obtained from our test pits and borings. These three laboratory testing programs were designed to evaluate physical geotechnical characteristics of site soils. A description of geotechnical test procedures and results are presented in Appendix B, *Geotechnical Laboratory Testing,* and summarized on logs in Appendix A, *Subsurface Exploration*.

- **Engineering Analysis**: Subsurface exploration and geotechnical laboratory testing data were analyzed to develop geotechnical conclusions and provide preliminary geotechnical recommendations. Two geotechnical cross-sections were drawn through the proposed warehouse footprint, as depicted on Plate 2, *Cross Sections A-A' and B-B'* (in pocket). Geotechnical responses to prior Kleinfelder review comments (on behalf of the City of Torrance) were provided in a matrix included in Appendix C, *Kleinfelder Review and Response Matrix*.

- **Report Preparation**: Results of our current and prior geotechnical explorations have been summarized in this report, presenting our findings, conclusions and preliminary geotechnical design recommendations for proposed improvements depicted on Plate 1 (in pocket) and described in Section 1.2 of this report. Routine *Earthwork and Grading Guide Specifications* are presented in Appendix D.

This report does not address potential for encountering hazardous materials in soils and/or groundwater. Important information about limitations of geotechnical reports in general, is presented in Appendix E, *GBA's Important Information About This Geotechnical-Engineering Report*.

2.0 FINDINGS

2.1 Regional Geology

This site is located within the Peninsular Ranges geomorphic province of California, at the western margin of the Los Angeles Basin, a broad gently seaward-sloping coastal plain. Dibblee (DF-70, 1999) and others map this site at the eastern margin of "*older, stabilized dune and drift sand – mostly unconsolidated fine-grained sand*" (Qos). There are **no** known geologic discontinuities on this site and there are no significant natural slopes. As is the case for most of southern California, strong ground shaking has and will impact this site.

2.2 Past and Existing Surface Conditions

During our fieldwork in the summer of 2019, there were horse stables covering about an acre or two in the southeastern portion of this site. Otherwise, this site is undeveloped at the surface. As can be seen on the 1934 "Torrance" USGS Quadrangle, the northeast central portion of the site adjacent to the railroad was the lowest point on this parcel, roughly 75-feet above mean sea level (MSL). Since then, a borrow pit had been excavated down to roughly 60-feet above mean sea level in the central portion of this site, while fill had been placed in the northwestern

zone, as deep as reportedly (SCS, 2019) 30 feet. Current (2018) plans are presumably based on the NAVD88 vertical datum while 1934 USGS topographic quadrangles were based on the NGVD29 elevation datum. NOAA reports that the NAVD88 elevations are roughly 2½ feet higher than the NGVD29 elevations at this location.

2.3 Prior Geotechnical Exploration

We are aware of four relatively recent geotechnical explorations at this site, described as follows:

- **SoCalGeo (2018)**: Southern California Geotechnical (SoCalGeo) prepared a June 25, 2018 "*Geotechnical Feasibility Study*" for this site. They reported drilling 20 borings up to 30-feet-deep and excavating six "trenches" up to 17½ feet deep (at locations depicted on Plate 1, in pocket). Reportedly, fill soils were encountered in seven borings and all six "trenches" to depths up to 22 feet below existing grade, with the deepest fill located in the northwestern corner of the site. SoCalGeo did not report encountering fill in the eastern and southern portion of the site adjacent to Del Amo Boulevard.

- **Five Leighton Test Pits (2019)**: Undocumented fill soils were encountered in all five of our test pits excavated on August 22, 2019 within the existing borrow pit at locations depicted on Plate 1 (in pocket). Encountered fill was highly variable but consisted predominantly of a black "fat" (high plasticity, CH with Liquid Limit as high as 57) clay that was expansive (EI=74) with a fuel hydrocarbon odor. Some small amounts of this fill contained trace organics, which measured no-higher-than (≤) 3.1% by loss-on-ignition weight. Mapped existing undocumented fill limits within the borrow pit are depicted in plan-view on Plate 1 (in pocket) and in section-view on Figure 2.

- **Two Sets of Five Leighton Borings (2022)**: Five exploratory borings were drilled (and redrilled) through existing undocumented fill at the bottom of the borrow pit, in two episodes on February 26, 2022 and March 22, 2022. Encountered fill thickness and compressibility are summarized in Table 2 on the following page. As listed in Table 2, fill thickness encountered in our four perimeter borings drilled in 2022 ranged from 0 to 6 feet below elevation 60-feet (**zero** within three of the five borings). At the center of this explored clayey fill mass, fill extended as much as **10 feet** below elevation 60 feet within our current borings. Encountered and tested fill was dark brown to gray plastic clay that was expansive.

Table 2. March 22, 2022 Borings Summary

2/26/2022 Borings	Bottom of Fill Elevation (feet)	3/22/2022 Borings	Bottom of Fill Elevation (feet)	Thickness of Fill Below Elevation 60 Feet	Liquid Limit	Coefficient of Consolidation (at 4.0 ksf)	Coefficient of Rebound
LB-1	59½	LB-6	61	½ to 0	45	4%	½%
LB-2	60	LB-7	54	0 to 6	41	1%	expansive
LB-3	52½	LB-8	50	7½ to 10	Proctor	4%	½%
LB-4	58½	LB-9	61½	1½ to 0	37	too thin to sample	
LB-5	57	LB-10	60½	3 to 0	50	5%	½%

- **Four Leighton Test Pits (2023)**: On October 4, 2023, four test pits were excavated with a backhoe, logged and sampled to depths ranging from 11- to 21-feet below existing grades along the western edge of the proposed warehouse footprint. Deep rubble fills were encountered along the western edge of this proposed warehouse footprint, with fill extending deeper than (>) 21-feet below existing grade at the southwest corner of this proposed warehouse footprint. Tested rubble fill densities were as low as 84% relative compaction (relative to the ASTM D1557 modified Proctor laboratory maximum density).

3.0 CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions and Findings Summary

Groundwater has been relatively deep at this site, presumably on the order of 60- to 100-feet below existing site surface. This site is geologically and geotechnically characterized as older stabilized dune sands (Dibblee's "Qos" and CGS's "Qoe"), and site topography is consistent with undulating dunes. The 1934 USGS "Torrance" Quadrangle shows a depression at and below the 75-foot elevation contour (NGVD29), filled by the railway at the northeast-center perimeter of the site; with the eastern, southern and western portions of the site roughly at elevation 100-feet. Psomas's March 16, 2018 (flown November 18, 2015) ALTA topographic survey for this site shows the lowest surveyed point in the borrow pit area at elevation 59.6 feet above mean sea level (presumably NAVD88; note that NAVD88 elevations are 2.4 feet higher at this site compared to the NGVD29 datum).

3.2 Warehouse Foundation Recommendations Summary

Best standard geotechnical practice is to remove all undocumented fill from under proposed building footprints, which would extend down to elevation 50 feet above mean sea level in the central portion of the existing borrow pit. Now that this is allowable, this is what we recommend.

Site sands are non-expansive and have desirable consolidation characteristics (compared to clay) when properly compacted. Therefore, we recommend that site finish grades be lowered to provide more balanced earthwork requiring less import. Torrance is known to have undesirable highly expansive clays not far from this site. Such clays are undesirable due to adverse expansion and consolidation characteristics, and will consolidate slower over time relative to sand. If it is absolutely unavoidable to import clays to the site, then clays should be placed within the pit at least 15 feet below finish grade. Even with this design, clay consolidation will need to be evaluated specific to the final grading scheme and structural requirements for differential settlement.

Although conventional tilt-up structures with conventional shallow spread footings are the likely structure alternative, differential settlement of new fill soils (presumably 35- to 40-feet-deep) needs to be evaluated relative to cut zones in older eolian (stabilized) sands. Compaction to 95% relative compaction in deeper fills (>15 feet thick) is recommended (described in more detail later) in this report.

We understand that in-situ solidification/stabilization (ISS) is proposed/promulgated by others to cement hazardous materials in-place, which was recommended and is to be permitted by others to mitigate impact to groundwater. This report does not address hazardous materials except to the extent that hazardous material remediation may impact our geotechnical recommendations. Therefore, as an alternative to excavating and hauling off site fill soils containing hazardous materials, ISS may be used as deep soil mixing (DSM) with Portland cement, to “fix” (or cement) soils with Portland cement. Within building footprint areas, we recommend that this DSM achieve a minimum 28-day-cured unconfined compressive strength of at least 50 pounds-per-square-inch (psi), and that any DSM zone be capped with at least 5-feet of new properly compacted fill. DSM must treat all existing fill soils down to undisturbed native soils within the proposed warehouse footprint. DSM strength must be verified during remediation by in-process (molded) quality control (QC) testing and post-cored quality assurance (QA) testing.

More detailed geotechnical recommendations are presented in the following sections of this report.

3.3 Earthwork

Routine *Earthwork and Grading Guide Specifications* are presented in Appendix D. Site-specific earthwork recommendations are presented in the following subsections.

3.3.1. Clearing and Site Preparation: Portions of the site to receive fill for support of buildings, retaining walls and/or pavements, should be cleared of all surface and subsurface deleterious materials including debris, brush and associated roots. Minimum recommended overexcavation is as follows:

- **Pavements**: Existing soils should be excavated to **at least 2 feet** below existing or finish grade, whichever is lower, in areas of proposed pavements.
- **Buildings and Retaining Walls**: **All** existing undocumented fills should be excavated from under building (warehouse) and retaining wall footprints (including all foundation bearing areas), extending half the thickness of the fill thickness, but not-less-than (≥) 5-feet beyond the outside perimeter of building (warehouse) and retaining wall foundations. In any case, existing soils should be excavated to **at least 5 feet** below existing or finish grade, whichever is lower, in areas of proposed warehouse building(s) and/or retaining walls.

Trees and brush will need to be removed from building, retaining wall and pavement areas, including complete removal of root-balls and associated organic soils. Any existing undocumented fill soils should be completely removed from under buildings and retaining wall footings, for support of shallow spread footings. **Existing fill removal down to elevation 50 feet is expected to be required within the existing borrow pit**, but deeper fill could be encountered between or beyond prior subsurface explorations (borings and/or test pits). Rubble piles should be legally disposed of off-site, or non-organic and non-hazardous materials can be pulverized to particles smaller than (<) 3-inches (7.6 cm) and screened for mixing into properly compacted fill. Shallow zones of organic soils must also be removed from building and retaining wall footprints (if and where encountered).

3.3.2. Subgrade Preparation: After the site has been properly cleared, stripped, and necessary excavations have been made as indicated above, the exposed surface soils in those areas to support pavements should be scarified to a depth of 8 inches, moisture conditioned to near optimum, and compacted in

accordance with the recommendations for fill presented in Section 3.3.4 "Compaction," later in this report.

In areas where pavements may be constructed over undocumented fill soils, exposed fill subgrades should be stabilized with a S2 biaxial geogrid (such as a Tensar® BX 1100 bi-axial geogrid or equivalent; see Table 213-5.2 (D) "BIAXIAL" of the *Standard Specifications for Public Works Construction*, 2021 Edition) in combination with crushed rock, as specified in Section 200-1.2 of the *Standard Specifications for Public Works Construction,* ("Greenbook"), 2021 Edition. Triaxial geogrids or similar geogrids could possibly be used, but such products should be reviewed by Leighton Consulting, Inc. beforehand (before bidding). A 4-inch-thick layer of ¾-inch crushed rock should then be placed atop the geogrid. Thicker gravel layers may be required in more heavily loaded areas, or in zones of very soft subgrades. Depending on the time of year and rainfall, pavement subgrades may also need to be stabilized with crushed rock and/or geogrids, to facilitate pavement subgrade and base compaction. Finished compacted subgrade should be firm and non-yielding under weight of compaction equipment.

3.3.3. **Material for Fill:** All on-site soils having an organic content less-than (<) 3 percent by weight are suitable for use as fill at the site. In general, fill material should not contain rocks or lumps larger than 3-inches (7.6 cm) in greatest dimension, with no more than (≤) 15 percent larger than 2½ inches (6.4 cm). Imported and non-expansive fill material should be predominantly granular with a Plasticity Index of 15 or less, and/or an Expansion Index (EI) of 30 or less.

If desired to recycle imported asphalt or Portland cement as engineered fill, we recommend that these materials be thoroughly broken down and mixed with on-site or import soil. In general, recycled asphalt or concrete should be ground or pulverized to particles less than 3 inches (7.6 cm) in greatest dimension, with no more than 25 percent larger than 2½ inches (6.4 cm). Recycled material should be thoroughly mixed with a sufficient amount of soil, such that there is no more than 40 percent by weight of recycled material in the final mix.

3.3.4. **Compaction:** All fill, as well as scarified surface soils in those areas to receive fill, should be compacted to at least **90 percent** relative compaction as determined by the ASTM D1557 Test Method (modified Proctor). Fill should be placed in lifts no greater than 8-inches in uncompacted thickness at a moisture content near the laboratory optimum. Each successive lift should be firm and non-yielding under the weight of the construction equipment.

Fills placed more-than (>) 15-feet below finish grade should be compacted to at least 95 percent relative compaction as determined by the ASTM D1557 Test Method (modified Proctor).

The upper 6 inches of subgrade in pavement areas and all aggregate base should also be compacted to at least **95 percent** relative compaction (ASTM D1557. Aggregate base and all import soils should be compacted at a moisture content near the laboratory optimum.

3.3.5. Construction Observation: Leighton Consulting, Inc. should observe all grading and test all earthwork, to check that subgrades are properly prepared, selected fill materials are satisfactory, and that placement and compaction of fill has been performed in accordance with our recommendations and project specifications. Sufficient notification to us prior to earthwork is essential. Project plans and specifications should incorporate our recommendations contained in this report.

Variations in site conditions are possible and may be encountered during construction. To confirm correlation between soil data obtained during our subsurface explorations and laboratory testing with actual encountered subsurface conditions encountered during construction, and to observe conformance with the plans and specifications, it is essential that we be retained to perform continuous or intermittent review during excavation, earthwork and foundation construction phases. Therefore, conclusions and recommendations presented in this report are contingent upon Leighton Consulting, Inc. performing construction observation services for this project.

3.4 Optional Deep Soil Mixing (DSM) for Hazardous Materials Mitigation

We understand that in-situ solidification/stabilization (ISS) is proposed (promulgated) by others to cement hazardous materials in-place, which was recommended and is to be permitted by others to mitigate impact to groundwater. This report does not address hazardous materials except to the extent that hazardous material remediation may impact our geotechnical recommendations. Therefore, as an alternative to excavating and hauling off site fill soils containing hazardous materials, ISS may be used as deep soil mixing (DSM) with Portland cement, to “fix” (or cement) soils with Portland cement.

In areas where DSM (ISS) is used within the proposed warehouse footprint, and for 20-feet-horizontally beyond the warehouse perimeter, it is essential that DSM extend down to naïve sands, such that no fill under the proposed warehouse footprint remains untreated and/or recompacted as specified.

It is essential that DSM cement **all** existing fill soils (that are not recompacted) down to undisturbed native soils within the proposed warehouse footprint. Within building footprint areas, we recommend that this DSM achieve a minimum 28-day-

cured unconfined compressive strength of at least 50 pounds-per-square-inch (psi), and that any DSM zone be capped with at least 5-feet of new properly compacted fill. In-situ DSM strength must be verified during remediation by in-process (molded) quality control (QC) testing and post-cored quality assurance (QA) testing as follows:

- **DSM Process Observation**: Leighton Consulting, Inc. must observe DSM construction full time, including review of equipment telemetering presenting depth versus auger revolutions-per-minute (RPM), torque and downward (crowd) force, documentation of reported grout quantities, etc. Wet soil cement samples should be obtained periodically (at least daily) and molded in cylinders for unconfined compressive strength testing in accordance with ASTM D1633.

- **DSM Coring**: After placement and initial curing, DSM zones should be cored down to native sands to verify depth of DSM treatment and obtain specimens for unconfined compressive strength testing. Typical requirements for coring integrity included:
  - Minimum 80 percent recovery for every run,
  - Minimum 90 percent recovery averaged over all runs, and
  - No more than 20 percent unimproved soil for each run (design depth).

- **DSM Specimens Geotechnical Laboratory Testing**: One core sample from each 5-foot should be transported to Leighton's geotechnical laboratory for compressive strength testing at 28-days from the date of in-situ mixing. Specified minimum 28-day unconfined compressive strength for this soil-grout mixture for both wet-molded and core specimens should be 50 pounds-per-square-inch (psi) within the building footprint.

- **Quality Management Plan**: A DSM quality management plan should be prepared by the specialty contractor and reviewed by Leighton Consulting, Inc. at least one month prior to mobilization.

3.5 Seismic Design Parameters

To accommodate effects of ground shaking produced by regional seismic events, seismic design can, at the discretion of the designing Structural Engineer, be performed in accordance with the 2022 Edition of the California Building Code (CBC). Seismic design parameters based on the 2022 CBC methodology are tabulated below:

Table 3. 2022 CBC Site-Specific Seismic Parameters

CBC Site-Specific Seismic Design Parameters	2022
Site Longitude (decimal degrees) West	-118.3427
Site Latitude (decimal degrees) North	33.8497
Site Class Definition (Chapter 20 of ASCE 7-16)	D
Mapped Spectral Response Acceleration at 0.2s Period, S_s (Figure 1613.2.1(1))	1.786
Mapped Spectral Response Acceleration at 1s Period, S_1 (Figure 1613.2.1(3))	0.638
Short Period Site Coefficient at 0.2s Period, F_a (Table 1613.2.3(1))	1.0
Long Period Site Coefficient at 1s Period, F_v (Table 1613.2.3(2))	1.7*
Adjusted Spectral Response Acceleration at 0.2s Period, S_{MS} (Eq. 16-20)	1.786
Adjusted Spectral Response Acceleration at 1s Period, S_{M1} (Eq. 16-21)	1.085*
Design Spectral Response Acceleration at 0.2s Period, S_{DS} (Eq. 16-22)	1.191
Design Spectral Response Acceleration at 1s Period, S_{D1} (Eq. 16-23)	0.723*
Long Period, T_L (seconds)	8
Seismic Design Category (2016 CBC Section 1613.3.5)	D

*From ASCE Standard 7-16 Supplement 3, effective November 5, 2021:
See requirements for site-specific ground motions in Section 11.4.8. These values of F_v shall only be used for (1) calculation of T_S, (2) determination of Seismic Design Category
(3) linear interpolation for intermediate values of S_1, and
(4) when taking the exceptions under Items 1 and 2 of Section 11.4.8 for the calculation of S_{D1}.

3.6 Shallow Spread Footing Foundations (Overlying Compacted Fill)

For this tilt-up warehouse building bearing on new properly compacted fill as described in Section 3.3 (previously in this report), shallow spread footings can be designed using the following geotechnical design parameters and recommendations:

3.6.1. Spread Footings Minimum Embedment and Width: Conventional shallow spread footings may be used to support warehousing facility and/or retaining walls, bearing solely on at least (≥) a 5-foot-thick layer of properly-compacted fill over undisturbed native soils. These recommendations are for dead plus sustained loads less-than (<) 10 kips-per-foot of wall for continuous footing, or 75-kips for isolated column loads. Footings should be embedded at least 18-inches below lowest adjacent grade, with a minimum width of 12-inches wide for building bearing walls or 30-inches wide for retaining walls (possibly wider for overturning resistance). Separate/isolated column (rectangular) footings should have a minimum width of 24-inches.

3.6.2. Spread Footings Allowable Bearing Pressure: For footings bearing solely on new properly compacted fill as described in Section 3.3 (previously in this report), a net allowable bearing pressure of 2,500 pounds-per-square-foot (psf)

may be used. This net allowable bearing pressure is based on minimum embedment depths and widths described above in Section 3.6.1, and can be increased by 500 psf for each additional foot of embedment or width beyond minimum footing dimensions recommended above, not to exceed 5,000 psf in any case. Also, these allowable bearing pressures are for total dead loads and frequently applied live loads, and can be increased by one-third for short duration wind loads (increases for seismic loading is not recommended due to liquefaction). Our recommended maximum allowable bearing pressures are net values; so weight of the portion of footings below lowest adjacent finish grade need not be added to design loads for structural analyses.

3.6.3. Spread Footing Lateral Load Resistance: Lateral (horizontal) loads on foundations embedded in properly compacted fill may be resisted by both frictional resistance along the base of the footing and passive resistance in properly compacted fill adjacent to the sides of footings. Frictional resistance between base-of-footings poured (cast) on properly compacted silty sand fill may be computed using a coefficient of friction of 0.45. Passive resistance may be computed using an equivalent fluid pressure of 300 pounds-per-square-foot per foot of embedment below lowest adjacent grade (pcf), assuming there is constant contact between these footings and properly compacted fill soils. Passive pressure should not exceed 2,500 psf. These values may be increased by one third when considering wind and seismic forces. Both friction and passive values have already been reduced by a factor-of-safety of 1½, and can be used in combination.

3.6.4. Uplift Load Resistance: If required to resist seismic uplift loads, properly compacted backfill soils over spread footings can be used, modeled with both dead weight and soil shear strength resisting short term dynamic uplift forces. Properly compacted backfill soils may be assumed to have a moist unit weight of 120 pounds-per-cubic-foot (pcf). A friction angle of 30° can be used along with cohesion of 300 pounds-per-square-foot (psf), to model properly compacted backfill soil's shear strengths. A factor-of-safety has not been applied to these values, although cohesion was reduced due to potential for shrinkage and desiccation-cracking, in addition to potential for backfill soil-type variability.

3.6.5. Spread Footing Settlement Estimates: Our settlement estimates are based on sustained (e.g. dead) loads listed on Table 1 presented previously in this report. Total static settlements are not expected to exceed one inch; but, settlement is a function of footing sustained load, size and contact bearing pressure, so larger differential settlement can be expected between adjacent dissimilarly loaded columns and walls where a large differential loading condition exists. Generally speaking, although some widely-different loading is expected between some columns (e.g. at loading docks), based on static loads provided in Table 1, differential settlements are expected to be half of total

static settlements; or ½-inch over spacing at least 25-feet).

3.7 Loading Dock Retaining Walls

Specific design recommendations for earth retaining structures are presented in the following subsections.

3.7.1. Lateral Earth Pressures: We recommend that loading-dock retaining walls be backfilled with non-expansive (EI≤30) soil, and constructed with a backdrain as described in Section 3.6.4, below. Based on these recommendations, the following parameters may be used for retaining wall design:

Table 4. Retaining Wall Design Earth Pressures

Retaining Wall Condition	Equivalent Fluid Pressure (pounds-per-cubic-foot)	
	Level Backfill	2:1 Backfill
Active (cantilever)*	35	50
At-Rest (braced)*	55	65
Passive (resistance)	300**	

*Only in properly compacted non-expansive (EI≤30) backfill.
**For level toe grades only in properly compacted fill, not to exceed 2,000 psf

Cantilever walls that are designed to yield at least 0.001H, where H is equal to the wall height, may be designed using the active condition. Rigid walls and walls braced at the top (e.g. valve vaults and manholes) should be designed using the at-rest condition. Passive pressure is used to compute soil resistance to lateral structural movement.

3.7.2. Retaining Wall Surcharges: In addition to the above lateral forces due to retained earth, surcharge due to above grade loads on the wall backfill, such as an adjacent structure or traffic, should be considered in design of the retaining wall. Vertical surcharge loads behind the retaining wall on or in the backfill within a 1:1 plane projection up and out from the retaining wall toe, should be considered as lateral and vertical surcharge. Unrestrained (cantilever) loading dock retaining walls should be designed to resist one-third of these surcharge loads applied as a uniform horizontal pressure on the wall. Braced walls should also be designed to resist an additional uniform horizontal-pressure equivalent to one-half of uniform vertical surcharge-loads.

3.7.3. Retaining Wall Sliding and Overturning: Total depth of retained earth for design of walls should be measured as the vertical height of the stem below the ground surface at the wall face for stem design, or measured at the heel of the footing for overturning and sliding. A soil unit weight of 120 pcf may be assumed for calculating the actual weight of the soil over the wall footing, assuming drained conditions, for properly compacted backfill.

3.7.4. **Retaining Wall Drainage:** Adequate drainage may be provided by a subdrain system positioned behind the walls. This system should consist of a 4-inch minimum diameter perforated pipe placed near the base of the wall (perforations placed downward). The pipe should be bedded and backfilled with pervious backfill material described in Section 300-3.6 of the *Standard Specifications for Public Works Construction* (Greenbook), 2021 Edition. This pervious backfill should extend at least 2 feet horizontally out from the wall and to within 2 feet of the outside finished grade. This pervious backfill and pipe should be wrapped in filter fabric, such as Mirafi 140N or equivalent, placed as described in Section 300-8 of the *Standard Specifications for Public Works Construction* (Greenbook), 2021 Edition. The subdrain outlet should be connected to a free-draining outlet or sump.

Miradrain or Enkadrain drainage geocomposites, or similar, may be used for wall drainage as an alternative to pervious backfill or drain rock backfill, particularly where horizontal space is limited adjacent to shoring or near vertical cuts. Drainage geocomposites should be connected to a perforated drainpipe at the base of the wall.

Note that loading dock retaining walls will conceptually be constructed 3- to 4-feet below existing grade. Groundwater has not recently been encountered within 40-feet of the surface, but this site is within the Whittier Narrows area, with historic groundwater rising to within 5-feet of the surface. Since the groundwater is not there now, we cannot predict groundwater recharge quantities or recharge rates. But we do recommend that all retaining walls be designed with a stem back-drain system, to drain retaining wall backfill with at least 4-inch-diameter perforated drainpipe.

3.7.5. **Retaining Wall Incremental Seismic Loads:** Seismic incremental loads need **not** be added to loading-dock retaining walls with **stem** heights on the order of (≤) 4-feet or less, with adjacent level backfill. Nevertheless, at the discretion of the project Structural Engineer (SE), incremental seismic earth pressures of 25 pounds-per-cubic-foot (pcf) may be applied for design in addition to static active earth and surcharge pressures presented above. This is based on traditional Mononobe-Okabe (1929) equations. Traditionally, this incremental seismic earth pressure has been applied as an inverted triangle (inverted equivalent fluid pressure), with largest dynamic earth pressure occurring at the top of the wall (upper ground surface). Resultant seismic earth pressure force has traditionally been applied at approximately 0.6H from the bottom of the wall, where H is the wall (stem) height (e.g. Seed and Whitman, 1970). This incremental load should be added to active static earth pressures, and **need not be added to at-rest earth pressures**.

However, recent studies (Sitar, et. al., 2010, U.C. Berkeley) suggest a uniform pressure distribution is likely closer to actual lateral seismic loads, so a uniform

pressure of 13H (psf) applied as a uniform/rectangular pressure distribution can also be considered (based on current research and observations). It is important to consider that for level backfill and in areas without shallow groundwater, both case history reviews and centrifuge test results suggest all of these approaches above are conservative, particularly for loading-dock retaining walls with modest heights.

3.8 Concrete Slab-On-Grade

Depending on rack or other point loading, slabs-on-grade should be designed by the project Structural Engineer. In general, slabs-on-grade should have the following minimum recommended components:

- **Subgrade:** Slab-on-grade sandy subgrade soil should be moisture conditioned to or within 3% of optimum moisture content, to a minimum depth of 24 inches within building footprints, then compacted to 95% of the modified Proctor (ASTM D1557) laboratory maximum density prior to placing either a moisture barrier, steel and/or concrete.

- **Moisture Barrier:** **Only in areas where moisture-sensitive floor coverings are used or equipment is installed**, a moisture barrier consisting of at least 15-mil-thick Stego-wrap vapor barriers (see: http://www.stegoindustries.com/products/stego_wrap_vapor_barrier.php), or equivalent, should then be placed.

- **Reinforced Concrete**: A conventionally reinforced concrete slab-on-grade with a thickness of at least 5-inches should be placed in pedestrian areas without heavy loads. Reinforcing steel should be designed by the structural engineer, but as a minimum should be No. 4 rebar placed at 24-inches on-center, each direction (perpendicularly), mid-depth in the slab. A modulus of subgrade reaction (k) as a linear spring constant, of 125 pounds-per-square-inch per inch deflection (pci) can be used for design of heavily loaded slabs-on-grade, assuming a linear response up to deflections on the order of ¾-inch. Fiber-reinforced concrete mix designs can be considered to replace rebar.

- **Slab-On-Grade Control Joints**: Slab-on-grade crack control joint locations and spacing should be designed by the project Structural Engineer (SE). However, consideration should be given to potential for differential-vertical-offset at control joints, due to potential subgrade expansion/shrinkage. Where possible, slabs-on-grade should be allowed to “float” on the subgrade to allow for differential vertical expansion/shrinkage of the subgrade.

Minor cracking of concrete after curing due to expansion, drying and shrinkage is normal and should be expected. However, cracking is often aggravated by a high water-to-cement ratio, high concrete temperature at the time of placement, small nominal aggregate size, and rapid moisture loss due to hot, dry, and/or windy

weather conditions during placement and curing. Cracking due to temperature and moisture fluctuations can also be expected. The use of low-slump concrete or low water/cement ratios can reduce the potential for shrinkage cracking.

3.9 Sulfate Attack and Ferrous Corrosion Protection

3.9.1. Sulfate Exposure: Sulfate ions in the soil can lower the soil resistivity and can be highly aggressive to Portland cement concrete by combining chemically with certain constituents of the concrete, principally tricalcium aluminate. This reaction is accompanied by expansion and eventual disruption of the concrete matrix. A potentially high sulfate content could also cause corrosion of reinforcing steel in concrete. Section 1904 of the 2022 California Building Code (CBC) defers to the American Concrete Institute's (ACI's) ACI 318-14 for concrete durability requirements. Table 19.3.1.1 of ACI 318-14 lists "Exposure categories and classes," including sulfate exposure as follows:

Table 5. Sulfate Concentration and Exposure

Soluble Sulfate in Water (parts-per-million)	Water-Soluble Sulfate (SO_4) in soil (percentage by weight)	ACI 318-14 Sulfate Class
0-150	0.00 - 0.10	S0 (negligible)
150-1,500	0.10 - 0.20	S1 (moderate*)
1,500-10,000	0.20 - 2.00	S2 (severe)
>10,000	>2.00	S3 (very severe)

*or seawater

3.9.2. Ferrous Corrosivity: Many factors can modify corrosion potential of soil including soil moisture content, electrical resistivity, permeability and pH, as well as chloride and sulfate concentration. In general, soil resistivity, which is a measure of how easily electrical current flows through soils, is the most influential factor. Based on the findings of studies presented in ASTM STP 1013 titled "*Effects of Soil Characteristics on Corrosion*" (February 1989), the approximate relationship between soil resistivity and soil corrosiveness was developed as follows:

Table 6. Soil Resistivity and Soil Corrosivity

Soil Resistivity (ohm-cm)	Classification of Soil Corrosiveness
0 to 900	Very Severely Corrosive
900 to 2,300	Severely Corrosive
2,300 to 5,000	Moderately Corrosive
5,000 to 10,000	Mildly Corrosive
10,000 to >100,000	Very Mildly Corrosive

Acidity is an important factor in soil corrosivity. The lower the pH (the more acidic the environment), the higher the soil corrosivity will be with respect to buried metallic structures and utilities. As soil pH increases above 7 (the neutral value), the soil is increasingly more alkaline and less corrosive to buried steel structures, due to protective surface films, which form on steel in high pH environments. A pH between 5 and 8.5 is generally considered relatively passive from a corrosion standpoint. Chloride and sulfate ion concentrations, and pH appear to play secondary roles in modifying corrosion potential. High chloride levels tend to reduce soil resistivity and break down otherwise protective surface deposits, which can result in corrosion of buried steel or reinforced concrete structures.

3.9.3. **Corrosivity Test Results:** To evaluate corrosion potential of soils sampled from this site, we tested a bulk soil sample for soluble sulfate content, soluble chloride content, pH and resistivity. Results of our one test in shallow fill is summarized below:

Table 7. Results of Corrosivity Testing

Test Pit Number	Sample Depth (feet)	Sulfate (ppm)	Chloride (ppm)	pH	Minimum Resistivity (ohm-cm)
TP-2023-2	0 to 2	**3,540**	337	**5.8**	**618**

Note: mg/kg = milligrams per kilogram, or parts-per-million (ppm)

These results are discussed as follows:

- **Sulfate Exposure**: Based on our previous experience and Table 19.3.1.1 of ACI 318-14, in our opinion, sulfate exposure should be considered severe (>2.000 ppm) with an **Exposure Class S2** for shallow soil sampled at this site. Based on Table 19.3.2.1 of ACI 318-14, for this Exposure Category S2, Type V Portland cement with a maximum water/cement ration of (≤) 0.45 should be used, and concrete should have a f_c' (28-day compressive strength) of at least 4,500 pounds-per-square-inch (psi). Calcium chloride should not be included as an admixture.
- **Ferrous Corrosivity**: As shown above, minimum soil resistivity of **618 ohm-centimeters** was measured in our tested soil sample. This soil sample was also notably acidic In our opinion, based on resistivity correlation presented in Table 6, it appears for at least one site soil sample that corrosion potential for buried steel may be characterized as "**very severely corrosive**." Ferrous pipe buried in moist to wet site earth materials should be avoided by using high-density polyethylene (HDPE) or other non-ferrous pipe when possible. Or ferrous pipe can be protected by

polyethylene bags, tap or coatings, di-electric fittings or other means to separate the pipe from on-site earth materials.

These results are for a shallow fill soil sample.
Uncontaminated native sands are expected to be less corrosive.

3.10 Pavements

All pavement areas should be supported on a zone of newly placed compacted fill extending at least (≥) 2-feet below existing or finish grade, whichever is lower. A zone of properly compacted fill should then be backfilled in lifts. Pavement subgrades and base should be compacted to **95 percent** of the ASTM D1557 (modified Proctor) laboratory maximum density for these materials.

3.10.1. Asphalt Concrete Pavements: Considering the effects of mixing of onsite soils, a representative R-value of 30 and Traffic Indexes (TI) of 5 through 8 were used to calculate pavement sections as listed below:

Table 8. Asphalt Pavement Section Thickness

General Traffic Condition	Design Traffic Index (TI)	Asphalt Concrete (inches)	Class 2 Aggregate Base* (inches)	Total Thickness (inches)
Automobile Parking	5.0	3.0	6.0	9
	5½	3.0	7.0	10
Truck Access & Parking Areas	6.0	3½	8.0	11½
	6½	4.0	9.0	13
	7.0	4.0	10.0	14
	7½	4½	11.0	15½
	8.0	5.0	12.0	17

*Conforming to Caltrans 2023 Standard Specifications Section 26-1.02B for Class 2 Aggregate Base.

Final pavement thickness should be based on subgrade R-value test results performed on representative finished sub-grade soils. Appropriate Traffic Index (TI) data should be selected by the project Civil Engineer or traffic engineering consultant for final design of pavement sections. These Caltrans pavement-section design calculations were based on a pavement life of approximately 20 years with a normal amount of flexible pavement maintenance. Portland cement concrete should be used, rather than asphalt, in point and impact load areas such as loading docks and trash truck bin loading areas.

Asphalt concrete and aggregate base should conform to *Caltrans Standard Specifications* (2023 Edition) Sections 39 and 26-1.02B, respectively; see:

https://dot.ca.gov/-/media/dot-media/programs/design/documents/2023_stdspecs-a11y.pdf

Aggregate base should have an R-value of at least (≥) 78. Minimum relative-compaction requirements for aggregate base should be 95 percent of the modified Proctor laboratory maximum density as determined by ASTM D1557.

As an alternative, asphalt concrete can conform to Section 203-6 of the *Standard Specifications for Public Works Construction* (Green Book), 2021 Edition. Crushed aggregate base or crushed miscellaneous base can conform to Sections 200-2.2 and 200-2.4 of the *Standard Specifications for Public Works Construction* (Green Book), 2021 Edition, respectively.

3.10.2. Portland Cement Concrete (PCC) Pavements: For preliminary planning purposes, fire lanes may be constructed of Portland Cement Concrete (PCC) with a minimum thickness of 7-inches assuming light axle loads and an average daily truck traffic (ADT) of less than 500. For medium/heavy axle loads and an ADT of 500 or more, a minimum PCC thickness of 8-inches should be used, such as for trash corrals and trash truck aprons, loading docks, etc.. All PCC pavements should have a minimum 28-day concrete compressive strength of 3,250 pounds-per-square-inch (psi), and have appropriate joints and saw cuts in accordance with either Portland Cement Association (PCA) or American Concrete Institute (ACI) guidelines. PCC subgrade should be compacted to 95 percent relative compaction in the upper 12-inches. These PCC sections should be re-evaluated based on the precise grading plan, which indicates locations of concrete pavements. We recommend that the ADT be confirmed by the project civil designer or traffic consultant prior to completion of plans.

The project Structural Engineer required the following concrete pavement section designs:

Table 9. Rigid Pavement Design Alternatives

Design Life	Traffic Index (TI)	With Lateral Support (feet)	Without Lateral Support (feet)
40-years	≤9.0	0.75 JPCP 1.00 AB	0.80 JPCP 1.00 AB

All units in feet. **JPCP**=Jointed Plain Concrete Pavement, over **AB**=Aggregate Base.

For truck lanes and ramps, a 4-inch (minimum) layer of Class 2 aggregate base at 95 percent relative compaction should be considered beneath the PCC paving. This 4-inch layer of Class 2 aggregate may be used beneath other areas of PCC pavement to improve performance. Additional details should be added to the plans indicating pavement thickness transitions, pavement joint dowels, expansion joints and sawcut joints. Use of concrete cutoff or edge barriers should be considered at the perimeter of common parking or driveway areas when abutting either open (unfinished) or landscaped areas.

4.0 CONSTRUCTION CONSIDERATIONS

4.1 Plans, Specifications, and Construction Review

Because subsurface conditions may vary considerably from those predicted by subsurface exploration by others, and to check that our report recommendations have been properly implemented, we recommend that we be retained to 1) review final grading and foundation plans and specifications, and 2) observe and test all earthwork. In addition, the assumed and/or actual geotechnical conditions can be greatly affected by the construction process and seasonal weather changes. For the above reasons, our geotechnical recommendations are contingent upon Leighton Consulting, Inc. providing geotechnical observation and testing services during construction.

4.2 Temporary Excavations

The contractor is responsible for all temporary slopes and trenches excavated at the site and the design of any required temporary shoring. Shoring, bracing and benching should be performed by the contractor in accordance with the 2018 Edition of the *California Construction Safety Orders*, Article 6, or more current. During construction, soil conditions should be regularly evaluated to verify that conditions are as anticipated. The contractor shall be responsible for providing the "competent person" required by OSHA standards to evaluate soil conditions. Soil types will vary, but **Type C** soils can be expected at this site. CAL/OSHA requires slopes in Type C soils to be cut back at gradients of 1½:1 (horizontal:vertical), if workers are to enter the excavation. Close coordination between the competent person and Leighton Consulting, Inc. should be maintained to facilitate construction while providing safe excavations.

5.0 LIMITATIONS

This report was based on subsurface exploration by others, our five test pits excavated in 2019, our ten borings drilled in 2022 and our four test pits excavated on October 4, 2023. Such information is, by necessity, incomplete. The nature of many sites is such that differing soil or geologic conditions can be present within small distances and under varying climatic conditions. Changes in subsurface conditions can and do occur over time. Therefore, findings, conclusions and recommendations presented in this report are based on the assumption that Leighton Consulting, Inc. will provide geotechnical observation and testing during construction.

Until reviewed and accepted by the City of Torrance, this report is subject to change. Changes may be required as part of the City review process. Leighton Consulting, Inc. assumes no risk or liability for consequential damages that may arise due to design work progressing before this report is reviewed and accepted by the City.

Environmental services were not included as part of this study. This report was prepared for the sole use of Prologis, Inc. based on their needs, directions and requirements at this time, for application to design of the proposed warehousing facility described in Section 1.2 of this report; in accordance with generally accepted geotechnical engineering practices at this time in Los Angeles County. This report is not authorized for use by, and is not to be relied upon by, any party except Prologis, Inc., with whom Leighton Consulting, Inc. has contracted for this work. Use of or reliance on this report by any other party is at that party's risk. Unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify Leighton Consulting, Inc. from and against any liability which may arise as a result of such use or reliance, regardless of any fault, negligence, and/or strict liability of Leighton Consulting, Inc.

R E F E R E N C E S

AECOM Technical Services, Inc., December 2022, Torrance Refinery North Posse Area, Additional Investigation 2022 Report, for Torrance Refining Company LLC, Torrance Refinery, Torrance, California, AECOM Project No. 60675012.

Bryant, W.A., and Hart, E.W., 2007, Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Zones Maps, Department of Conservation, California Geological Survey, Special Publication 42. 2007 Interim Revision.

California Building Standards Commission, 2019, 2019 California Building Code, California Code of Regulations Title 24, Volume 2 of 2, based on the 2018 International Building Code.

California Division of Mines and Geology (CDMG, renamed California Geologic Survey - CGS), 1997, "Guidelines for Evaluating and Mitigating Seismic Hazards in California," CDMG Special Publications 117, Adopted March 13, 1997.

_____, 1998, "*Seismic Hazard Zone Report for the Torrance 7½-Minute Quadrangle, Los Angeles County, California*," Seismic Hazard Zone Report 035.

_____, 2008, "*Guidelines for Evaluating and Mitigating Seismic Hazards in California*," CGS Special Publications 117A, Revised and Re-adopted September 11, 2008:

California Environmental Protection Agency, State Water Resources Control Board, GeoTracker website; http://geotracker.waterboards.ca.gov/

ENTACT, LLC, March 24, 2023, *"In Situ Solidification/Stabilization Bench Scale Study Report, Torrance Technology Center, Torrance, California*," prepared for Prologis.

Martin, G. R., and Lew, M., ed., 1999, "*Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction Hazards in California*," Southern California Earthquake Center, dated March 1999.

Public Works Standards, Inc., 2021, Standard Specifications for Public Works Construction, 2021 Edition, published by BNI Building News.

SCS Engineers, January 2018, "*Phase I Environmental Assessment, North Posse Site, 3041 Del Amo Boulevard, Torrance, California 90503*."

SCS Engineers, September 17, 2018, "*Phase II Investigation Report, North Posse Site, 3041 Del Amo Boulevard, Torrance, California 90503*."

SCS Engineers, December 23, 2022, "*Data Gap Investigation Report, North Posse Site, 3041 Del Amo Boulevard, Torrance, California 90503, (APNs 7352-015-004, -005, -006), LARWQCB Case# 1434; Global ID T10000012263*," for Torrance Black Beauty, LLC, SCS Project No. 01217339.00.

Southern California Geotechnical, June 25, 2018, "*Geotechnical Feasibility Study, Proposed Commercial/Industrial Development, NEC Del Amo Boulevard and Madrona Avenue, Torrance, California*," for Prologis, Project No. 17G221-1.



Project: 12452.004	Eng/Geol: TCB/JH
Scale: 1 " = 500 '	Date: October 2023

Base Map: ESRI ArcGIS Online 2023
Thematic Information: Leighton
Author: Leighton Geomatics (btran)

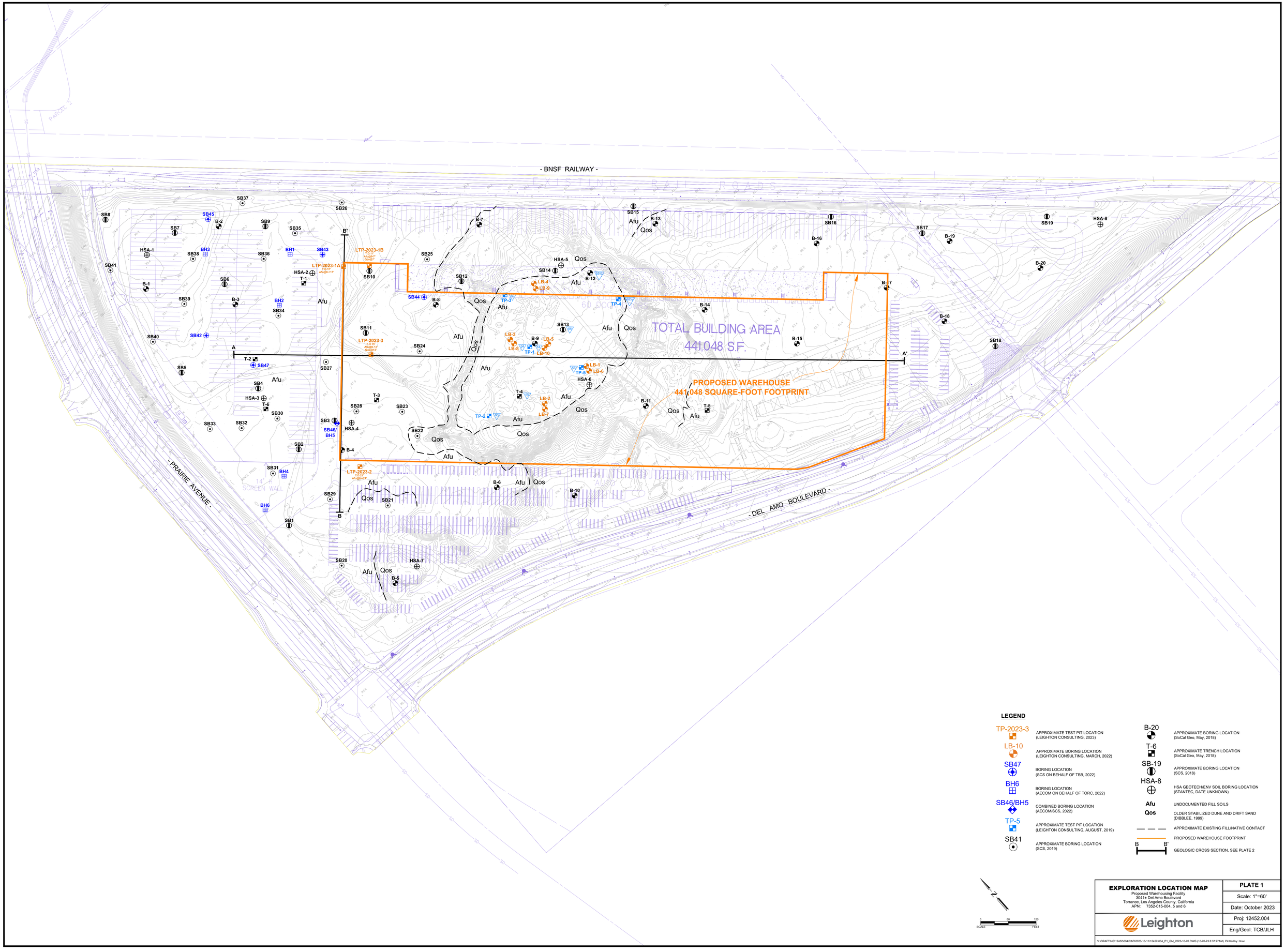
SITE LOCATION MAP

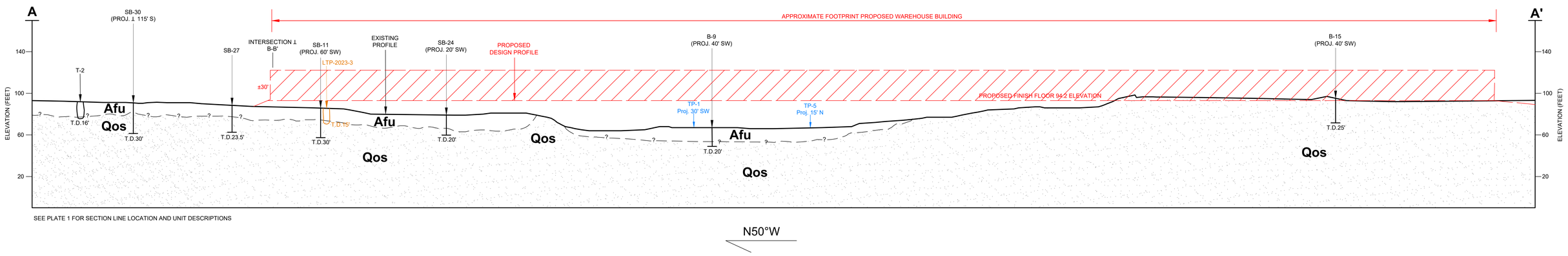
Proposed Warehousing Facility
3041± Del Amo Boulevard
Torrance, Los Angeles County, California
APN: 7352-015-004, 5 and 6

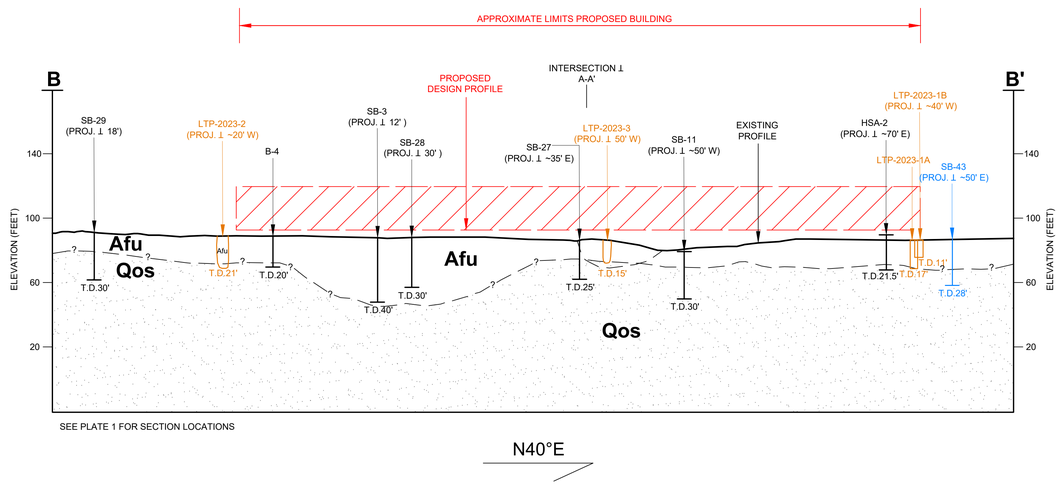
FIGURE 1

Leighton

Map Saved as V:\Drafting\12452\004\Maps\12452-004_F01_SLM_2023-10-09.mxd on 10/9/2023 12:35:04 PM


- BNSF RAILWAY -
- PRAIRIE AVENUE -
- DEL AMO BOULEVARD -
14' SCREEN WALL
TOTAL BUILDING AREA
441,048 S.F.
PROPOSED WAREHOUSE
441,048 SQUARE-FOOT FOOTPRINT
A
A'
B
B'
Afu
Qos
SB8
SB45
SB37
SB26
SB15
SB16
SB17
SB19
HSA-8
SB7
B-2
SB9
SB35
B-7
B-13
B-16
B-19
HSA-1
SB38
BH3
SB36
BH1
SB43
LTP-2023-1B
T.D.=11'
Afu@6'-7'
Qos@7'
SB25
HSA-5
B-20
SB41
LTP-2023-1A
T.D.=7'
Afu@6'-11'
HSA-2
T-1
SB10
SB12
SB14
B-12
B-1
SB6
LB-4
LB-9
B-7
SB39
B-3
BH2
SB34
SB44
B-8
TP-3
TP-4
B-14
B-18
SB40
SB42
SB11
LTP-2023-3
T.D.=11'
Afu@6'-13'
Qos@13'
SB13
LB-3
LB-8
B-9
LB-5
TP-1
LB-10
B-15
SB18
SB24
T-2
SB47
SB27
SB5
LB-1
TP-5
LB-6
HSA-6
SB4
HSA-3
T-6
T-3
T-4
LB-2
LB-7
B-11
T-5
SB30
SB28
SB23
TP-2
SB33
SB32
SB3
SB46/
BH5
HSA-4
SB22
B-6
B-10
SB2
B-4
SB31
BH4
LTP-2023-2
T.D.=7'
Afu@5'-7'
SB29
SB21
BH6
SB1
SB20
HSA-7
B-5
LEGEND
TP-2023-3
APPROXIMATE TEST PIT LOCATION (LEIGHTON CONSULTING, 2023)
LB-10
APPROXIMATE BORING LOCATION (LEIGHTON CONSULTING, MARCH, 2022)
SB47
BORING LOCATION (SCS ON BEHALF OF TBB, 2022)
BH6
BORING LOCATION (AECOM ON BEHALF OF TORC, 2022)
SB46/BH5
COMBINED BORING LOCATION (AECOM/SCS, 2022)
TP-5
APPROXIMATE TEST PIT LOCATION (LEIGHTON CONSULTING, AUGUST, 2019)
SB41
APPROXIMATE BORING LOCATION (SCS, 2019)
B-20
APPROXIMATE BORING LOCATION (SoCal Geo, May, 2018)
T-6
APPROXIMATE TRENCH LOCATION (SoCal Geo, May, 2018)
SB-19
APPROXIMATE BORING LOCATION (SCS, 2018)
HSA-8
HSA GEOTECH/ENV SOIL BORING LOCATION (STANTEC, DATE UNKNOWN)
Afu
UNDOCUMENTED FILL SOILS
Qos
OLDER STABILIZED DUNE AND DRIFT SAND (DIBBLEE, 1999)
APPROXIMATE EXISTING FILL/NATIVE CONTACT
PROPOSED WAREHOUSE FOOTPRINT
B B'
GEOLOGIC CROSS SECTION, SEE PLATE 2
N
0 60 120
SCALE FEET
EXPLORATION LOCATION MAP
Proposed Warehousing Facility
3041s Del Amo Boulevard
Torrance, Los Angeles County, California
APN: 7352-015-004, 5 and 6
PLATE 1
Scale: 1"=60'
Date: October 2023
Leighton
Proj: 12452.004
Eng/Geol: TCB/JLH
V:\DRAFTING\12452\004\CAD\2023-10-11\12452-004_P1_GM_2023-10-26.DWG (10-26-23 8:37:27AM) Plotted by: btran





CROSS SECTION A-A' AND B-B'

Proposed Warehousing Facility
3041± Del Amo Boulevard
Torrance, Los Angeles County, California
APN: 7352-015-004, 5 and 6

Leighton

PLATE 2
Scale: 1"=40'
Date: October 2023
Proj: 12452.004
Eng/Geol: TCB/JLH

V:\DRAFTING\12452\004\CAD\2023-10-11\12452-004_P2_CSAB_2023-10-26.DWG (10-26-23 8:48:19AM) Plotted by: btran

APPENDIX A

SUBSURFACE EXPLORATION

Our subsurface exploration consisted of a surface reconnaissance, and three subsurface exploration events as bulleted below. Prior to beginning fieldwork, we marked proposed test pit and boring locations on site and contacted Underground Service Alert (USA) to mark utilities at proposed subsurface exploration locations. Encountered soils were continuously logged in the field by our representative and described in accordance with the Unified Soil Classification System (ASTM D2488). These subsurface exploration locations are plotted on Plate 1, *Location of Explorations* (in pocket), and describe in more detail below:

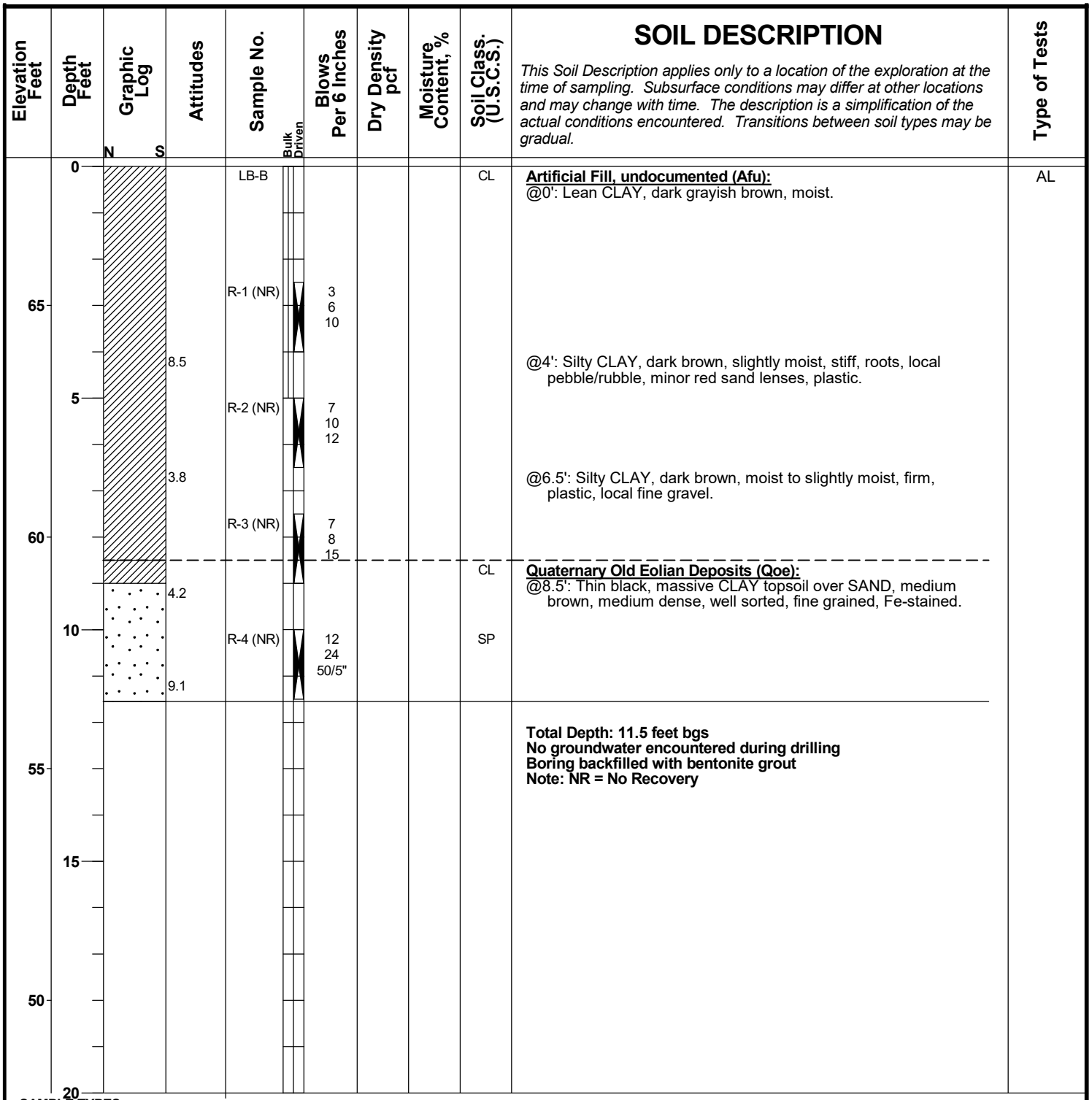
- **Five Test Pits (2019)**: Our Certified Engineering Geologist (CEG) visited this site to observe exposed geologic conditions. On August 22, 2019, five test pits were excavated with a backhoe, logged and sampled to depths ranging from 5- to 14-feet below existing grades within the borrow pit area. Bulk soil samples were collected from these test pits.
- **Ten Borings (2022)**: Five hollow-stem borings (LB-1 through LB-5) were drilled on February 26, 2022 to depths of 4- to 14-feet below existing grade at the bottom of the borrow pit, but recovered drive samples were stolen from a locked facility; bulk soil samples were unmolested. Five additional borings (LB-6 through LB-10) were then drilled on March 22, 2022 to depths of 4- to 13 feet, adjacent to the first five borings (see Plate 1, in pocket) to obtain driven ring-lined samples of fill soils.
- **Four Test Pits (2023)**: Our Certified Engineering Geologist (CEG) revisited this site to observe exposed geologic conditions in more detail west of the borrow pit. On October 4, 2023, four test pits were excavated with a backhoe, logged and sampled to depths ranging from 11- to 21-feet below existing grades. In-situ soil moisture and density was determined as shown on the logs, using a nuclear soil density gauge in accordance with ASTM D6938. Bulk soil samples were collected from these test pits.

Soil samples were transported to our Irvine geotechnical laboratory (DSA LEA-63) for geotechnical testing. Test pit and boring logs are included as part of this appendix. After sampling and logging, all explorations were immediately backfilled with excavated soils.

Attached logs depict subsurface conditions at the specific approximate locations noted on our Plate 1 (in pocket), during designated date(s) of exploration. Subsurface conditions at other locations may differ from those encountered in our explorations. It is also possible that passage of time could alter conditions due to environmental changes, fluctuations in groundwater, or occurrence of a significant geological event such as an earthquake. In addition, boundaries between soil or geologic units noted on our logs are based on field observations and results of geotechnical laboratory testing. Vertical location of these “contacts” is not precise, given vertical sampling intervals, and possible transitional/gradual changes in soil types.

GEOTECHNICAL BORING LOG LB-1

Project No.	12452.005	**Date Drilled**	2-26-22
Project	Prologis Warehouse - Surcharge Zone	**Logged By**	JLH
Drilling Co.	Choice Drilling	**Hole Diameter**	8"
Drilling Method	CME-95 HSA Truck - 140lb - Autohammer - 30" Drop	**Ground Elevation**	68'
Location	See Plate 1 - Location of Explorations	**Sampled By**	JLH



SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

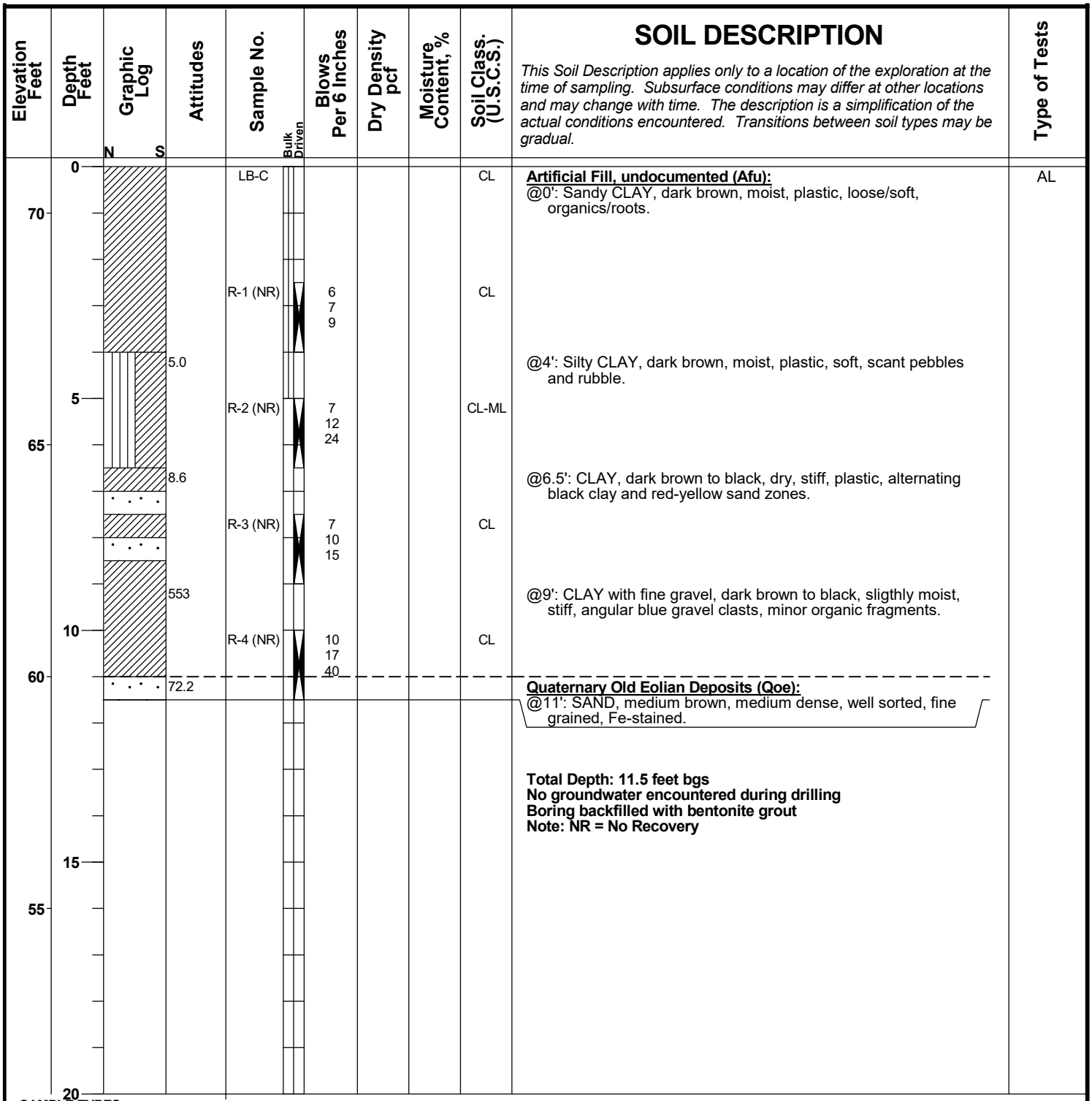
-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-2

Project No.	12452.005	**Date Drilled**	2-26-22
Project	Prologis Warehouse - Surcharge Zone	**Logged By**	JLH
Drilling Co.	Choice Drilling	**Hole Diameter**	8"
Drilling Method	CME-95 HSA Truck - 140lb - Autohammer - 30" Drop	**Ground Elevation**	71'
Location	See Plate 1 - Location of Explorations	**Sampled By**	JLH



SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

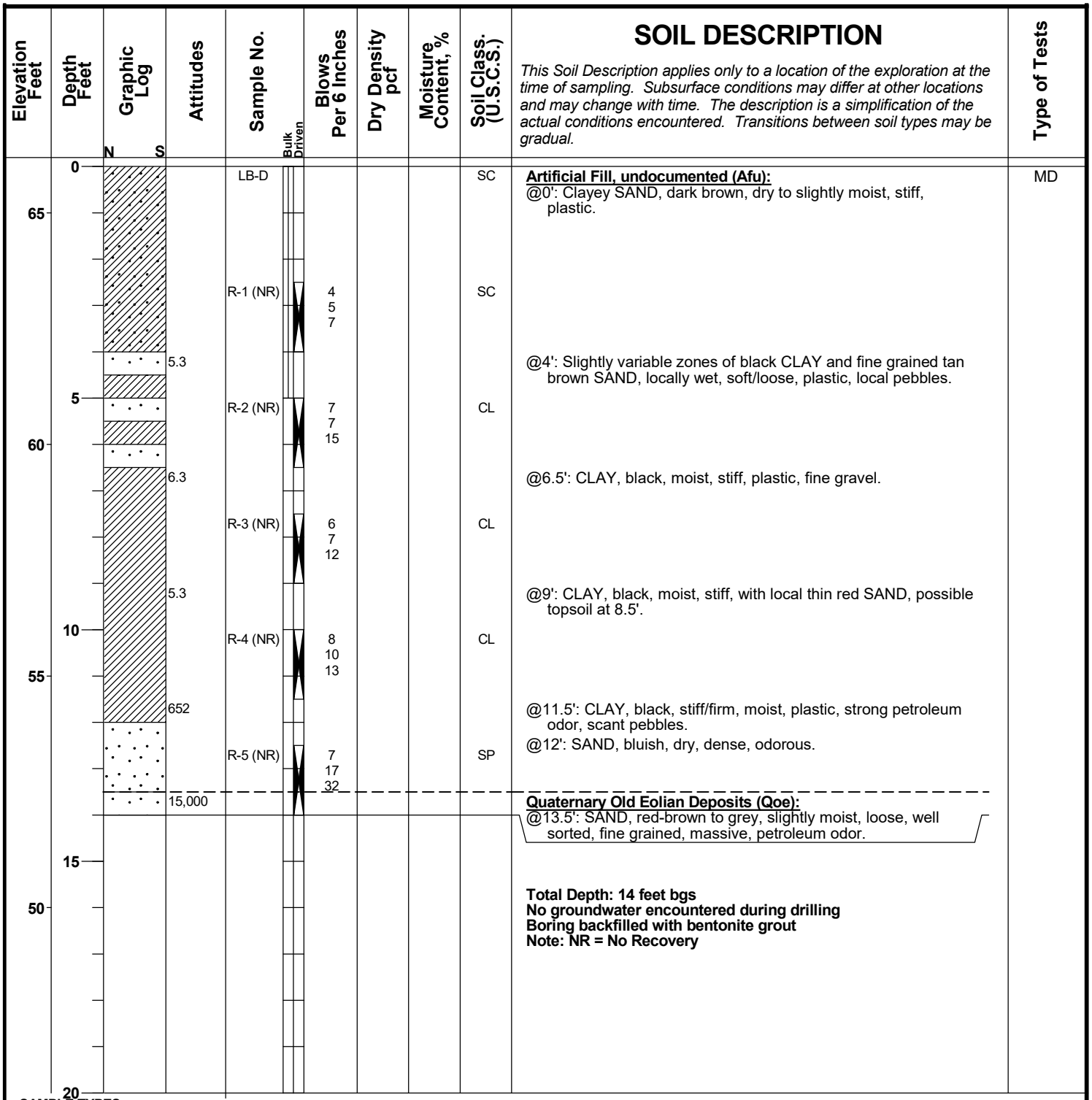
-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-3

Project No.	12452.005	**Date Drilled**	2-26-22
Project	Prologis Warehouse - Surcharge Zone	**Logged By**	JLH
Drilling Co.	Choice Drilling	**Hole Diameter**	8"
Drilling Method	CME-95 HSA Truck - 140lb - Autohammer - 30" Drop	**Ground Elevation**	66'
Location	See Plate 1 - Location of Explorations	**Sampled By**	JLH



SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-4

Project No.	12452.005	**Date Drilled**	2-26-22
Project	Prologis Warehouse - Surcharge Zone	**Logged By**	JLH
Drilling Co.	Choice Drilling	**Hole Diameter**	8"
Drilling Method	CME-95 HSA Truck - 140lb - Autohammer - 30" Drop	**Ground Elevation**	62'
Location	See Plate 1 - Location of Explorations	**Sampled By**	JLH

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Bulk / Driven	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
60	0			LB-E					SC	**Artificial Fill, undocumented (Afu):** @0': Clayey SAND, medium brown, moist, soft, plastic.	AL
				R-1 (NR)		12 15 25			SC		
	3.6									**Quaternary Old Eolian Deposits (Qoe):** @3.5': SAND, medium yellow brown, slightly moist, loose to medium dense, well sorted, fine grained, massive, slightly Fe-stained.	
55	5									**Total Depth: 4 feet bgs** **No groundwater encountered during drilling** **Boring backfilled with bentonite grout** **Note: NR = No Recovery**	
50	10										
45	15										
	20										

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-5

Project No.	12452.005	**Date Drilled**	2-26-22
Project	Prologis Warehouse - Surcharge Zone	**Logged By**	JLH
Drilling Co.	Choice Drilling	**Hole Diameter**	8"
Drilling Method	CME-95 HSA Truck - 140lb - Autohammer - 30" Drop	**Ground Elevation**	67'
Location	See Plate 1 - Location of Explorations	**Sampled By**	JLH

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No. (Bulk / Driven)	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0			LB-A				CH	**Artificial Fill, undocumented (Afu):** @0': Fat CLAY with sand, dark grayish brown, dry to slightly moist, local pebble clasts, plastic	AL
65				R-1 (NR)	2 4 5			CL-ML	@2.5': Silty CLAY, dark brown to black, dry to slightly moist, soft, local pebble clasts, plastic.	
	5			R-2 (NR)	8 9 11			CL-ML		
60			178.3	R-3 (NR)	7 8 15			CL-ML	@6.5': Petroliferous odor, local coarse grained SAND lenses, slightly moist, loose/soft, local roots.	
			1.0						@9': SAND, tan, slightly moist, loose, medium grained, well sorted, strong gasoline odor, local black color.	
	10			R-4 (NR)	6 11 18			SP	**Quaternary Old Eolian Deposits (Qoe):** @10': SAND, light brown to tan, slightly moist, loose and friable, well sorted, fine grained quartz and feldspar, massive, moderately Fe-stained, local red-green mottling, sligthly petroliferous odor.	
55			70.7							
				R-5 (NR)	10 27 50/5"			SP		
			487.2							
	15								**Total Depth: 14 feet bgs** **No groundwater encountered during drilling** **Boring backfilled with bentonite grout** **Note: NR = No Recovery**	
50										
	20									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-6

Project No.	12452.005	**Date Drilled**	3-22-22
Project	Prologis Warehouse - Surcharge Zone	**Logged By**	BTM
Drilling Co.	Choice Drilling	**Hole Diameter**	8"
Drilling Method	CME-95 HSA Truck - 140lb - Autohammer - 30" Drop	**Ground Elevation**	70'
Location	See Plate 1 - Location of Explorations	**Sampled By**	BTM

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No. (Bulk / Driven)	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
70	0								**Artificial fill, undocumented (Afu)** @0': CLAY, dark brown, moist, medium plasticity, trace medium sand.	
			62.4	R-1	17 23 23			CL	@2.5': CLAY with gravel, hard, mottled dark brown to gray, moist, medium plasticity, fine subangular gravel, massive.	
65	5		32.5	R-2	15 18 22				@5': Hard, slightly laminated.	
			25.0	R-3	8 14 17	108	20		@7.5': Lean CLAY, dark olive brown, very stiff, some orange fine sand lenses, some rootlets, trace fine to course gravel.	CN
								SP	**Quaternary Old Eolian Deposits (Qoe)** @9': SAND, very dense, orange brown, moist, fine sand, well sorted.	
60	10		28.2	R-4	23 38 50/5"					
									Total Depth: 11.5 feet bgs **No groundwater encountered during drilling** **Boring backfilled with bentonite grout**	
55	15									
50	20									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-7

Project No.	12452.005	**Date Drilled**	3-22-22
Project	Prologis Warehouse - Surcharge Zone	**Logged By**	BTM
Drilling Co.	Choice Drilling	**Hole Diameter**	8"
Drilling Method	CME-95 HSA Truck - 140lb - Autohammer - 30" Drop	**Ground Elevation**	63'
Location	See Plate 1 - Location of Explorations	**Sampled By**	BTM

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No. (Bulk / Driven)	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0							SC	**Artificial fill, undocumented (Afu)** @0': Clayey SAND, medium brown, moist, low plasticity, organics/roots, trace gravel.	
60			13.3	R-1	7 8 9			SC-CL	@2.5': Interbedded Clayey SAND and CLAY, stiff, medium to dark brown, fine sand, medium plasticity, mottled with small gray and black inclusions, trace to few subangular gravel.	
	5		16.4	R-2	12 18 26			SP-CL	@5': SAND, dense, orange, moist, fine sand, slightly micaceous, grades to interbedded SAND and CLAY, medium to dark brown, slightly moist, fine sand, medium plasticity clay.	
55			25.2	R-3	19 30 40	109	16	CL	@7.5': Lean CLAY, hard, dark olive brown, moist, petroliferous odor, medium to high plasticity (exhibits expansion).	CN
								SP	**Quaternary Old Eolian Deposits (Qoe)** @8.5': SAND, very dense, orangish tan, moist, very fine to fine sand, well sorted.	
	10		15.8	R-4	45 50/4"					
50									**Total Depth: 11.5 feet bgs** **No groundwater encountered during drilling** **Boring backfilled with bentonite grout**	
	15									
45										
	20									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-8

Project No.	12452.005	**Date Drilled**	3-22-22
Project	Prologis Warehouse - Surcharge Zone	**Logged By**	BTM
Drilling Co.	Choice Drilling	**Hole Diameter**	8"
Drilling Method	CME-95 HSA Truck - 140lb - Autohammer - 30" Drop	**Ground Elevation**	63'
Location	See Plate 1 - Location of Explorations	**Sampled By**	BTM

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No. (Bulk / Driven)	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0							ML-CL	**Artificial fill, undocumented (Afu)** @0': Silty CLAY to Clayey SILT, dark brown, dry to slightly moist, stiff, plastic, scant pebbles.	
60			11.8	R-1	8 12 18			CL	@2.5': Sandy CLAY, very stiff, olive brown, moist, medium plasticity, fine sand, trace course sand and shell fragments, trace gravel, some small orange sand lenses.	
	5		14.2	R-2	14 16 24	106	21		@5': Lean CLAY, hard, dark brown, moist, medium plasticity, massive, pockets of dark brown sand.	CN
55			7.2	R-3	10 12 17				@7.5': Very stiff.	
	10		26.3	R-4	13 15 21	103	22	CH	@10.5': CLAY, hard, gray, moist, petroliferous odor, medium to high plasticity, some roots, few course sand, trace fine subangular gravel (exhibits expansion).	CN
			122.9	R-5	28 40 50/5"					
50								SP	**Quaternary Old Eolian Deposits (Qoe)** @12.7': SAND, very dense, tan, moist, fine sand, well sorted, slight odor.	
	15								**Total Depth: 13 feet bgs** **No groundwater encountered during drilling** **Boring backfilled with bentonite grout**	
45										
	20									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-9

Project No.	12452.005	**Date Drilled**	3-22-22
Project	Prologis Warehouse - Surcharge Zone	**Logged By**	BTM
Drilling Co.	Choice Drilling	**Hole Diameter**	8"
Drilling Method	CME-95 HSA Truck - 140lb - Autohammer - 30" Drop	**Ground Elevation**	64'
Location	See Plate 1 - Location of Explorations	**Sampled By**	BTM

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No. (Bulk / Driven)	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
64	0							CL	**Artificial fill, undocumented (Afu)** @0': Sandy CLAY, hard, medium brown, slightly moist, fine to medium sand, trace course sand, roots.	
			15.3	R-1	22 23 36					
60	5		13.9	R-2	35 42 50/5"			SP	**Quaternary Old Eolian Deposits (Qoe)** @2.5': SAND, very dense, tan to orange, moist, fine sand, slightly micaceous, slight odor.	
55	10								**Total Depth: 4 feet bgs** **No groundwater encountered during drilling** **Boring backfilled with bentonite grout**	
50	15									
45	20									

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-10

Project No.	12452.005	**Date Drilled**	3-22-22
Project	Prologis Warehouse - Surcharge Zone	**Logged By**	BTM
Drilling Co.	Choice Drilling	**Hole Diameter**	8"
Drilling Method	CME-95 HSA Truck - 140lb - Autohammer - 30" Drop	**Ground Elevation**	68'
Location	See Plate 1 - Location of Explorations	**Sampled By**	BTM

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No. (Bulk / Driven)	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0							CL	**Artificial fill, undocumented (Afu)** @0': Sandy CLAY, dark brown, moist, medium plasticity clay, fine to medium sand, roots/organics, trace subangular gravel.	
65			18.5	R-1	9 14 17				@2.5': Very stiff @3.5': CLAY, dark brown, moist, medium to high plasticity, trace iron oxidation stains, small black inclusions, slight odor.	
	5		21.9	R-2	14 17 21	103	26	SC	@5': Clayey SAND, dense to hard, orange brown, moist, low plasticity, fine to medium sand, few course sand.	CN
								CL	@6.5': CLAY, mottled dark brown to gray, moist, high plasticity, petroliferous odor, few medium to course sand.	
60			35.3	R-3	28 44 50/5"			SP	**Quaternary Old Eolian Deposits (Qoe):** @7.5': SAND, very dense, tan to yellow, moist, very fine to fine sand, well sorted, petroliferous odor.	
	10								**Total Depth: 9 feet bgs** **No groundwater encountered during drilling** **Boring backfilled with bentonite grout**	
55										
	15									
50										
	20									

The Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

Project Name: Prologis Warehouse **Logged by:** JLH

Project Number: 12452.002 **Elevation:** 66 feet amsl

Equipment: Backhoe **Location/Grid:** Adjacent prior boring B-9

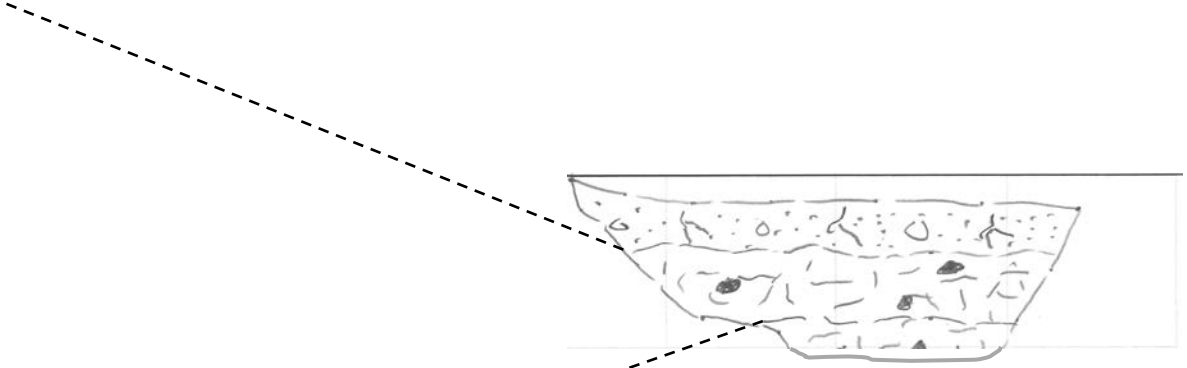
TEST PIT TP-1

Earth Material Description: These earth material descriptions apply only to an exploration location at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Earth Materials Exposed On: August 22, 2019	**Soil Unit**	**Sample Results**			
		Unified Soil Classification	**Sample No.**	**Moisture (%)**	**Laboratory Tests**
IMPORTED ARTIFICIAL FILL – UNDOCUMENTED (0-13') @0'-18": SAND (SW), with gravel, light gray, dry, loose, scattered rootlets @18"-41": CLAY (CL), medium brown to black, moist, firm, local shale fragments @41"-72": CLAYEY SAND (SC), medium orange/brown, moist, med. dense, med-grained, cobble-size inclusions of black clay topsoil, 65% fines, LL=40, PI=27		CL-ML	GS-1 @6 feet	15	#200

Graphical Representation: **Total Depth: 6 feet** **Scale: 1-inch=5-feet** **Level Surface** **Trend: N20°W**





***** This log is a part of a report by Leighton and should not be used as a stand-alone document.*****

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

Project Name: Prologis Warehouse **Logged by:** JLH

Project Number: 12452.002 **Elevation:** 68 feet amsl

Equipment: Backhoe **Location/Grid:** Western borrow pit

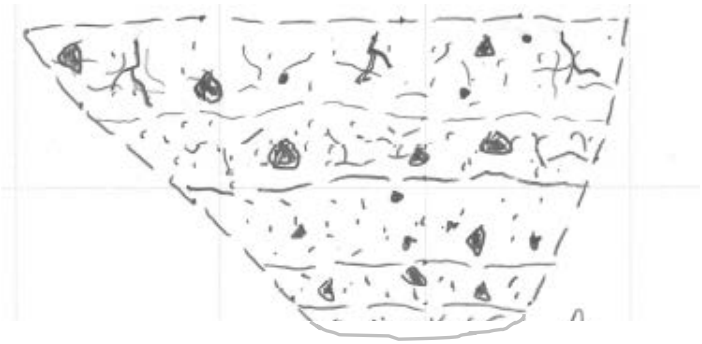
TEST PIT TP-2

Earth Material Description: These earth material descriptions apply only to an exploration location at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Earth Materials Exposed On: August 22, 2019	Soil Unit	Sample Results: Unified Soil Classification	Sample No. Depth (feet)	Moisture (%)	Laboratory Tests
IMPORTED ARTIFICIAL FILL – UNDOCUMENTED (0-8')					
@0-2.4': CLAY (CL), with sand, medium gray and brown mottled, dry, soft, scattered rootlets, local pebbles, ¾-inch rock, with concrete and asphaltic rubble		(CL)s	GS-1 @4	16	
@2.4-4': CLAYEY SAND (SC), medium orange/brown, slightly moist, loose, fine-grained, scattered clay topsoil clasts		(SM)g	GS-2 @7-8	8	ORG %
@4': CLAYEY SAND (SC), light olive, moist, loose, scattered gravels and asphalt clasts, 3.1% organic content					
@6': asphalt fragment in same matrix as above		(CL)s	B-1 @4-6	5	
@7': CLAY (CL), with sand, light orange-brown, moist, lift containing caliche					
@7-8': SAND (SW), dark brown, slightly moist, loose, asphalt fragment.					
QUATERNARY TERRACE DEPOSITS (8')					
@8': SAND (SP), medium orange-brown, slightly moist, loose, friable, well sorted, fine to medium-grained, horizontal laminae, iron-stained, thinly laminated, non-cohesive, 1½% fines (passing #200 sieve)					#200

Graphical Representation: **Total Depth: 8 feet** **Scale: 1-inch=5-feet** **Level Surface** **Trend: S55°E** →





***** This log is a part of a report by Leighton and should not be used as a stand-alone document.*****

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

Project Name: Prologis Warehouse **Logged by:** JLH

Project Number: 12452.002 **Elevation:** 62 feet amsl

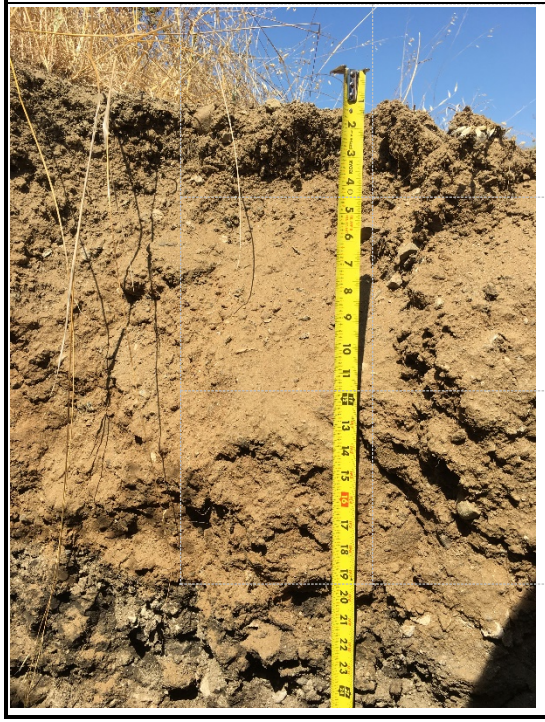
Equipment: Backhoe **Location/Grid:** Northwestern borrow pit

TEST PIT TP-3

Earth Material Description: These earth material descriptions apply only to an exploration location at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Earth Materials Exposed On: August 22, 2019	**Soil Unit**	**Sample Results**			
		Unified Soil Classification	**Sample No. Depth (feet)**	**Moisture (%)**	**Laboratory Tests**
IMPORTED ARTIFICIAL FILL – UNDOCUMENTED (0-2') @0 – 1.5': SAND (SW), with gravel, light orange/brown, dry, loose, scattered rootlets and metal fragments, local cobble/pebble clasts @1.5 - 2': CLAY (CL); with gravel, medium gray, brown and black (clay topsoil), dry, loose, scattered brick, asphalt and concrete (some boulder size) fragments		CL	B-1 @1.5-2	14	

Graphical Representation: Total Depth: 2 feet **Scale: 1-inch=2-feet** **Surface Slope: 10°** **Trend: N35°E** →





***** This log is a part of a report by Leighton and should not be used as a stand-alone document.*****

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

Project Name: Prologis Warehouse **Logged by:** JLH

Project Number: 12452.002 **Elevation:** 67 feet amsl

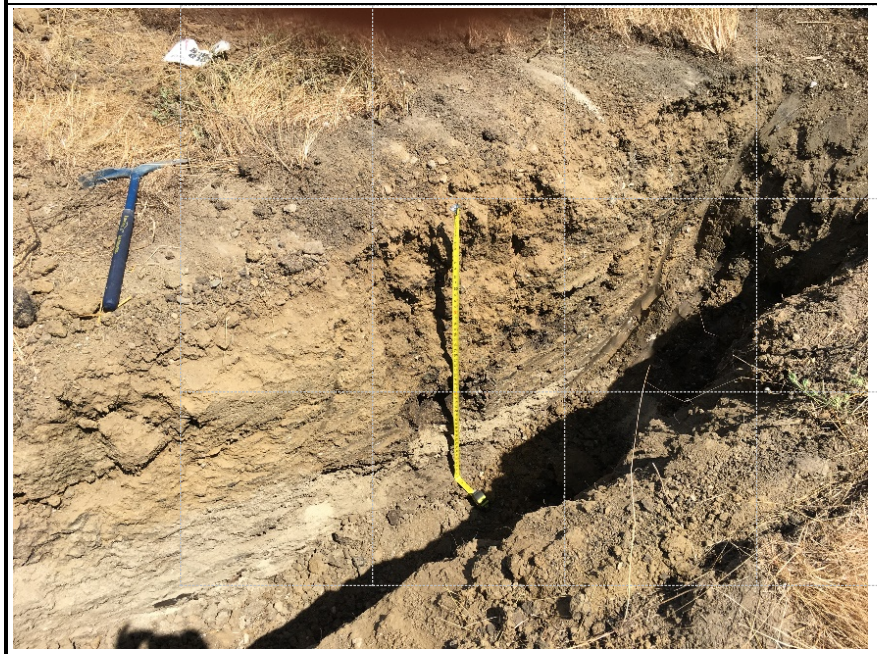
Equipment: Backhoe **Location/Grid:** Northern borrow pit

TEST PIT TP-4

Earth Material Description: These earth material descriptions apply only to an exploration location at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Earth Materials Exposed On: August 22, 2019	**Soil Unit**	**Sample Results**			
		Unified Soil Classification	**Sample No. Depth (feet)**	**Moisture (%)**	**Laboratory Test**
IMPORTED ARTIFICIAL FILL – UNDOCUMENTED (0-6.5') @0'-2¼': CLAY (CL), with sand, medium orange-brown to medium gray-brown, dry, firm/soft, scattered pebbles, locally olive sand/gravel lenses @2¼-3¼': CLAY (CL), dark brown to black (clay topsoil), slightly moist, firm, local geo-fabric fragment, scattered cobble and brick fragments @3¼-4': SAND (SW), with gravel, light brown to tan, dry, loose, local concrete rubble (boulder and large cobble clasts), @4': CLAY (CL), dark brown to black (clay topsoil), moist, firm, local ¾-inch rock **QUATERNARY TERRACE DEPOSITS (6.5'-7')** @6.5-7': SAND (SP), medium orange-brown, slightly moist to moist, loose, massive friable, well sorted, fine to med-grained, indistinct thin horizontal laminae, iron-stained, non-cohesive, slightly micaceous		CL	GS-1 @2+-3+	16	

Graphical Representation: Total Depth: 7 feet **Scale: 1-inch=5-feet** **Level Surface** **Trend: N70°E →**





***** This log is a part of a report by Leighton and should not be used as a stand-alone document.*****

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

Project Name: Prologis Warehouse **Logged by:** JLH

Project Number: 12452.002 **Elevation:** 67 feet amsl

Equipment: Backhoe **Location/Grid:** Southeastern borrow pit

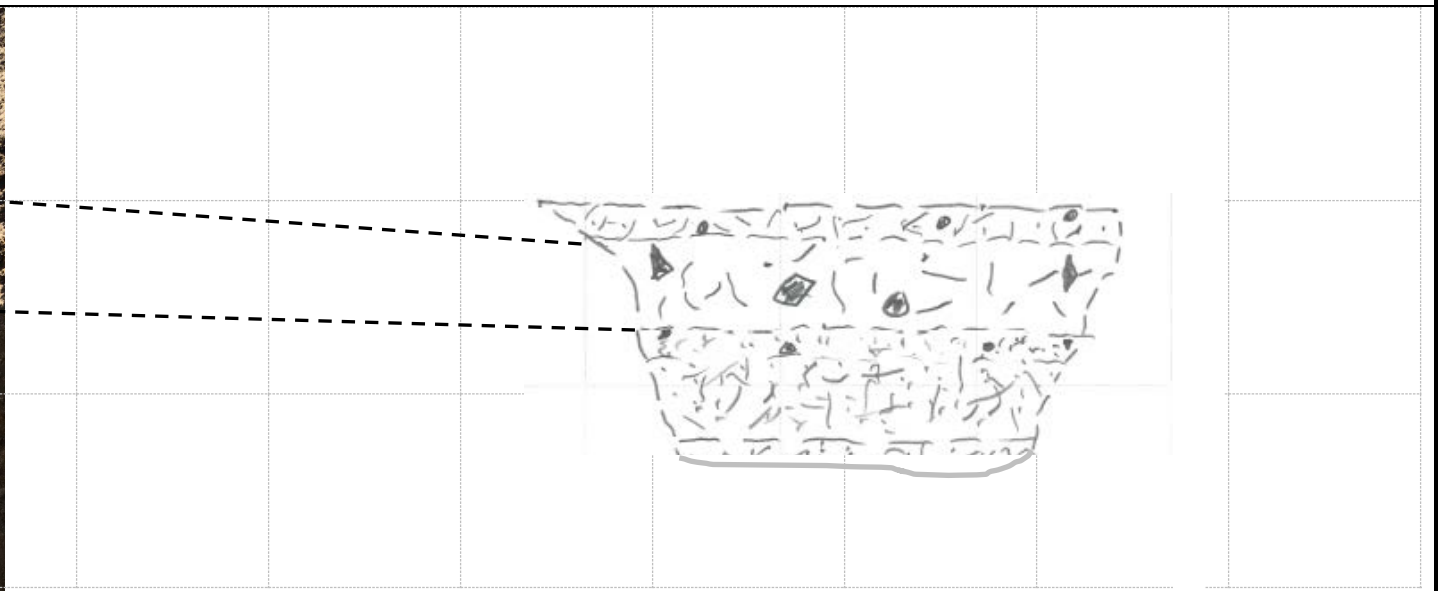
TEST PIT TP-5

Earth Material Description: These earth material descriptions apply only to an exploration location at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Earth Materials Exposed On: August 22, 2019	**Soil Unit**	**Sample Results**			
		Unified Soil Classification	**Sample No. Depth (feet)**	**Moisture (%)**	**Laboratory Test**
IMPORTED ARTIFICIAL FILL – UNDOCUMENTED (0-7') @0-0.8': CLAY (CL), sandy, medium gray, dry, soft/loose, scattered gravel @0.8': CLAY (CL), medium to dark gray and black, (clay topsoil), moist, firm/soft, local pebble-size brick and concrete fragments @3'-6': CLAYEY SAND (SC), medium orange-brown to black (clay topsoil), moist, loose/soft, local pebble-size angular fragments, @6': CLAY (CL), with sand, black, moist, soft, uniform @7': SAND (SW), with gravel, medium-brown, moist, loose		CL-ML CL-ML	GS-1 @1-3 GS-2 @3-3+	15 18	

Graphical Representation: **Total Depth: 7 feet** **Scale: 1-inch=5-feet** **Level Surface** **Trend: N10°W** →





***** This log is a part of a report by Leighton and should not be used as a stand-alone document.*****

GEOTECHNICAL TEST PIT LTP-2023-1A

Project No.	12452.004	**Date Drilled**	10-4-23
Project	Prologis Warehouse - TBB	**Logged By**	AS
Drilling Co.	Relaible Equiptment Rental	**Hoe Width (feet)**	2'
Excavation Method	Test Pit - Bulk Sample	**Ground Elevation**	85'
Location	See Plate 1, "Exploration Location Map"	**Sampled By**	AS

Elevation Feet	Depth Feet	Graphic Log	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S						*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
85	0		BB-1				GM GW	**UNDOCUMENTED ARTIFICIAL FILL - (Afu)** @ 0': SILTY GRAVEL (GM): with scattered debris including catalytic beads, dried brush, wood and bricks, light gray, slightly moist to dry, loose	
			NG-1		88.3	19.8	GM	@ 0.5': GRAVEL (GW): fine well graded with sand, topsoil and rootlets, dark brown, slightly moist @ 1.4': SILTY GRAVEL (GM): Light brown to white thin layer, dry, loose, lots of gravel	
80	5		NG-2		102.2	16.7	SP SM	@ 5': SAND (SP): medium orange brown, slightly moist, densely packed, medium to fine grained sand, iron stained @ 6': SANDY SILT (SM): with debris including catalytic beads, crushed concrete up to 8 inches in diameter (no rebar), brick and glass, dark brown to black, moist (hydrocarbon odor), fine grained	
75	10								
70	15						SP	@ 17': SAND (SP): with debris including catalytic beads, brick and up to 8-inch diameter crushed concrete (no rebar) , dark brown to black, moist (hydrocarbon odor), fine grained	
65	20							**Total Depth: 17 feet** **No groundwater encountered** **Backfilled with soil cuttings**	
60	25								
55	30								

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER	NG	NUCLEAR GAUGE
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL TEST PIT LTP-2023-1B

Project No.	12452.004	**Date Drilled**	10-4-23
Project	Prologis Warehouse - TBB	**Logged By**	AS
Drilling Co.	Relaible Equiptment Rental	**Hoe Width (feet)**	2'
Excavation Method	Test Pit - Bulk Sample	**Ground Elevation**	82'
Location	See Plate 1, "Exploration Location Map"	**Sampled By**	AS

Elevation Feet	Depth Feet	Graphic Log	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S						*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
80	0		BB-1				SM GM	**UNDOCUMENTED ARTIFICIAL FILL - (Afu)** @ 0': SILTY GRAVEL (GM): 17% fines with scattered debris such as wood, brick, and metal, light gray silty sands component, slightly moist to dry, loose	17% Fines
							GM	@ 2': SILTY GRAVEL (GM): with scattered debris such as blocks of crushed concrete up to 6 inches in diameter (no rebar), light brown to white, dry loose	
75	5						SW	@ 5': SAND with gravel (SW): light to medium brown, medium to fine grained sand, slightly moist	
							SP	**QUATERNARY MARINE TERRACE DEPOSIT (Qos)** @ 7': SAND (SP): medium orange to brown, slightly moist, loose, fine to medium grained	
70	10		BB-2					**Total Depth: 11 feet** **No groundwater encountered** **Backfilled with soil cuttings**	
65	15								
60	20								
55	25								
	30								



SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER	NG	NUCLEAR GAUGE
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL TEST PIT LTP-2023-2

Project No.	12452.004	**Date Drilled**	10-4-23
Project	Prologis Warehouse - TBB	**Logged By**	AS
Drilling Co.	Relaible Equiptment Rental	**Hoe Width (feet)**	2'
Excavation Method	Test Pit - Bulk Sample	**Ground Elevation**	89'
Location	See Plate 1, "Exploration Location Map"	**Sampled By**	AS

Elevation Feet	Depth Feet	Graphic Log (N / S)	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
								This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
89	0		BB-1				SM	**UNDOCUMENTED ARTIFICIAL FILL - (Afu)** @ 0': SILTY SAND (SM): with scattered debris such as catalytic beads and branches, light gray, dry, loose, fine grained sand	
							SM	@ 1.5': SILT (SM): light yellowish brown, dry, loose, thin layer approx 3-6"	
							SM	@ 2': SANDY SILT (SM): with debris such as catalytic beads, crushed concrete with 12-inch largest diameter (no rebar), wood, and metal, dark to medium brown, dry, loose	
85	5						SC/SM	@ 4.5': CLAYEY SAND/SILTY SAND (SC/SM): with debris such as catalytic beads, dark brown, moist (hydrocarbon odor), fine grained sand	
80	10								
75	15						SC/SM	@ 14': CLAYEY SAND/SILT SAND (SC/SM): with debris such as catalytic beads, dark brown, very moist (hydrocarbon odor), fine grained sand	
							SM	@ 17': SANDY SILT (SM): with debris such as concrete fragments up to 10 inches in diameter (no rebar), dark brown, moist (hydrocarbon odor), clay blebs, fine grained sand	
70	20						SC/SM	@ 20': SANDY SILT with CLAYS (SC/SM): petroleum stained, dark brown to black, moist (hydrocarbon odor), fine grained	
65	25							**Total Depth: 21 feet** **No groundwater ecnountered** **Backfilled with soil cuttings**	
60	30								

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER	NG	NUCLEAR GAUGE
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL TEST PIT LTP-2023-3

Project No.	12452.004	**Date Drilled**	10-4-23
Project	Prologis Warehouse - TBB	**Logged By**	AS
Drilling Co.	Relaible Equiptment Rental	**Hoe Width (feet)**	2'
Excavation Method	Test Pit - Bulk Sample	**Ground Elevation**	82'
Location	See Plate 1, "Exploration Location Map"	**Sampled By**	AS

Elevation Feet	Depth Feet	Graphic Log	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S						*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
82	0						GW	**UNDOCUMENTED ARTIFICIAL FILL - (Afu)** @ 0': GRAVELLY SAND (GW): with vegetation coverage, light to medium gray, slightly moist to dry, medium to fine grained sand, sparse gravels, sub-angular to surrounded gravels	
80							SC	@ 2': CLAYEY SAND (SC): light gray to brown, slightly moist, medium to fine grained sand, debris such as metal in place, sparse gravels, sub-angular to sub-rounded	
			NG-1		86.2	17.7			
			BB-1				SP	@ 4.5': SAND (SP): with debris such as metal and crushed concrete up to 6 inches in diameter, light brown to white, dry, medium to fine grained sand	
75	5		NG-2		75	18.9	SP	@ 5.5': Black layer of vitrified material, with shiny crystals within matrix possibly petroleum refining product such as coke or residual slag	
			BB-2				SM	@ 6': SAND (SP): medium orange to brown, slightly moist, loose, well sorted, fine to medium grained	
70	10							@ 7': SILTY SAND (SM): with debris such as catalytic beads, and crushed concrete fragments up to 8 inches in diameter (no rebar), dark brown to black, moist (hydrocarbon odor), fine grained	
			BB-3				SM SP	**QUATERNARY MARINE TERRACE DEPOSIT (Qos)** @ 13': SAND (SP): 19% fines, medium orange to brown, moist, loose, fine to medium grained sand, well sorted	19% Fines
65	15							**Total Depth: 15 feet** **No groundwater ecnountered** **Backfilled with soil cuttings**	
60	20							 	
55	25								
	30								

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER	NG	NUCLEAR GAUGE
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

Leighton

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

`

APPENDIX B

GEOTECHNICAL LABORATORY TESTING

Our prior geotechnical laboratory testing program was directed toward a quantitative and qualitative evaluation of physical and mechanical properties of soils underlying this site, and to aid in verifying soil classification. This geotechnical testing was performed at our Irvine laboratory (DSA LEA 63).

In-Situ Moisture and Density: As-sampled soil moisture content was measured (ASTM D2216) on selected samples recovered from our test pits. Results of these tests are shown on our logs at the appropriate sample depths in Appendix A.

Percent Fines (Percentage Passing No. 200 Sieve, -200): Selected soil samples were wet-washed through a No. 200 U.S. Standard brass sieve in accordance with ASTM Test Methods D1140 to measure percent fines (silts and clays). This data was used to refine the Unified Soil Classification for tested soil samples. Test results are tabulated in this appendix and listed on logs in Appendix A.

Sieve Analysis (SA): Selected bulk soil samples were tested for grain size distribution by sieving in accordance with ASTM Test Methods D6913. This data was used to refine the Unified Soil Classification for tested soil samples and to correlate engineering properties for similar soil types. Test results are plotted as particle-size distribution curves in this appendix.

Atterberg Limits (ASTM D4318): Liquid Limit (LL), Plastic Limit (PL) and Plasticity Index (PI) were determined for selected soil samples in accordance with ASTM D 4318. These soil samples were air-dried and passed through a No. 40 sieve and moisturized. Liquid and plastic limit tests were performed on the soil fraction passing the No. 40 sieve. Results of these Atterberg limits tests are presented in this appendix on the "Atterberg Limits" sheets.

Expansion Index (EI, ASTM D4829): Expansion Index (EI) tests were performed in accordance with the ASTM D 4829 Standard Test Method, for shallow bulk soil samples from the site. EI results are included in this appendix on the "*Expansion Index of Soils*" sheets.

Consolidation (ASTM D2435): Consolidation tests were run on relatively undisturbed drive samples from our borings, performed in accordance with ASTM D2435. Results are included in this appendix on the *One-Dimensional Consolidation Properties of Soils* sheet.

Organic Content (Loss On Ignition): Organic content in soils was determined for a bulk soil sample by incineration. Results are included at the end of this appendix.

Corrosivity Suite (CTM Tests 417, 422 and 643): Corrosivity suite soil testing consisting of soluble sulfate content, soluble chloride content, minimum electrical resistivity and pH were conducted on a shallow bulk soil sample in accordance with Caltrans Test Methods (CTMs) 417, 422 and 643. These results are presented at the end of this appendix.

Boring No.	TP-1	TP-2						
Sample No.	LB-1	LB-2						
Depth (ft.)	5'-5' 5"	9-10						
Sample Type	Bulk	Bulk						
Soil Identification	Brown sandy lean clay s(CL)	Brown poorly-graded sand (SP)						
Moisture Correction								
Wet Weight of Soil + Container (g)	0.0	0.0						
Dry Weight of Soil + Container (g)	0.0	0.0						
Weight of Container (g)	1.0	1.0						
Moisture Content (%)	0.0	0.0						
Sample Dry Weight Determination								
Weight of Sample + Container (g)	749.4	626.4						
Weight of Container (g)	109.3	108.4						
Weight of Dry Sample (g)	640.1	518.0						
Container No.:								
After Wash								
Method (A or B)	A	A						
Dry Weight of Sample + Cont. (g)	331.7	618.7						
Weight of Container (g)	109.3	108.4						
Dry Weight of Sample (g)	222.4	510.3						
% Passing No. 200 Sieve	**65.3**	**1.5**						
% Retained No. 200 Sieve	34.7	98.5						

Leighton

PERCENT PASSING
No. 200 SIEVE
ASTM D 1140

Project Name: Prologis Proposed Del Amo Warehousing Facility, Torrance

Project No.: 12452.002

Tested By: S. Felter Date: 08/27/19

Boring No.	LTP-2023-1B	LTP-2023-3						
Sample No.	BB-1	BB-3						
Depth (ft.)	0-4	13						
Sample Type	Bulk	Bulk						
Soil Identification	Olive brown silty sand (SM)	Yellowish brown silty sand (SM)						
No Moisture Correction; ASTM D 1140 modified to include splitting the sample on the #4 sieve								
Total Sample Dry Weight Determination								
Dry Weight of Soil + Container (g)	3746.00	1677.26						
Weight of Container (g)	225.70	229.84						
Dry Weight of Soil (g)	3520.30	1447.42						
Sample Dry Weight Determination, Retained on Sieve #4								
Dry Weight of Sample + Cont. (g)	130.85	0.00						
Weight of Container (g)	75.98	0.00						
Weight of Dry Sample (g)	54.87	0.00						
Sample Dry Weight Determination, Passing Sieve #4								
Dry Weight of Sample + Cont. (g)	733.40	668.30						
Weight of Container (g)	225.70	106.01						
Weight of Dry Sample (g)	507.70	562.29						
After Wash								
Method (A or B)	A	A						
Dry Weight of Sample + Cont. (g)	646.71	559.32						
Weight of Container (g)	225.70	106.01						
Weight of Dry Sample (g)	421.01	453.31						
% Passing No. 4 Sieve	98.4	100.0						
% Retained No. 4 Sieve	1.6	0.0						
% Passing No. 200 Sieve	**16.8**	**19.4**						

Leighton

PERCENT PASSING
No. 200 SIEVE
ASTM D 1140

Project Name: Prologis/TBB Warehouse

Project No.: 12452.004

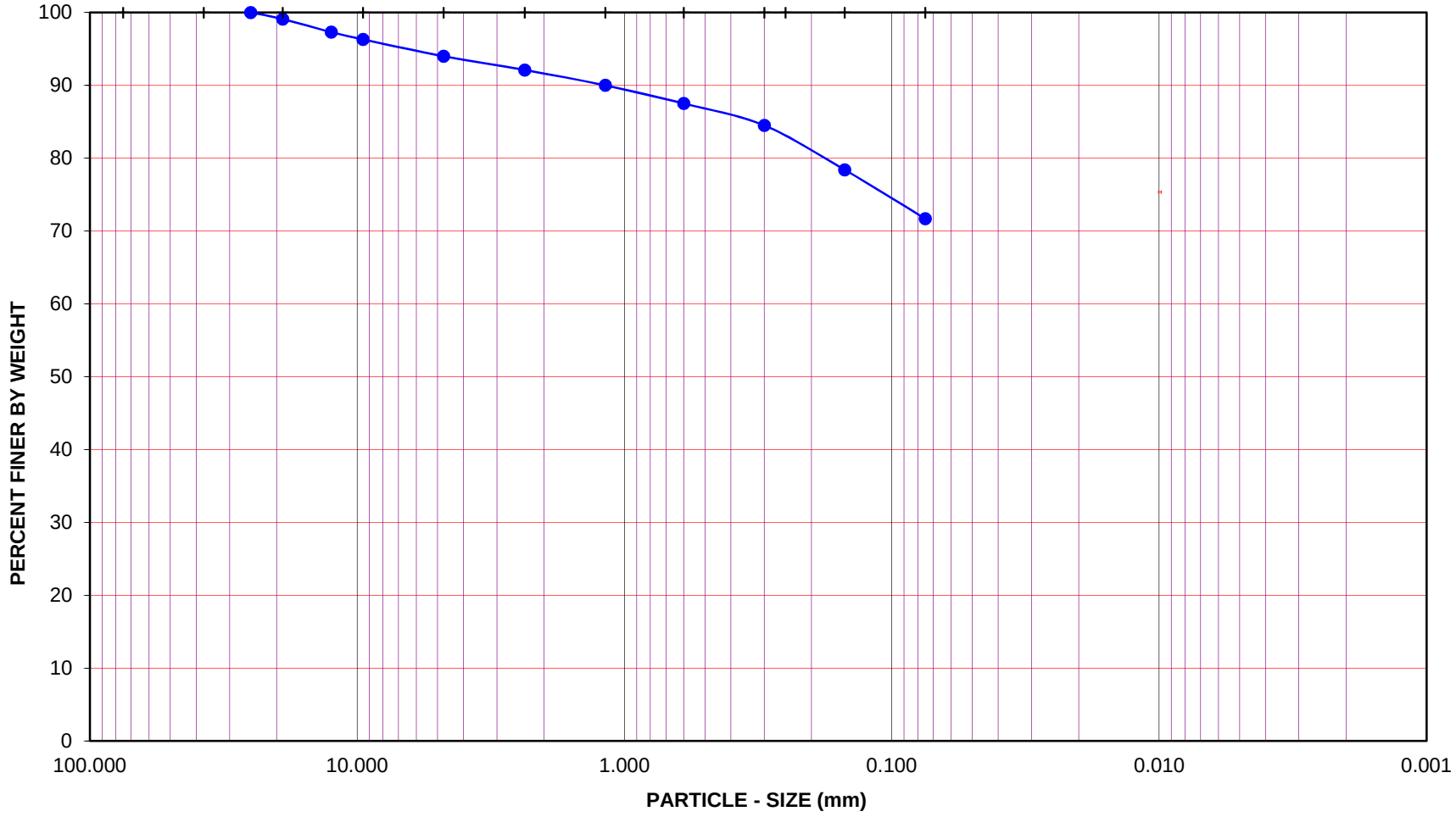
Tested By: ACS/KJ Date: 10/11/23

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: Prologis Proposed Del Amo Warehousing Facility, Torrance

Project No.: 12452.002

Boring No.: TP-2 Sample No.: LB-1

Depth (feet): 4-6 Soil Type : (CL)s

Soil Identification: Olive brown lean clay with sand (CL)s

GR:SA:FI : (%) 6 : 22 : 72

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 6913

Sep-19

ATTERBERG LIMITS

ASTM D 4318

Project Name:	Prologis Proposed Del Amo Warehousing Facility, Torrance	Tested By:	S. Felter	Date:	09/05/19
Project No. :	12452.002	Input By:	J. Ward	Date:	09/09/19
Boring No.:	TP-1	Checked By:	J. Ward		
Sample No.:	LB-1	Depth (ft.)	5'-5' 5"		
Soil Identification:	Brown sandy lean clay s(CL)				

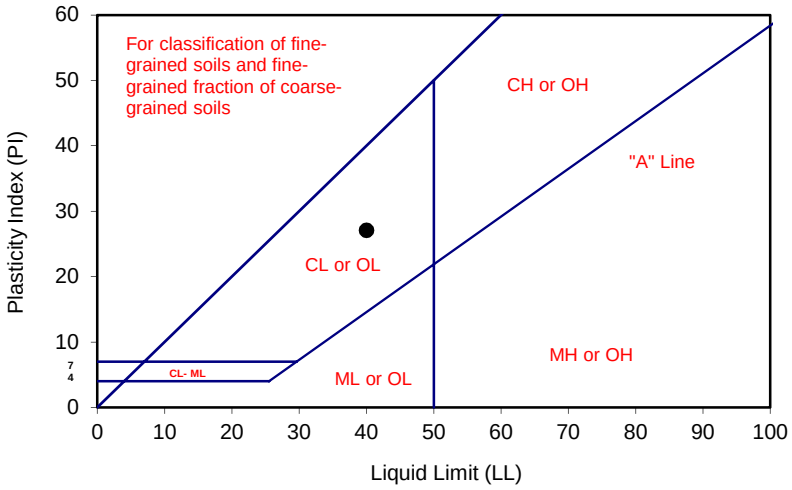
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			34	26	19	
Wet Wt. of Soil + Cont. (g)	10.25	10.32	20.92	20.76	22.37	
Dry Wt. of Soil + Cont. (g)	9.20	9.26	15.45	15.17	16.18	
Wt. of Container (g)	1.06	1.06	1.08	1.04	1.07	
Moisture Content (%) [Wn]	12.90	12.93	38.07	39.56	40.97	

Liquid Limit	**40**
Plastic Limit	**13**
Plasticity Index	**27**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 14.6

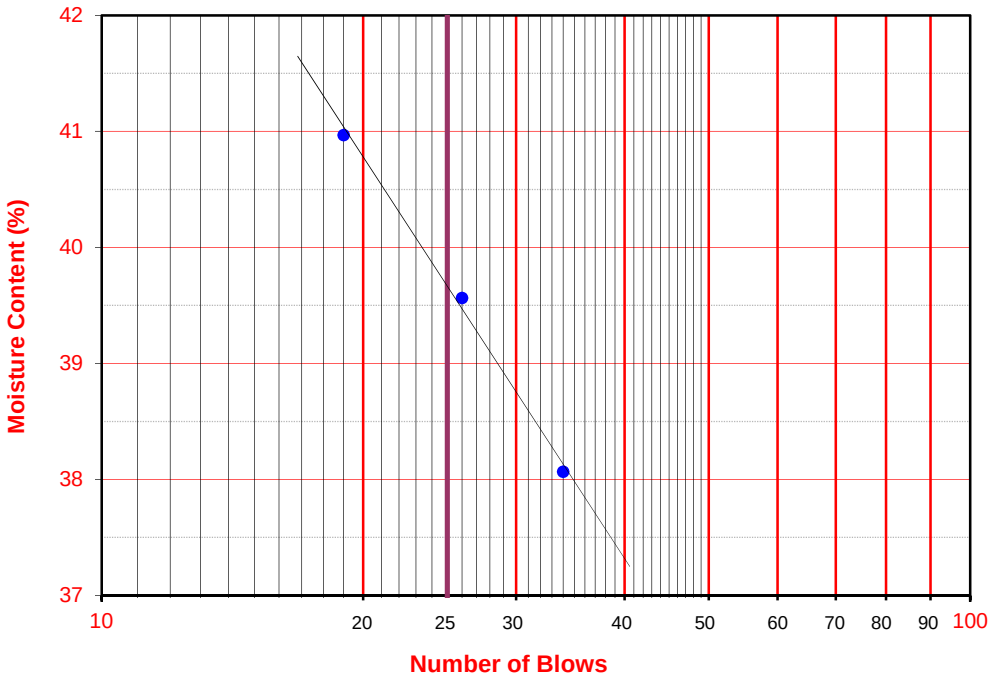
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Prologis Proposed Del Amo Warehousing Facility, Torrance	Tested By:	S. Felter	Date:	09/04/19
Project No. :	12452.002	Input By:	J. Ward	Date:	09/09/19
Boring No.:	TP-1	Checked By:	J. Ward		
Sample No.:	LB-2	Depth (ft.)	10-11		
Soil Identification:	Dark brown fat clay (CH)				

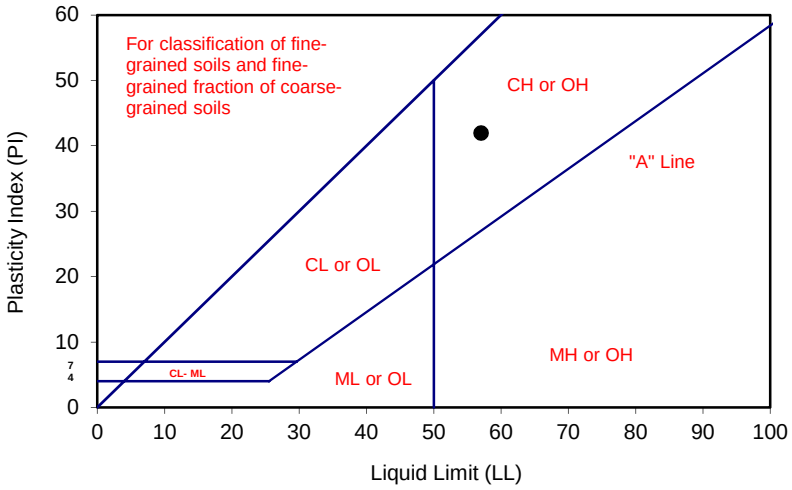
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			34	27	20	
Wet Wt. of Soil + Cont. (g)	10.26	10.17	20.22	20.38	20.21	
Dry Wt. of Soil + Cont. (g)	9.05	8.99	13.35	13.37	13.16	
Wt. of Container (g)	1.11	1.03	1.05	1.13	1.08	
Moisture Content (%) [Wn]	15.24	14.82	55.85	57.27	58.36	

Liquid Limit	**57**
Plastic Limit	**15**
Plasticity Index	**42**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 27.01

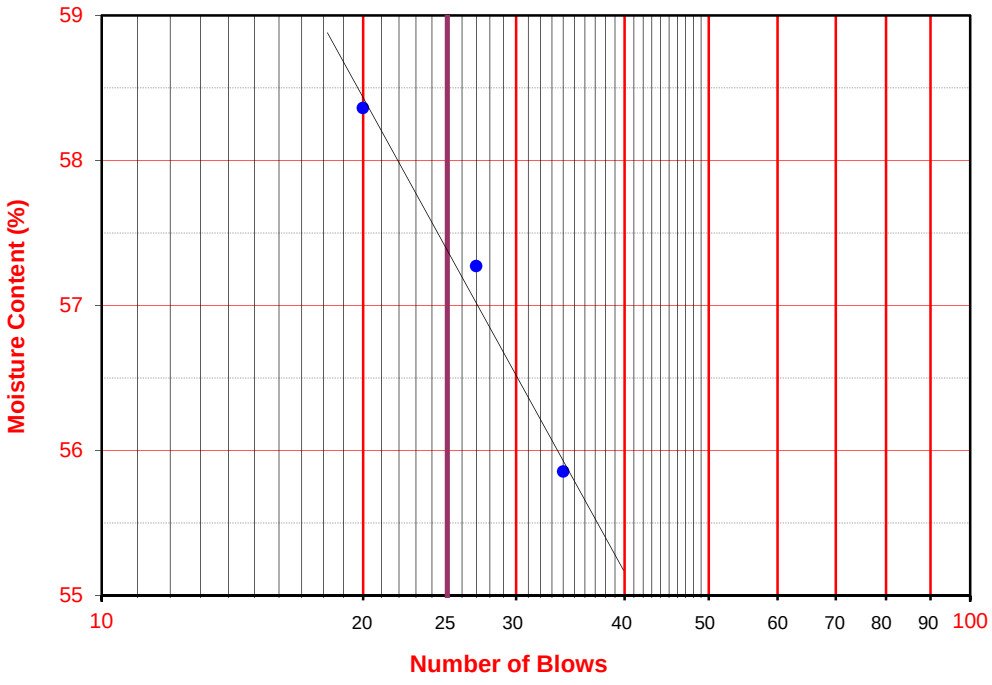
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Prologis Proposed Del Amo Warehousing Facility, Torrance	Tested By:	S. Felter	Date:	09/05/19
Project No. :	12452.002	Input By:	J. Ward	Date:	09/09/19
Boring No.:	TP-5	Checked By:	J. Ward		
Sample No.:	GS-3	Depth (ft.)	7.5		
Soil Identification:	Dark gray fat clay (CH)				

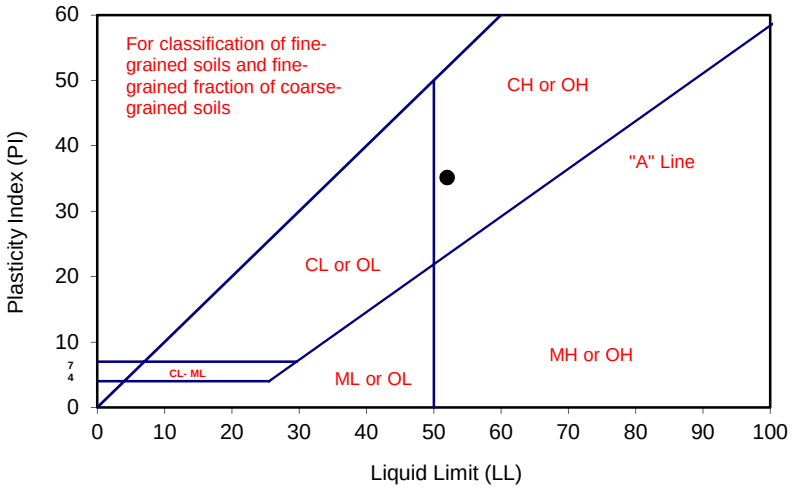
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	28	21	
Wet Wt. of Soil + Cont. (g)	10.06	10.10	22.65	21.12	21.64	
Dry Wt. of Soil + Cont. (g)	8.75	8.81	15.43	14.27	14.58	
Wt. of Container (g)	1.04	1.09	1.06	1.08	1.15	
Moisture Content (%) [Wn]	16.99	16.71	50.24	51.93	52.57	

Liquid Limit	**52**
Plastic Limit	**17**
Plasticity Index	**35**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 23.36

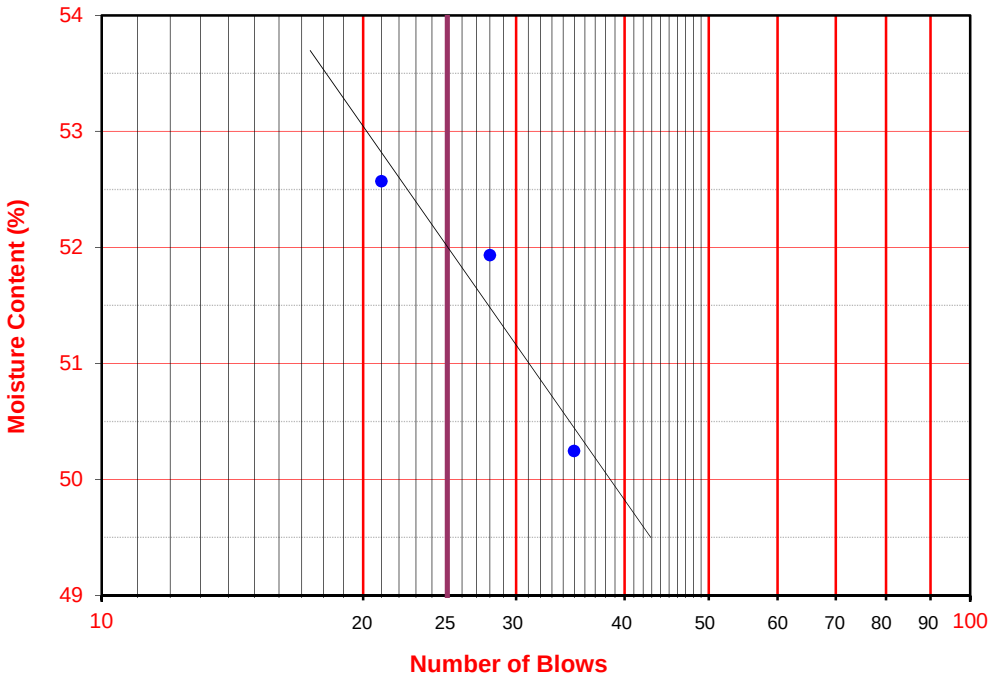
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS
ASTM D 4318

Project Name:	Prologis/TBB Warehouse Surcharge	Tested By:	J. Domingo	Date:	03/03/22
Project No. :	12452.005	Input By:	A. Santos	Date:	03/08/22
Boring No.:	LB-1	Checked By:	J. Ward		
Sample No.:	LB-B	Depth (ft.)	0-5		
Soil Identification:	Dark grayish brown lean clay (CL)				

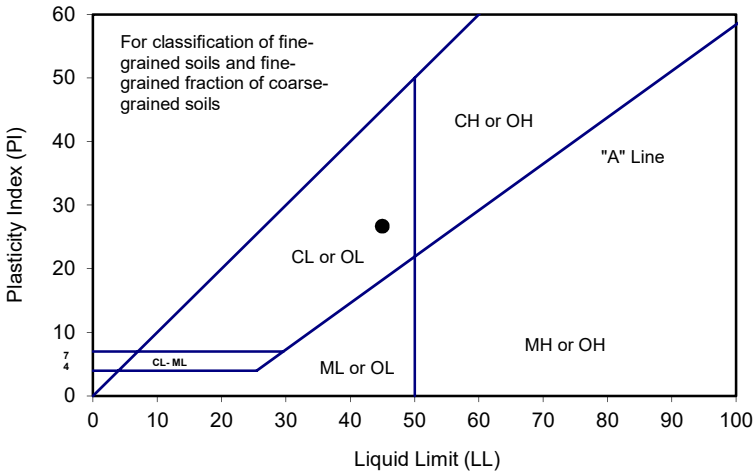
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	29	22	
Wet Wt. of Soil + Cont. (g)	9.81	9.74	20.83	19.78	20.74	
Dry Wt. of Soil + Cont. (g)	8.46	8.41	14.83	14.01	14.51	
Wt. of Container (g)	1.10	1.12	1.07	1.05	1.01	
Moisture Content (%) [Wn]	18.34	18.24	43.60	44.52	46.15	

Liquid Limit	**45**
Plastic Limit	**18**
Plasticity Index	**27**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 18.25

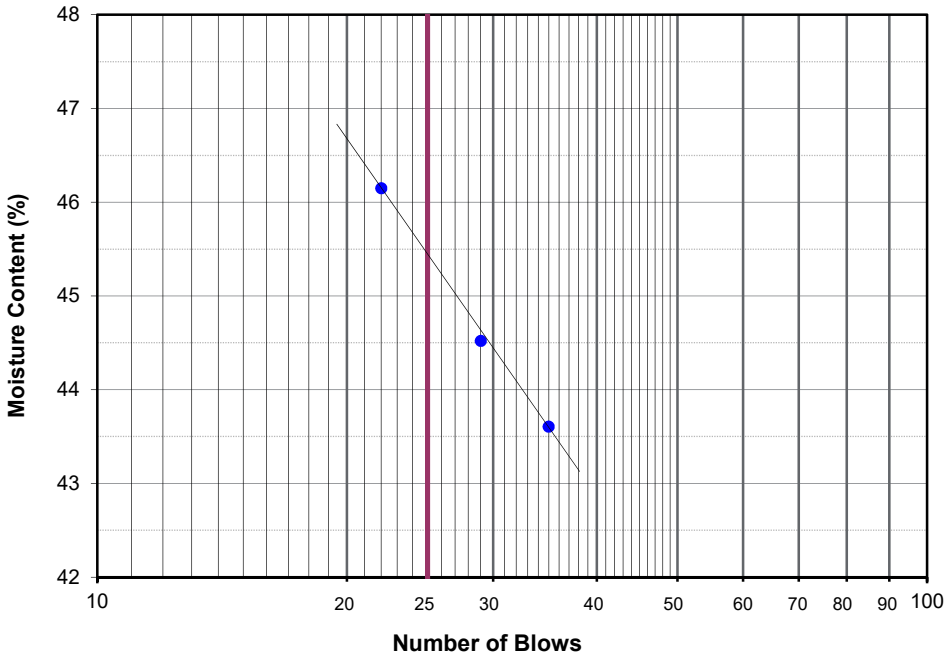
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS
ASTM D 4318

Project Name:	Prologis/TBB Warehouse Surcharge	Tested By:	J. Domingo	Date:	03/03/22
Project No. :	12452.005	Input By:	A. Santos	Date:	03/08/22
Boring No.:	LB-2	Checked By:	J. Ward		
Sample No.:	LB-C	Depth (ft.)	0-5		
Soil Identification:	Dark brown lean clay (CL)				

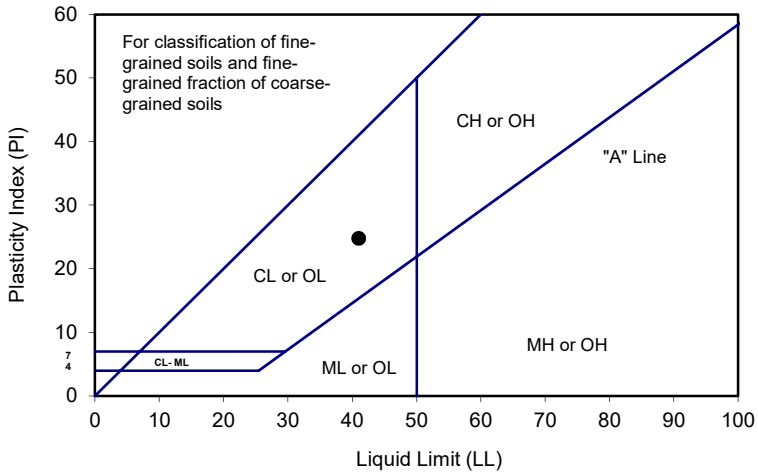
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			30	25	17	
Wet Wt. of Soil + Cont. (g)	8.79	8.66	20.35	19.95	21.49	
Dry Wt. of Soil + Cont. (g)	7.70	7.59	14.85	14.50	15.41	
Wt. of Container (g)	0.99	1.00	1.06	1.05	1.11	
Moisture Content (%) [Wn]	16.24	16.24	39.88	40.52	42.52	

Liquid Limit	**41**
Plastic Limit	**16**
Plasticity Index	**25**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 15.33

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



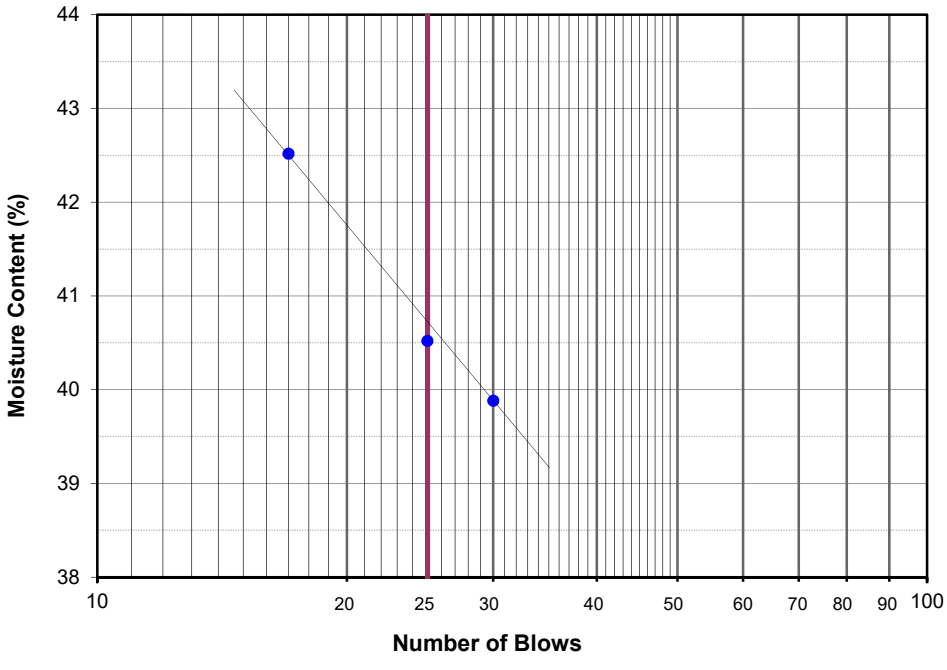
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



ATTERBERG LIMITS
ASTM D 4318

Project Name:	Prologis/TBB Warehouse Surcharge	Tested By:	J. Domingo	Date:	03/03/22
Project No. :	12452.005	Input By:	A. Santos	Date:	03/08/22
Boring No.:	LB-4	Checked By:	J. Ward		
Sample No.:	LB-E	Depth (ft.)	0-2.5		
Soil Identification:	Brown lean clay with sand (CL)s				

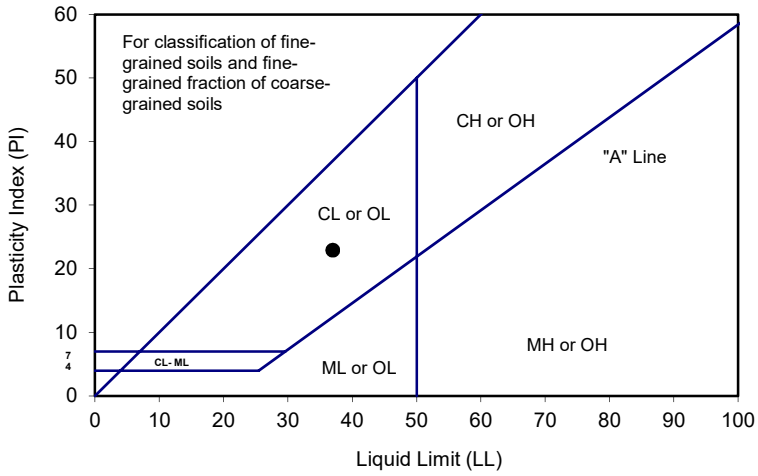
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			31	25	19	
Wet Wt. of Soil + Cont. (g)	9.20	9.14	18.38	20.01	20.04	
Dry Wt. of Soil + Cont. (g)	8.20	8.14	13.80	14.85	14.75	
Wt. of Container (g)	1.08	1.04	1.07	1.02	1.12	
Moisture Content (%) [Wn]	14.04	14.08	35.98	37.31	38.81	

Liquid Limit	**37**
Plastic Limit	**14**
Plasticity Index	**23**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 12.41

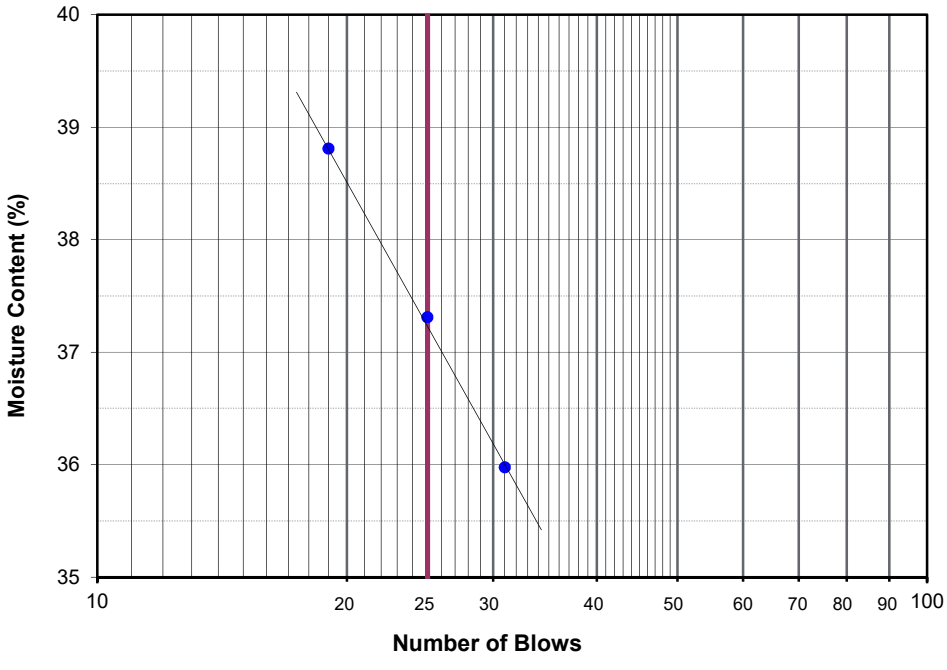
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS
ASTM D 4318

Project Name:	Prologis/TBB Warehouse Surcharge	Tested By:	J. Domingo	Date:	03/07/22
Project No. :	12452.005	Input By:	A. Santos	Date:	03/08/22
Boring No.:	LB-5	Checked By:	J. Ward		
Sample No.:	LB-A	Depth (ft.)	0-5		
Soil Identification:	Dark grayish brown fat clay with sand (CH)s				

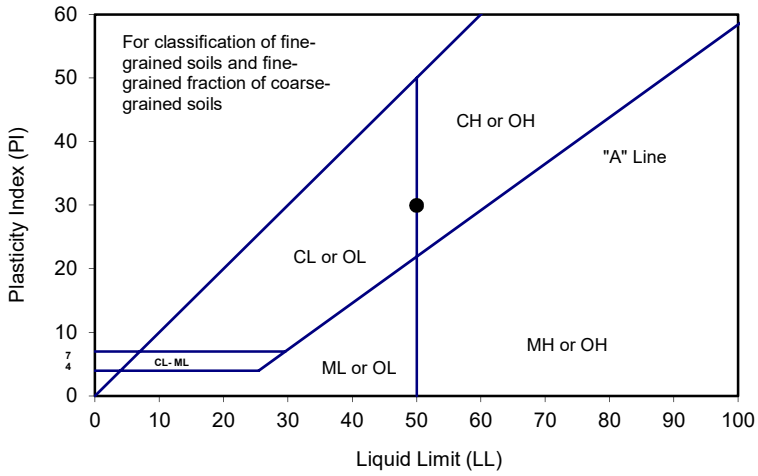
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			27	21	15	
Wet Wt. of Soil + Cont. (g)	9.29	9.28	21.47	20.67	20.24	
Dry Wt. of Soil + Cont. (g)	7.91	7.91	14.67	14.00	13.59	
Wt. of Container (g)	1.07	1.01	1.02	1.07	1.10	
Moisture Content (%) [Wn]	20.18	19.86	49.82	51.59	53.24	

Liquid Limit	**50**
Plastic Limit	**20**
Plasticity Index	**30**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 21.9

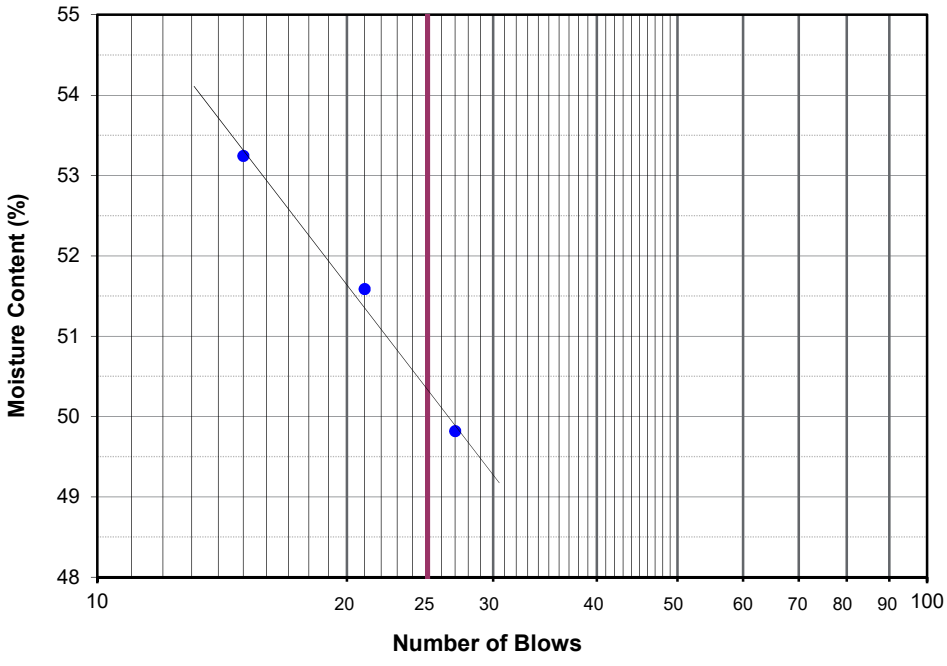
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Leighton

Project Name:	Prologis Proposed Del Amo Warehousing Facility, Torrance	Tested By:	G. Berdy	Date:	09/05/19
Project No.:	12452.002	Input By:	J. Ward	Date:	09/09/19
Boring No.:	TP-2	Depth (ft.):	4-6		
Sample No.:	LB-1				
Soil Identification:	Olive brown lean clay with sand (CL)s				

Note: Corrected dry density calculation assumes specific gravity of 2.70 and moisture content of 1.0% for oversize particles

Preparation Method:	X	Moist	Scalp Fraction (%)		Rammer Weight (lb.) = 10.0
		Dry	#3/4		Height of Drop (in.) = 18.0
Compaction Method	X	Mechanical Ram	#3/8		
		Manual Ram	#4	6.0	Mold Volume (ft³) 0.03320

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3569	3648	3703	3712		
Weight of Mold (g)	1817	1817	1817	1817		
Net Weight of Soil (g)	1752	1831	1886	1895		
Wet Weight of Soil + Cont. (g)	430.7	446.8	412.7	460.5		
Dry Weight of Soil + Cont. (g)	404.4	411.3	371.7	406.6		
Weight of Container (g)	39.4	39.4	38.0	38.8		
Moisture Content (%)	7.21	9.55	12.29	14.65		
Wet Density (pcf)	116.3	121.6	125.2	125.8		
Dry Density (pcf)	108.5	111.0	111.5	109.8		

Maximum Dry Density (pcf)	**111.7**	**Optimum Moisture Content (%)**	**11.5**
Corrected Dry Density (pcf)	**114.0**	**Corrected Moisture Content (%)**	**10.9**

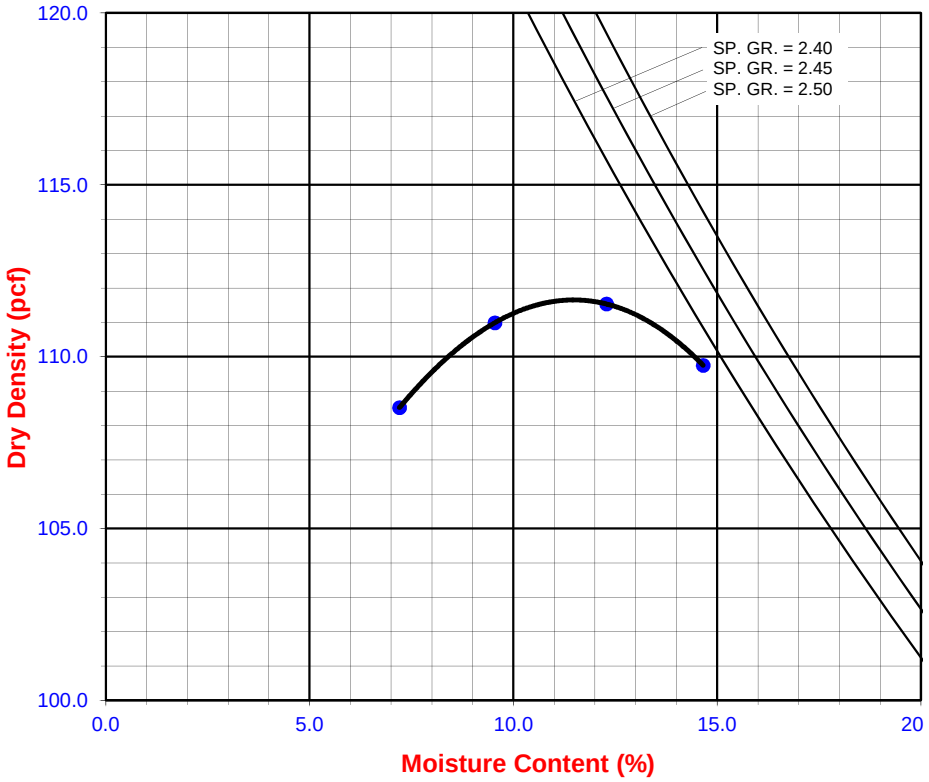
X Procedure A
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

☐ Procedure B
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

☐ Procedure C
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:
6:22:72
GR:SA:FI

Atterberg Limits:
LL,PL,PI



MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Prologis/TBB Warehouse Surcharge	Tested By:	J. Gonzalez	Date:	03/04/22
Project No.:	12452.005	Checked By:	ACS/JHW	Date:	03/08/22
Boring No.:	LB-3	Depth (ft.):	0-5		
Sample No.:	LB-D				
Soil Identification:	Dark brown clayey sand (SC)				

Note: Corrected dry density calculation assumes specific gravity of 2.70 and moisture content of 1.0% for oversize particles

Preparation Method:	X	Moist	
		Dry	
Compaction Method	X	Mechanical Ram	
		Manual Ram	

Scalp Fraction (%)	
#3/4	
#3/8	
#4	6.8

Rammer Weight (lb.) = 10.0

Height of Drop (in.) = 18.0

Mold Volume (ft³) 0.03330

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3665	3831	3817			
Weight of Mold (g)	1826	1826	1826			
Net Weight of Soil (g)	1839	2005	1991			
Wet Weight of Soil + Cont. (g)	522.1	450.8	421.0			
Dry Weight of Soil + Cont. (g)	483.3	406.8	374.0			
Weight of Container (g)	40.7	38.9	36.6			
Moisture Content (%)	8.77	11.96	13.93			
Wet Density (pcf)	121.7	132.7	131.8			
Dry Density (pcf)	111.9	118.6	115.7			

Maximum Dry Density (pcf) 118.6

Corrected Dry Density (pcf) 121.0

Optimum Moisture Content (%) 11.9

Corrected Moisture Content (%) 11.2

[X] Procedure A
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

[ ] Procedure B
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

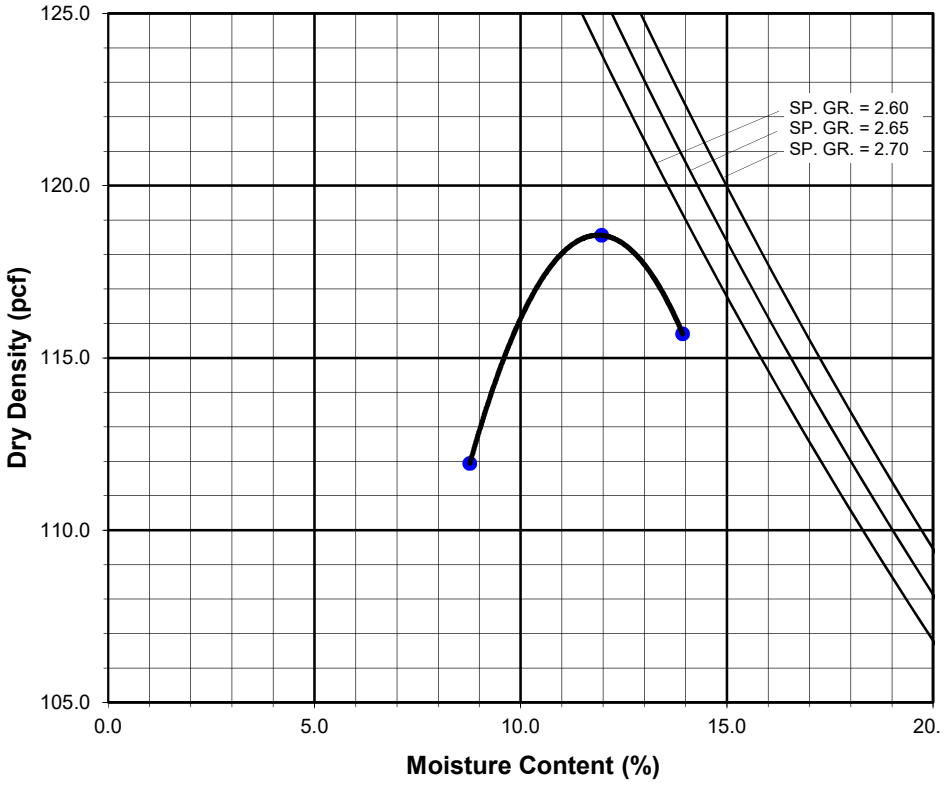
[ ] Procedure C
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Prologis/TBB Warehouse	Tested By:	A. Santos	Date:	10/12/23
Project No.:	12452.004	Checked By:	A. Santos	Date:	10/16/23
Boring No.:	LTP-2023-1B	Depth (ft.):	0-4		
Sample No.:	BB-1				
Soil Identification:	Olive brown silty sand (SM)				

Preparation Method: [X] Moist [ ] Dry

[X] Mechanical Ram [ ] Manual Ram

Mold Volume (ft³) 0.03320 *Ram Weight = 10 lb.; Drop = 18 in.*

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3597	3670	3648			
Weight of Mold (g)	1808	1808	1808			
Net Weight of Soil (g)	1789	1862	1840			
Wet Weight of Soil + Cont. (g)	763.4	799.9	699.1			
Dry Weight of Soil + Cont. (g)	677.0	696.6	597.5			
Weight of Container (g)	78.6	89.0	77.5			
Moisture Content (%)	14.45	17.00	19.55			
Wet Density (pcf)	118.8	123.6	122.2			
Dry Density (pcf)	103.8	105.7	102.2			

Maximum Dry Density (pcf) **105.8** **Optimum Moisture Content (%)** **16.8**

PROCEDURE USED

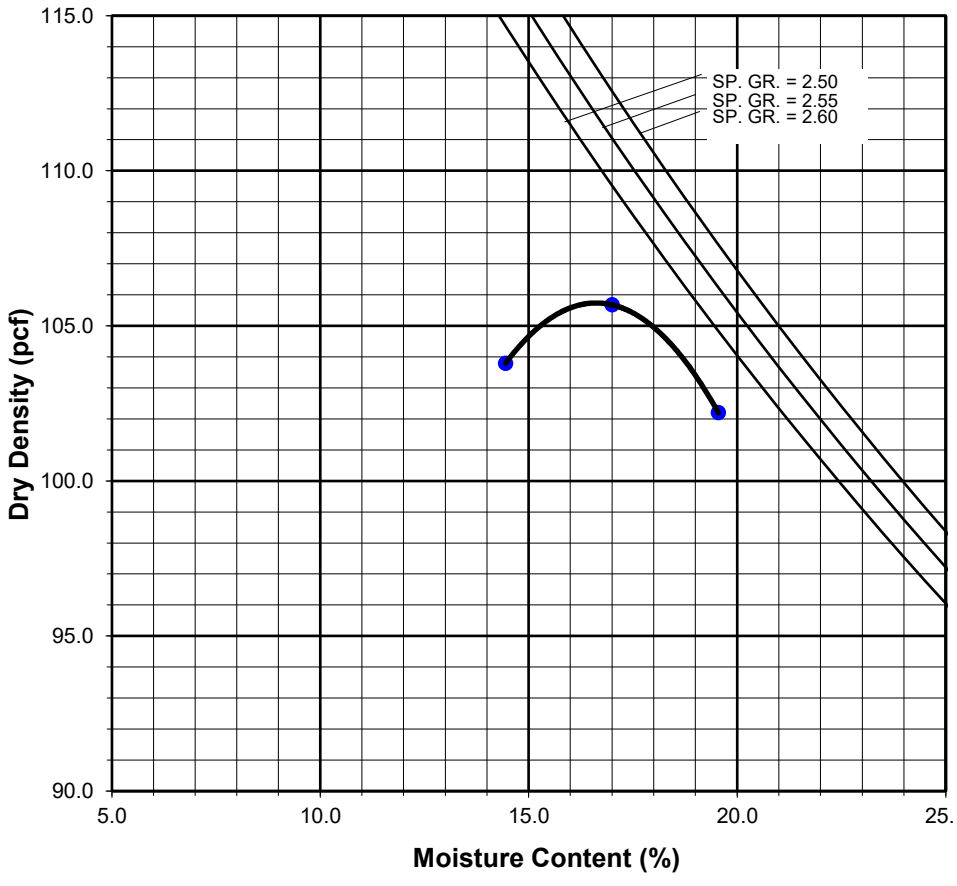
[X] **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:
GR:SA:FI

Atterberg Limits:
LL,PL,PI



MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Prologis/TBB Warehouse	Tested By:	A. Santos	Date:	10/11/23
Project No.:	12452.004	Checked By:	A. Santos	Date:	10/15/23
Boring No.:	LTP-2023-3	Depth (ft.):	13		
Sample No.:	BB-3				
Soil Identification:	Yellowish brown silty sand (SM)				

Preparation Method: [X] Moist [ ] Dry

[X] Mechanical Ram [ ] Manual Ram

Mold Volume (ft³) 0.03320 *Ram Weight = 10 lb.; Drop = 18 in.*

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3726	3799	3782			
Weight of Mold (g)	1808	1808	1808			
Net Weight of Soil (g)	1918	1991	1974			
Wet Weight of Soil + Cont. (g)	762.5	839.6	862.7			
Dry Weight of Soil + Cont. (g)	697.0	750.4	758.7			
Weight of Container (g)	88.8	77.1	89.3			
Moisture Content (%)	10.77	13.25	15.54			
Wet Density (pcf)	127.4	132.2	131.1			
Dry Density (pcf)	115.0	116.7	113.5			

Maximum Dry Density (pcf) **116.9** **Optimum Moisture Content (%)** **12.8**

PROCEDURE USED

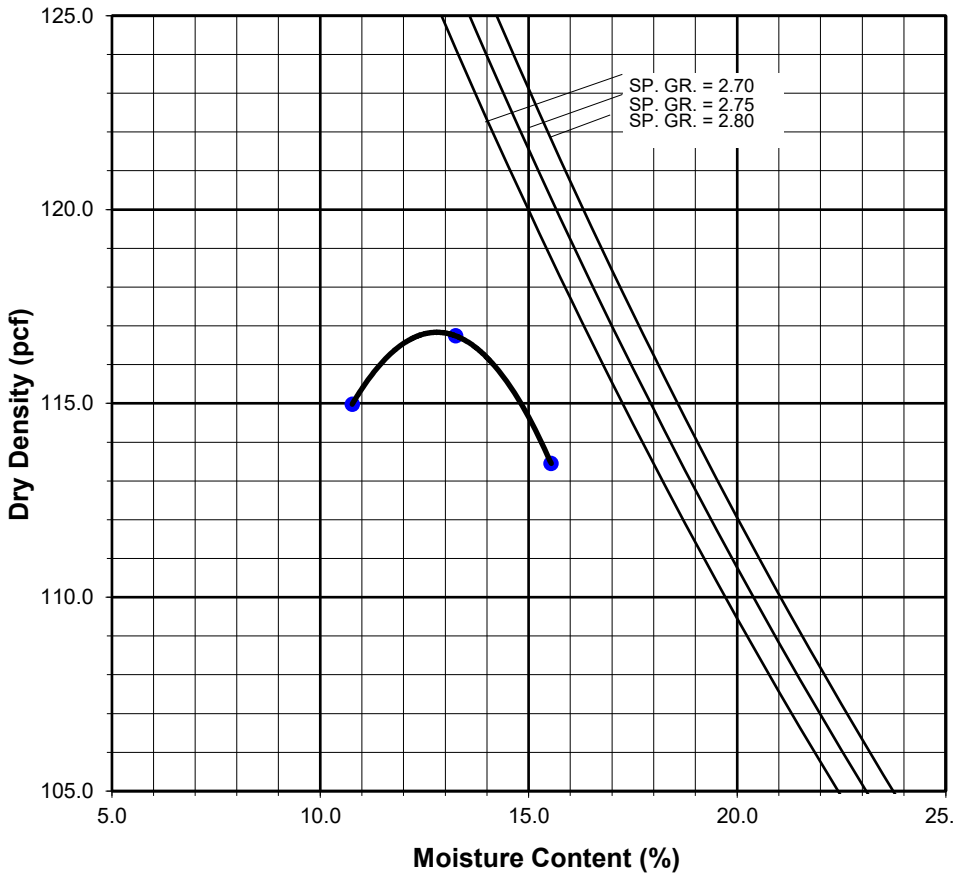
[X] **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:
GR:SA:FI

Atterberg Limits:
LL,PL,PI



EXPANSION INDEX of SOILS

ASTM D 4829

Leighton

Project Name:	Prologis Proposed Del Amo Warehousing Facility, Torrance	Tested By:	SF/OHF	Date:	08/27/19
Project No.:	12452.002	Checked By:	J. Ward	Date:	09/09/19
Boring No.:	TP-1	Depth (ft.):	10-11		
Sample No.:	LB-2				
Soil Identification:	Dark brown fat clay (CH)				

Dry Wt. of Soil + Cont.	(g)	1000.00
Wt. of Container No.	(g)	0.00
Dry Wt. of Soil	(g)	1000.00
Weight Soil Retained on #4 Sieve		0.00
Percent Passing # 4		100.00

MOLDED SPECIMEN		Before Test	After Test
Specimen Diameter	(in.)	4.01	4.01
Specimen Height	(in.)	1.0000	1.0745
Wt. Comp. Soil + Mold	(g)	575.40	426.08
Wt. of Mold	(g)	191.70	0.00
Specific Gravity (Assumed)		2.70	2.70
Container No.		O	O
Wet Wt. of Soil + Cont.	(g)	759.30	617.78
Dry Wt. of Soil + Cont.	(g)	678.00	534.29
Wt. of Container	(g)	0.00	191.70
Moisture Content	(%)	11.99	24.37
Wet Density	(pcf)	115.7	119.6
Dry Density	(pcf)	103.3	96.2
Void Ratio		0.631	0.753
Total Porosity		0.387	0.430
Pore Volume	(cc)	80.1	95.5
Degree of Saturation (%) [S_{meas}]		**51.3**	87.4

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
08/27/19	10:20	1.0	0	0.4925
08/27/19	10:30	1.0	10	0.4930
Add Distilled Water to the Specimen				
08/27/19	14:00	1.0	210	0.5530
08/28/19	6:13	1.0	1183	0.5670
08/28/19	7:30	1.0	1260	0.5670

Expansion Index (EI_{meas}) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	**74**

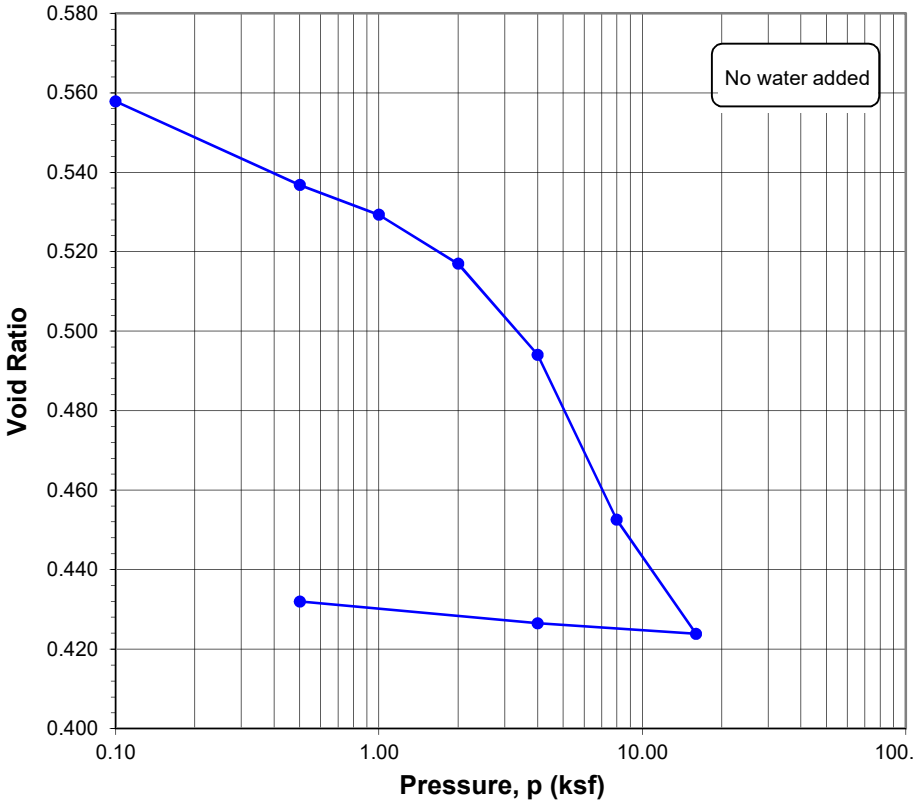
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name: Prologis/TBB Warehouse Surcharge
Project No.: 12452.005
Boring No.: LB-6
Sample No.: R-3
Soil Identification: Dark olive brown lean clay (CL)

Tested By: G. Bathala Date: 03/23/22
Checked By: J. Ward Date: 04/03/22
Depth (ft.): 7.5
Sample Type: Ring

Sample Diameter (in.):	2.415
Sample Thickness (in.):	1.000
Weight of Sample + ring (g):	200.36
Weight of Ring (g):	44.52
Height after consol. (in.):	0.9182
Before Test	
Wt. of Wet Sample+Cont. (g):	187.39
Wt. of Dry Sample+Cont. (g):	166.48
Weight of Container (g):	61.47
Initial Moisture Content (%)	19.9
Initial Dry Density (pcf)	108.1
Initial Saturation (%):	96
Initial Vertical Reading (in.)	0.0654
After Test	
Wt. of Wet Sample+Cont. (g):	247.10
Wt. of Dry Sample+Cont. (g):	229.81
Weight of Container (g):	53.73
Final Moisture Content (%)	13.14
Final Dry Density (pcf):	119.2
Final Saturation (%):	86
Final Vertical Reading (in.)	0.1502
Specific Gravity (assumed):	2.70
Water Density (pcf):	62.43

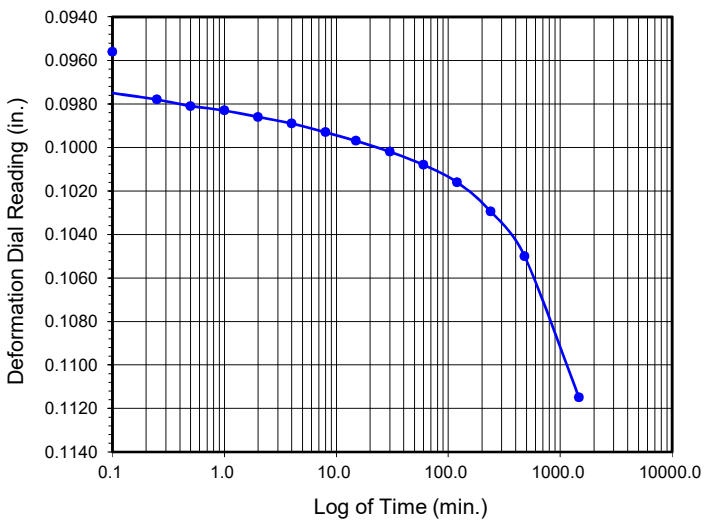


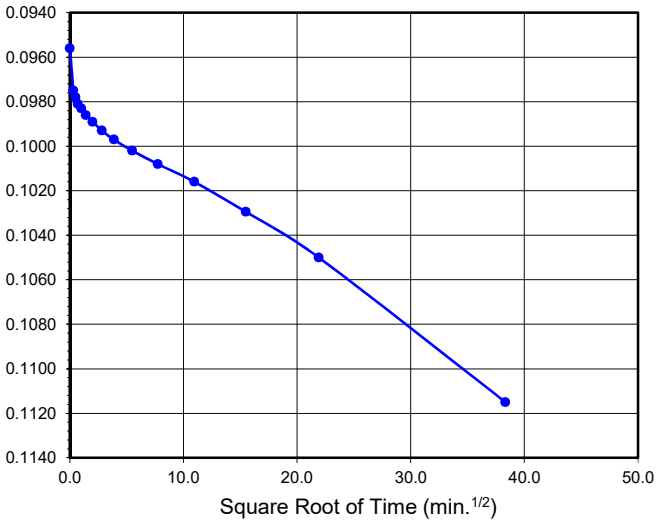
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deforma-tion (%)
0.10	0.0665	0.9989	0.00	0.11	0.558	0.11
0.50	0.0811	0.9843	0.11	1.57	0.537	1.46
1.00	0.0867	0.9787	0.19	2.13	0.529	1.94
2.00	0.0956	0.9698	0.29	3.02	0.517	2.73
4.00	0.1115	0.9539	0.41	4.61	0.494	4.20
8.00	0.1394	0.9260	0.54	7.40	0.453	6.86
16.00	0.1593	0.9061	0.69	9.39	0.424	8.70
4.00	0.1558	0.9096	0.51	9.04	0.427	8.53
0.50	0.1502	0.9152	0.30	8.48	0.432	8.18

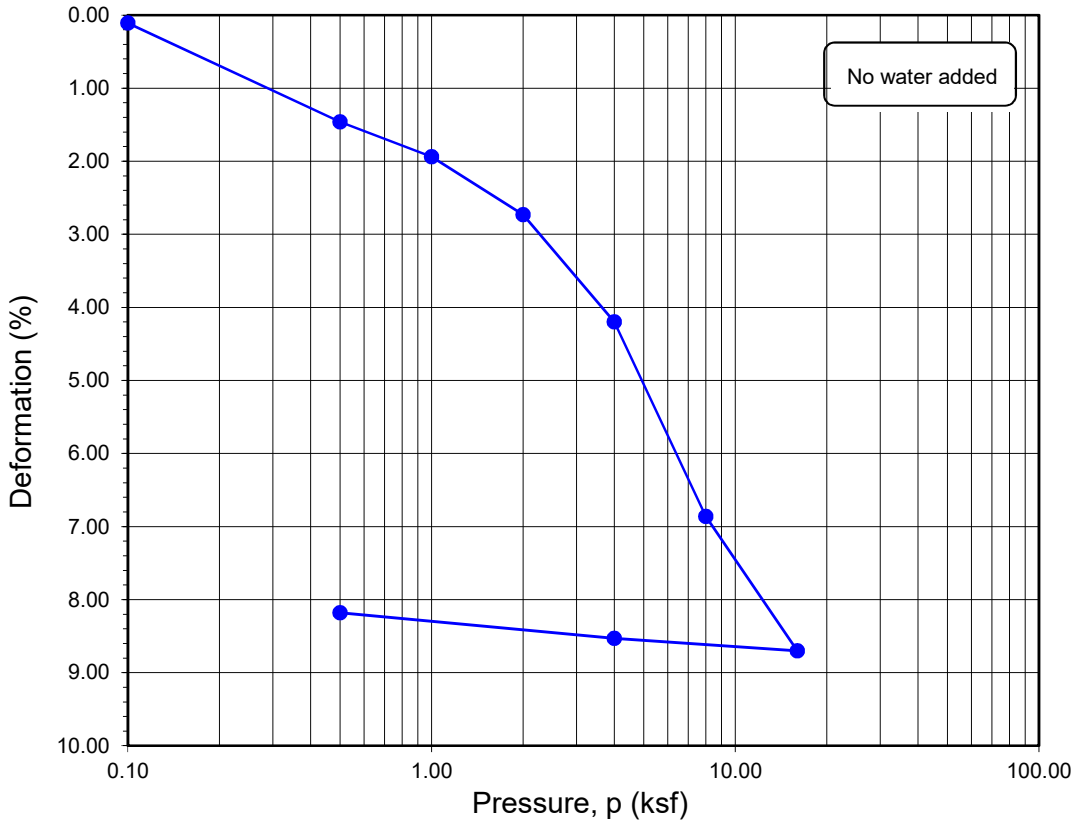
Time Readings @ 4.0 ksf

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)
3/25/22	8:23:00	0.0	0.0	0.0956
3/25/22	8:23:06	0.1	0.3	0.0975
3/25/22	8:23:15	0.2	0.5	0.0978
3/25/22	8:23:30	0.5	0.7	0.0981
3/25/22	8:24:00	1.0	1.0	0.0983
3/25/22	8:25:00	2.0	1.4	0.0986
3/25/22	8:27:00	4.0	2.0	0.0989
3/25/22	8:31:00	8.0	2.8	0.0993
3/25/22	8:38:00	15.0	3.9	0.0997
3/25/22	8:53:00	30.0	5.5	0.1002
3/25/22	9:23:00	60.0	7.7	0.1008
3/25/22	10:23:00	120.0	11.0	0.1016
3/25/22	12:23:00	240.0	15.5	0.1030
3/25/22	16:23:00	480.0	21.9	0.1050
3/26/22	8:53:00	1470.0	38.3	0.1115

Time Readings @ 4.0 ksf







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-6	**R-3**	**7.5**	**19.9**	**13.1**	**108.1**	**119.2**	**0.560**	**0.432**	**96**	**86**

Soil Identification: Dark olive brown lean clay (CL)

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 12452.005

Prologis/TBB Warehouse Surcharge

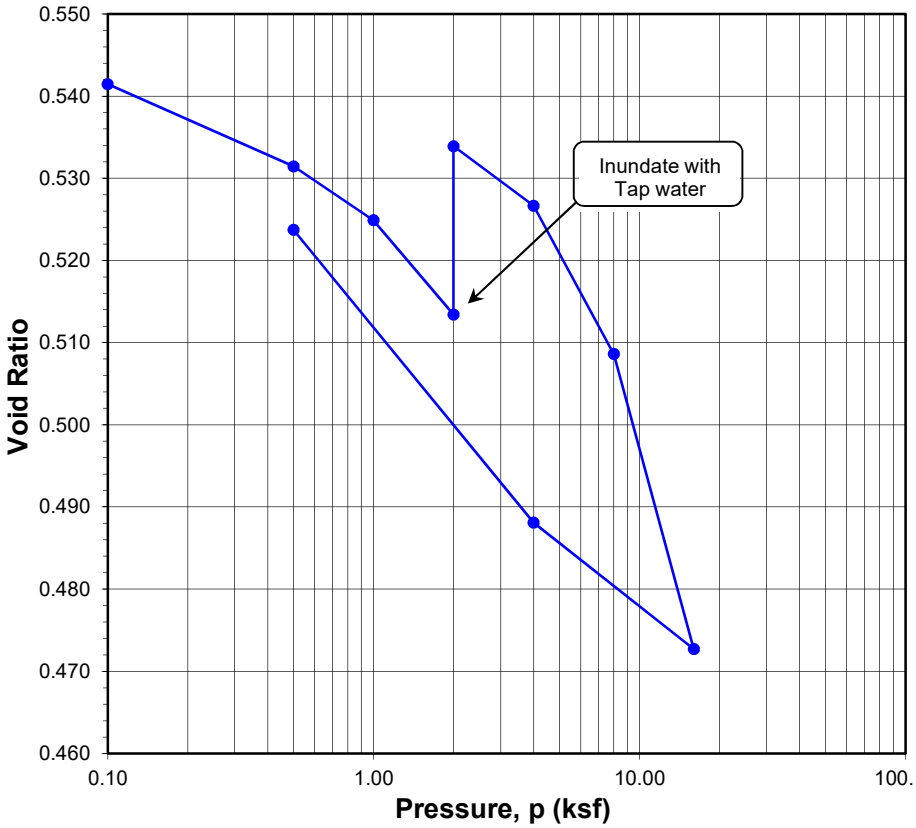
04-22

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name:	Prologis/TBB Warehouse Surcharge		Tested By:	G. Bathala	Date: 03/23/22
Project No.:	12452.005		Checked By:	J. Ward	Date: 04/03/22
Boring No.:	LB-7		Depth (ft.):	7.5	
Sample No.:	R-3		Sample Type:	Ring	
Soil Identification:	Dark olive brown lean clay (CL)				

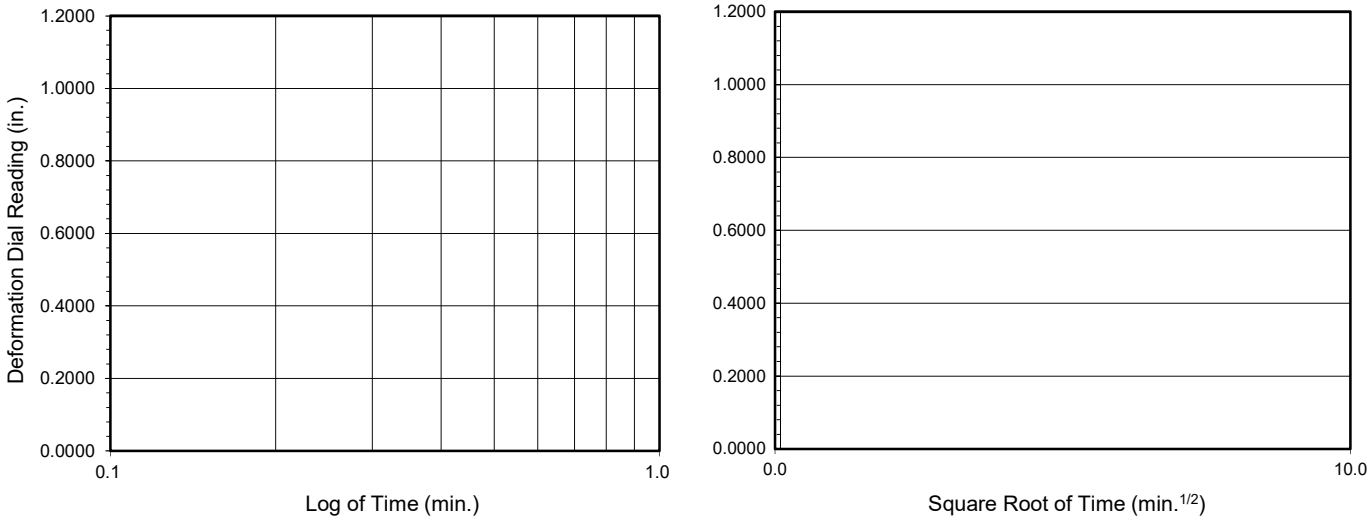
Sample Diameter (in.)	2.415
Sample Thickness (in.)	1.000
Wt. of Sample + Ring (g)	198.40
Weight of Ring (g)	45.62
Height after consol. (in.)	0.9882
Before Test	
Wt.Wet Sample+Cont. (g)	70.30
Wt.of Dry Sample+Cont. (g)	68.75
Weight of Container (g)	59.20
Initial Moisture Content (%)	16.2
Initial Dry Density (pcf)	109.3
Initial Saturation (%)	81
Initial Vertical Reading (in.)	0.2947
After Test	
Wt.of Wet Sample+Cont. (g)	269.41
Wt. of Dry Sample+Cont. (g)	243.19
Weight of Container (g)	69.12
Final Moisture Content (%)	20.41
Final Dry Density (pcf)	108.1
Final Saturation (%)	99
Final Vertical Reading (in.)	0.2787
Specific Gravity (assumed)	2.70
Water Density (pcf)	62.43

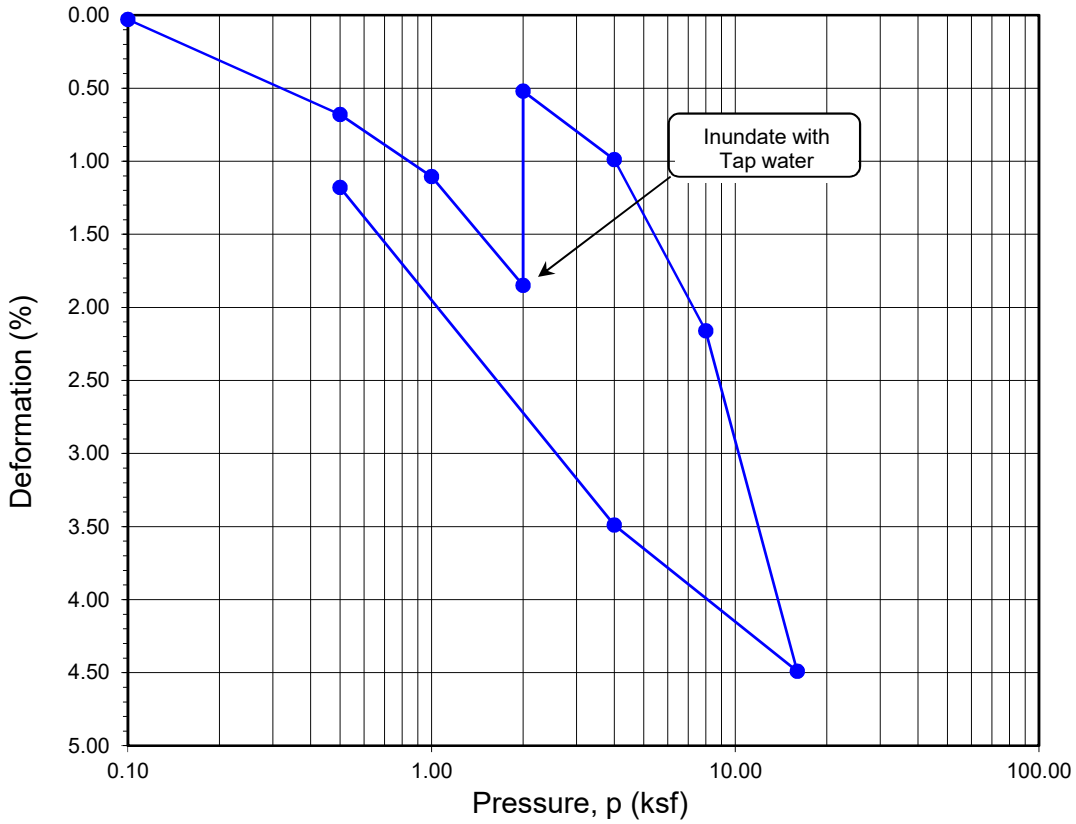


Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.2944	0.9997	0.00	0.03	0.541	0.03
0.50	0.2861	0.9914	0.18	0.86	0.531	0.68
1.00	0.2808	0.9861	0.29	1.40	0.525	1.11
2.00	0.2719	0.9772	0.43	2.28	0.513	1.85
2.00	0.2852	0.9905	0.43	0.95	0.534	0.52
4.00	0.2786	0.9839	0.62	1.61	0.527	0.99
8.00	0.2647	0.9700	0.84	3.00	0.509	2.16
16.00	0.2391	0.9444	1.07	5.56	0.473	4.49
4.00	0.2515	0.9568	0.83	4.32	0.488	3.49
0.50	0.2787	0.9840	0.42	1.60	0.524	1.18

Time Readings				
Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)

Time Readings





Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-7	**R-3**	**7.5**	**16.2**	**20.4**	**109.3**	**108.1**	**0.542**	**0.524**	**81**	**99**

Soil Identification: Dark olive brown lean clay (CL)

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 12452.005

Prologis/TBB Warehouse Surcharge

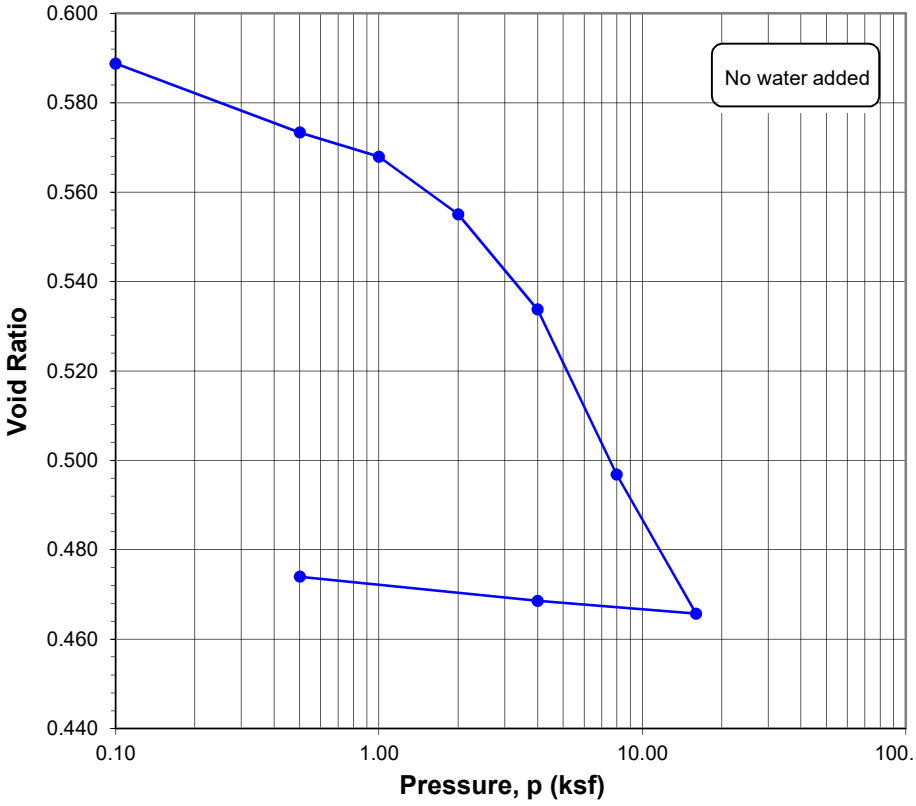
04-22

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name:	Prologis/TBB Warehouse Surcharge	Tested By: G. Bathala	Date: 03/23/22
Project No.:	12452.005	Checked By: J. Ward	Date: 04/03/22
Boring No.:	LB-8	Depth (ft.): 5.0	
Sample No.:	R-2	Sample Type: Ring	
Soil Identification:	Dark brown lean clay (CL)		

Sample Diameter (in.):	2.415
Sample Thickness (in.):	1.000
Weight of Sample + ring (g):	200.14
Weight of Ring (g):	45.82
Height after consol. (in.):	0.9270
Before Test	
Wt. of Wet Sample+Cont. (g):	181.27
Wt. of Dry Sample+Cont. (g):	156.22
Weight of Container (g):	37.30
Initial Moisture Content (%)	21.1
Initial Dry Density (pcf)	106.0
Initial Saturation (%):	96
Initial Vertical Reading (in.)	0.1365
After Test	
Wt. of Wet Sample+Cont. (g):	252.58
Wt. of Dry Sample+Cont. (g):	232.40
Weight of Container (g):	59.52
Final Moisture Content (%)	15.88
Final Dry Density (pcf):	114.0
Final Saturation (%):	90
Final Vertical Reading (in.)	0.2129
Specific Gravity (assumed):	2.70
Water Density (pcf):	62.43

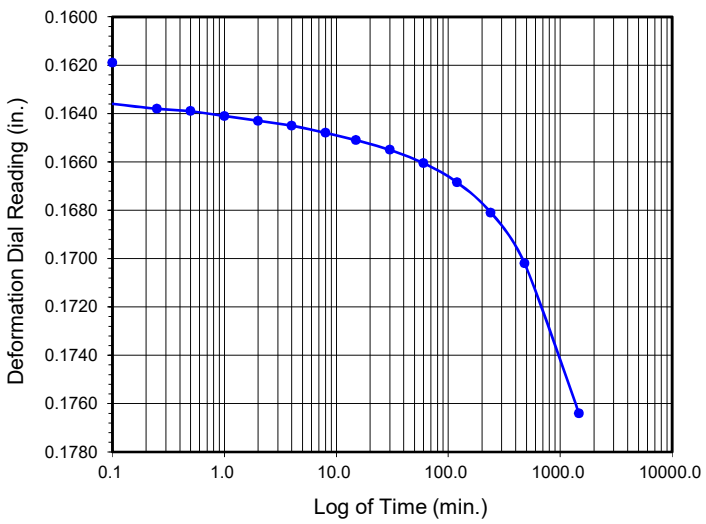


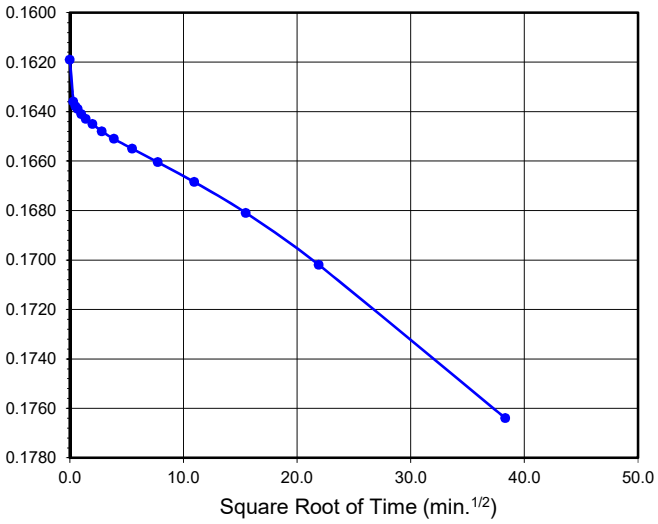
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.1373	0.9992	0.00	0.08	0.589	0.08
0.50	0.1484	0.9881	0.14	1.19	0.573	1.05
1.00	0.1528	0.9837	0.24	1.63	0.568	1.39
2.00	0.1619	0.9746	0.34	2.54	0.555	2.20
4.00	0.1764	0.9601	0.45	3.99	0.534	3.54
8.00	0.2009	0.9356	0.58	6.44	0.497	5.86
16.00	0.2220	0.9145	0.73	8.55	0.466	7.82
4.00	0.2185	0.9180	0.56	8.20	0.469	7.64
0.50	0.2129	0.9236	0.34	7.64	0.474	7.30

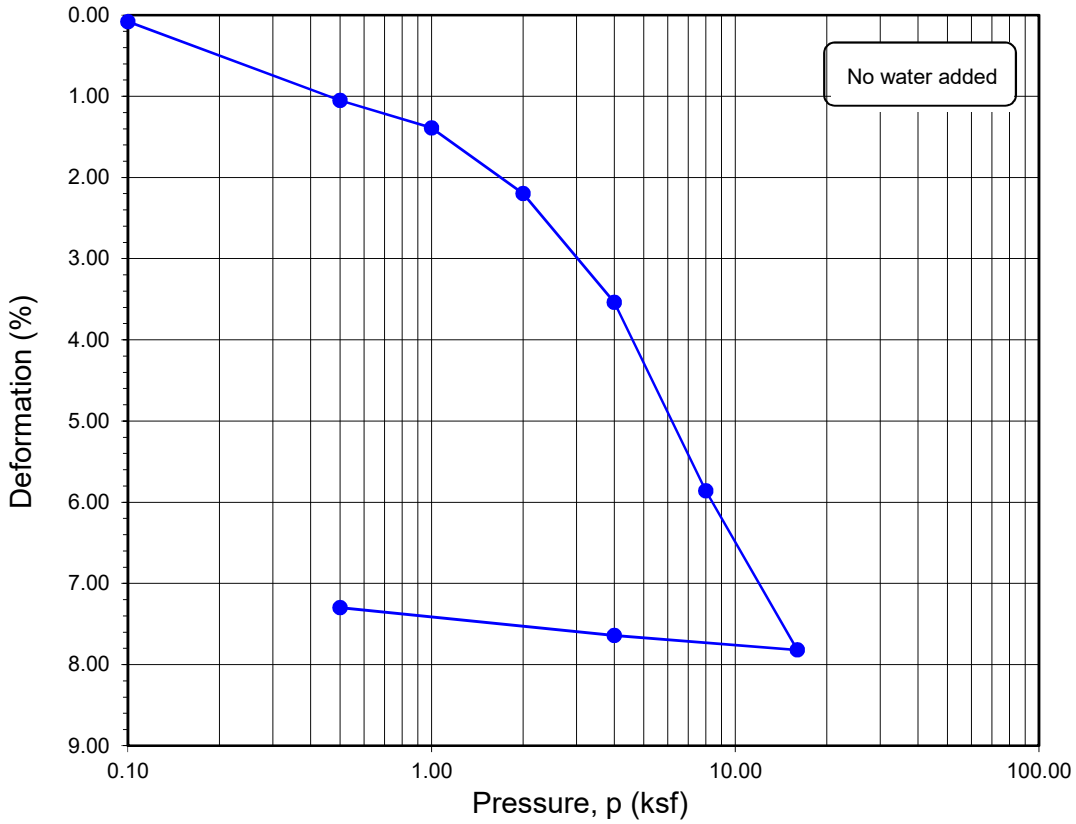
Time Readings @ 4.0 ksf

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)
3/25/22	8:29:00	0.0	0.0	0.1619
3/25/22	8:29:06	0.1	0.3	0.1636
3/25/22	8:29:15	0.2	0.5	0.1638
3/25/22	8:29:30	0.5	0.7	0.1639
3/25/22	8:30:00	1.0	1.0	0.1641
3/25/22	8:31:00	2.0	1.4	0.1643
3/25/22	8:33:00	4.0	2.0	0.1645
3/25/22	8:37:00	8.0	2.8	0.1648
3/25/22	8:44:00	15.0	3.9	0.1651
3/25/22	8:59:00	30.0	5.5	0.1655
3/25/22	9:29:00	60.0	7.7	0.1661
3/25/22	10:29:00	120.0	11.0	0.1669
3/25/22	12:29:00	240.0	15.5	0.1681
3/25/22	16:29:00	480.0	21.9	0.1702
3/26/22	8:59:00	1470.0	38.3	0.1764

Time Readings @ 4.0 ksf







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-8	**R-2**	**5**	**21.1**	**15.9**	**106.0**	**114.0**	**0.590**	**0.474**	**96**	**90**

Soil Identification: Dark brown lean clay (CL)

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 12452.005

Prologis/TBB Warehouse Surcharge

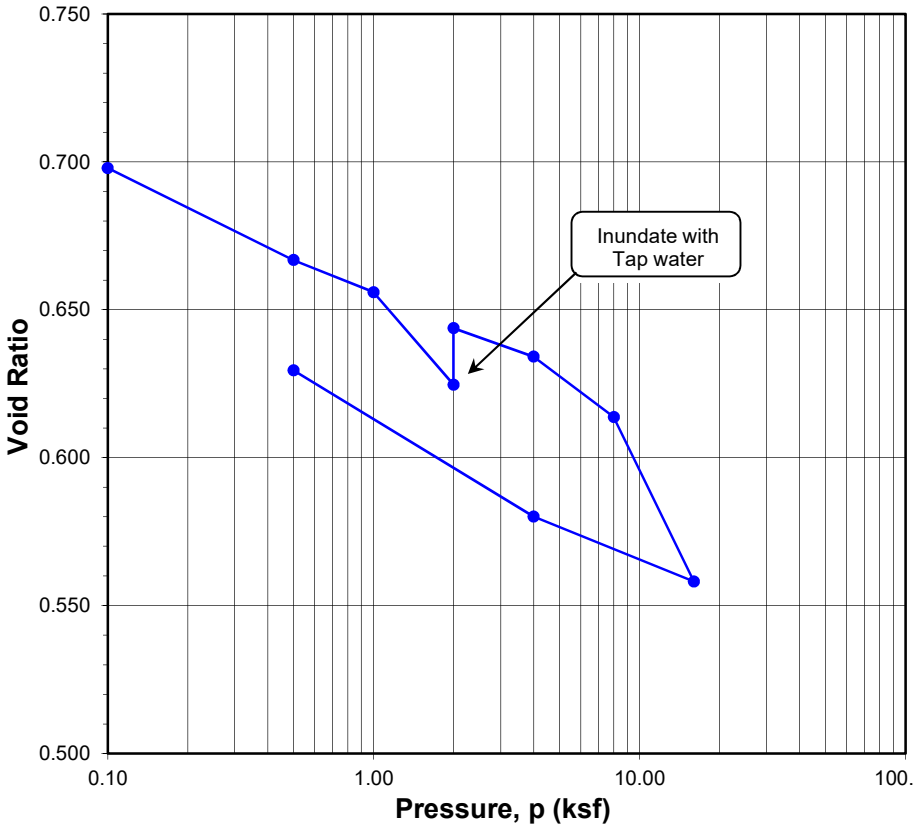
04-22

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name:	Prologis/TBB Warehouse Surcharge		Tested By:	G. Bathala	Date: 03/23/22
Project No.:	12452.005		Checked By:	J. Ward	Date: 04/03/22
Boring No.:	LB-8		Depth (ft.):	10.0	
Sample No.:	R-4		Sample Type:	Ring	
Soil Identification:	Dark olive brown lean clay (CL)				

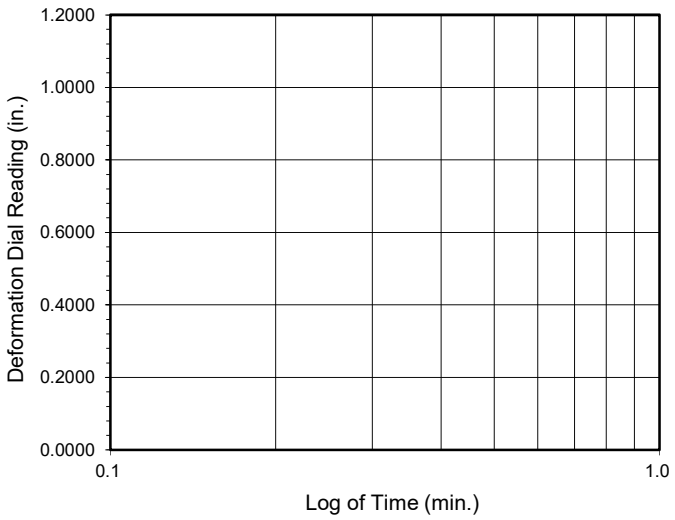
Sample Diameter (in.)	2.415
Sample Thickness (in.)	1.000
Wt. of Sample + Ring (g)	196.57
Weight of Ring (g)	45.58
Height after consol. (in.)	0.9584
Before Test	
Wt.Wet Sample+Cont. (g)	200.72
Wt.of Dry Sample+Cont. (g)	176.36
Weight of Container (g)	66.35
Initial Moisture Content (%)	22.1
Initial Dry Density (pcf)	102.8
Initial Saturation (%)	89
Initial Vertical Reading (in.)	0.2979
After Test	
Wt.of Wet Sample+Cont. (g)	247.12
Wt. of Dry Sample+Cont. (g)	218.14
Weight of Container (g)	52.22
Final Moisture Content (%)	24.08
Final Dry Density (pcf)	104.4
Final Saturation (%)	100
Final Vertical Reading (in.)	0.2520
Specific Gravity (assumed)	2.80
Water Density (pcf)	62.43

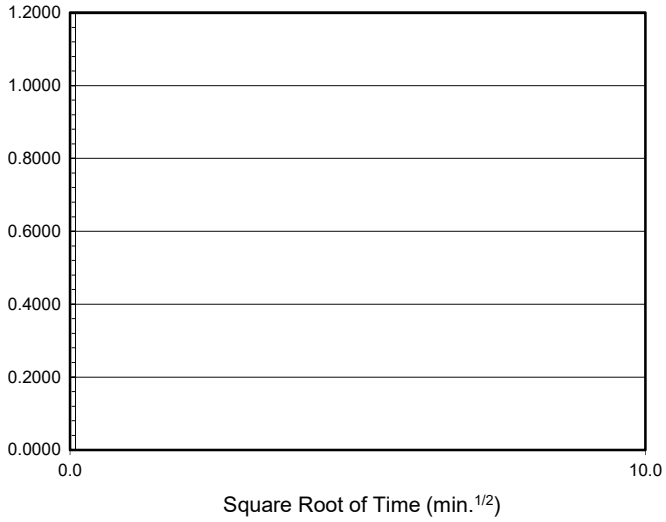


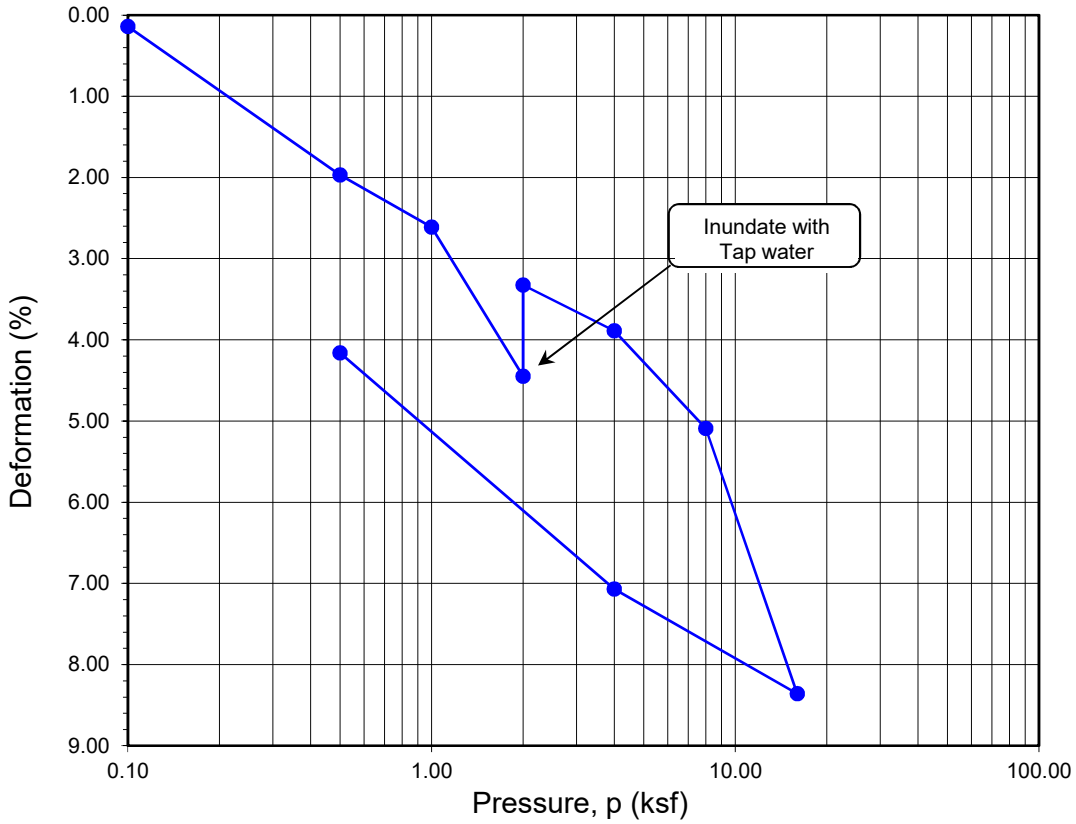
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.2965	0.9986	0.00	0.14	0.698	0.14
0.50	0.2769	0.9790	0.13	2.10	0.667	1.97
1.00	0.2697	0.9718	0.21	2.82	0.656	2.61
2.00	0.2501	0.9522	0.33	4.78	0.625	4.45
2.00	0.2614	0.9635	0.33	3.66	0.644	3.33
4.00	0.2544	0.9565	0.46	4.35	0.634	3.89
8.00	0.2406	0.9427	0.64	5.73	0.614	5.09
16.00	0.2057	0.9078	0.86	9.22	0.558	8.36
4.00	0.2204	0.9225	0.68	7.75	0.580	7.07
0.50	0.2520	0.9541	0.43	4.59	0.630	4.16

Time Readings				
Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)

Time Readings







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-8	**R-4**	**10.0**	**22.1**	**24.1**	**102.8**	**104.4**	**0.700**	**0.630**	**89**	**100**

Soil Identification: Dark olive brown lean clay (CL)

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 12452.005

Prologis/TBB Warehouse Surcharge

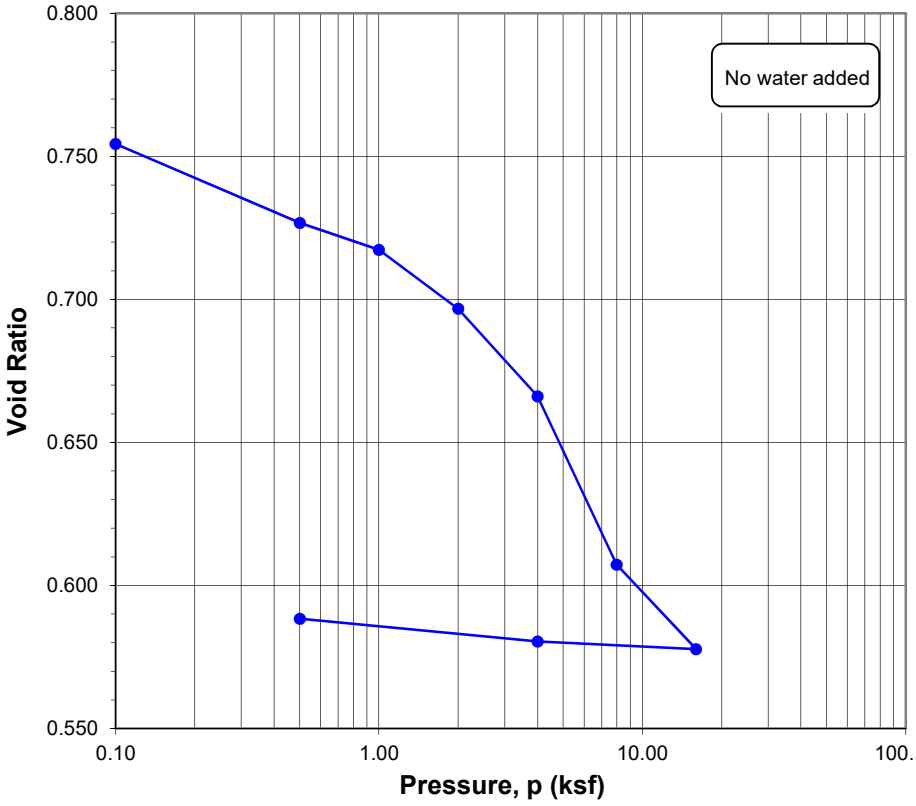
04-22

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name:	Prologis/TBB Warehouse Surcharge	Tested By: G. Bathala	Date: 03/23/22
Project No.:	12452.005	Checked By: J. Ward	Date: 04/03/22
Boring No.:	LB-10	Depth (ft.): 5.0	
Sample No.:	R-2	Sample Type: Ring	
Soil Identification:	Dark olive brown lean clay (CL)		

Sample Diameter (in.):	2.415
Sample Thickness (in.):	1.000
Weight of Sample + ring (g):	202.29
Weight of Ring (g):	45.56
Height after consol. (in.):	0.9042
Before Test	
Wt. of Wet Sample+Cont. (g):	202.78
Wt. of Dry Sample+Cont. (g):	173.03
Weight of Container (g):	58.75
Initial Moisture Content (%)	26.0
Initial Dry Density (pcf)	103.4
Initial Saturation (%):	100
Initial Vertical Reading (in.)	0.0718
After Test	
Wt. of Wet Sample+Cont. (g):	263.47
Wt. of Dry Sample+Cont. (g):	243.47
Weight of Container (g):	68.90
Final Moisture Content (%)	15.50
Final Dry Density (pcf):	118.7
Final Saturation (%):	85
Final Vertical Reading (in.)	0.1705
Specific Gravity (assumed):	2.91
Water Density (pcf):	62.43

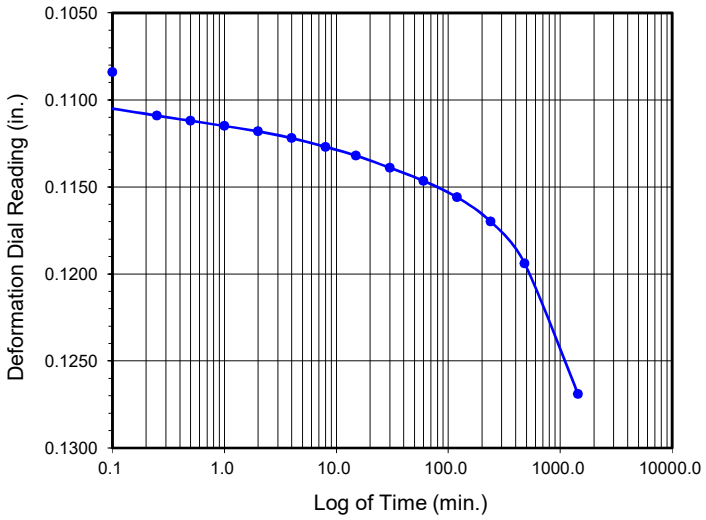


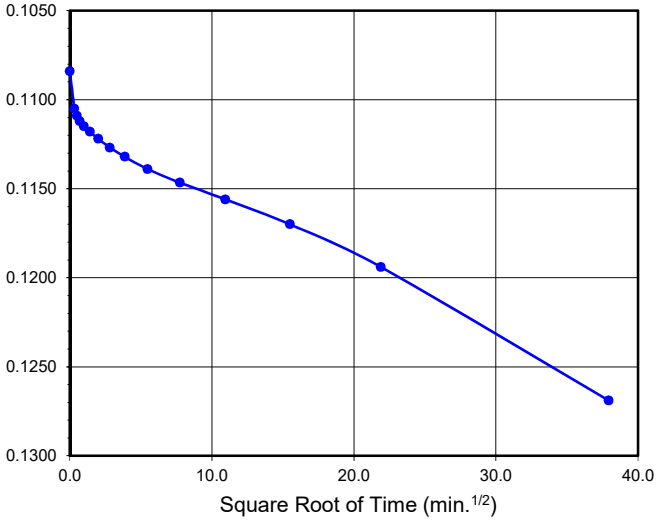
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.0731	0.9987	0.00	0.13	0.754	0.13
0.50	0.0896	0.9822	0.08	1.78	0.727	1.70
1.00	0.0957	0.9762	0.15	2.39	0.717	2.24
2.00	0.1084	0.9634	0.25	3.66	0.697	3.41
4.00	0.1269	0.9449	0.36	5.51	0.666	5.15
8.00	0.1617	0.9101	0.49	8.99	0.607	8.50
16.00	0.1800	0.8918	0.64	10.82	0.578	10.18
4.00	0.1768	0.8950	0.47	10.50	0.580	10.03
0.50	0.1705	0.9013	0.29	9.87	0.588	9.58

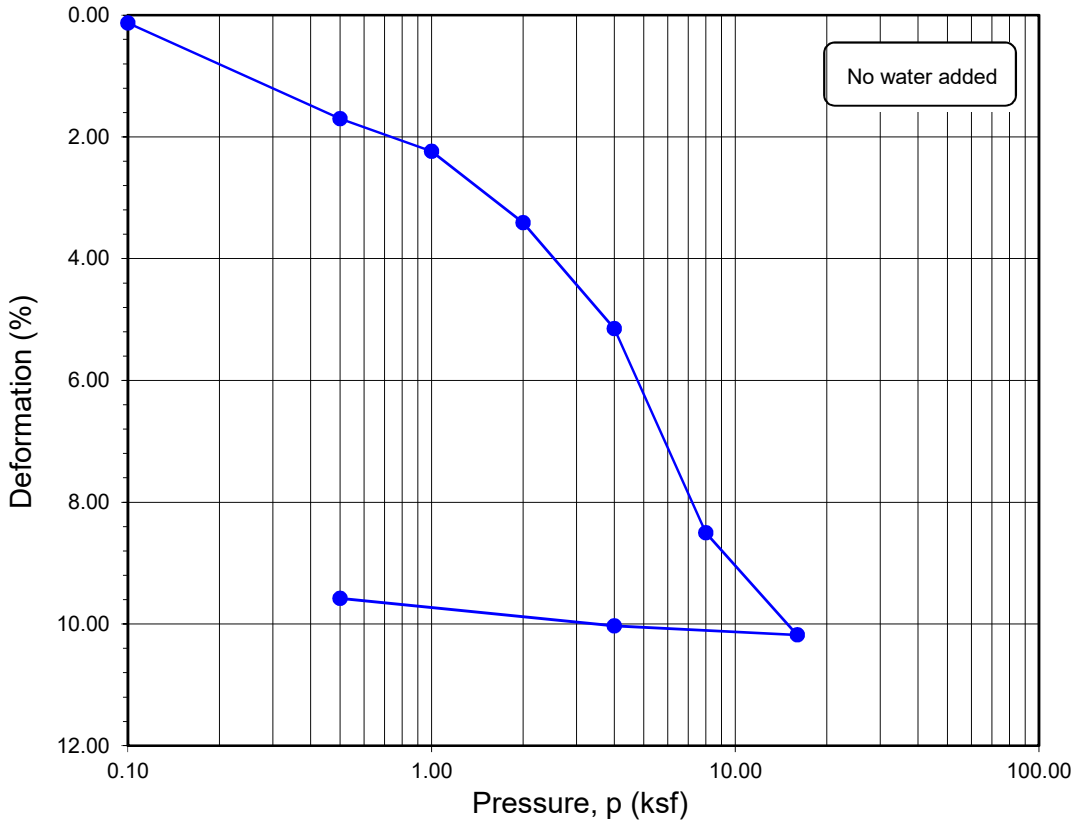
Time Readings @ 4.0 ksf

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)
3/25/22	9:20:00	0.0	0.0	0.1084
3/25/22	9:20:06	0.1	0.3	0.1105
3/25/22	9:20:15	0.2	0.5	0.1109
3/25/22	9:20:30	0.5	0.7	0.1112
3/25/22	9:21:00	1.0	1.0	0.1115
3/25/22	9:22:00	2.0	1.4	0.1118
3/25/22	9:24:00	4.0	2.0	0.1122
3/25/22	9:28:00	8.0	2.8	0.1127
3/25/22	9:35:00	15.0	3.9	0.1132
3/25/22	9:50:00	30.0	5.5	0.1139
3/25/22	10:20:00	60.0	7.7	0.1147
3/25/22	11:20:00	120.0	11.0	0.1156
3/25/22	13:20:00	240.0	15.5	0.1170
3/25/22	17:20:00	480.0	21.9	0.1194
3/26/22	9:20:00	1440.0	37.9	0.1269

Time Readings @ 4.0 ksf







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-10	**R-2**	**5**	**26.0**	**15.5**	**103.4**	**118.7**	**0.757**	**0.588**	**100**	**85**

Soil Identification: Dark olive brown lean clay (CL)

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 12452.005

Prologis/TBB Warehouse Surcharge

04-22

Leighton

MOISTURE, ORGANIC MATTER and ASH CONTENT of SOILS

ASTM D 2974 (Test Methods A & C)

Project Name: Prologis Proposed Del Amo Warehousing Facility, Torrance | Tested By: G. Bathala | Date: 09/04/19

Project No. : 12452.002 | Input By: J. Ward | Date: 09/09/19

Boring No.	TP-2				
Sample No.	LB-1				
Depth (ft)	4-6				
Soil Description	Olive brown lean clay with sand (CL)s				
Wt. of Moist Soil + Container (gm)	231.20				
Wt. of Dried Soil + Container (gm)	221.55				
Wt. Container (gm)	39.50				
Crucible No.	12, 6				
Furnace Temperature (°C)	440				
Time In / Time Out	8:35/14:05				
Duration of Combustion (hr)	5:30				
Wt. of Dried Soil + Crucible (gm)	105.82				
Wt. of Ash + Crucible (gm)	103.81				
Wt. of Crucible (gm)	41.45				
Moisture Content @ 105 °C (%) "as received"	5.3				
Dry wt. of Soil (gm) (1)	64.37				
Wt. of Ash (gm) (2)	62.36				
Ash Content (%) = [(2) / (1)] x 100 (3)	96.9				
Organic Matter (%) = 100 - (3)	**3.1**				

Remarks: Moisture, ash & organic contents are calculated as percentages of oven-dried mass of test specimen.

TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: Prologis/TBB Warehouse Tested By : J. Domingo Date: 10/10/23

Project No. : 12452.004 Checked By: A. Santos Date: 10/15/23

Boring No.	LTP-2023-2			
Sample No.	BB-1			
Sample Depth (ft)	0-2			
Soil Identification:	Dark brown SM			
Wet Weight of Soil + Container (g)	134.81			
Dry Weight of Soil + Container (g)	130.94			
Weight of Container (g)	55.71			
Moisture Content (%)	5.14			
Weight of Soaked Soil (g)	100.43			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	5			
Crucible No.	303			
Furnace Temperature (°C)	860			
Time In / Time Out	7:30/8:15			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	60.2787			
Wt. of Crucible (g)	60.1971			
Wt. of Residue (g) (A)	0.0816			
PPM of Sulfate (A) x 41150	3357.84			
PPM of Sulfate, Dry Weight Basis	**3540**			

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)	30			
ml of AgNO3 Soln. Used in Titration (C)	3.4			
PPM of Chloride (C -0.2) * 100 * 30 / B	320			
PPM of Chloride, Dry Wt. Basis	**337**			

pH TEST, DOT California Test 643

pH Value	**5.76**			
Temperature °C	20.6			

SOIL RESISTIVITY TEST

DOT CA TEST 643

Project Name:	Prologis/TBB Warehouse		Tested By :	G. Berdy	Date: 10/12/23
Project No. :	12452.004		Checked By:	A. Santos	Date: 10/15/23
Boring No.:	LTP-2023-2		Depth (ft.) :	0-2	
Sample No. :	BB-1				

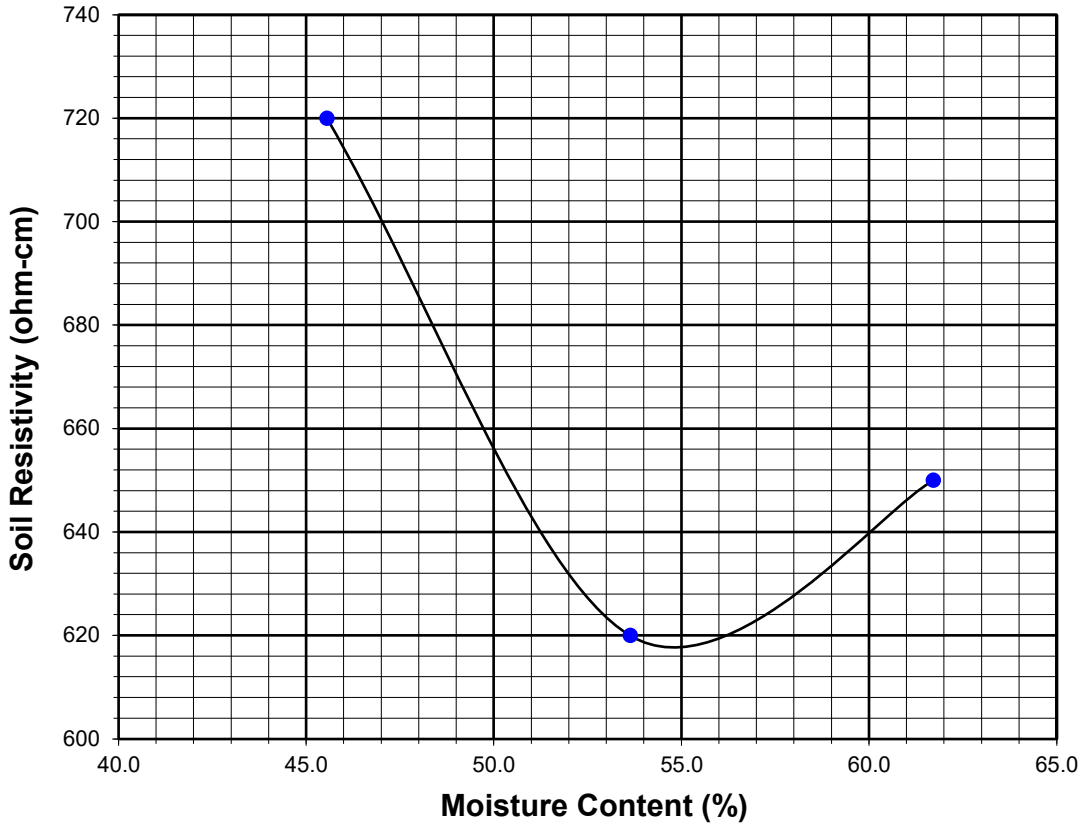
Soil Identification:* Dark brown SM

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	50	45.55	720	720
2	60	53.64	620	620
3	70	61.72	650	650
4				
5				

Moisture Content (%) (MCi)	5.14
Wet Wt. of Soil + Cont. (g)	134.81
Dry Wt. of Soil + Cont. (g)	130.94
Wt. of Container (g)	55.71
Container No.	
Initial Soil Wt. (g) (Wt)	130.10
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 643	
618	**55.0**	**3540**	**337**	**5.76**	**20.6**



APPENDIX C

KLEINFELDER REVIEW AND RESPONSE MATRIX

TABLE OF REVIEW COMMENTS, NORTH POSSE SITE

Number	Comment	Response
1	Document reviewed is a Geotechnical Design Memorandum. Is this the final geotechnical design document for the site/project?	Our intent is for this to be the final geotechnical design document for this site/project. However, there will be extensive geotechnical involvement during surcharging and earthwork.
2	Please provide site specific field and laboratory data for the site. Specifically test pit logs and lab testing results.	This was previously provided as the June 25, 2018 Southern California Geotechnical report.
3	Page 3 refers to "SCS, 2019". Please provide this reference for review.	Numerous SCS documents for this site can be found on *GEOTRACKER*: https://geotracker.waterboards.ca.gov/profile_report.asp?global_id=T10000012263
4	Page 3, Are Plate 2 and Figure 2 the same? If not, please provide the missing figure/plate.	There is only a Plate 2 (no Figure 2).
5	Page 4, How much differential dynamic compaction should be considered?	Due to the fat clay (cohesive) nature of the undocumented fill, we expect dynamically-induced differential settlement (or compaction) will be modest (<2.7-inch in 30 feet, in accordance with ASCE 7-16 Table 12.13-3), but should be reevaluated after surcharging is completed. (Dynamic compaction is not proposed as a ground-improvement technique.)
6	Page 5, State why the design intent is to only excavate to elevation 60. Provide background regarding the selection of 60 feet as well as why the overexcavation cannot extend past 60 feet.	As discussed during our Thursday, February 11, 2021 teleconference, we are prohibited from excavating below elevation 60 feet (NAVD88).
7	Page 5, What is "worst-case 5% consolidation" based on? Provide data and analysis for this.	Undocumented fill left in place below elevation 60 feet (NAVD88) is fat clay, not submerged. This material may actually expand when wetted (rather than consolidate). But since we are prohibited from sampling this material, this is a geotechnical hypothesis based on soil classification. This is basically a moot question since we will know the amount of consolidation observed during our measurements and documentation of surcharging these soils in-situ.
8	Page 5, provide data to support the statement "negligible settlement in native sands".	Dibblee (DF-70, 1999) regionally maps this site as "*older stabilized dune and drift sand*" (Qos) as a Pleistocene (older indurated) deposit. At depths >15 feet in the Southern California Geotechnical 2018 borings, N-values predominantly >30 were reported (very dense).
9	Page 6, What are the "environmental considerations" leading to design team limiting overexcavation.	This was discussed during our Thursday, February 11, 2021 teleconference.
10	Page 6, Additional information should be provided as data to delineate the northwest edge of the fill/surcharge berm	Please note the topography at this location (see Plate 2; please zoom in). This is the northwestern edge of the borrow pit, with a steep ascending slope that can be visually logged as native indurated dune sands. Based on geomorphology, the limits of fill is obvious here.
11	There does not appear to be a Comment 11.	
12	Page 7, Please provide an approximate minimum settlement rate over time that determines when the "diminished asymptotic settlement" has been achieved.	Our surcharge analyses will be generally as depicted as Figure 10 of the August 2012 version of Caltrans CTM 112 (see: https://dot.ca.gov/-/media/dot-media/programs/engineering/documents/californiatestmethods-ctm/ctm-112-a11y.pdf). We had discussed we would want to see <¼-inch additional settlement over a month, but the shape of the consolidation/settlement curve (once full surcharge is applied) is important. Drawing tangent lines for a time interval including full surcharge will be evaluated.
13	Page 8, Onsite soils were stated to be expansive fat clay. Are these soils an acceptable "Material for Fill" throughout the site at any depth? Will this material need to be processed and moisture conditioned within a specified range over optimum?	Compacted fill soil requirements were stipulated in our "*Material for Fill*" section at the bottom of page 8 of our July 22, 2020 GDM. We recommended a PI≤15 and an IE≤30 for proposed compacted fill.
14	Page 9, Please clarify why the bottom of the overexcavation is at elevation 60 feet, See Comment #6 above.	See our response to Comment 6, above.
15	Page 9, Provide recommended minimum vertical or horizontal distances for the benches.	We recommended 5-feet of overexcavation under the whole warehouse footprint. Benching into side slopes of the borrow pit should be in accordance with Appendix J, Section J107.3 and Figure J107.3 of the 2019 California Building Code (CBC). Fill placed in the borrow pit will be constrained on all sides as filling in a hole.
16	Page 10, Were there any lab testing or calculations performed to provide the minimum allowable surcharge time of 6 months.	No laboratory tests were performed to measure consolidation potential in these deeper soils. As discussed during our Thursday, February 11, 2021 teleconference, we are prohibited from excavating below elevation 60 feet (NAVD88), which prohibits us from sampling these deeper soils. We believe this to be a moot issue since measuring surcharge settlement will provide settlement characteristics of these soils in-situ.
17	Page 10, Please provide an approximate settlement rate that determines "diminished asymptotic settlement". Same as Comment #10 above	See our response to Comment 12, above.
18	Page 13, Is this report for final design as presented on Page 1 or is additional settlement analysis required as presented on Page 13? Please clarify.	See our response to Comment 1, above. In addition, geotechnical review of grading and foundation plans is always recommended. Note that Prologis has coordinated geotechnical, structural and civil design since July 2020.

TABLE OF REVIEW COMMENTS, TORRANCE (TBB) SITE

Number	Comment	Response
1	**Section 3.2**. Based on test pits/borings excavated at the site, the deepest location of fill observed is approximately 10 feet below the 60-foot excavation threshold. Clarify whether the fill is expected to extend deeper than 10 feet elsewhere in the Borrow Pit area.	Yes, the deepest fill encountered was in LB-8, extending down to elevation 50 feet near the center of the partially-filled borrow pit as interpreted in section view on Plate 2. Based on geomorphology (shape of the borrow pit), we do not expect existing fill to extend deeper elsewhere. When standing in the pit, native sands can be seen rising in cut slopes around the perimeter of this existing pit. Surface extent of clay fill in contrast to native sands can be easily mapped in the pit. There have been 16 borings and six test pits excavated in the pit to adequately characterize this fill extent.
2	**Section 3.2**. There appears to be variability in the fill thickness and consistency. Provide additional justification for the use of 4% strain for the settlement estimates. Additionally, comment on how the potential variability could affect the proposed structure.	Inherent nature of undocumented fill is that compressibility is variable and indeterminate. But, having said that, 4% consolidation is a very conservative assumption. In fact, this clay could be expansive. In any event, remaining consolidation potential will be empirically removed by over-consolidating this clay with a surcharge that weighs more than the structure. This existing fill thickness does vary from 10-feet thick in the center to zero at the perimeter.
3	**Section 3.2**. The report states that 40 feet of fill creates 4 ksf of surcharge. Therefore, it appears that 100 pcf is being used as the total unit weight for the new fill. Please provide supporting data that justifies an average total unit weight of 100 pcf based on the compaction criteria in the report. If the new compacted fill is anticipated to be more than 100 pcf, provide revised settlement estimates.	Yes, 100 pounds-per-cubic-foot (pcf) density for compacted fill and surcharge was a demonstrative conservative estimate. Moist compacted fill will be denser and provide a greater surcharge, which is beneficial for quicker and more extensive surcharge and consolidation. We could assume 120 pcf as a less-conservative approach.
4	**Section 3.2**. Differential settlement of 4.8 inches over 53 feet is not in conformance with the Administrative Manual GS 045.0 for the County of Los Angeles.	This differential settlement will be mitigated by pre-surcharging the existing fill before this warehouse is constructed.
5	**Section 3.2**. Will the reported building slab load (an aerial load) of 1,000 psf induce additional settlement of the remaining undocumented fill? If so, please provide revised settlement estimates.	It will to a lesser-extent as a live load, but this has been accommodated with the fill surcharge loading proposed.
6	**Section 3.2**. Tolerable settlements for similar concrete tilt-up warehouses are typically 1 inch of total settlement with ½ inch of differential settlement over 40 feet. 4.8 inches of differential settlement is excessive for a concrete tilt up structure. Will the developer select the surcharge option to mitigate the excessive differential settlement.	Yes, that is the design intent.
7	**Section 3.2**. Compacted fill will settle under its own weight. Provide comment on the anticipated total settlement of the approximately 40 feet of new compacted fill and revise the settlement estimates, as needed. If the fill thickness varies across the pad, provide a discussion of anticipated thickness, and total and differential settlement.	This should be about 2.4 inches, which will occur rapidly in dry sand and is to be consolidated with the overlying surcharge along with the underlying clay.
8	Provide a discussion of total and differential settlement for surcharged (if selected) vs. non-surcharged areas within the building pad.	Native sands are expected to have modest settlement (1-inch total and ½-inch differential within a column bay width) relative to the filled borrow pit. This is why overexcavation is recommended for the whole warehouse footprint overlying both conditions. However, fill to native differential settlement will be mitigated by surcharge.
9	**Section 3.3.5**. Provide supplemental information regarding the location and number of settlement monuments to be installed.	Geotechnical design input for this proposed surcharge was presented in our July 22, 2020 "*Geotechnical Design Memorandum*."
10	The approximate limits of the surcharge should be presented on Plate 1 or as a supplemental plate.	
11	Provide the significance of Elevation 52.5 feet MSL shown on Plate 2. Old fill appears to go deeper than Elevation 52.5 feet.	That is solely a spot elevation and not globally relevant since fill thickness is variable as a lens or shallow "bowl."
12	Appendix A and B: Based on our review of the boring logs, there are samples with lower blow counts beneath Elevation 60 feet with no consolidation testing. Please provide information why the samples with lower blow counts were not selected. Please comment on the selection of the samples tested.	Samples from Borings LB-1 through LB-5 were stolen from our locked cage in Irvine. We could only test samples from redrilled borings LB-6 through LB-10. (We have never experience soil samples being stolen before and acknowledge this is very unusual.) Viable clay samples with the lowest blow counts from Borings LB-6 through LB-10 were tested. Note that shallower samples that were above elevation 60 feet will be excavated and recompacted, so consolidation tests were not run on those samples. Sandier samples were also not run since they will consolidate quicker than clay.

APPENDIX D

EARTHWORK AND GRADING GUIDE SPECIFICATIONS

APPENDIX D

LEIGHTON CONSULTING, INC.
EARTHWORK AND GRADING GUIDE SPECIFICATIONS

TABLE OF CONTENTS

Section		Appendix D Page
D-1.0	**GENERAL**	**1**
D-1.1	Intent	1
D-1.2	Role of Leighton Consulting, Inc.	1
D-1.3	The Earthwork Contractor	1
D-2.0	**PREPARATION OF AREAS TO BE FILLED**	**2**
D-2.1	Clearing and Grubbing	2
D-2.2	Processing	3
D-2.3	Overexcavation	3
D-2.4	Benching	3
D-2.5	Evaluation/Acceptance of Fill Areas	3
D-3.0	**FILL MATERIAL**	**4**
D-3.1	Fill Quality	4
D-3.2	Oversize	4
D-3.3	Import	4
D-4.0	**FILL PLACEMENT AND COMPACTION**	**4**
D-4.1	Fill Layers	4
D-4.2	Fill Moisture Conditioning	5
D-4.3	Compaction of Fill	5
D-4.4	Compaction of Fill Slopes	5
D-4.5	Compaction Testing	5
D-4.6	Compaction Test Locations	6
D-5.0	**EXCAVATION**	**6**
D-6.0	**TRENCH BACKFILLS**	**6**
D-6.1	Safety	6
D-6.2	Bedding and Backfill	6
D-6.3	Lift Thickness	7

D-1.0 GENERAL

D-1.1 Intent

These *Earthwork and Grading Guide Specifications* are for grading and earthwork shown on the current, approved grading plan(s) and/or indicated in the Leighton Consulting, Inc. geotechnical report(s). These Guide Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the project-specific recommendations in the geotechnical report shall supersede these Guide Specifications. Leighton Consulting, Inc. shall provide geotechnical observation and testing during earthwork and grading. Based on these observations and tests, Leighton Consulting, Inc. may provide new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

D-1.2 Role of Leighton Consulting, Inc.

Prior to commencement of earthwork and grading, Leighton Consulting, Inc. shall meet with the earthwork contractor to review the earthwork contractor's work plan, to schedule sufficient personnel to perform the appropriate level of observation, mapping and compaction testing. During earthwork and grading, Leighton Consulting, Inc. shall observe, map, and document subsurface exposures to verify geotechnical design assumptions. If observed conditions are found to be significantly different than the interpreted assumptions during the design phase, Leighton Consulting, Inc. shall inform the owner, recommend appropriate changes in design to accommodate these observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include (1) natural ground after clearing to receiving fill but before fill is placed, (2) bottoms of all "remedial removal" areas, (3) all key bottoms, and (4) benches made on sloping ground to receive fill.

Leighton Consulting, Inc. shall observe moisture-conditioning and processing of the subgrade and fill materials, and perform relative compaction testing of fill to determine the attained relative compaction. Leighton Consulting, Inc. shall provide *Daily Field Reports* to the owner and the Contractor on a routine and frequent basis.

D-1.3 The Earthwork Contractor

The earthwork contractor (Contractor) shall be qualified, experienced and knowledgeable in earthwork logistics, preparation and processing of ground to

receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Guide Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing grading and backfilling in accordance with the current, approved plans and specifications.

The Contractor shall inform the owner and Leighton Consulting, Inc. of changes in work schedules at least one working day in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that Leighton Consulting, Inc. is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish earthwork and grading in accordance with the applicable grading codes and agency ordinances, these Guide Specifications, and recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of Leighton Consulting, Inc., unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, adverse weather, etc., are resulting in a quality of work less than required in these specifications, Leighton Consulting, Inc. shall reject the work and may recommend to the owner that earthwork and grading be stopped until unsatisfactory condition(s) are rectified.

D-2.0 PREPARATION OF AREAS TO BE FILLED

D-2.1 Clearing and Grubbing

Vegetation, such as brush, grass, roots and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies and Leighton Consulting, Inc.. Care should be taken not to encroach upon or otherwise damage native and/or historic trees designated by the Owner or appropriate agencies to remain. Pavements, flatwork or other construction should not extend under the “drip line” of designated trees to remain.

Leighton Consulting, Inc. shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 3 percent of organic materials (by dry weight: ASTM D2974). Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed

immediately for proper evaluation and handling of these materials prior to continuing to work in that area. As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

D-2.2 Processing

Existing ground that has been declared satisfactory for support of fill, by Leighton Consulting, Inc., shall be scarified to a minimum depth of 6 inches (15 cm). Existing ground that is not satisfactory shall be over-excavated as specified in the following Section C-2.3. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

D-2.3 Overexcavation

In addition to removals and over-excavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be over-excavated to competent ground as evaluated by Leighton Consulting, Inc. during grading. All undocumented fill soils under proposed structure footprints should be excavated

D-2.4 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), (>20 percent grade) the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet (4.5 m) wide and at least 2 feet (0.6 m) deep, into competent material as evaluated by Leighton Consulting, Inc.. Other benches shall be excavated a minimum height of 4 feet (1.2 m) into competent material or as otherwise recommended by Leighton Consulting, Inc.. Fill placed on ground sloping flatter than 5:1 (horizontal to vertical units), (<20 percent grade) shall also be benched or otherwise over-excavated to provide a flat subgrade for the fill.

D-2.5 Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by Leighton Consulting, Inc. as suitable to receive fill. The Contractor shall obtain a written acceptance (*Daily Field Report*) from Leighton

Consulting, Inc. prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys and benches.

D-3.0 FILL MATERIAL

D-3.1 Fill Quality

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by Leighton Consulting, Inc. prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to Leighton Consulting, Inc. or mixed with other soils to achieve satisfactory fill material.

D-3.2 Oversize

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 6 inches (15 cm), shall not be buried or placed in fill unless location, materials and placement methods are specifically accepted by Leighton Consulting, Inc.. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 feet (3 m) measured vertically from finish grade, or within 2 feet (0.61 m) of future utilities or underground construction.

D-3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of Section C-3.1, and be free of hazardous materials ("contaminants") and rock larger than 3-inches (8 cm) in largest dimension. All import soils shall have an Expansion Index (EI) of 20 or less and a sulfate content no greater than ($\leq$) 500 parts-per-million (ppm). A representative sample of a potential import source shall be given to Leighton Consulting, Inc. at least four full working days before importing begins, so that suitability of this import material can be determined and appropriate tests performed.

D-4.0 FILL PLACEMENT AND COMPACTION

D-4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill, as described in Section C-2.0, above, in near-horizontal layers not exceeding 8 inches (20 cm) in loose thickness. Leighton Consulting, Inc. may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers, and

only if the building officials with the appropriate jurisdiction approve. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

D-4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM) Test Method D1557.

D-4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, each layer shall be uniformly compacted to not-less-than (≥) 90 percent of the maximum dry density as determined by ASTM Test Method D1557. In some cases, structural fill may be specified (see project-specific geotechnical report) to be uniformly compacted to at-least (≥) 95 percent of the ASTM D1557 modified Proctor laboratory maximum dry density. For fills thicker than (>) 15 feet (4.5 m), the portion of fill deeper than 15 feet below proposed finish grade shall be compacted to 95 percent of the ASTM D1557 laboratory maximum density. Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

D-4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by back rolling of slopes with sheep's-foot rollers at increments of 3 to 4 feet (1 to 1.2 m) in fill elevation, or by other methods producing satisfactory results acceptable to Leighton Consulting, Inc.. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of the ASTM D1557 laboratory maximum density.

D-4.5 Compaction Testing

Field-tests for moisture content and relative compaction of the fill soils shall be performed by Leighton Consulting, Inc.. Location and frequency of tests shall be at our field representative(s) discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

D-4.6 Compaction Test Locations

Leighton Consulting, Inc. shall document the approximate elevation and horizontal coordinates of each density test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that Leighton Consulting, Inc. can determine the test locations with sufficient accuracy. Adequate grade stakes shall be provided.

D-5.0 EXCAVATION

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by Leighton Consulting, Inc. during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by Leighton Consulting, Inc. based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, then observed and reviewed by Leighton Consulting, Inc. prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by Leighton Consulting, Inc..

D-6.0 TRENCH BACKFILLS

D-6.1 Safety

The Contractor shall follow all OSHA and Cal/OSHA requirements for excavation safety. Work should be performed in accordance with Article 6 of the *California Construction Safety Orders*, 2015 Edition or more current (see also: http://www.dir.ca.gov/title8/sb4a6.html).

D-6.2 Bedding and Backfill

All utility trench bedding and backfill shall be performed in accordance with applicable provisions of the 2021 Edition of the *Standard Specifications for Public Works Construction* (Green Book). Bedding material shall have a Sand Equivalent (SE) greater-than 30 (SE>30). Bedding shall be placed to 1-foot (0.3 m) over the top of the conduit, and densified by jetting in areas of granular soils, if allowed by the permitting agency. Otherwise, the pipe-bedding zone shall be backfilled with Controlled Low Strength Material (CLSM) consisting of at least one sack of Portland cement per cubic-yard of sand, conforming to Section 201-6 of the 2021 Edition of the *Standard Specifications for Public Works Construction* (Green Book). Backfill over the bedding zone shall be placed and densified mechanically to a minimum of 90 percent of relative compaction (ASTM D1557) from 1 foot (0.3 m) above the top of the conduit to the surface. Backfill above the pipe zone shall **not** be jetted. Jetting of the bedding around the conduits shall be observed by Leighton

Consulting, Inc. and backfill above the pipe zone (bedding) shall be observed and tested by Leighton Consulting, Inc..

D-6.3 Lift Thickness

Trench backfill, and engineered fill of any kind, lift thickness shall not exceed those allowed in the 2021 Edition of the *Standard Specifications for Public Works Construction* (Green Book); unless the Contractor can demonstrate to Leighton Consulting, Inc., the Owner **and** the appropriate-jurisdiction building official that fill lifts can be consistently compacted to specified relative compaction using alternative equipment and methods intended for production earthwork.

APPENDIX E

GBA'S IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

Copyright 2019 by Geoprofessional Business Association (GBA). Duplication, reproduction, or copying of this document, in whole or in part, by any means whatsoever, is strictly prohibited, except with GBA's specific written permission. Excerpting, quoting, or otherwise extracting wording from this document is permitted only with the express written permission of GBA, and only for purposes of scholarly research or book review. Only members of GBA may use this document or its wording as a complement to or as an element of a report of any kind. Any other firm, individual, or other entity that so uses this document without being a GBA member could be committing negligent or intentional (fraudulent) misrepresentation.