REPORT

Sunnymead MDP Line F and F-7 Flood Control Improvement Project, City of Moreno Valley

Geotechnical Exploration and Recommendations

Submitted to:

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1.0 INTRODUCTION

This report presents the results of a geotechnical exploration performed by WSP USA Earth & Environment (WSP) to support the design of the Riverside County Flood Control and Water Conservation District (RCFCD) Sunnymead MDP Line F and F-7 Flood Control Improvement project (referred to as "the Project") located in the City of Moreno Valley, California (referred to as "the Site").

Our recommendations presented herein are primarily based on the recent subsurface exploration, our experience working on similar projects, and the provisions of the 2022 California Building Code (CBC).

1.1 Use of this Report

This report pertains only to the proposed drainage improvements shown in "Riverside County Flood Control and Water Conservation District, Contract Drawings, Sunnymead Boulevard, Sunnymead MDP Line F and F-7, October 2020," herein referred to as "design plans". The proposed improvements are described in Section 2.0. Appendix D has further information regarding the proper use and interpretation of this geotechnical report. The general project location relative to the surrounding geography is presented in Figure 1.

2.0 PROJECT UNDERSTANDING AND SITE CONDITIONS

WSP understands that RCFCD plans to improve the condition of a flood control corridor within the City of Moreno Valley. The purpose of the proposed improvements is to enhance the overall drainage within this corridor by constructing new storm drain infrastructure and regrading an existing flood control channel (also referred to as a natural habitat channel). Based on our review of the 60% design drawing set prepared by WSP, the Project will include the following primary components:

1) Construct approximately 4,500 lf of 48- to 72-inch diameter reinforced concrete pipe (RCP). About 1,000 lf will be constructed along Hemlock Avenue.

2) Construct one stormwater infiltration basin within the existing flood control channel.

3) Regrade the existing flood control channel to accommodate the infiltration basins and an access road along the RCP storm drain alignment.

4) Jack and Bore approximately 250 lf of the proposed RCP storm drain below State Route 60 (SR 60).

5) Construct various ancillary storm drain components (e.g., catch basins, manholes, etc.).

The site conditions vary significantly along the proposed Project alignment as summarized below:

- **Southern Segment (~2,000 lf)** - the southern segment is comprised of the existing natural flood control channel. The channel is moderately vegetated, varies in width, and is bounded by a residential development to the east and west. The channel appears to drain from north to south and connects an existing concrete-lined channel at the southern end. An existing 18-inch diameter sewer line is located along the eastern edge of the channel.
- **Middle Segment (~1,300 lf)** - the middle segment includes Sunnymead Boulevard, an undeveloped parcel of land, SR 60, and an existing apartment complex. The undeveloped parcel of land appears to be relatively flat with little vegetation. The apartment complex is comprised of one- and two-story buildings, landscaped areas, and paved parking and access roads. The southern portion of the apartment complex is undeveloped with moderate vegetation and bounded by a Caltrans sound wall (retaining wall).

- **Northern Segment (1,000 lf)** - the northern segment traverses along Hemlock Avenue and extends to the intersection of Hemlock Avenue and Graham Street. Hemlock Avenue is an east-west two-lane arterial.

3.0 FIELD EXPLORATION AND LABORATORY TESTING

WSP performed a geotechnical field exploration at the Site to support the design of the proposed development. The geotechnical field exploration consisted of the following four components:

1) Pre-field Activities
2) Soil Borings
3) Percolation Testing
4) Laboratory Testing

3.1 Pre-Field Activities

WSP performed a preliminary field reconnaissance to mark out the proposed boring locations and notified DigAlert (i.e. the 811 call center) of the proposed boring locations, as required by law. The entrance of the Site was cleared by the current owners of the private properties within the project limits, and the proposed boring locations were cleared by DigAlert. In addition to DigAlert, WSP subcontracted a private utility locator to identify subsurface utilities at each boring location prior to drilling as required by WSP's Ground Disturbance Procedures. WSP's field engineer accompanied the private utility locator.

3.2 Soil Borings

A combination of hand-augering and air knifing was performed from ground surface to 10 feet below ground surface (ft-bgs) to expose any possible underground utilities for borings B-1 through B-3. All other borings were hand augered from the ground surface to 5 ft-bgs. No nearby utilities were observed immediately around the borehole locations. As hand-augering was performed, bulk samples were collected for laboratory testing, and the field engineer noted changes in the material in the boring logs (Appendix A).

WSP's geotechnical field exploration for this project consisted of advancing 13 borings (B-1 through B-13) using a truck-mounted hollow stem auger drill rig. Borings B-1 through B-3 were completed between April 11, 2022 and April 15, 2022. Borings B-4 through B-13 were completed between December 6, 2022 and December 8, 2022. The borings were drilled by ABC Liovin Drilling, Inc (ABC Liovin) of Signal Hill, California, under subcontract to WSP. The approximate coordinates of the borings and depths drilled are provided in Table 1. The exploration locations are shown in Figure 2.

Table 1: Summary of Borings

Boring ID	Approximate Station[1]	Depth (feet)
B-1	STA 02+50	26.5
B-2	STA 10+00	26.5
B-3	STA 15+00	31.5
B-4	STA 20+00	51.5
B-5	STA 25+00	41.5
B-6	STA 27+50	26.5

Boring ID	Approximate Station[1]	Depth (feet)
B-7[2]	STA 32+50	21.5
B-8	STA 32+50	41.5
B-9[2]	STA 32+50	16.5
B-10	STA 35+00	16.5
B-11	STA 40+00	16.5
B-12	STA 45+00	16.5
B-13	STA 49+30	31.5

Notes:

1. Station numbers are approximate and are based on the stationing provided on the 60% design drawings
2. Percolation tests were performed at borings B-7 and B-9 as discussed in Section 3.3

Soil samples were primarily obtained using either a standard penetration test (SPT) split spoon sampler or a Modified California (MC) split barrel sampler. The SPT sampler consisted of a two-inch outside diameter (O.D.), 1.4-inch inside diameter (I.D.) split barrel while the MC sampler consisted of a three-inch O.D., 2.4- inch I.D. split barrel. The interior of the MC split barrel sampler was lined with one 2.4-inch diameter, 6-inch long brass ring and twelve 2.4-inch diameter, 1-inch long brass rings to retain soil for certain laboratory tests as well as visual classification in the field. Soils collected inside the SPT samplers were visually classified in the field, placed in sealed plastic bags, and stored for future reference and laboratory testing. Both samplers were driven a total of 18 inches into the soil at the bottom of the boring (or until refusal, where refusal was taken as 50 blows for 6 inches or less). Disturbed bulk soil samples within the upper 45 feet of the borings were also collected from the auger cuttings and/or near-surface hand-augering.

Both the MC and SPT samplers were driven into the soil using an automatic 140-pound hammer free-falling a vertical distance of 30-inches. The total number of hammer blows required to drive the sampler the final 12 inches is termed the standard penetration resistance (N) value. The procedures employed in the field were generally consistent with those described in ASTM D1586.

Appendix A contains the logs for the soil borings (Report of Borehole). The logs show the soils encountered, N-values, and the locations of samples. The logs also show the boring number, drilling date, and the name of the WSP field engineer who logged the boring. The soils were described in general accordance with ASTM D2487 (i.e., the Unified Soil Classification System). The boundaries between different soil/rock types shown on the logs are approximate because the actual transition between layers may be gradual.

Upon reaching termination depths, each boring was backfilled with soil cuttings from the drilling and compacted with a downhole hammer. The surface at borings B-1 through B-3 was restored using asphalt cold patch the surface at borings B-4 through B-13 was restored by matching the surrounding native topsoil grades.

3.3 Soil Percolation

Soil percolation testing was performed in borings B-7 and B-9 on December 6, 2022, following the guidelines set forth by the RCFCD (2011). Upon reaching termination depth, each respective boring was prepared for percolation testing. B-7 and B-9 were drilled to a depth of 21.5 ft-bgs and 16.5 ft-bgs, respectively. Approximately 2 to 4 inches of #2 sand was placed at the bottom of the boring followed by the insertion of a 2-inch diameter PVC

casing down the center of the boring. The PVC casing consisted of 5-foot to 10-foot long flush-threaded PVC pipe sections with the bottom 10-foot section having 0.02-inch slots (the remaining length of the casing was solid). After setting the casing, additional sand was poured into the boring to fill the annular space between the PVC casing and the boring walls to approximately 6 feet above the bottom of the casing. The sand and casing were installed in the boring through the hollow stem auger.

After the hollow stem auger was completely removed from the borings, each boring was pre-soaked. The pre-soak process consisted of pouring clean water down the casings of the borings until the water level in each boring was approximately 6 to 8 feet above the bottom. In both percolation test locations, WSP observed two consecutive measurements of over 6 inches of water seepage in less than 25 minutes. Per RCFCD test, the test locations met the sandy soil criteria so overnight pre-soaking was not required.

Therefore, the tests were immediately run for an additional hour with measurements taken every 10 minutes. At the end of the pre-soak and each 10-minute time interval, additional clean water was poured down the PVC casing to raise the water level in the boring to approximately its original level. At the beginning and end of each 10-minute interval, the water level in the boring was measured using an electronic water level indicator along with a fixed reference point (i.e., the top of the PVC casing) from which to measure the depth to water. Measurements were taken with a precision of 0.01 foot. At the start of the percolation test readings, the height of the water column in the boring was at least 8.8 feet above the bottom of the boring in B-7 and 8.3 feet in B-9.

Upon the completion of the percolation tests, the PVC casings were removed from the borings and they were completely backfilled as described above. The surface at each boring location was patched to match original conditions with native topsoil. The measured percolation rates calculated for each boring are shown on the percolation test data sheets presented in Appendix C. Recommendations for the design of infiltration structures are presented in Section 6.3.

3.4 Laboratory Testing

Representative soil samples retrieved during WSP's limited field exploration were selected by WSP and transported to a geotechnical laboratory for testing. The laboratory testing was performed by Hushmand Associates, Inc. (HAI) of Irvine, California, for the purposes of substantiating visual field classifications and estimating engineering parameters. Laboratory testing consisted of particle size analysis (ASTM D6913), Atterberg Limits (ASTM D4318), and corrosivity potential (ASTM G187, D516, D512B, G51). The geotechnical laboratory test results are provided in Appendix B.

4.0 TECTONIC AND GEOLOGIC SETTING

4.1 Physiography

The subject site is located east of Riverside in the northern extent of the Peninsular Ranges Geomorphic province of California (CGS 2002). The mountain ranges are comprised of uplifted blocks of granitic rock that form the Peninsular Ranges batholith, a large intrusion of igneous rock that solidified below the Earth's crust about 100 million years ago. Uplift and downwarping within the province over the last 15 million years formed deep basins that rapidly filled with sediments eroded from the mountains. The subject site is located within the northern limits of Moreno Valley, one such basin within the province.

The project alignment begins north of Highway 60 and east of Pidgeon Pass Road along Hemlock Avenue (east to west) then extends south and southwest for about 0.6 miles (1 km) to the proposed basin just north of Adeline Avenue in Moreno Valley, California. The Box Springs plutonic complex, a Cretaceous aged assemblage of

granitic rocks of varying composition, makes up the Box Springs Mountains north-northwest of the Site. In this area, very old alluvial fan deposits (early Pleistocene) emanating from the southeastern exposure of the Box Springs Mountains descend toward the southeast as they extend past the proposed alignment. These alluvial fans are composed of silts, sands, and gravels formed by the disintegration of the exposed granitic rocks (Morton and Cox 2001a,b) (Figure 3).

4.2 Tectonic Setting

The Peninsular Ranges are transected by several right-lateral strike-slip faults and fault zones that extend subparallel to the San Andreas fault (SAF) system, the primary boundary between the Pacific and North America tectonic plates. From west to east, these faults include the Newport-Inglewood fault which extends through western Los Angeles and coastal Orange County, the Elsinore fault, which extends from the southeastern base of the Chino Hills to the north, to the Mexican border about 25 miles (40 km) west of Calexico and the San Jacinto fault. The San Jacinto fault is the closest of these faults to the Site and extends southward from its intersection with the SAF in northern San Bernardino, west of the Salton Sea to El Centro near the Mexican border. The SAF extends from the Mendocino Triple Junction in northern California, southward through San Francisco and the Coastal Ranges in central California, along the western extent of the Mojave Desert and through eastern Coachella Valley before transitioning to the transform fault system within the Sea of Cortez, Mexico. In southern California, the SAF separates the Mojave Desert from both the Peninsular Ranges and the Colorado Desert (Coachella Valley).

4.3 Regional Geology

The Site is located in Moreno Valley, a relative low stand bounded on the north by the Box Springs mountains (characterized as a granitic diaper inclusive of tonalite, granodiorite, and gabbro deposits) and on the east by the San Jacinto Mountains block (characterized by granitic rocks of the Peninsular Ranges batholith in addition to Plio-Pleistocene aged clastic sedimentary rocks). South of the Box Springs mountains and west of the San Jacinto fault, the valley is filled with Pleistocene age fluvial deposits which gently descend in elevation from northwest to southeast.

4.4 Site Geology

The surficial geology along the proposed structure alignment site has been mapped by Morton and Cox (2001a,b) as "very old alluvial fan deposits" of early Pleistocene age consisting of reddish-brown, indurated and dissected sandy deposits with duripans (soil horizon cemented with silica into a hardpan) and silicretes (sand and gravel zones cemented by dissolved silica). Bedrock does not crop out at the Site but is located at the ground surface within about 1,100 ft (330 m) west of the Site (Figure 3).

4.5 Historical Earthquakes and Active Faults

4.5.1 Earthquakes

The Site is located in Southern California within an active tectonic regime. Figure 4 shows major fault zones and historic earthquake epicenters within about 62 miles (100 km) of the Sunnymead site. Instrumental and reported historic records from the early 20th century through February 1, 2023, reveal that more than 4,600 earthquakes with moment magnitudes (**M**) greater than **M**3.0 have been recorded and reviewed within this radius. Earthquake epicenter locations and magnitudes were taken from the Advanced National Seismic System Catalog (ANSS CatCom) (USGS 2017). Of these recorded earthquakes, 75 have exceeded **M**5.0 the most recent in June 2016. The largest earthquake recorded within 62 miles (100 km) of the Site was the Landers Earthquake, an **M**7.3 event

in June 1992 located about 50 miles (81 km) to the northeast of the site improvements (Figure 4). The closest recorded event to the Site above **M**5 was an **M**6.2 earthquake in July 1923 located about 10.2 miles (16.4 km) north of the Site within the city of San Bernardino (Figure 4).

4.5.2 Active Faults

The Peninsular Ranges of Southern California (CGS 2002) are transected by several right-lateral strike-slip (RLSS) fault zones that extend subparallel to the San Andreas fault (SAF) system. These include the San Jacinto fault, the Elsinore fault, and the Newport-Inglewood fault zone, among others. The Site is located between the Elsinore and San Jacinto fault systems, about 5 miles (8 km) southwest of the San Jacinto fault (Figure 4). This fault system extends southwestward from its junction with the SAF near Cajon Pass, along the western margin of the Salton Sea trough toward Calexico/Mexicali at the U.S./Mexico border and the Gulf of California, a distance of more than 150 miles (235 km).

The Site is specifically located within the Perris Block, a tectonically stable region bounded by the Chino fault and Elsinore trough on the west, the San Jacinto fault zone to the east and northeast, the Cucamonga fault to the north, and the San Filipe fault zone to the south (CGS 2002). The Perris Block has been uplifted and is characterized as an eroded mass of both Cretaceous and older intrusive rocks of the Southern California Batholith and metasedimentary basement rocks (Morton and Cox 2001a,b). Because of an unusual pattern of oscillatory uplift and erosion through the last 20 million years or so, the Perris Block shows little of the northwest-trending structural grain typical of the Peninsular Ranges Geomorphic Province. Instead, the Perris Block has developed isolated and randomly oriented ridges composed of crystalline and metamorphic rock separated by wide and flat alluvial basins.

4.6 Geologic Hazards

4.6.1 Surface Fault Rupture

Based on the mapped location of the San Jacinto Fault Zone and our review of the Special Studies Zones map of the Sunnymead quadrangle (CDMG 1974), the Site is not located within a State of California Alquist-Priolo Earthquake Fault Zone. Therefore, the likelihood of surface fault rupture at the Site is low.

4.6.2 Landslide Hazards

The Site is relatively flat and located in a central portion of Moreno Valley. The surrounding areas are fully developed and generally characterized by gently sloping topography that is not expected to be susceptible to landslides. There are no known landslides near the Site, nor is the Site in the path of any known or potential landslides. Hence, the likelihood of landslides at the Site is very low.

4.6.3 Liquefaction Potential

The Site is not located within an area mapped as a potential liquefaction zone by the City of Moreno Valley (CMV 2017). As discussed in Section 5.2, the groundwater at the Site is likely at least 80 ft-bgs. Furthermore, the Site is primarily underlain by dense sands and gravels and very stiff clays. On this basis, the liquefaction potential of the earth materials underlying the Site is considered to be negligible. Similarly, seismic compaction settlements of the unsaturated subsurface materials underlying the Site are anticipated to be insignificant due to the generally dense/stiff nature of the subsurface soils.

4.6.4 Tsunamis, Seiches, and Flooding

Tsunamis are very large waves in the ocean caused by undersea earthquakes, landslides, or volcanic eruptions. The Site is located over 40 miles from the Pacific Ocean at an elevation of at least 1,615 feet above mean sea level. Therefore, tsunami hazards are not significant at the Site.

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures or land-locked bodies of water are located immediately upgradient from the Site. In addition, the Site is not located within a Federal Emergency Management Agency (FEMA) flood hazard zone. Therefore, the risk of seiches and flooding at the Site is considered to be minimal.

5.0 SUBSURFACE CONDITIONS

5.1 Observed Soil Conditions

A summary of the soils encountered along the alignment is provided below. Refer to the borehole logs in Appendix A for additional detail.

- **Northern Segment Along Hemlock Avenue (Borings B-1 to B-3):** In general, 3 to 6.5 inches of asphalt overlying 4 to 5 inches of base was encountered in the borings along Hemlock Avenue. A 5-inch thick layer of concrete pavement was encountered below the asphalt and above the road base in boring B-2. Below the asphalt and road base, medium dense to very dense clayey sand with trace gravel was encountered.
- **Middle Segment (Borings B-4 to B-6):** In general, interbedded layers of clayey sand and poorly graded sand with varying amounts of gravel were encountered in the middle segment of the alignment. These soils are generally medium dense to dense.
- **Southern Segment (Borings B-7 to B-13):** In general, interbedded layers of clayey sand and poorly graded sand with varying amounts of gravel were encountered in the southern segment of the alignment. These soils are medium dense to dense. Loose clayey sand was encountered at 5 ft-bgs in borings B-8 and B-11.

These subsurface conditions represent a simplified stratigraphy of the Site based on the current subsurface exploration and laboratory results described herein. Conditions different from those described above and presented in Appendix A may be encountered during site excavations/grading. Because of the nearly random depositional environment of the soils underlying the Site as the nearby hills were eroded, significant lateral variability in the soils should be anticipated. Although fill was not encountered in any of the borings, the urban environment surrounding the Site suggests that fill soils could be present along the proposed alignment.

5.2 Groundwater Conditions

Groundwater was not encountered during our field investigation. However, WSP reviewed publicly available groundwater data from nearby wells from the California Department of Water Resources (DWR) Water Data Library WDL (DWR 2020). The nearest groundwater wells are located about 0.75 miles (1.2 km) east of proposed alignment and indicate that the regional groundwater flows toward the south-southwest and varies between 80 and 90 ft-bgs. Seasonal fluctuations in groundwater elevation should be expected in the alluvial soils encountered at the Site. Due to the granular nature of the soils underlying the project, perched groundwater conditions are not likely, but could be possible.

6.0 GEOTECHNICAL RECOMMENDATIONS

This section presents preliminary recommendations for the design of the proposed improvements.

6.1 Seismic Design

As with all of Southern California, the Site is exposed to strong earthquake ground motions (e.g., the 1994 Northridge Earthquake). The 2022 California Building Code (CBC) seismic parameters are spectral accelerations (5%-damped) for 0.2 seconds (S_S) and 1 second (S_1) for an outcropping weak rock site (i.e., CBC 2022 soil Site Class B). These spectral accelerations are established for a risk-adjusted Maximum Considered Earthquake (MCE_R). The MCE_R spectral accelerations have a mean return period of 2,475 years (i.e., 2% probability of being exceeded in 50 years). At some locations near active faults, the 2,475-year accelerations can be capped by deterministically-evaluated ground motions.

For this study, the S_S and S_1 values were evaluated using US Geological Survey Seismic Design Web Services SEAOC/OSHPD Seismic Design Maps Tool (https://seismicmaps.org) for the site location. Site coefficients (F_a and F_v) are used to scale the spectral accelerations as a function of Soil Site Class to develop a soil-modified, site-specific, acceleration response values (5%-damped) for S_{MS} and S_{M1}. Table 2 provides the 2022 CBC seismic design parameters for the Site based on the results of WSP's geotechnical exploration and on Section 1613 of the 2022 CBC.

Table 2: 2022 CBC Seismic Design Parameters

Seismic Design Parameter	Value
Soil Site Class	D
5%-damped, 0.2-sec spectral acceleration (S_S)	1.60 g
5%-damped, 1-sec spectral acceleration (S_1)	0.62 g
Site Coefficient F_a	1.2
Site Coefficient F_v	1.4
Site Class D, 5%-damped, maximum considered earthquake geometric mean (MCE_G) peak ground acceleration (PGA_M)	0.81g

Note: Assumes structures associated with the improvements will be Risk Category I.

6.2 Shallow Foundations

WSP is not aware of any planned building structures. However, if small, single-story buildings (e.g., pump house, maintenance shed) are added to the project later, the structural engineer can use the following preliminary foundation recommendations for design:

- Maximum allowable bearing pressure of 1,800 pounds per square foot (psf).
- Footings should be embedded at least 2 feet below the adjacent finished grade.
- Footings should be founded on firm and unyielding native soils.
- The recommended maximum allowable bearing pressure is gross bearing pressure. The allowable bearing pressure value may be increased by one-third for short-term wind and seismic loading.
- The recommended maximum allowable bearing pressure will result in less than 1 inch of total settlement.

The above recommendations are based on centric pressures applied at the base of the footings. In the case of eccentric pressures (e.g., due to lateral loads), WSP may need to re-evaluate the recommended pressures.

Building foundations must resist lateral loads due to earth pressures, wind, and seismic events. For design purposes, these loads can be resisted simultaneously by:

- **BASE FRICTION**: An allowable value of 0.25 can be assumed for base friction between the soil and spread footings. This value includes a factor of safety of 1.5. The allowable base friction value may be increased by one-third for the seismic loading.
- **PASSIVE RESISTANCE ON SIDES OF SHALLOW FOOTINGS**: For design purposes, we recommend that the allowable passive pressure be based on a fluid with a density of 150 pounds per cubic foot (pcf) (including a factor of safety of 1.5) for shallow foundations. Note the recommended passive resistance assumes footings embedded in medium dense native soils and direct contact of the native soil with the sides of the foundation. The allowable passive resistance can be increased by one-third for seismic loading. Since some disturbance is likely to occur during construction, we recommend the upper 2 feet of passive resistance be neglected.

It is essential that proper surface water drainage be provided to minimize the chance of water infiltrating into the earthen materials beneath and surrounding the foundations. Proper design measures must be taken to minimize changes in the moisture content of the earthen materials underlying the foundations. These measures include, but are not limited to, properly controlling surface water around the structures (e.g., sloping the ground surface away from the structures and their foundations) and minimizing the potential infiltration of water under and behind the structures (e.g., keeping sources of water away from the excavations).

6.3 Infiltration Recommendations

The percolation test data sheets presented in Appendix C present the results of the field percolation tests and the methods used to calculate the design infiltration rates. Specifically, WSP calculated the tested infiltration rate by using the Porchet equation in conjunction with the measured percolation rates and then divided the tested infiltration rate by a factor of safety of 3.0 to yield the design infiltration rate. The factor of safety of 3.0 is per Appendix A of the RCFCD (2011) guidelines. Note that a factor of safety 3.0 is higher than the recommended factor of safety of 2.0 provided in the City of Moreno Valley Water Quality Management Plan (WQMP). The design infiltration rates for each boring are summarized in Table 3.

Table 3: Design Infiltration Rates

Boring ID	Layer Tested	Approximate Zone of Percolation Test (feet bgs)	Tested Infiltration Rate (inches/hour)	Design Infiltration Rate (inches/hour)
B-7	Clayey Sand (alluvium)	10 to 20 (10-foot screen interval)	12.30	4.10
B-9	Clayey Sand (alluvium)	5 to 15 (10-foot screen interval)	8.91	2.97

The proposed stormwater infiltration structures should be sized using the design infiltration rates presented in Table 3 and should have invert elevations that are within the layers tested. Based on the results of the borings,

the sandy alluvial soils extend to at least 41.4 ft-bgs, which indicates there should be sufficient permeable material below the proposed infiltration depths.

All stormwater infiltration structures shall be offset a minimum horizontal distance of 30 feet from the nearest edge of a structural foundation such that no stormwater is infiltrated within 30 feet of a foundation. Similarly, it is preferable that no stormwater infiltration structures be installed within 15 feet of drive isles for trucks. If it is necessary to infiltrate stormwater beneath a truck drive isle, then additional pavement maintenance/rehabilitation costs may be incurred over the life of the Site. In addition, the stormwater infiltration facilities shall be offset a minimum horizontal distance of 50 feet from the toe or crest of any permanent cut or fill slopes.

The proposed stormwater infiltration structures are not expected to significantly increase the risk of exposure to potential geotechnical hazards at the Site, such as liquefaction, slope instability, soil collapse/expansion, and build-up of hydrostatic pressures behind retaining walls. In addition, there are no known contaminated materials underlying the proposed location of the drainage infrastructure. Therefore, pollutant mobilization due to subsurface stormwater infiltration is not expected.

During construction, it should be verified that the stormwater infiltration facilities are established in the appropriate layers and that no unexpected impermeable layers are present at the infiltration depth(s).

6.4 Corrosion Potential

Four bulk soil samples were collected from the Site and subjected to laboratory corrosivity testing (resistivity, pH, chloride content, and sulfate content). The bulk samples were selected to represent the soil in the vicinity of the proposed pipe and infiltration basins. Test methods used and comprehensive results are presented in Appendix B, while a summary is listed in Table 4 below.

Table 4: Soil Corrosivity Results

Description	B-4	B-5	B-8	B-13
Depth (ft)	15-20	20-25	15-20	0-5
Sulfates (ppm)	62.9	74.1	114.4	97.1
Chlorides (ppm)	12.2	41.9	120.7	34.9
Resistivity As Rec'd (Ohm-cm)	11,390	10,720	11,390	10,050
Resistivity Minimum (Ohm-cm)	5,829	3,484	1,742	2,412
pH	8.2	7.9	8.2	8.2

According to the 2021 Caltrans Corrosion Guidelines (Caltrans 2021), a minimum resistivity value for soils of less than 1,500 ohm-cm indicates the presence of high quantities soluble salts and a higher propensity for corrosion. For structural elements, Caltrans (2021) considers the soil to be corrosive if one or more of the following conditions exists:

- Chloride concentration of 500 ppm or greater, or
- Sulfate concentration of 1,500 ppm or greater, or
- pH of 5.5 or less.

Based on the above criteria, WSP considers the existing soil underlying the middle and southern segments of the proposed alignment to be non-corrosive

6.5 Jack and Bore Pipe Installation

The Jack and Bore method is a multi-stage process that consists of constructing temporary horizontal jacking platform and a starting alignment track in an entrance pit at a desired elevation below the existing ground surface. A pipe casing, with a slightly larger diameter than the proposed storm drainpipe, is then jacked by manual control along the starting alignment track with simultaneous excavation of the soil being accomplished by a rotating cutting head in the leading edge of the casing's annular space. The spoils generated during augering are transported back to the entrance pit by helical auger flights rotating inside the product. Once Jack and Bore is completed along the proposed length of the alignment beneath State Road 60, the proposed RCP will be installed, and the casing will be removed. Potential geotechnical hazards associated with Jack and Bore method include:

- Ground loss and instability during augering
- Settlement after pipe casing removal
- Presence of cobbles and/or boulders

The following sections address these hazards and their potential impact to the project.

6.5.1 Ground Loss and Instability During Augering

Ground loss and instability can occur in front or behind the auger cutting head as the auger is advanced and the excavated soils are transported to the source pit. Particularly, loose and cohesionless soils may cave or flow into the voids created by the cutting head resulting in ground loss or instability of the overlying soils. The soils encountered in borings B-4 and B-5 (closest borings to the proposed Jack and Bore) primarily consisted of medium dense to dense sands and clayey sands. Based on the density of the soils and the presence of fines, significant ground loss and/or instability during augering is not expected.

6.5.2 Settlement After Pipe Casing Removal

The pipe casing installed during the Jack and Bore method will likely have a slightly larger diameter than the proposed storm drainpipe. Once the smaller diameter RCP is installed and the larger diameter casing is removed, a void will be created within the annulus space between the two pipes. This void may settle/collapse over time and potentially result in ground deformations at the surface. Although development of deformations at the surface are unlikely due to the density of the soils and depth of the proposed Jack and Bore, WSP recommends grouting the annulus between the casing pipe and the RCP as the casing pipe is removed to prevent any settlement/collapse of the void space.

6.5.3 Presence of Cobbles and/or Boulders

Cobbles and/or boulders encountered during augering can cause damage to the cutting head or prevent further advancement of the pipe casing. Based on the subsurface conditions encountered in Borings B-4 and B-5, cobbles and boulders are not anticipated at the depths of the proposed Jack and Bore. It is likely that similar alluvial sands are underlying SR 60. However, WSP did not perform any subsurface explorations within the SR 60 right-of-way. Therefore, the contractor should verify this assumption.

6.5.4 Feasibility

Based on our review of existing nearby subsurface data and the subsurface conditions encountered during our geotechnical investigation, it is WSP's opinion, Jack and Bore method is feasible for installation of the proposed RCP storm drain section crossing below SR 60. However, the contractor should review the geotechnical information presented in this report and make a determination on the feasibility of the Jack and Bore method. Ultimately, it is the contractor's responsibility to develop the "means and methods" approach for the trenchless installation below SR 60. All pre-construction, installation, and post-construction activities and requirements associated with trenchless installations (including Jack and Bore method) should be executed by the contractor and in accordance with the "Guidelines and Specifications for Trenchless Technology Projects" (Caltrans 2018).

7.0 CONSTRUCTION CONSIDERATIONS

Site preparation and earthwork operations should be performed in accordance with all applicable codes. In this report, all references to maximum dry density and optimum moisture content refer to those values obtained in accordance with ASTM D1557 (the "modified Proctor" compaction test). Proctor curves tested as part of this geotechnical investigation are included in Appendix B. All earthwork operations should be observed and tested by a qualified representative to verify the design recommendations provided herein are properly implemented during construction.

7.1 Site Preparation

Existing debris and obstructions should be removed from within the footprints of the proposed utility trenches and all areas to be graded (e.g., infiltration basin). Exposed deleterious, vegetative, inert, and oversized materials (materials greater than 6 inches in maximum dimension) partially exposed at the subgrade elevation should be stripped and isolated prior to the removal of reusable soils. The soil exposed in excavation subgrades should be observed by WSP to confirm that the soil has the desired engineering properties. Additional removals may be required as a result of observation and testing of the exposed subgrade soil.

If contaminated soils are encountered, these soils should be stockpiled separately. The stockpiled soils should be placed on plastic and covered with an impermeable tarp/liner. These soils will have to be sampled and tested to identify the proper disposal method.

If the subsurface conditions exposed during grading operations vary from those described in this report, WSP should be notified immediately as a revision of the recommendations contained herein may be necessary.

7.2 Pipe Bedding and Trench Backfill

Pipe bedding should consist of sand or similar granular material that has 100 percent of its particles passing the 0.5-inch sieve, 0 to 10 percent passing the No. 200 sieve, and a minimum sand equivalent of 30. The pipe bedding material should be placed on a firm and unyielding subgrade and within a zone that extends a minimum of 6 inches below and 12 inches above the pipe for the full trench width. The bedding material should be compacted to a minimum of 90 percent of its ASTM D1557 maximum dry density using mechanical compaction methods. Jetting of pipe bedding should not be permitted.

Trench backfill above the pipe bedding may consist of approved on-site or import soils placed in lifts no greater than 10 inches loose thickness and compacted to at least 90 percent of its ASTM D1557 maximum dry density. The trench backfill placed within the upper 3 feet of the trench should be compacted to 95 percent of its ASTM D1557 maximum dry density. All trench backfill should be placed at a water content within ±3 percent of the

optimum moisture content, as evaluated per ASTM D1557. Jetting of trench backfill materials should not be permitted.

7.3 Temporary Excavations

7.3.1 Utility Trenches

Temporary excavations will be required for installation of the new storm drain infrastructure. If very steep or vertical-sided excavations deeper than 4 feet are necessary, WSP recommends that the sidewalls be braced and shored in accordance with Cal/OSHA standards and all other applicable safety ordinances and codes to provide temporary trench stability during construction. The contractor should be responsible for the structural design and safety of the temporary shoring system, and it is recommended that this design be submitted to WSP for review. The design of the temporary shoring system should account for any surcharge loads, such as those from construction equipment.

Heavy construction loads, such as those resulting from material stockpiles or heavy machinery, should be set back from the top of all temporary excavations at a minimum distance equal to the depth of the excavation unless the excavation is specifically designed by a qualified professional engineer to accommodate these additional surcharge loads. All surface water should be diverted away from excavations.

7.3.2 Jack and Bore Entry and Exit Pits

Temporary shoring will likely be needed for the Jack and Bore entry and exit pits. WSP recommends that the contractor design the shoring in accordance with the latest version of the Caltrans Trenching and Shoring Manual (Caltrans 2011). The design of the temporary shoring system should be submitted and WSP for review and should account for any surcharge loads, such as those from construction equipment.

Depending on the available space surrounding the entry and exit pits, temporary cut slopes may be constructed to achieve the proposed subgrade elevations. WSP recommends that temporary cut slopes should be graded at inclinations no steeper than 1.5H:1V in the native alluvial sands. Heavy construction loads, such as those resulting from material stockpiles or heavy machinery, should be set back from the top of the excavation a minimum distance equal to the depth of the excavation unless the excavation is specifically designed by a qualified professional engineer to accommodate these additional surcharge loads.

8.0 ADDITIONAL SERVICES

WSP should review the project's construction documents before they are finalized. This review is necessary to verify that the geotechnical recommendations contained in this report have been properly interpreted and implemented into the project's design. If WSP does not perform this review, then WSP can assume no responsibility for misinterpretation of the geotechnical recommendations provided herein.

The construction process is an integral design component with respect to the geotechnical aspects of a project. Geotechnical engineering is not an exact science because of the variability of natural processes. Only a very small portion of the subsurface materials that will affect the performance of the proposed project have been observed, sampled, and tested. Unanticipated or changed conditions can occur during grading and excavation (Appendix D). Proper geotechnical observation and testing during construction are necessary to allow the geotechnical engineer the opportunity to verify design assumptions. Therefore, WSP should be retained during site grading and construction to observe compliance with the design concepts and geotechnical recommendations contained herein. WSP can recommend design changes if subsurface conditions or methods of construction differ from those assumed in this report.

9.0 LIMITATIONS

This report has been prepared for the exclusive use of the City of Moreno Valley and their agents for specific application to the Sunnymead MDP Line F and F-7 Flood Control Improvement project located in the City of Moreno Valley, California. The findings, conclusions, and recommendations presented in this report were prepared in a manner consistent with the level of care and skill ordinarily exercised by other members of the geotechnical engineering profession currently practicing under similar conditions subject to the time limits and financial, physical, and other constraints applicable to the scope of work. No warranty, express or implied, is made. Appendix D contains further information regarding the proper use and interpretation of this geotechnical report.

The City of Moreno Valley has the responsibility to see that all parties to the project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. This report contains information that may be useful in the preparation of contract specifications and contractor cost estimates. However, this report is not written as a specification document and may not contain sufficient information for this use without proper modification.

WSP USA Inc.

Meggy Gidula, PE
Senior Consultant

Jason Cox, PE
Lead Consultant

AM/MG/JC/ks

https://golderassociates.sharepoint.com/sites/150340/project files/6 deliverables/draft report/12804b-rev0-sunnymead mdp line geotechnical report-041923.docx

10.0 REFERENCES

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Figures

SOURCE: 2023 GOOGLE EARTH PRO IMAGERY

0 2500 5000
1" = 5000' FEET

CLIENT
PUBLIC WORKS CITY OF MORENO VALLEY
14177 FREDRICK STREET
MORENO VALLEY, CA 92553

CONSULTANT
wsp

YYYY-MM-DD	2023-03-01
DESIGNED	AM
PREPARED	AM
REVIEWED	MG
APPROVED	

PROJECT
SUNNYMEAD MDP LINE AND F AND F-7
FLOOD CONTROL IMPROVEMENT PROJECT

TITLE
SITE LOCATION MAP

PROJECT NO.	REV.	FIGURE
12804b	0	1

Last Edited By: amenchaca Date: 2023-03-22 Time:9:50:25 AM | Printed By: AMenchaca Date: 2023-03-22 Time:9:50:58 AM
Path: \\golder.gds\complexdata\office\Irvine\Projects\City of Moreno Valley\21462068_RCFCSunnymeadMDPline\10_CADD\CIVIL3D\ | File Name: Figure 1 - Site Location Map.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
0 1 in

LEGEND

- B-1 — GEOTECHNICAL BORING
- B-7 — PERCOLATION BORING
- PERCOLATION BASIN
- PROPOSED MDP LINE
- PROJECT BOUNDARY

CLIENT
CITY OF MORENO VALLEY PUBLIC WORKS DEPARTMENT
14177 FREDRICK STREET
MORENO VALLEY, CA 92553

CONSULTANT
wsp

YYYY-MM-DD	2023-03-21
DESIGNED	EPD
PREPARED	VRL
REVIEWED	MG
APPROVED	

PROJECT
SUNNYMEAD MDP LINE F AND F-7
FLOOD CONTROL IMPROVEMENT PROJECT

TITLE
BORING LOCATION MAP

PROJECT NO.	CONTROL	REV.	FIGURE
12804b		0	2

LEGEND

SURFICIAL DEPOSITS

Qyf	Young alluvial fan deposits (Holocene and late Pleistocene)
Qya	Young axial channel deposits (Holocene and late Pleistocene)
Qvof	Very old alluvial fan deposits (early Pleistocene)

BOX SPRINGS PLUTONIC COMPLEX

Kbfg	Biotite granodiorite and tonalite
Kbhg	Heterogeneous porphyritic granodiorite
Kbg	Porphyritic granodiorite
Kvt	Val Verde tonalite

PENINSULAR RANGES BATHOLITH

Kgd	Granodiorite, undifferentiated (Cretaceous)
Kt	Tonalite, undifferentiated (Cretaceous)
Khg	Heterogeneous granitic rocks (Cretaceous)

KgPz	Intermixed Paleozoic(?) schist and gneiss and Cretaceous granitic rocks (Cretaceous and Paleozoic?)

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Morton, D.M. and Matti, J.C., 2001. Geologic map of the Sunnymead 7.5' Quadrangle, Riverside County, California. U.S. Geologic Survey Open-File Report 01-450, 1:24,000 scale.

CLIENT
PUBLIC WORKS CITY OF MORENO VALLEY
14177 FREDRICK STREET
MORENO VALLEY, CA 92553

CONSULTANT
wsp

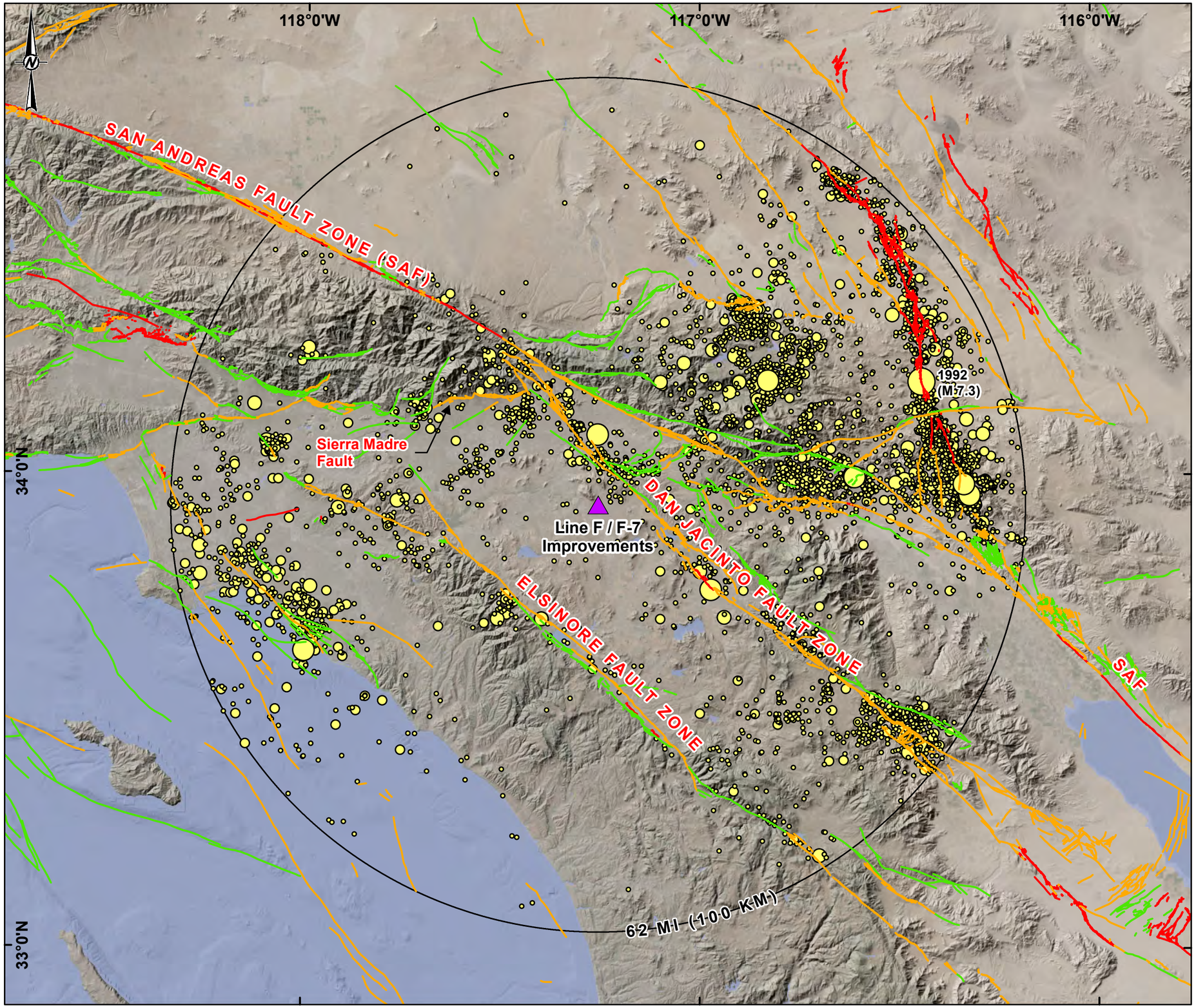
YYYY-MM-DD	2023-02-09
DESIGNED	####
PREPARED	FLM
REVIEWED	DJL
APPROVED	

PROJECT
SUNNYMEAD MDP LINE F AND F-7 FLOOD CONTROL IMPROVEMENT PROJECT

TITLE
GEOLOGIC MAP WITH PROJECT ALIGNMENT

PROJECT NO.	REV.	FIGURE
12804b	A	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D



LEGEND

Line F / F-7 Improvements

Faults

Age of Most Recent Activity

- Historic (<150 years)
- Holocene (<15,000 years)
- Late Quaternary (<130,000 years)

ANSS Historical Earthquake Epicenters

Magnitude

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9 (Year and magnitude of significant events labeled)

0 5 10 20 MI

0 10 20 40 KM

REFERENCE(S)

1. EARTHQUAKE EPICENTERS (FIELD ET AL. 2013, ANSS DATABASE)
2. FAULT LOCATIONS: USGS (2018), NISHENKO ET AL. (2018), PG&E (2015)
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 11N
4. SERVICE LAYER CREDITS: AIRBUS,USGS,NGA,NASA,CGIAR,GEBCO,NCEAS,NLS,OS,NMA,GEODATASTYRELSEN,GSA,GSI AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

CLIENT
PUBLIC WORKS CITY OF MORENO VALLEY
14177 FREDRICK STREET
MORENO VALLEY, CA 92553

PROJECT
SUNNYMEAD MDP LINE F AND F-7
FLOOD CONTROL IMPROVEMENT PROJECT

TITLE
HISTORICAL EARTHQUAKE EPICENTERS AND MAPPED FAULTS WITHIN ABOUT 62 MI (100 KM) OF THE SUNNYMEAD LINE F / F-7 IMPROVEMENTS

CONSULTANT
wsp

YYYY-MM-DD	2023-02-21
PREPARED	MK
REVIEWED	DL
APPROVED	DL

PROJECT NO.	PHASE	REV.	FIGURE
12804B	6005	A	4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: G:\Riverside\County_City\Moreno Valley\Sunnymead\99_PROJECTS\12804B_Sunnymead_MDP_FloodControlImprovement\6005_GeotechReport\02_PRODUCTION\MXD\FIGURES\FloodControlImprovement_Sunnymead_SHA.mxd

APPENDIX A

Boring Logs

REPORT OF BOREHOLE: LEGEND

CLIENT:	City of Moreno Valley Public Works Department	DRIVE WEIGHT: 140 lbs.	SHEET: 1 OF 1		
PROJECT:	Sunnymead MDP Line F and F-7	DROP DISTANCE: 30 in.	DRILLER: ABC Liovin Drilling		
LOCATION:	Hemlock Ave. ~STA XX+XX (See Figure 2)	LAT: 33.941 LON: -117.258	DRILL RIG: CME-75		
PROJECT NO.:	12804B	ELEVATION: 100 ft DATUM:	LOGGED: AM	DATE:	03/21/23
		BOREHOLE DIAMETER: 8 inches	CHECKED:	DATE:	

Drilling

METHOD: HOLLOW STEM AUGER

DRILL DATE/ TIME:

WATER:

DEPTH feet: 0, 5, 10, 15, 20, 25

LAYER ELEVATION: 84.0 / 16.0; 72.0 / 28.0

Sampling

SAMPLE ID: S-1, S-2

SAMPLE TYPE

BLOWS PER 6 INCHES: S-1: 1 2 3; S-2: 4 5 6

RECOVERY (ft)

Material Description

GRAPHIC LOG

USCS: CL; SP

(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks

MOISTURE

DRY DENSITY (pcf)

ADDITIONAL LAB TESTING: MP CS; SA AL

Graphic Log: Standard symbols for soil and rock types

USCS: Unified Soil Classification System per ASTM D2487

MATERIAL DESCRIPTION FOR SOIL:
Soil Classifications are based on the Unified Soil Classification System per ASTM D2487 and include density, particle size, color, moisture and minor components

Standard Penetration Test (SPT) or Modified California (MC) Penetration Test:
Blows Per 6 Inches/Penetration : Number of hammer blows required to drive the sampler 6 inches or the indicated length (i.e., 50/4" indicates 50 hammer blows to drive the the sampler 4 inches)

Sample Types:
SPT: 2-inch OD, 1.4-inch ID split-spoon sampler

Inferred material contact (dashed line) - actual material contact may be gradual

RELATIVE DENSITY OR CONSISTENCY:

Blows	Coarse-Grained Soil	Blows	Fine-Grained Soil
0-4	Very Loose	0-2	Very soft
5-10	Loose	3-4	Soft
11-30	Medium Dense	5-8	Medium Stiff
31-50	Dense	9-15	Stiff
>50	Very Dense	16-30	Very stiff
		>30	Hard

DESCRIPTIVE TERMINOLOGY DENOTING PROPORTIONS:

Descriptive Terms:	Range of Proportions:
Trace	0-5%
Little	5-12%
Some	12-30%
And	30-50%

ADDITIONAL LABORATORY TESTING:
SA = Sieve Analysis
AL = Atterberg Limits
CS = Soil Corrosion Suite
MP = Modified Proctor Compaction

Bottom of boring. Total boring depth and additional remarks.

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-1

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: Hemlock Ave. ~STA 02+50 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
N: E:
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 1 OF 1
DRILLER: ABC Liovin Driling
DRILL RIG: CME-85
LOGGED: EPD DATE: 04/11/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description						
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING	
			0								4" of Asphalt overlying 5" of road base				
Air knife				0.8	GS-1					SC	CLAYEY SAND, fine- to coarse, reddish brown, slightly moist, trace fine gravel GS-1 grab sample taken at 3'				
Hydro vac				7.5						GC	CLAYEY GRAVEL, light grey, well cemented, no sample obtained,				
Hollow stem auger				9.2	S-1		47 50/5"	0.9		SC	CLAYEY SAND, fine- to coarse, reddish brown, slightly moist, trace fine gravel very dense				
			15		S-2		45 50/5"	0.9							
			20		S-3		8 13 15	1.5			medium dense				
			25		S-4		6 17 22	1.5			dense				
				26.5							Bottom of borehole at approximately 26.5 feet. Groundwater not encountered during drilling. Borehole backfilled with compacted soil cuttings.				

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-2

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: Hemlock Ave. ~STA 10+00 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
N: E:
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 1 OF 1
DRILLER: ABC Liovin Driling
DRILL RIG: CME-85
LOGGED: EPD DATE: 04/12/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description						
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING	
			0								6.5" of asphalt overlying 5" of concrete overlying 4" of road base				
Air knife				1.3						SC	CLAYEY SAND, fine- to coarse sand, brown, slightly moist, trace fine gravel				
			5												
Hand Auger															
			10		S-1		9 11 14	1.5			medium dense, dark brown				
					S-2		13 35 50/6"	1.25			very dense, brown, trace fine gravel			SA	
			15		S-3		13 41 50/5"	1.25							
Hollow stem auger															
			20		S-4		14 43 50/6"	1.5			low plasticity, no gravel				
			25		S-5		13 16 19	1.5			dense, light brown, sub-angular				
				26.5							Bottom of borehole at approximately 26.5 feet. Groundwater not encountered during drilling. Borehole backfilled with compacted soil cuttings.				

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-3

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: Hemlock Ave. ~STA 15+00 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
N: E:
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 1 OF 2
DRILLER: ABC Liovin Driling
DRILL RIG: CME-85
LOGGED: EPD DATE: 04/15/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description					
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
			0								3" of Asphalt overlying 5" of road base			
Air knife				0.7						SC	CLAYEY SAND, fine- to coarse sand, reddish brown, medium plasticity, trace fine gravel			
Hand auger					BS-1						BS-1 bulk sample taken from 4'-5'			
			5											
			10		S-1		13 25 43	1.5			very dense, low plasticity, slightly moist			SA AL
			15		S-2		12 23 25	1.5			dense			
Hollow stem auger			20		S-3		11 27 50/6"	1.25			very dense			SA AL
			25		S-4		19 25 26	1.5						
			30											

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-3

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: Hemlock Ave. ~STA 15+00 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
N: E:
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 2 OF 2
DRILLER: ABC Liovin Driling
DRILL RIG: CME-85
LOGGED: EPD DATE: 04/15/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description						
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING	
			30												
					S-5		12 20 23	1.5		SC	CLAYEY SAND, fine- to coarse sand, reddish brown, medium plasticity, trace fine gravel dense, light reddish brown				
				31.5							Bottom of borehole at approximately 31.5 feet. Groundwater not encountered during drilling. Borehole backfilled with compacted soil cuttings.				

REPORT OF BOREHOLE: B-4

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: North of SR-60 ~STA 20+00 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
LAT: 33.941 LON: -117.258
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 1 OF 2
DRILLER: ABC Liovin Drilling
DRILL RIG: CME-75
LOGGED: DL DATE: 12/08/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description						
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING	
Hand Auger			0							SC	CLAYEY SAND, fine- to coarse sand, light brown to orangish brown, moist, trace fine gravel				
			5		S-1		4 16 25	1.5			dense, tan to beige				
			10		S-2A		5				olive brown, moist, slight plasticity, some fine gravel				
				10.5	S-2B		15 23			GC	CLAYEY GRAVEL, dense, fine gravel, grey, moist, low plasticity, trace fine- to coarse sand			SA	
				11.0	S-2C			1.5		SP	POORLY GRADED SAND, dense, fine- to coarse sand, orangish brown, moist, trace fines				
Hollow Stem Auger			15	15.0	S-3		9 13 17	1.5		SC	CLAYEY SAND, medium dense to dense, fine- to coarse sand, light brown, moist, low plasticity				
					BS-1						BS-1 bulk sample taken from 15'-20'			MP CS	
			20	20.0	S-4A		14 15 15			SP	POORLY GRADED SAND, medium dense to dense, fine- to coarse sand, light orangish brown, moist				
				21.0	S-4B			1.5		SC	CLAYEY SAND, medium dense to dense, fine- to coarse sand, light brown, moist, low plasticity				
			25		S-5		8 11 19	1.5							
			30												

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

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

REPORT OF BOREHOLE: B-4

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: North of SR-60 ~STA 20+00 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
LAT: 33.941 LON: -117.258
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 2 OF 2
DRILLER: ABC Liovin Drilling
DRILL RIG: CME-75
LOGGED: DL DATE: 12/08/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description					
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
Hollow Stem Auger			30		S-6		7 11 15	1.5		SC	CLAYEY SAND, medium dense to dense, fine- to coarse sand, light brown, moist, low plasticity medium dense, trace fine gravel			
			35	35.0	S-7A		15			SP	POORLY GRADED SAND, dense, fine- to coarse sand, light brown, moist			
				35.5	S-7B		15 25	1.5		SC	CLAYEY SAND, dense, fine- to coarse sand, light brown, moist, medium plasticity			AL
			40		S-8A		12 18 32	1.5			reddish brown dense to very dense, brown, moist, low plasticity			AL
					S-8B									
			45	45.0	S-9		22 32 23	1.5		SP	POORLY GRADED SAND, very dense, fine- to coarse sand, poorly graded, orangish brown to light brown, moist, trace fines			
			50	50.0	S-10		13 21 35	1.5		SC	CLAYEY SAND, very dense, fine- to coarse sand, light brown with reddish/orangish spotting, moist, trace fine gravel, iron oxide staining			
				51.5							Bottom of borehole at approximately 51.5 feet. Groundwater not encountered during drilling. Borehole backfilled with compacted soil cuttings.			

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-5

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: South of SR-60 ~STA 25+00 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
LAT: 33.940 LON: -117.258
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 1 OF 2
DRILLER: ABC Liovin Driling
DRILL RIG: CME-75
LOGGED: DL DATE: 12/07/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description						
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING	
Hand Auger			0							SC	CLAYEY SAND, fine- to coarse sand, light brown, moist, trace fine gravel				
			5		S-1		8 15 27	1.5			dense, reddish/orangish brown, iron oxide staining				
			10		S-2		10 15 17	1.5			mottled reddish brown to greyish brown, iron oxide staining				
Hollow Stem Auger			15		S-3		10 13 21	1.5			reddish/orangish brown, low plasticity				
			20	20.0	S-4		13 20 23	1.5		SC	CLAYEY SAND, dense, fine- to coarse sand, yellowish brown to light brown, moist				
					BS-1						BS-1 bulk sample taken from 20'-25'			MP CS	
			25		S-5		15 20 20	1.5			yellowish brown, iron oxide staining				
			30												

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-5

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: South of SR-60 ~STA 25+00 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
LAT: 33.940 LON: -117.258
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 2 OF 2
DRILLER: ABC Liovin Driling
DRILL RIG: CME-75
LOGGED: DL DATE: 12/07/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description					
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
Hollow Stem Auger			30		S-6		9 10 15	1.5		SC	CLAYEY SAND, dense, fine- to coarse sand, yellowish brown to light brown, moist reddish brown, low plasticity			
			35		S-7		8 11 23	1.5			brown			SA
			40	40.0	S-8		16 24 23	1.5		SP SC	POORLY GRADED SAND WITH CLAY, dense, fine- to coarse sand, reddish brown, moist, trace fine gravel			
				41.5							Bottom of borehole at approximately 41.5 feet. Groundwater not encountered during drilling. Borehole backfilled with compacted soil cuttings.			

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

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

REPORT OF BOREHOLE: B-6

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: North of Sunnymead Blvd. ~STA 27+50 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
LAT: 33.940 LON: -117.258
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 1 OF 1
DRILLER: ABC Liovin Driling
DRILL RIG: CME-75
LOGGED: DL DATE: 12/07/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description					
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
Hand Auger			0							SC	CLAYEY SAND, fine- to coarse sand, reddish brown, moist, trace fine gravel			
Hollow Stem Auger			5		S-1		9 13 13	1.5			medium dense			
			10		S-2		9 12 25	1.5			dense, olive brown, low plasticity, iron oxide staining			SA
			15	15.0	S-3		6 6 8	1.5		SP	POORLY GRADED SAND, medium dense, fine- to coarse sand, reddish brown, moist, some fines			
			20	20.0	S-4		7 13 22	1.5		SC	CLAYEY SAND, dense, fine- to coarse sand, reddish brown, moist, low plasticity			
			25		S-5		7 9 15	1.5			medium dense, medium plasticity			AL
				26.5							Bottom of borehole at approximately 26.5 feet. Groundwater not encountered during drilling. Borehole backfilled with compacted soil cuttings.			

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-7

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: South of Sunnymead Blvd. ~STA 32+50 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
LAT: 33.939 LON: -117.258
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 1 OF 1
DRILLER: ABC Liovin Drilling
DRILL RIG: CME-75
LOGGED: DL DATE: 12/06/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description					
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
Hand Auger			0							SP	POORLY GRADED SAND WITH GRAVEL, fine- to coarse sand, orangish brown, moist, trace fines			
			5	5.0	S-1		8 10 5	1.5		SC	CLAYEY SAND, medium dense, fine- to coarse sand, beige to brown, moist, trace fine gravel			
Hollow Stem Auger			10		S-2		30 38 45	1.5			very dense, orangish brown			
			15		S-3		15 25 38	1.5						SA
			20	20.0	S-4		17 22 27	1.5		SP	POORLY GRADED SAND, dense, fine- to coarse sand, orangish brown to brown, moist, trace fines			
				21.5							Bottom of borehole at approximately 21.5 feet. Groundwater not encountered during drilling. Borehole backfilled with compacted soil cuttings.			

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-8

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: South of Sunnymead Blvd. ~STA 32+50 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
LAT: 33.939 LON: -117.258
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 1 OF 2
DRILLER: ABC Liovin Driling
DRILL RIG: CME-75
LOGGED: DL DATE: 12/06/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description						
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING	
Hand Auger			0							SP	POORLY GRADED SAND, fine- to coarse sand, orangish brown, moist, some fines, trace fine gravel				
			5	5.0	S-1		7 5 4	1.5		SC	CLAYEY SAND, loose, fine- to coarse sand, brown, moist, trace fine gravel				
			10	10.0	S-2		11 25 26	1.5		SP	POORLY GRADED SAND, very dense, fine- to coarse sand, light brown mottled orangish brown, moist, trace fines, trace fine gravel, iron oxide staining				
Hollow Stem Auger			15	15.0	S-3		15 20 20	1.5		SC	CLAYEY SAND, dense, fine- to coarse sand, orangish brown, moist, trace fine gravel				
					BS-1						BS-1 bulk sample taken from 15'-20'			MP CS	
			20	20.0	S-4		23 30 30	1.5		SP	POORLY GRADED SAND, very dense, fine- to coarse sand, beige to orangish brown, moist, trace fines, trace fine gravel				
			25	25.0	S-5		20 27 34	1.5		SC	CLAYEY SAND, very dense, fine- to coarse sand, orangish brown, moist, trace fine gravel				
			30												

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-8

CLIENT:	City of Moreno Valley Public Works Department	DRIVE WEIGHT: 140 lbs.	SHEET: 2 OF 2
PROJECT:	Sunnymead MDP Line F and F-7	DROP DISTANCE: 30 in.	DRILLER: ABC Liovin Driling
LOCATION:	South of Sunnymead Blvd. ~STA 32+50 (See Figure 2)	LAT: 33.939 LON: -117.258	DRILL RIG: CME-75
PROJECT NO.:	12804B	ELEVATION: DATUM:	LOGGED: DL DATE: 12/06/22
		BOREHOLE DIAMETER: 8 inches	CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description					
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
Hollow Stem Auger			30		S-6		13 16 20	1.5		SC	CLAYEY SAND, very dense, fine- to coarse sand, orangish brown, moist, trace fine gravel dense, light brown to orangish brown			
			35		S-7		12 19 19	1.5			fine- to coarse sand, brown			SA
			40		S-8		16 28 50/3"	1.25			very dense, low plasticity, iron oxide staining			
				41.5							Bottom of borehole at approximately 41.5 feet. Groundwater not encountered during drilling. Borehole backfilled with compacted soil cuttings.			

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-9

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: South of Sunnymead Blvd. ~STA 32+50 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
LAT: 33.939 LON: -117.258
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 1 OF 1
DRILLER: ABC Liovin Drilling
DRILL RIG: CME-75
LOGGED: DL DATE: 12/06/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description						
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING	
Hand Auger			0							SC	CLAYEY SAND, fine- to coarse sand, orangish brown, moist, some fine gravel				
			5		S-1		8 11 7	1.2			medium dense, reddish/orangish brown to brown				
Hollow Stem Auger			10	10.0	S-2		4 7 10	0.6		SP	POORLY GRADED SAND, medium dense, fine- to coarse sand, orangish brown, moist, trace fines, some fine gravel				
			15	15.0	S-3		21 25 31	1.5		SC	CLAYEY SAND, very dense, fine- to coarse sand, orangish brown, moist, trace fine gravel				
				16.5							Bottom of borehole at approximately 16.5 feet. Groundwater not encountered during drilling. Borehole backfilled with compacted soil cuttings.				

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-10

CLIENT:	City of Moreno Valley Public Works Department	DRIVE WEIGHT: 140 lbs.	SHEET: 1 OF 1
PROJECT:	Sunnymead MDP Line F and F-7	DROP DISTANCE: 30 in.	DRILLER: ABC Liovin Driling
LOCATION:	South of Sunnymead Blvd. ~STA 35+00 (See Figure 2)	LAT: 33.937 LON: -117.258	DRILL RIG: CME-75
PROJECT NO.:	12804B	ELEVATION: DATUM:	LOGGED: DL DATE: 12/06/22
		BOREHOLE DIAMETER: 8 inches	CHECKED: JTC DATE: 03/21/23

Drilling					Sampling					Material Description						
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING		
Hand Auger			0							CL	SANDY LEAN CLAY, medium plasticity, orangish brown to light brown, moist, fine- to coarse sand, trace fine gravel					
			5		S-1		11 19 22	1.5			very stiff to hard, brown, iron oxide staining			SA AL		
Hollow Stem Auger			10	10.0	S-2		16 23 37	1.5		SW	WELL-GRADED SAND, very dense, fine- to coarse sand, well graded, reddish brown to light brown, moist, trace fines					
			15	15.0	S-3		11 17 29	1.5		SC	CLAYEY SAND, dense, fine- to coarse sand, reddish brown, moist, trace fine gravel					
				16.5							Bottom of borehole at approximately 16.5 feet. Groundwater not encountered during drilling. Borehole backfilled with compacted soil cuttings.					

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-11

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: South of Sunnymead Blvd. ~STA 40+00 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
LAT: 33.936 LON: -117.259
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 1 OF 1
DRILLER: ABC Liovin Driling
DRILL RIG: CME-75
LOGGED: DL DATE: 12/08/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description					
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING
Hand Auger			0							GC	CLAYEY GRAVEL, coarse gravel, angular, orangish brown, moist, some fine- to coarse sand			
			5	5.0	S-1A		8 4 4	1.5		SP	POORLY GRADED SAND, loose, fine- to coarse sand, light brown, moist, trace fines, trace fine gravel			
				5.5	S-1B					SC	CLAYEY SAND, loose, fine- to coarse sand, brown, moist, medium plasticity			
					BS-1						BS-1 bulk sample taken from 5'-10'			
Hollow Stem Auger			10		S-2		6 14 17	1.5			dense, orangish brown, low plasticity			SA
			15	15.0	S-3		9 12 16	1.5		SP	POORLY GRADED SAND, medium dense, fine- to coarse sand, orangish brown, moist, some fines			
				16.5							Bottom of borehole at approximately 16.5 feet. Groundwater not encountered during drilling. Borehole backfilled with compacted soil cuttings.			

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-12

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: South of Sunnymead Blvd. ~STA 45+00 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
LAT: 33.935 LON: -117.259
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 1 OF 1
DRILLER: ABC Liovin Driling
DRILL RIG: CME-75
LOGGED: DL DATE: 12/08/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description						
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING	
Hand Auger			0							CL	SANDY LEAN CLAY light brown, moist, some fine- to coarse sand				
Hollow Stem Auger			5	5.0	S-1		4 18 25	1.5		SP	POORLY GRADED SAND, dense, fine- to coarse sand, light brown, moist, some fines				
			10		S-2		7 15 20	1.5			orangish brown, trace fine gravel, trace fines				
			15	15.0	S-3		7 19 22	1.5		SW	WELL-GRADED SAND, dense, fine- to coarse sand, orangish brown, moist, trace fines, trace fine gravel				
				16.5							Bottom of borehole at approximately 16.5 feet. Groundwater not encountered during drilling. Borehole backfilled with compacted soil cuttings.				

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-13

CLIENT:	City of Moreno Valley Public Works Department	DRIVE WEIGHT: 140 lbs.	SHEET: 1 OF 2
PROJECT:	Sunnymead MDP Line F and F-7	DROP DISTANCE: 30 in.	DRILLER: ABC Liovin Driling
LOCATION:	South of Sunnymead Blvd. ~STA 49+29.74 (See Figure 2)	LAT: 33.934 LON: -117.259	DRILL RIG: CME-75
PROJECT NO.:	12804B	ELEVATION: DATUM:	LOGGED: DL DATE: 12/07/22
		BOREHOLE DIAMETER: 8 inches	CHECKED: JTC DATE: 03/21/23

Drilling					Sampling					Material Description						
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING		
Hand Auger			0							SC	CLAYEY SAND, fine- to coarse sand, orangish brown to light brown, moist					
					BS-1						BS-1 bulk sample taken from 0'-5'			MP CS		
			5		S-1		14 23 31	1.5			very dense, light brown to tan					
			10		S-2		14 24 33	1.5			orangish/reddish brown to light brown					
Hollow Stem Auger			15	15.0	S-3		13 25 29	1.5		SP	POORLY GRADED SAND, very dense, fine- to coarse sand, reddish brown to light brown, moist					
			20		S-4		14 22 33	1.5								
			25	25.0	S-5		14 30 45	1.5		SC	CLAYEY SAND, very dense, fine- to coarse sand, reddish brown, moist, trace fine gravel, minor stratification			SA		
			30													

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

GEOTECH WITH MATERIAL GRAPHICS AND USCS SUNNYMEAD_MDP_LINE (2).GPJ GINT STD US LAB.GDT 03/22/23

REPORT OF BOREHOLE: B-13

CLIENT: City of Moreno Valley Public Works Department
PROJECT: Sunnymead MDP Line F and F-7
LOCATION: South of Sunnymead Blvd. ~STA 49+30 (See Figure 2)
PROJECT NO.: 12804B

DRIVE WEIGHT: 140 lbs.
DROP DISTANCE: 30 in.
LAT: 33.934 LON: -117.259
ELEVATION: DATUM:
BOREHOLE DIAMETER: 8 inches

SHEET: 2 OF 2
DRILLER: ABC Liovin Driling
DRILL RIG: CME-75
LOGGED: DL DATE: 12/07/22
CHECKED: JTC DATE: 03/21/23

Drilling					Sampling				Material Description						
METHOD	DRILL DATE/ TIME	WATER	DEPTH feet	LAYER ELEVATION	SAMPLE ID	SAMPLE TYPE	BLOWS PER 6 INCHES	RECOVERY (ft)	GRAPHIC LOG	USCS	(SYMBOL) SOIL NAME, density/consistency, particle size/plasticity, color, moisture, minor components; additional remarks	MOISTURE	DRY DENSITY (pcf)	ADDITIONAL LAB TESTING	
			30		S-6		9 13 16	1.5		SC	CLAYEY SAND, very dense, fine- to coarse sand, reddish brown, moist, trace fine gravel, minor stratification medium dense, light brown				
				31.5							Bottom of borehole at approximately 31.5 feet. Groundwater not encountered during drilling. Borehole backfilled with compacted soil cuttings.				

APPENDIX B

Laboratory Test Results

HUSHMAND ASSOCIATES, INC.
Geotechnical and Earthquake Engineers

Hushmand Associates, Inc.
250 Goddard,
Irvine, CA 92618

p. (949) 777-1274
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e. hai@haieng.com

January 23, 2023

Golder Associates USA Inc.
7 Corporate Park, Suite 260
Irvine, CA 92602

Attention: Ms. Meggy Gidula

SUBJECT: **Laboratory Test Results**
Project Name: **Sunnymead MDP Line F and F-7 Flood Control**
Project No.: **12804B**
HAI Project No.: **GAUI-23-002**

Dear Ms. Gidula:

Enclosed is the result of the laboratory testing conducted on samples for the subject project. The testing was conducted in general accordance with the following test procedures:

Type of Test	Test Procedure
Particle Size Analysis (Sieve Only)	ASTM D6913
Atterberg Limits	ASTM D4318
Modified Proctor Compaction (4'')	ASTM D1557
Corrosion (Set 1)	ASTM G187, D516, D512B, G51

Attached are: eleven (11) Particle Size Analysis test results; six (6) Atterberg Limits test results; four (4) Modified Proctor (4'' Mold) test results; and four (4) Corrosion test results.

We appreciate the opportunity to provide our testing services to Golder Associates USA Inc. If you have any questions regarding these test results, please contact us.

Sincerely,

HUSHMAND ASSOCIATES, INC.

Kang C. Lin, BS, EIT
Laboratory Manager

Samin Donyanavard, MS, EIT
Senior Staff Engineer

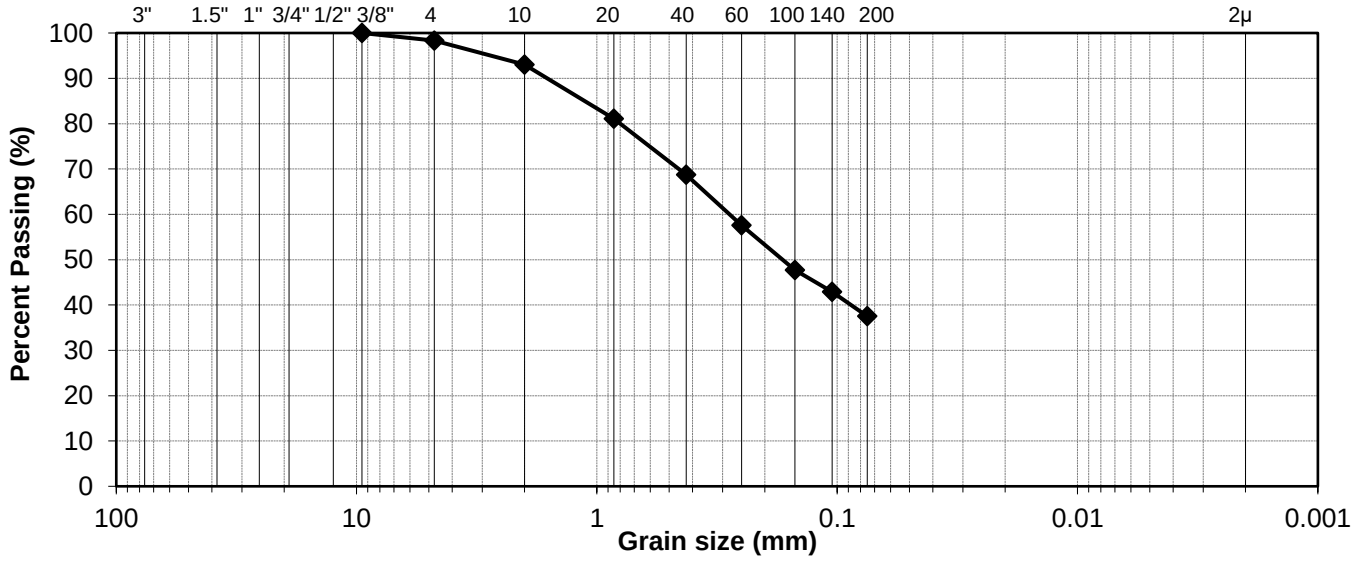
PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D6913

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improveme	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-2	*Date:*	01/13/22
Sample No.:	S-2		
Depth (ft):	12.5-14'		
Sample Description:	Brown, Clayey Sand (SC)		

Dry Weight (g) **504.5**

Sieve Size	Aperture	Weight Retained	% Retained	**% Passing**	**Project Specification**
	mm	g	%	**%**	**%**
3"	76.2	0.00	0.0	**100.0**	**-**
1.5"	38.1	0.00	0.0	**100.0**	**-**
1"	25.4	0.00	0.0	**100.0**	**-**
3/4 "	19.1	0.00	0.0	**100.0**	**-**
1/2 "	12.5	0.00	0.0	**100.0**	**-**
3/8 "	9.5	0.00	0.0	**100.0**	**-**
# 4	4.75	8.57	1.7	**98.3**	**-**
# 10	2.00	26.42	5.2	**93.1**	**-**
# 20	0.85	60.52	12.0	**81.1**	**-**
# 40	0.425	62.07	12.3	**68.8**	**-**
# 60	0.250	56.50	11.2	**57.6**	**-**
# 100	0.150	49.91	9.9	**47.7**	**-**
# 140	0.105	24.11	4.8	**42.9**	**-**
# 200	0.075	27.18	5.4	**37.5**	**-**
Soil % passing 200 sieve (%)		189.25	37.5	**0.0**	**-**



Particle-Size Analysis	D_{10}	-	% Gravel	% Sand	% Fines
	D_{30}	-	1.7	60.8	37.5
	D_{60}	-	Sample Description / USCS Classification		
	C_u	-	Brown, Clayey Sand (SC)		
	C_c	-			

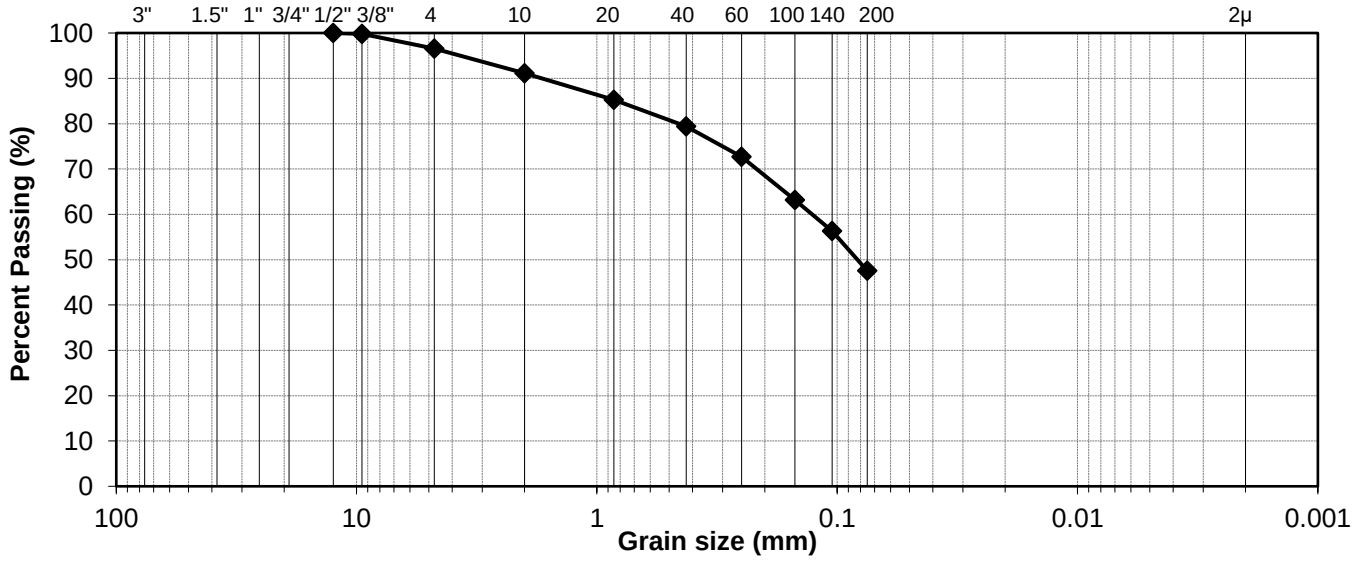
PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D6913

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improveme	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-3	*Date:*	01/13/22
Sample No.:	S-1		
Depth (ft):	10-11.5		
Sample Description:	Reddish Brown, Clayey Sand (SC)		

Dry Weight (g) **492.7**

Sieve Size	Aperture	Weight Retained	% Retained	**% Passing**	**Project Specification**
	mm	g	%	**%**	**%**
3"	76.2	0.00	0.0	**100.0**	**-**
1.5"	38.1	0.00	0.0	**100.0**	**-**
1"	25.4	0.00	0.0	**100.0**	**-**
3/4 "	19.1	0.00	0.0	**100.0**	**-**
1/2 "	12.5	0.00	0.0	**100.0**	**-**
3/8 "	9.5	0.88	0.2	**99.8**	**-**
# 4	4.75	16.16	3.3	**96.5**	**-**
# 10	2.00	26.65	5.4	**91.1**	**-**
# 20	0.85	28.93	5.9	**85.3**	**-**
# 40	0.425	28.90	5.9	**79.4**	**-**
# 60	0.250	32.84	6.7	**72.7**	**-**
# 100	0.150	47.01	9.5	**63.2**	**-**
# 140	0.105	33.97	6.9	**56.3**	**-**
# 200	0.075	43.12	8.8	**47.5**	**-**
Soil % passing 200 sieve (%)		234.24	47.5	**0.0**	**-**



Particle-Size Analysis	D_{10}	-	% Gravel	% Sand	% Fines
	D_{30}	-	3.5	49.0	47.5
	D_{60}	-	Sample Description / USCS Classification		
	C_u	-	Reddish Brown, Clayey Sand (SC)		
	C_c	-			

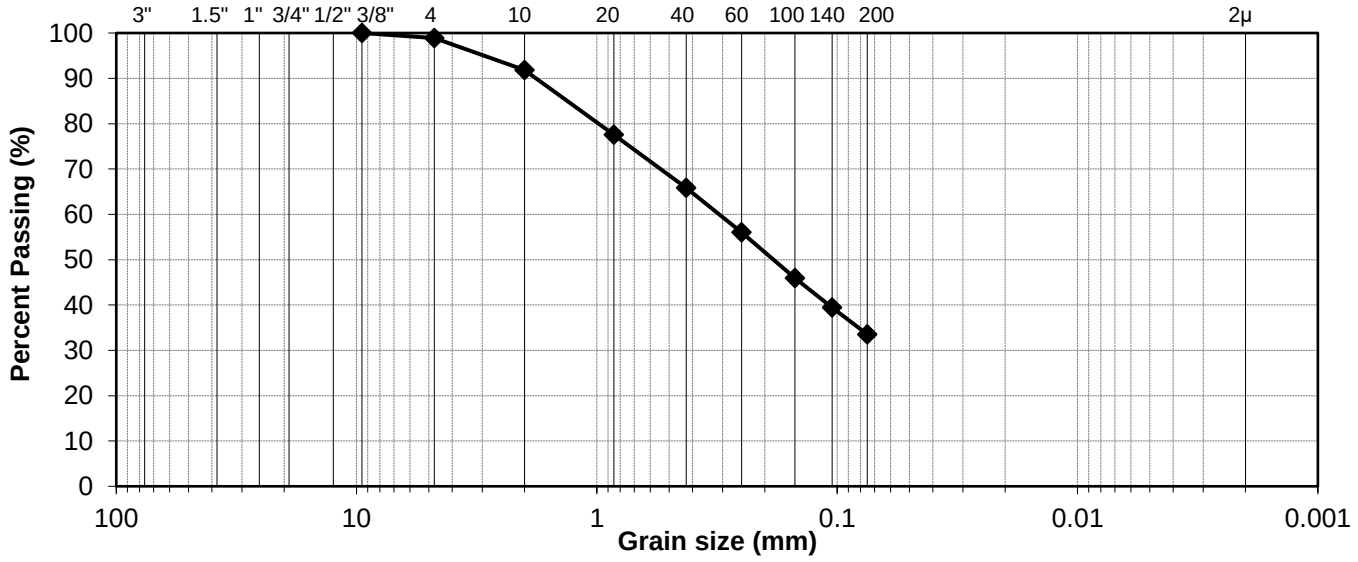
PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D6913

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-3	*Date:*	01/13/22
Sample No.:	S-3		
Depth (ft):	20-21.5		
Sample Description:	Brown, Clayey Sand (SC)		

Dry Weight (g) **210.2**

Sieve Size	Aperture	Weight Retained	% Retained	**% Passing**	**Project Specification**
	mm	g	%	**%**	**%**
3"	76.2	0.00	0.0	**100.0**	**-**
1.5"	38.1	0.00	0.0	**100.0**	**-**
1"	25.4	0.00	0.0	**100.0**	**-**
3/4 "	19.1	0.00	0.0	**100.0**	**-**
1/2 "	12.5	0.00	0.0	**100.0**	**-**
3/8 "	9.5	0.00	0.0	**100.0**	**-**
# 4	4.75	2.31	1.1	**98.9**	**-**
# 10	2.00	14.93	7.1	**91.8**	**-**
# 20	0.85	29.95	14.2	**77.5**	**-**
# 40	0.425	24.63	11.7	**65.8**	**-**
# 60	0.250	20.58	9.8	**56.0**	**-**
# 100	0.150	21.18	10.1	**46.0**	**-**
# 140	0.105	13.69	6.5	**39.4**	**-**
# 200	0.075	12.43	5.9	**33.5**	**-**
Soil % passing 200 sieve (%)		70.48	33.5	**0.0**	**-**



Particle-Size Analysis	D_{10}	-	% Gravel	% Sand	% Fines
	D_{30}	-	1.1	65.4	33.5
	D_{60}	-	Sample Description / USCS Classification		
	C_u	-	Brown, Clayey Sand (SC)		
	C_c	-			

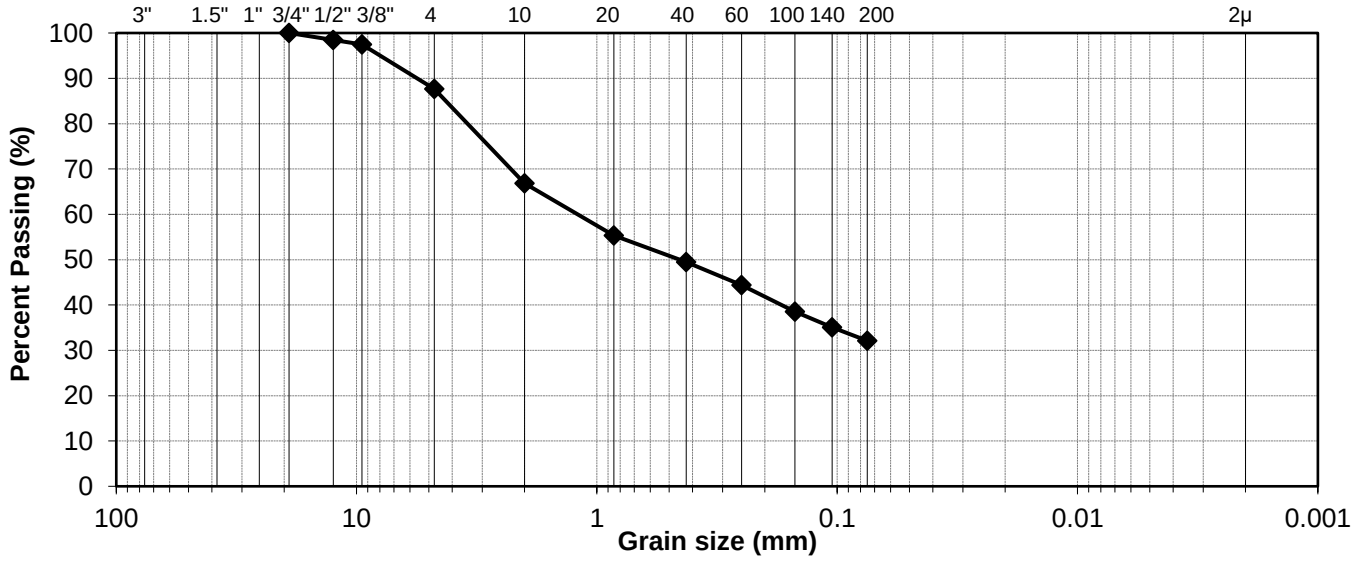
PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D6913

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-4	*Date:*	01/13/22
Sample No.:	S-2A		
Depth (ft):	10-11.5		
Sample Description:	Olive Brown, Clayey Sand (SC)		

Dry Weight (g) **296.2**

Sieve Size	Aperture	Weight Retained	% Retained	**% Passing**	**Project Specification**
	mm	g	%	**%**	**%**
3"	76.2	0.00	0.0	**100.0**	**-**
1.5"	38.1	0.00	0.0	**100.0**	**-**
1"	25.4	0.00	0.0	**100.0**	**-**
3/4 "	19.1	0.00	0.0	**100.0**	**-**
1/2 "	12.5	4.47	1.5	**98.5**	**-**
3/8 "	9.5	2.95	1.0	**97.5**	**-**
# 4	4.75	29.15	9.8	**87.7**	**-**
# 10	2.00	61.72	20.8	**66.8**	**-**
# 20	0.85	33.96	11.5	**55.4**	**-**
# 40	0.425	17.50	5.9	**49.4**	**-**
# 60	0.250	14.88	5.0	**44.4**	**-**
# 100	0.150	17.41	5.9	**38.5**	**-**
# 140	0.105	10.33	3.5	**35.1**	**-**
# 200	0.075	8.76	3.0	**32.1**	**-**
Soil % passing 200 sieve (%)		95.09	32.1	**0.0**	**-**



Particle-Size Analysis	D_{10}	-	% Gravel	% Sand	% Fines
	D_{30}	-	12.3	55.6	32.1
	D_{60}	-	Sample Description / USCS Classification		
	C_u	-	Olive Brown, Clayey Sand (SC)		
	C_c	-			

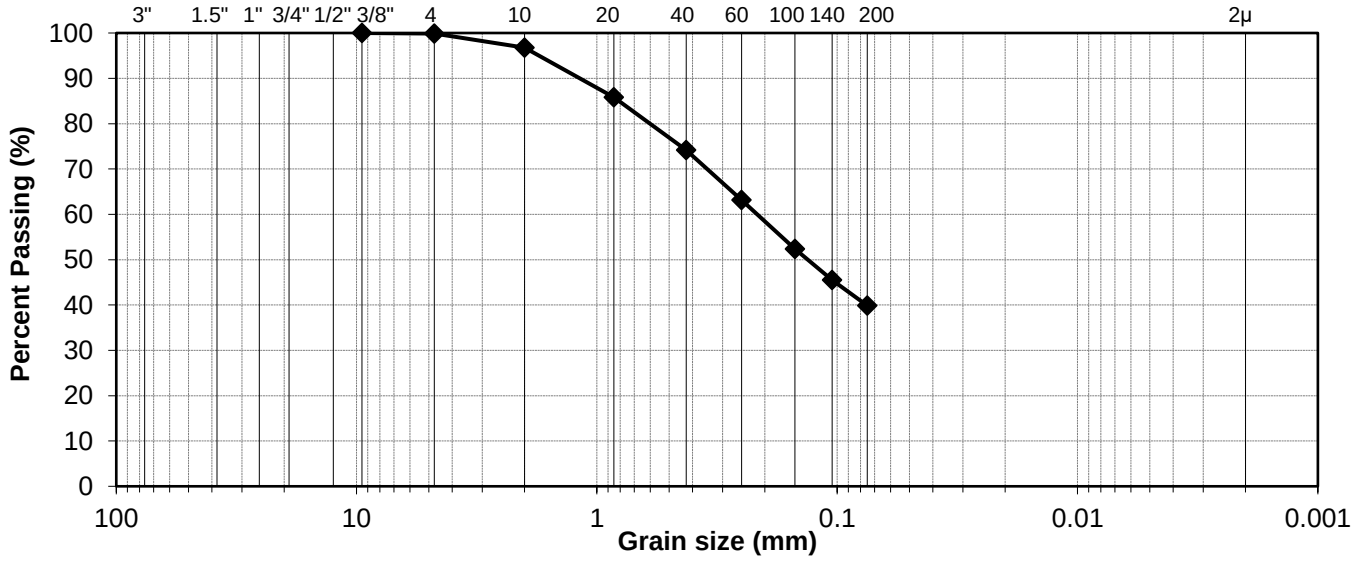
PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D6913

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-5	*Date:*	01/13/22
Sample No.:	S-7		
Depth (ft):	35-36.5		
Sample Description:	Brown, Clayey Sand (SC)		

Dry Weight (g) **506.6**

Sieve Size	Aperture	Weight Retained	% Retained	**% Passing**	**Project Specification**
	mm	g	%	**%**	**%**
3"	76.2	0.00	0.0	**100.0**	**-**
1.5"	38.1	0.00	0.0	**100.0**	**-**
1"	25.4	0.00	0.0	**100.0**	**-**
3/4 "	19.1	0.00	0.0	**100.0**	**-**
1/2 "	12.5	0.00	0.0	**100.0**	**-**
3/8 "	9.5	0.00	0.0	**100.0**	**-**
# 4	4.75	0.68	0.1	**99.9**	**-**
# 10	2.00	15.85	3.1	**96.7**	**-**
# 20	0.85	55.17	10.9	**85.8**	**-**
# 40	0.425	59.18	11.7	**74.2**	**-**
# 60	0.250	55.83	11.0	**63.1**	**-**
# 100	0.150	54.50	10.8	**52.4**	**-**
# 140	0.105	34.61	6.8	**45.6**	**-**
# 200	0.075	28.85	5.7	**39.9**	**-**
Soil % passing 200 sieve (%)		201.94	39.9	**0.0**	**-**



Particle-Size Analysis	D_{10}	-	% Gravel	% Sand	% Fines
	D_{30}	-	0.1	60.0	39.9
	D_{60}	-	Sample Description / USCS Classification		
	C_u	-	Brown, Clayey Sand (SC)		
	C_c	-			

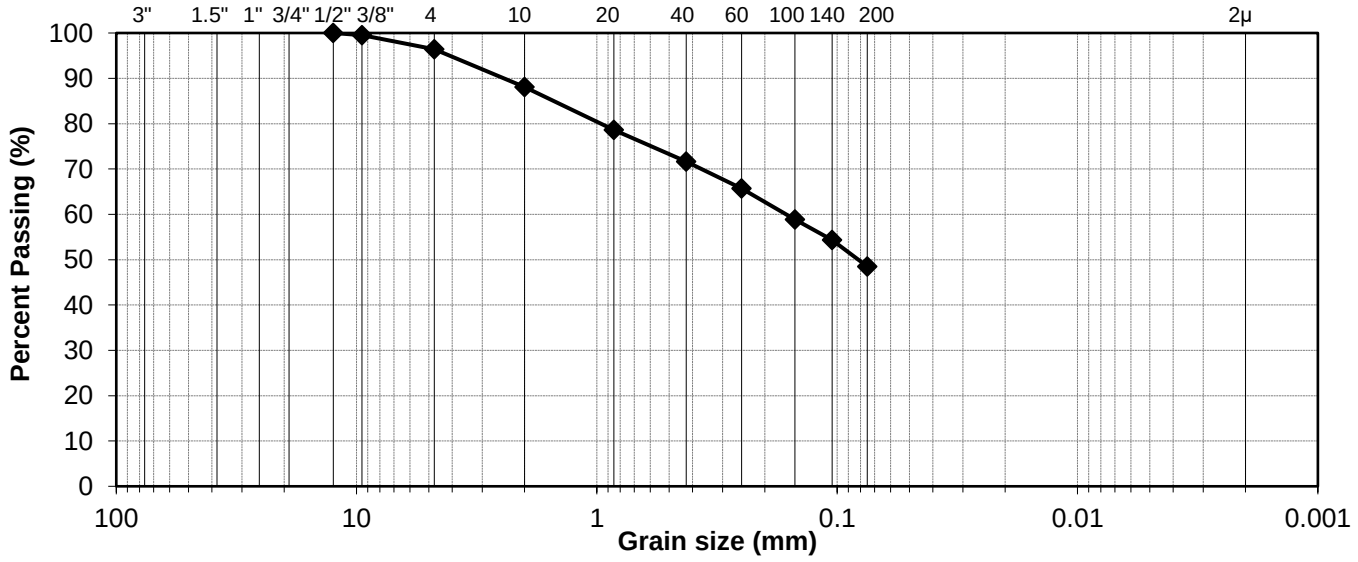
PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D6913

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improveme	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-6	*Date:*	01/13/23
Sample No.:	S-2		
Depth (ft):	10-11.5'		
Sample Description:	Olive Brown, Clayey Sand (SC)		

Dry Weight (g) **503.2**

Sieve Size	Aperture	Weight Retained	% Retained	**% Passing**	**Project Specification**
	mm	g	%	**%**	**%**
3"	76.2	0.00	0.0	**100.0**	**-**
1.5"	38.1	0.00	0.0	**100.0**	**-**
1"	25.4	0.00	0.0	**100.0**	**-**
3/4 "	19.1	0.00	0.0	**100.0**	**-**
1/2 "	12.5	0.00	0.0	**100.0**	**-**
3/8 "	9.5	2.45	0.5	**99.5**	**-**
# 4	4.75	15.46	3.1	**96.4**	**-**
# 10	2.00	42.11	8.4	**88.1**	**-**
# 20	0.85	47.50	9.4	**78.6**	**-**
# 40	0.425	35.07	7.0	**71.7**	**-**
# 60	0.250	30.11	6.0	**65.7**	**-**
# 100	0.150	34.22	6.8	**58.9**	**-**
# 140	0.105	22.68	4.5	**54.4**	**-**
# 200	0.075	29.47	5.9	**48.5**	**-**
Soil % passing 200 sieve (%)		244.16	48.5	**0.0**	**-**



Particle-Size Analysis	D_{10}	-	% Gravel	% Sand	% Fines
	D_{30}	-	3.6	47.9	48.5
	D_{60}	-	Sample Description / USCS Classification		
	C_u	-	Olive Brown, Clayey Sand (SC)		
	C_c	-			

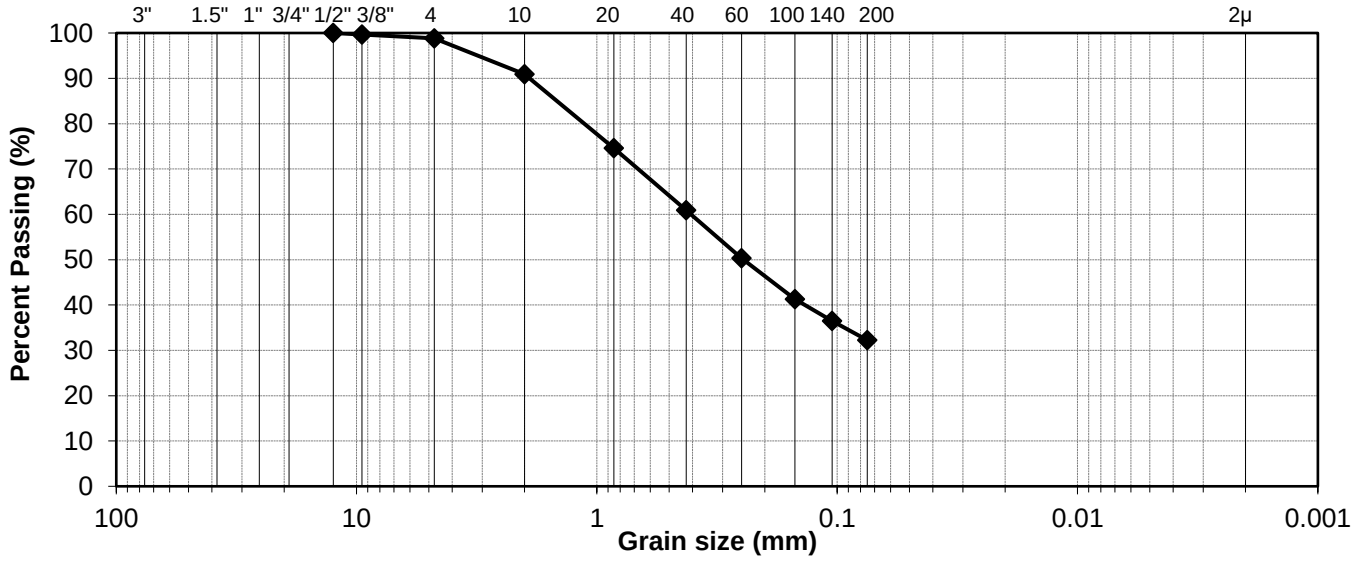
PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D6913

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-7	*Date:*	01/13/23
Sample No.:	S-3		
Depth (ft):	15-16.5		
Sample Description:	Brown, Clayey Sand (SC)		

Dry Weight (g) **530.2**

Sieve Size	Aperture	Weight Retained	% Retained	**% Passing**	**Project Specification**
	mm	g	%	**%**	**%**
3"	76.2	0.00	0.0	**100.0**	**-**
1.5"	38.1	0.00	0.0	**100.0**	**-**
1"	25.4	0.00	0.0	**100.0**	**-**
3/4 "	19.1	0.00	0.0	**100.0**	**-**
1/2 "	12.5	0.00	0.0	**100.0**	**-**
3/8 "	9.5	1.64	0.3	**99.7**	**-**
# 4	4.75	4.60	0.9	**98.8**	**-**
# 10	2.00	41.97	7.9	**90.9**	**-**
# 20	0.85	86.32	16.3	**74.6**	**-**
# 40	0.425	72.78	13.7	**60.9**	**-**
# 60	0.250	56.01	10.6	**50.3**	**-**
# 100	0.150	48.02	9.1	**41.3**	**-**
# 140	0.105	25.23	4.8	**36.5**	**-**
# 200	0.075	22.67	4.3	**32.2**	**-**
Soil % passing 200 sieve (%)		170.92	32.2	**0.0**	**-**



Particle-Size Analysis	D_{10}	-	% Gravel	% Sand	% Fines
	D_{30}	-	1.2	66.6	32.2
	D_{60}	-	Sample Description / USCS Classification		
	C_u	-	Brown, Clayey Sand (SC)		
	C_c	-			

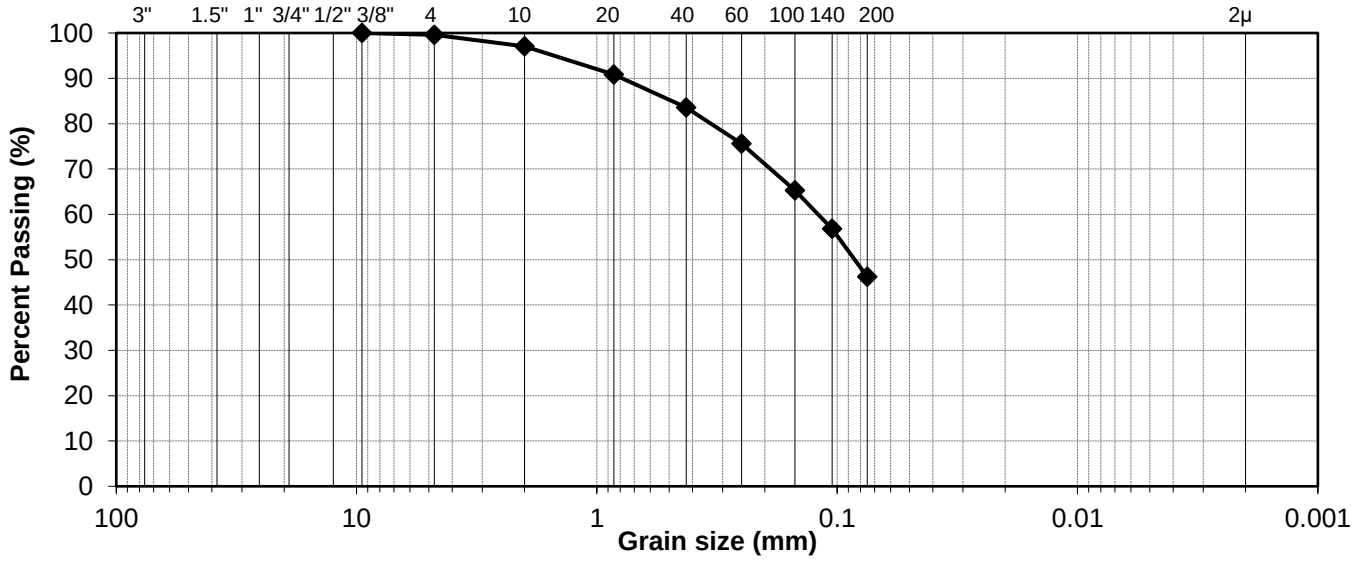
PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D6913

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-8	*Date:*	01/13/23
Sample No.:	S-7		
Depth (ft):	35-36.5		
Sample Description:	Brown, Clayey Sand (SC)		

Dry Weight (g) **460.6**

Sieve Size	Aperture	Weight Retained	% Retained	**% Passing**	**Project Specification**
	mm	g	%	**%**	**%**
3"	76.2	0.00	0.0	**100.0**	**-**
1.5"	38.1	0.00	0.0	**100.0**	**-**
1"	25.4	0.00	0.0	**100.0**	**-**
3/4 "	19.1	0.00	0.0	**100.0**	**-**
1/2 "	12.5	0.00	0.0	**100.0**	**-**
3/8 "	9.5	0.00	0.0	**100.0**	**-**
# 4	4.75	1.89	0.4	**99.6**	**-**
# 10	2.00	11.77	2.6	**97.0**	**-**
# 20	0.85	28.45	6.2	**90.9**	**-**
# 40	0.425	33.69	7.3	**83.5**	**-**
# 60	0.250	36.74	8.0	**75.6**	**-**
# 100	0.150	47.26	10.3	**65.3**	**-**
# 140	0.105	39.16	8.5	**56.8**	**-**
# 200	0.075	48.77	10.6	**46.2**	**-**
Soil % passing 200 sieve (%)		212.82	46.2	**0.0**	**-**



Particle-Size Analysis	D_{10}	-	% Gravel	% Sand	% Fines
	D_{30}	-	0.4	53.4	46.2
	D_{60}	-	Sample Description / USCS Classification		
	C_u	-	Brown, Clayey Sand (SC)		
	C_c	-			

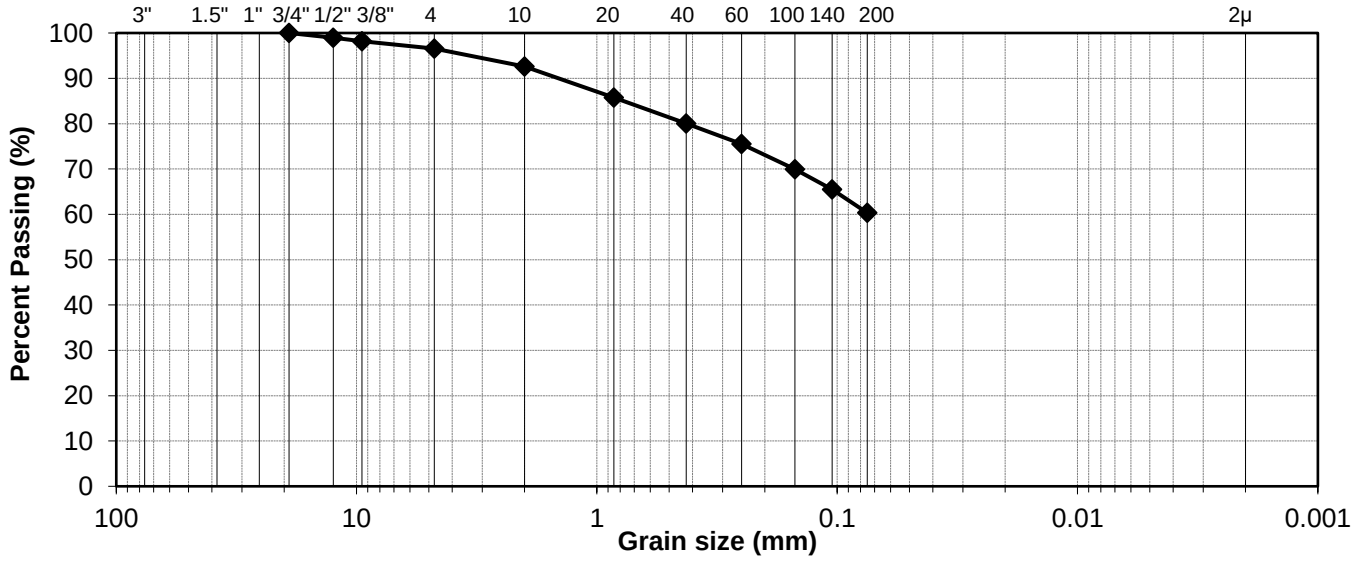
PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D6913

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-10	*Date:*	01/13/22
Sample No.:	S-1		
Depth (ft):	5-6.5		
Sample Description:	Brown, Sandy Lean Clay (CL)		

Dry Weight (g) **434.7**

Sieve Size	Aperture	Weight Retained	% Retained	**% Passing**	**Project Specification**
	mm	g	%	**%**	**%**
3"	76.2	0.00	0.0	**100.0**	**-**
1.5"	38.1	0.00	0.0	**100.0**	**-**
1"	25.4	0.00	0.0	**100.0**	**-**
3/4 "	19.1	0.00	0.0	**100.0**	**-**
1/2 "	12.5	4.56	1.0	**99.0**	**-**
3/8 "	9.5	3.22	0.7	**98.2**	**-**
# 4	4.75	7.07	1.6	**96.6**	**-**
# 10	2.00	17.35	4.0	**92.6**	**-**
# 20	0.85	29.73	6.8	**85.8**	**-**
# 40	0.425	24.81	5.7	**80.0**	**-**
# 60	0.250	19.56	4.5	**75.5**	**-**
# 100	0.150	24.24	5.6	**70.0**	**-**
# 140	0.105	19.38	4.5	**65.5**	**-**
# 200	0.075	22.56	5.2	**60.3**	**-**
Soil % passing 200 sieve (%)		262.22	60.3	**0.0**	**-**



Particle-Size Analysis	D_{10}	-	% Gravel	% Sand	% Fines
	D_{30}	-	3.4	36.3	60.3
	D_{60}	-	Sample Description / USCS Classification		
	C_u	-	Brown, Sandy Lean Clay (CL)		
	C_c	-			

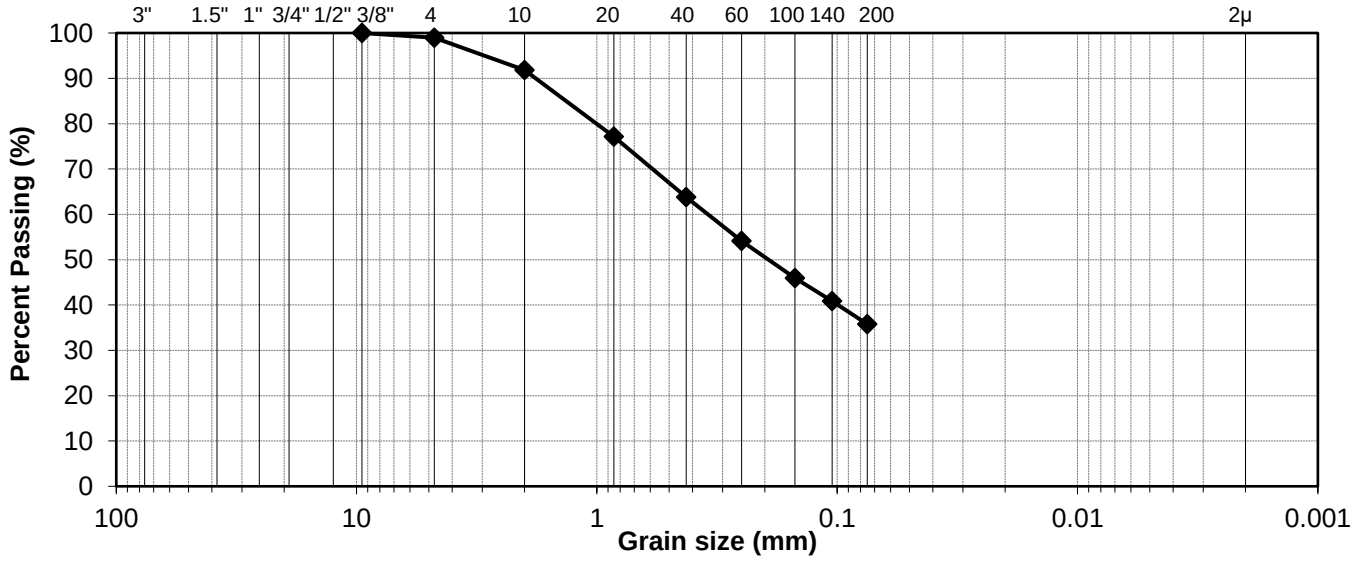
PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D6913

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-11	*Date:*	01/13/23
Sample No.:	S-2		
Depth (ft):	10-11.5		
Sample Description:	Brown, Clayey Sand (SC)		

Dry Weight (g) **482.7**

Sieve Size	Aperture	Weight Retained	% Retained	**% Passing**	**Project Specification**
	mm	g	%	**%**	**%**
3"	76.2	0.00	0.0	**100.0**	**-**
1.5"	38.1	0.00	0.0	**100.0**	**-**
1"	25.4	0.00	0.0	**100.0**	**-**
3/4 "	19.1	0.00	0.0	**100.0**	**-**
1/2 "	12.5	0.00	0.0	**100.0**	**-**
3/8 "	9.5	0.00	0.0	**100.0**	**-**
# 4	4.75	5.04	1.0	**99.0**	**-**
# 10	2.00	34.54	7.2	**91.8**	**-**
# 20	0.85	70.74	14.7	**77.1**	**-**
# 40	0.425	64.44	13.4	**63.8**	**-**
# 60	0.250	46.70	9.7	**54.1**	**-**
# 100	0.150	39.45	8.2	**45.9**	**-**
# 140	0.105	24.50	5.1	**40.9**	**-**
# 200	0.075	24.62	5.1	**35.8**	**-**
Soil % passing 200 sieve (%)		172.63	35.8	**0.0**	**-**



Particle-Size Analysis	D_{10}	-	% Gravel	% Sand	% Fines
	D_{30}	-	1.0	63.2	35.8
	D_{60}	-	Sample Description / USCS Classification		
	C_u	-	Brown, Clayey Sand (SC)		
	C_c	-			

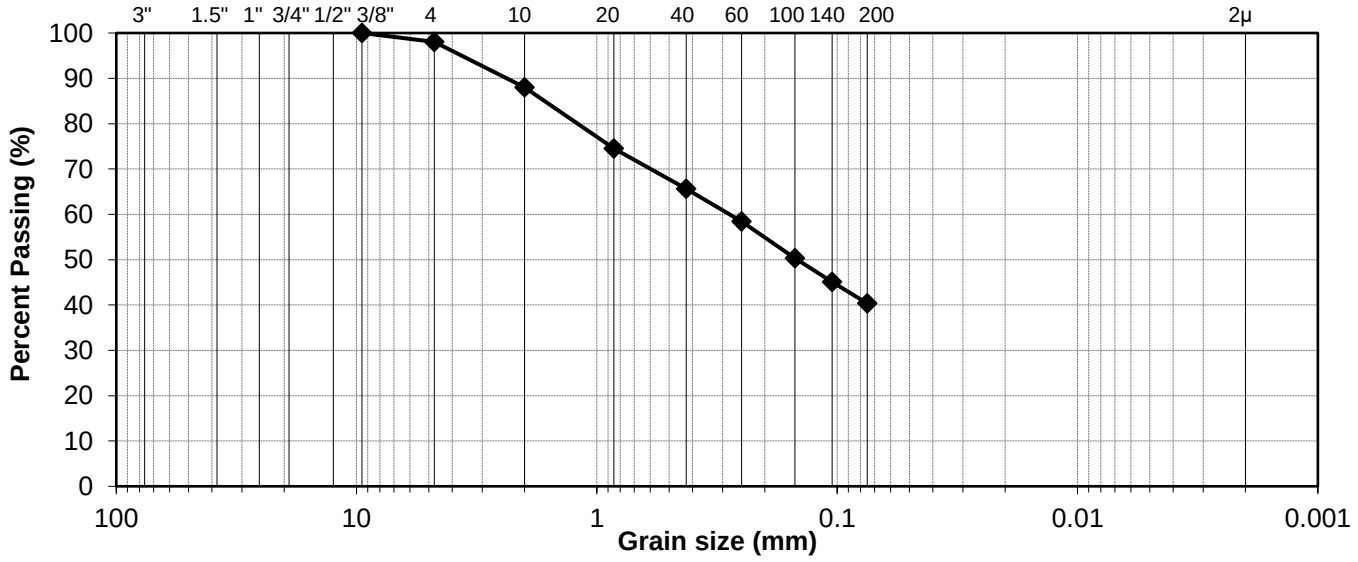
PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D6913

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-13	*Date:*	01/13/23
Sample No.:	S-5		
Depth (ft):	25-26.5		
Sample Description:	Reddish Brown, Clayey Sand (SC)		

Dry Weight (g) **501.8**

Sieve Size	Aperture	Weight Retained	% Retained	**% Passing**	**Project Specification**
	mm	g	%	**%**	**%**
3"	76.2	0.00	0.0	**100.0**	**-**
1.5"	38.1	0.00	0.0	**100.0**	**-**
1"	25.4	0.00	0.0	**100.0**	**-**
3/4 "	19.1	0.00	0.0	**100.0**	**-**
1/2 "	12.5	0.00	0.0	**100.0**	**-**
3/8 "	9.5	0.00	0.0	**100.0**	**-**
# 4	4.75	9.78	1.9	**98.1**	**-**
# 10	2.00	50.45	10.1	**88.0**	**-**
# 20	0.85	67.59	13.5	**74.5**	**-**
# 40	0.425	44.69	8.9	**65.6**	**-**
# 60	0.250	36.05	7.2	**58.4**	**-**
# 100	0.150	40.83	8.1	**50.3**	**-**
# 140	0.105	26.25	5.2	**45.1**	**-**
# 200	0.075	23.71	4.7	**40.3**	**-**
Soil % passing 200 sieve (%)		202.45	40.3	**0.0**	**-**



Particle-Size Analysis	D_{10}	-	% Gravel	% Sand	% Fines
	D_{30}	-	1.9	57.7	40.3
	D_{60}	-	Sample Description / USCS Classification		
	C_u	-	Reddish Brown, Clayey Sand (SC)		
	C_c	-			

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4318

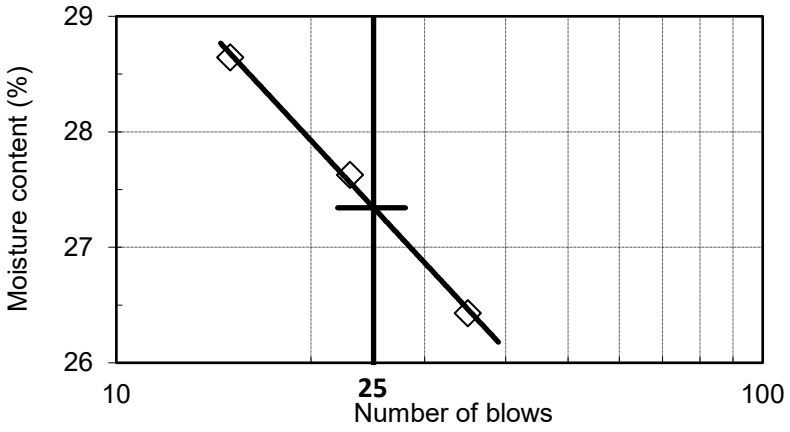
Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	AH
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-3	*Date:*	01/13/23
Sample No.:	S-1		
Depth (ft):	10-11.5		
Soil Description:	Reddish Brown, Clayey Sand (SC)		

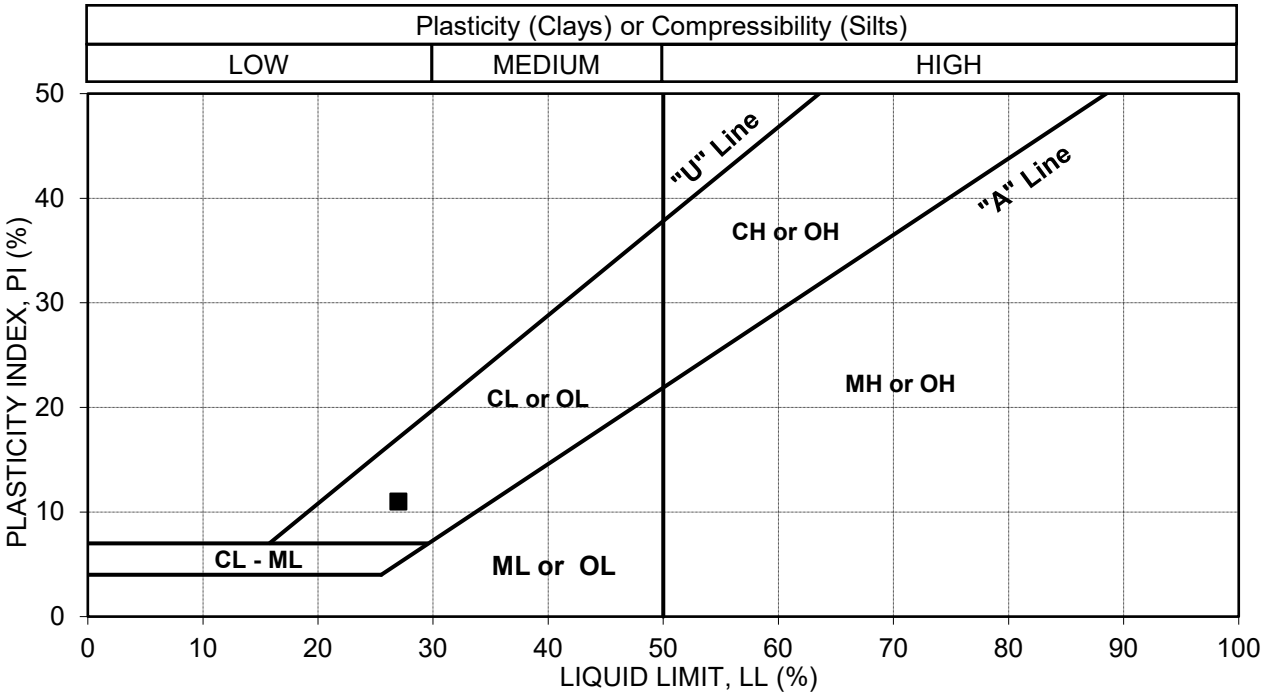
Test		LL	LL	LL	PL	PL
No. of blows	**-**	**35**	**23**	**15**	-	-
Wt. of Wet Soil + Container	(g)	18.4	18.3	18.6	9.4	9.4
Wt. of Dry soil + Container	(g)	16.9	16.6	16.9	8.3	8.2
Wt. of Container	(g)	11.3	10.7	11.1	1.1	1.1
Water content	**(%)**	**26.4**	**27.6**	**28.6**	**15.7**	**16.1**

Liquid Limit (LL)	**27**
Plastic Limit (PL)	**16**
Plasticity Index (PI)	**11**
USCS	**CL**

Remarks:

- Fine Sample is Less than 50% of Passing #200





Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4318

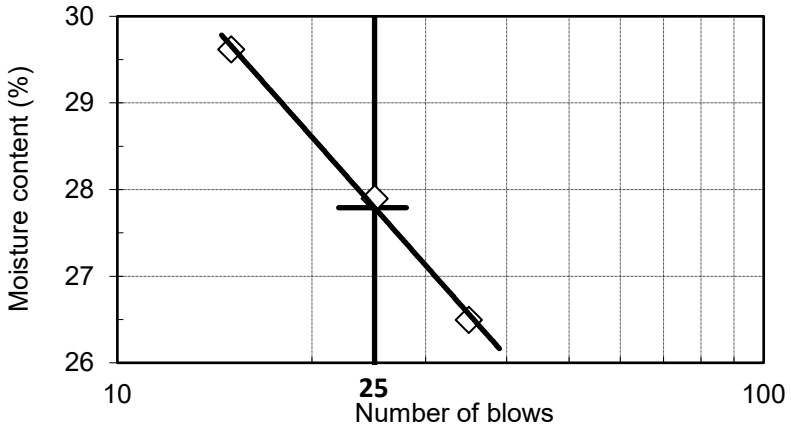
Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	AH
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-3	*Date:*	01/13/23
Sample No.:	S-3		
Depth (ft):	20-21.5		
Soil Description:	Brown, Clayey Sand (SC)		

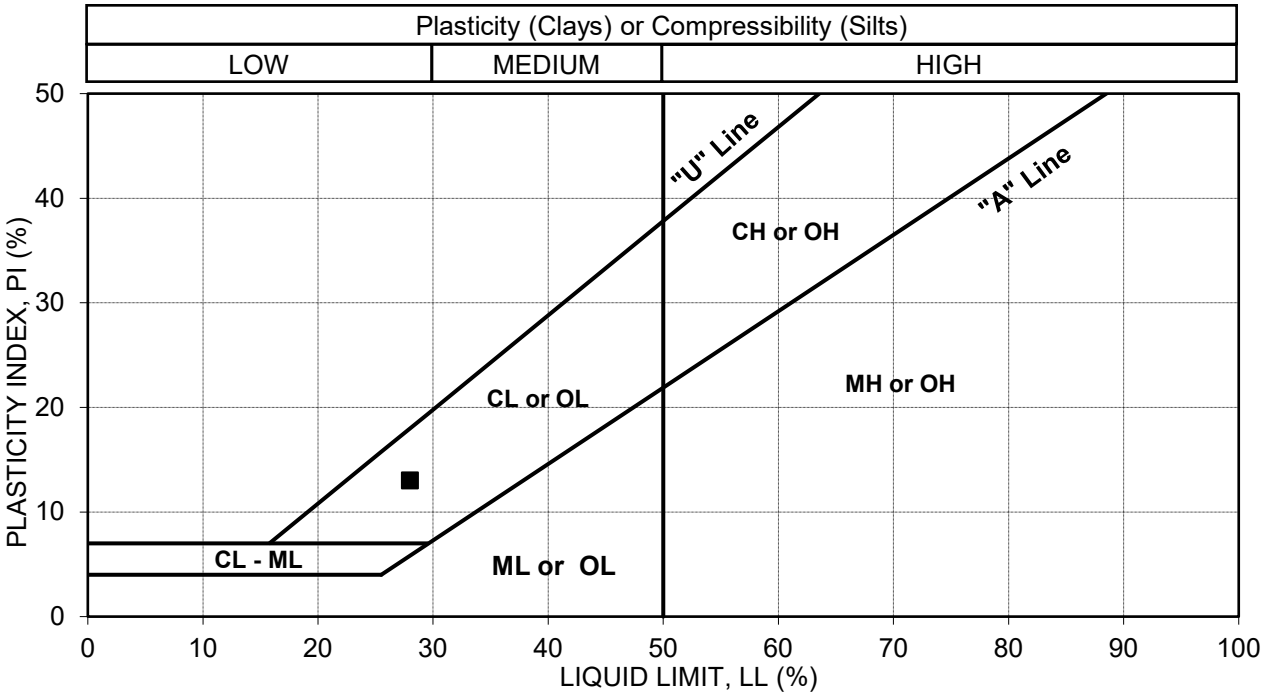
Test		LL	LL	LL	PL	PL
No. of blows	**-**	**35**	**25**	**15**	-	-
Wt. of Wet Soil + Container	(g)	18.1	18.5	19.0	7.0	7.0
Wt. of Dry soil + Container	(g)	16.6	16.9	17.2	6.2	6.2
Wt. of Container	(g)	11.1	11.2	11.2	1.1	1.1
Water content	**(%)**	**26.5**	**27.9**	**29.6**	**15.5**	**15.4**

Liquid Limit (LL)	**28**
Plastic Limit (PL)	**15**
Plasticity Index (PI)	**13**
USCS	**CL**

Remarks:

- Fine Sample is Less than 50% of Passing #200





Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4318

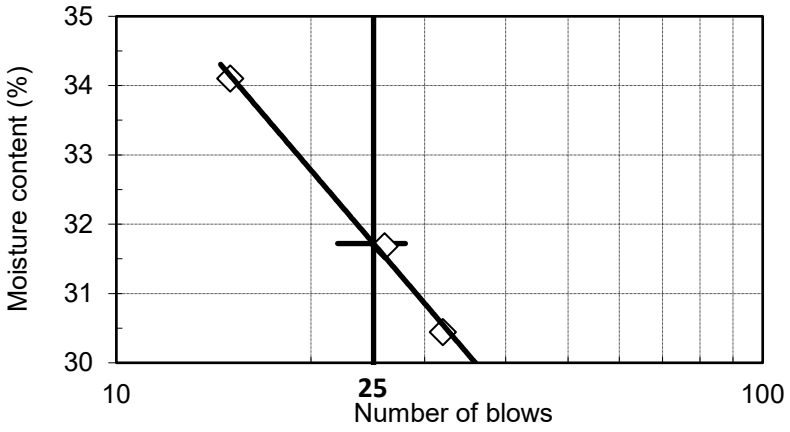
Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	AH
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-4	*Date:*	01/13/23
Sample No.:	S-7B		
Depth (ft):	35.5-36.5		
Soil Description:	Brown, Clayey Sand (SC)		

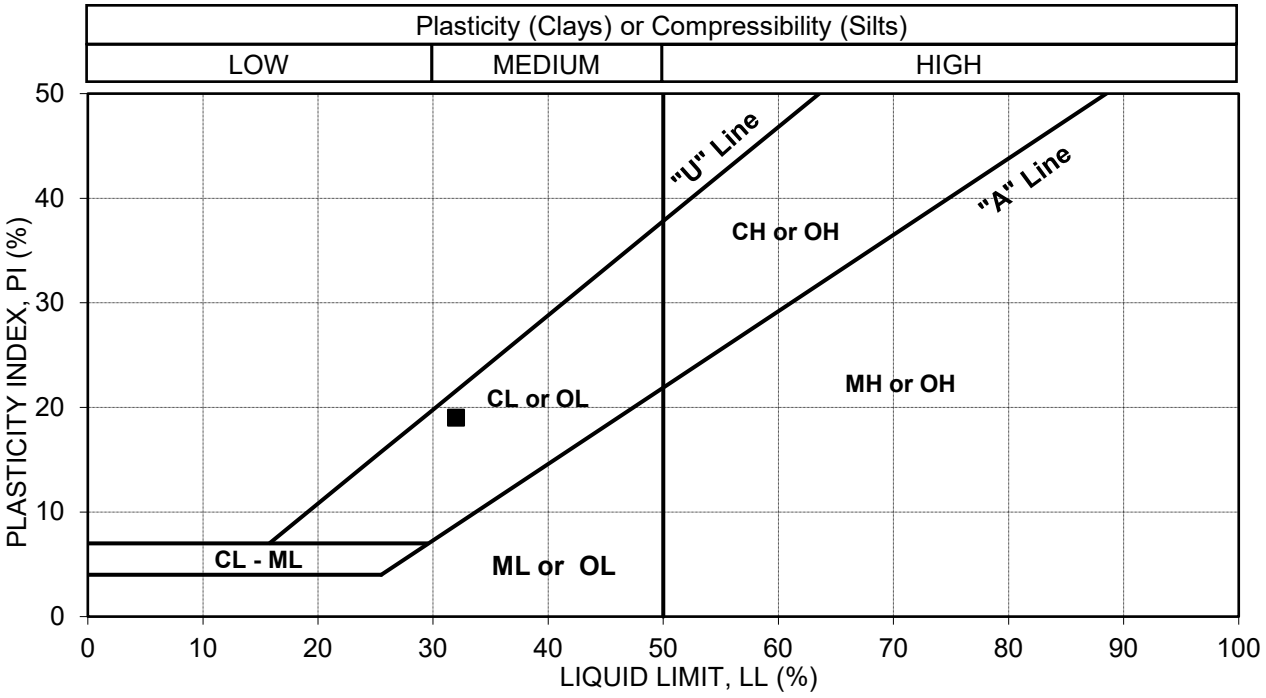
Test		LL	LL	LL	PL	PL
No. of blows	**-**	**32**	**26**	**15**	-	-
Wt. of Wet Soil + Container	(g)	19.3	19.0	19.7	10.1	10.1
Wt. of Dry soil + Container	(g)	17.3	17.1	17.5	9.1	9.1
Wt. of Container	(g)	11.0	11.0	11.0	1.1	1.1
Water content	**(%)**	**30.4**	**31.7**	**34.1**	**13.4**	**13.5**

Liquid Limit (LL)	**32**
Plastic Limit (PL)	**13**
Plasticity Index (PI)	**19**
USCS	**CL**

Remarks:

- Fine Sample is Less than 50% of Passing #200





Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4318

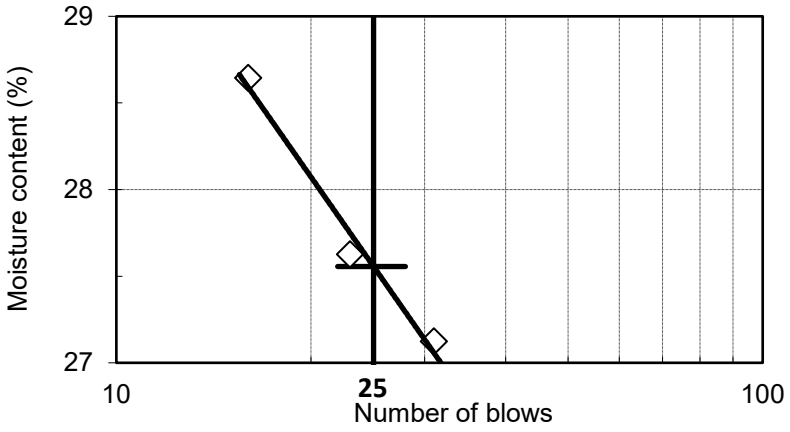
Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	AH
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-4	*Date:*	01/13/23
Sample No.:	S-8B		
Depth (ft):	40.75-41.5		
Soil Description:	Brown, Clayey Sand (SC)		

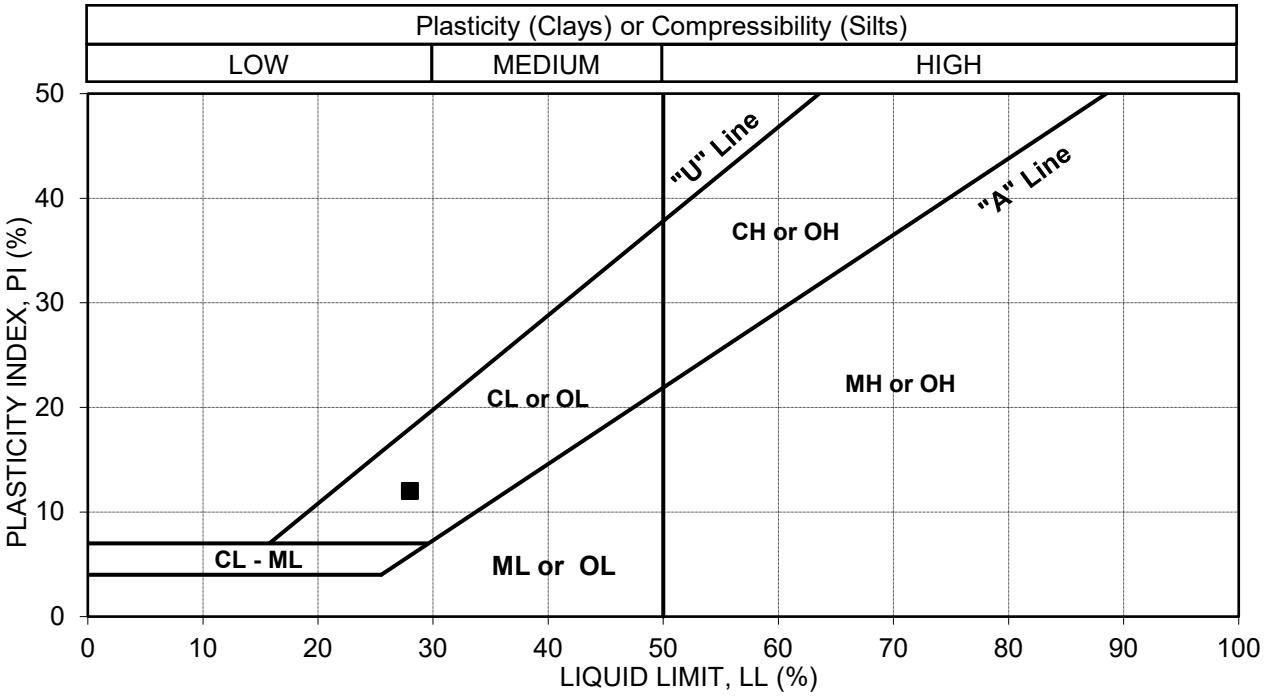
Test		LL	LL	LL	PL	PL
No. of blows	**-**	**31**	**23**	**16**	-	-
Wt. of Wet Soil + Container	(g)	19.0	18.3	18.6	9.4	9.4
Wt. of Dry soil + Container	(g)	17.4	16.6	16.9	8.3	8.2
Wt. of Container	(g)	11.2	10.7	11.1	1.1	1.1
Water content	**(%)**	**27.1**	**27.6**	**28.6**	**15.7**	**16.1**

Liquid Limit (LL)	**28**
Plastic Limit (PL)	**16**
Plasticity Index (PI)	**12**
USCS	**CL**

Remarks:

- Fine Sample is Less than 50% of Passing #200





Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4318

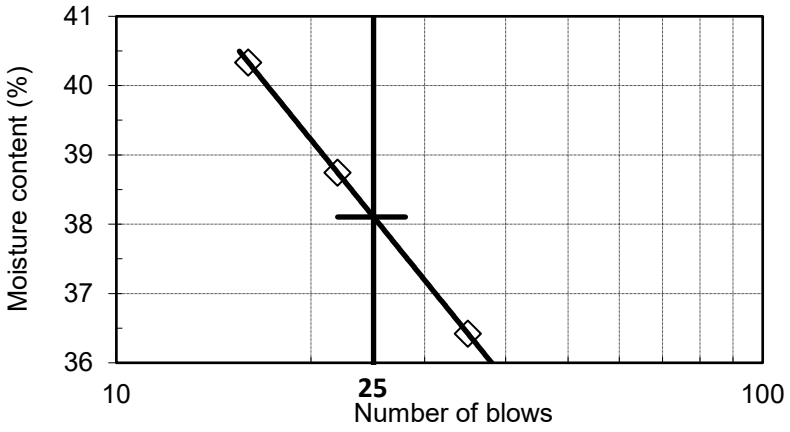
Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	AH
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-6	*Date:*	01/13/23
Sample No.:	S-5		
Depth (ft):	25-26.5		
Soil Description:	Brown, Clayey Sand (SC)		

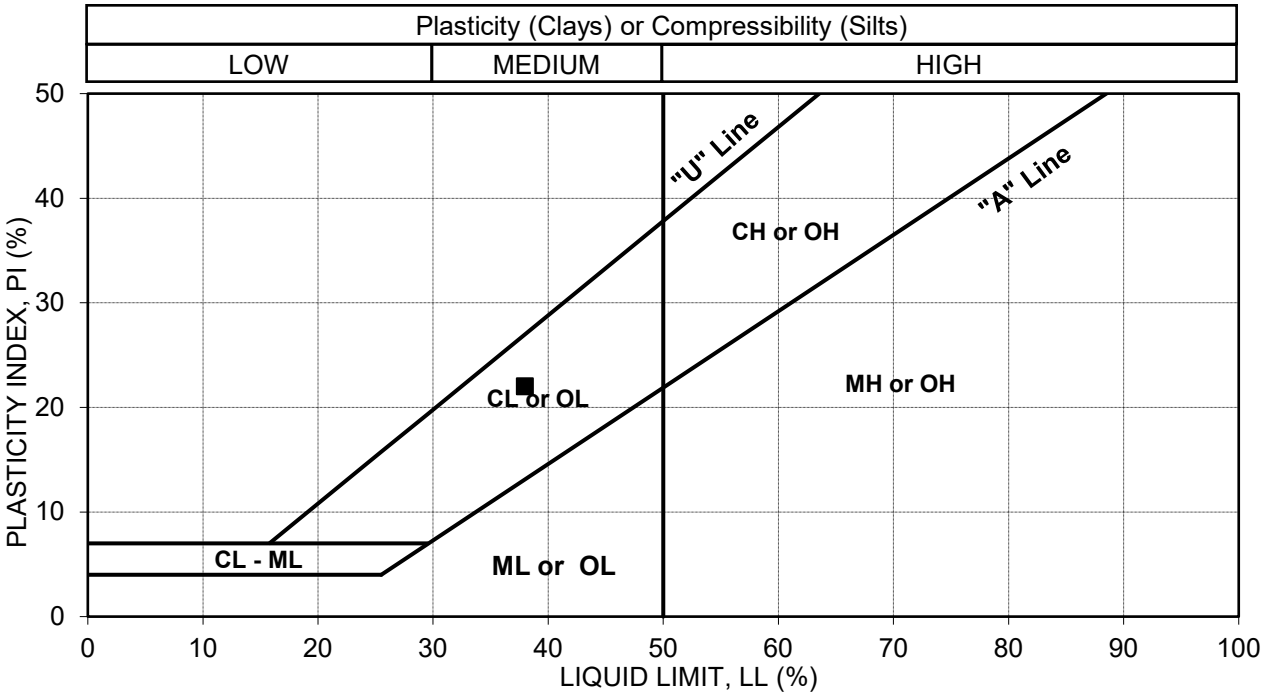
Test		LL	LL	LL	PL	PL
No. of blows	**-**	**35**	**22**	**16**	-	-
Wt. of Wet Soil + Container	(g)	17.9	18.6	17.9	9.2	10.5
Wt. of Dry soil + Container	(g)	16.2	16.5	16.0	8.1	9.2
Wt. of Container	(g)	11.3	11.1	11.2	1.1	1.1
Water content	**(%)**	**36.4**	**38.7**	**40.3**	**16.0**	**15.7**

Liquid Limit (LL)	**38**
Plastic Limit (PL)	**16**
Plasticity Index (PI)	**22**
USCS	**CL**

Remarks:

- Fine Sample is Less than 50% of Passing #200





Liquid Limit, Plastic Limit, and Plasticity Index of Soils

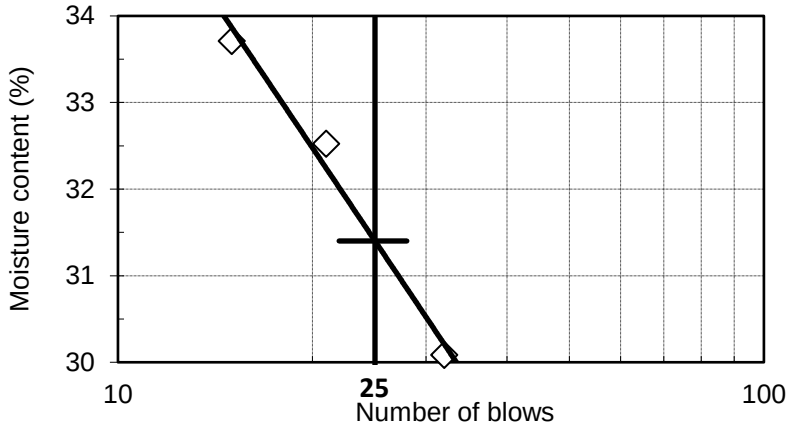
ASTM D4318

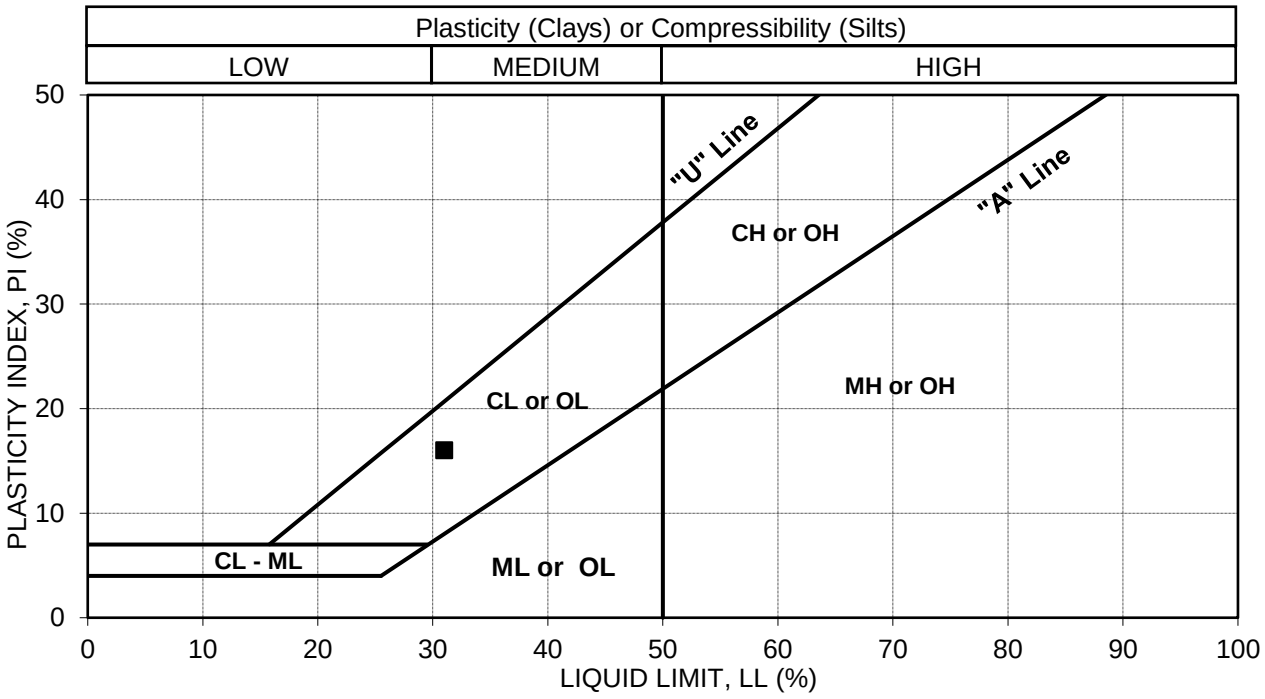
Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project Name:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	AH
Project No.:	12804B	*Checked by:*	KL
Boring No.:	B-10	*Date:*	01/13/23
Sample No.:	S-1		
Depth (ft):	5-6.5		
Soil Description:	Brown, Sandy Lean Clay (CL)		

Test		LL	LL	LL	PL	PL
No. of blows	**-**	**32**	**21**	**15**	-	-
Wt. of Wet Soil + Container	(g)	18.8	19.2	18.1	6.5	6.1
Wt. of Dry soil + Container	(g)	17.0	17.2	16.3	5.8	5.5
Wt. of Container	(g)	11.1	11.0	11.0	1.1	1.1
Water content	**(%)**	**30.1**	**32.5**	**33.7**	**15.3**	**14.7**

Liquid Limit (LL)	**31**
Plastic Limit (PL)	**15**
Plasticity Index (PI)	**16**
USCS	**CL**

Remarks:





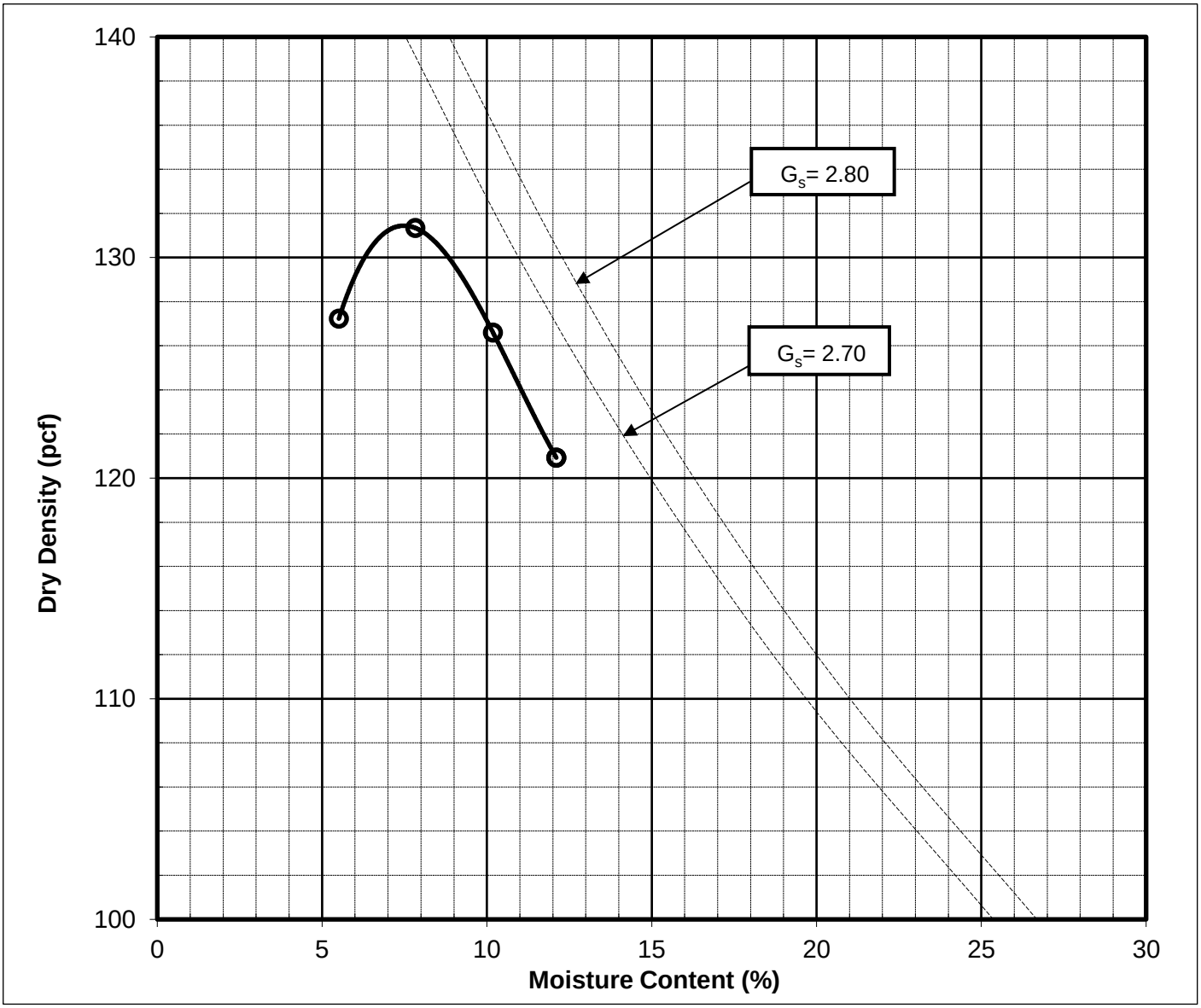
Compaction Characteristics of Soils Using Modified Effort

ASTM D1557

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring Number:	B-4	*Date:*	01/10/23
Sample Number:	BS-1		
Depth (ft) :	15-20		
Soil Description:	Light Brown, Clayey Sand (SC)		

Mold size (in)	4.0
Procedure	A
Weight Retained on:	2.5
Remarks:	

Maximum Dry Density (pcf)	**131.5**
Optimum Moisture Content (%)	**7.6**
Corrected Maximum Dry Density (pcf)	**-**
Corrected Optimum Moisture Content (%)	**-**



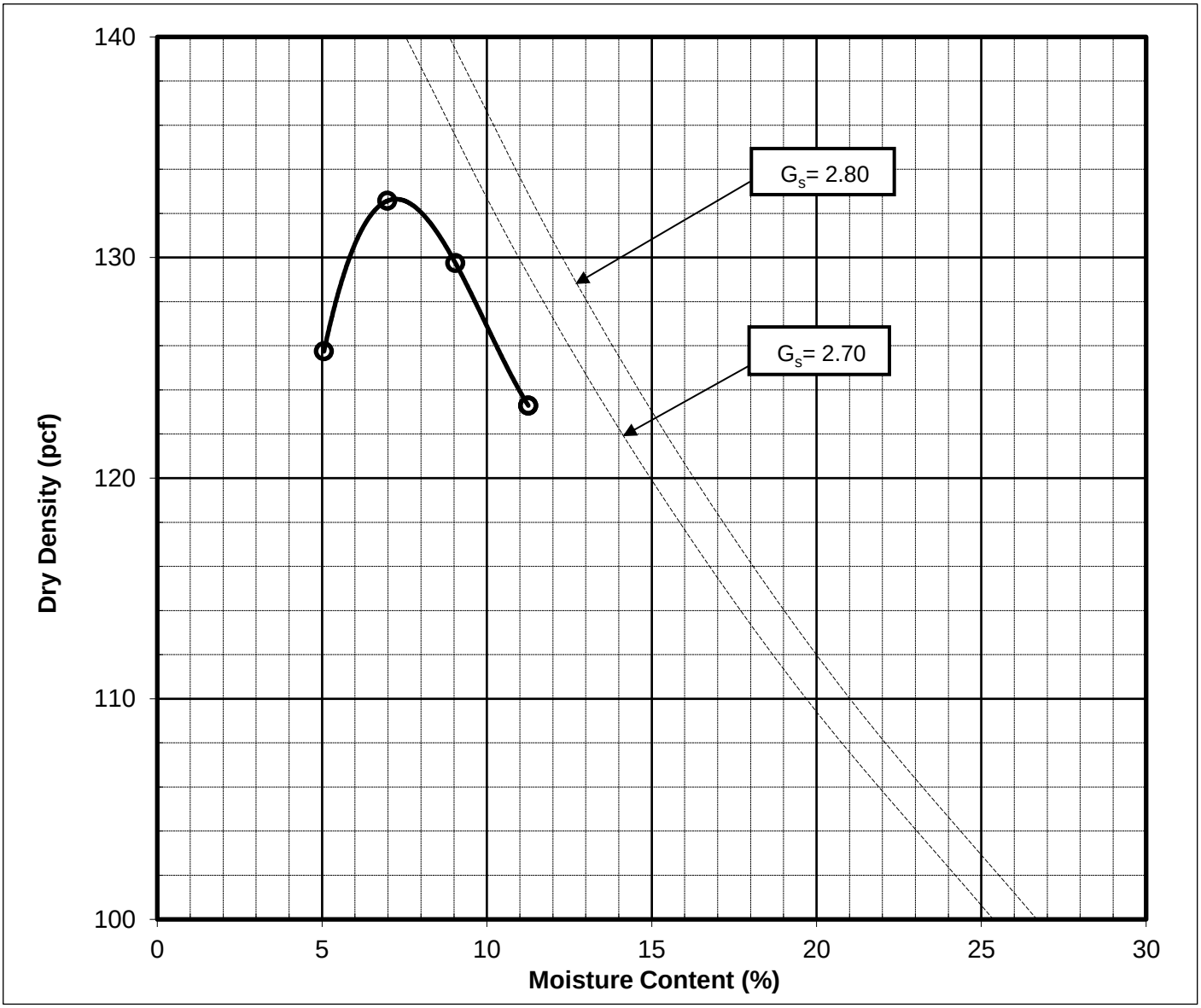
Compaction Characteristics of Soils Using Modified Effort

ASTM D1557

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring Number:	B-5	*Date:*	01/10/23
Sample Number:	BS-1		
Depth (ft) :	20-25		
Soil Description:	Light Brown, Clayey Sand (SC)		

Mold size (in)	4"
Procedure	A
Weight Retained on:	2.7
Remarks:	

Maximum Dry Density (pcf)	**132.7**
Optimum Moisture Content (%)	**7.3**
Corrected Maximum Dry Density (pcf)	**-**
Corrected Optimum Moisture Content (%)	**-**



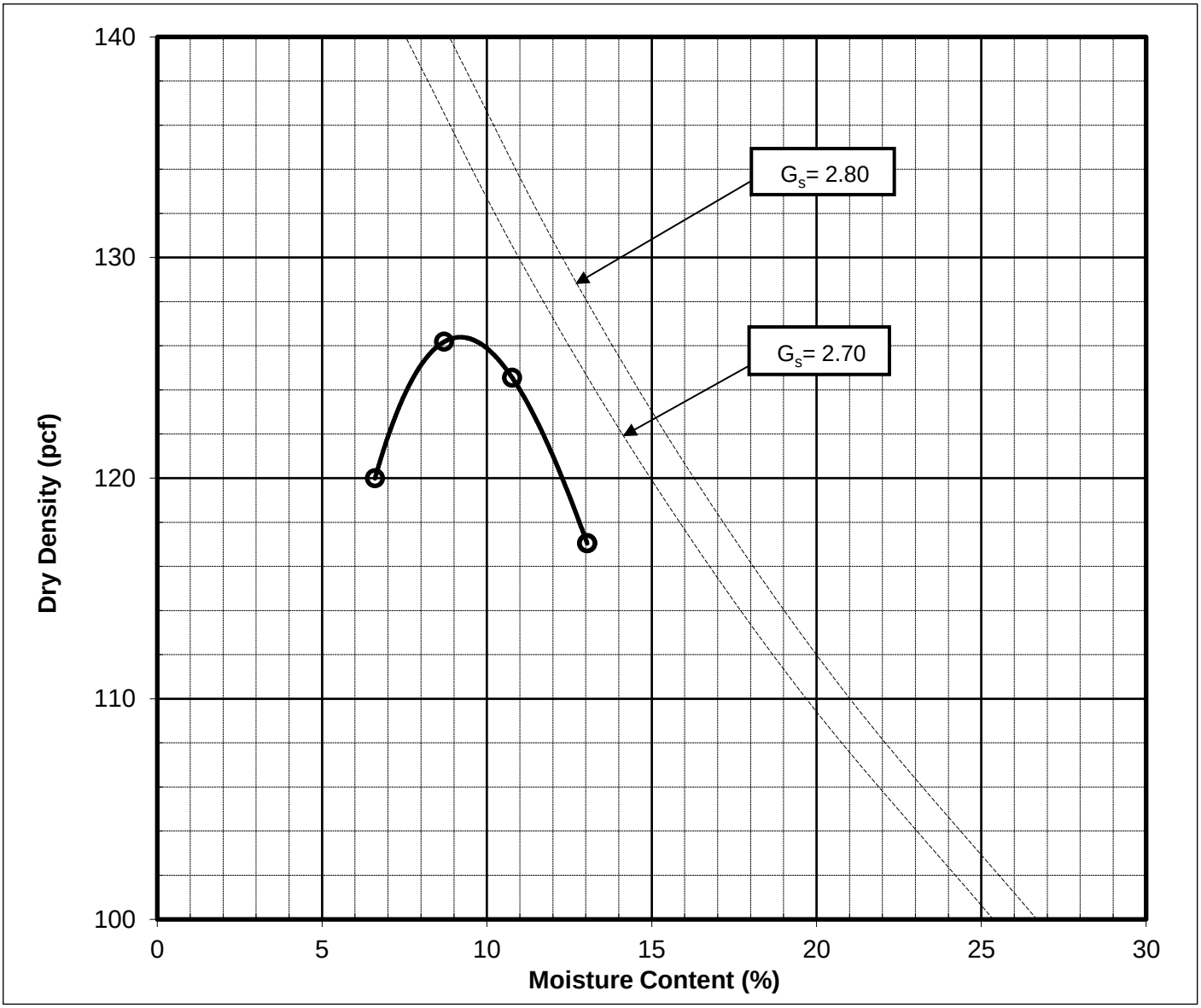
Compaction Characteristics of Soils Using Modified Effort

ASTM D1557

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring Number:	B-8	*Date:*	01/11/23
Sample Number:	BS-1		
Depth (ft) :	15-20		
Soil Description:	Brown, Clayey Sand (SC)		

Mold size (in)	4.0
Procedure	A
Weight Retained on:	0.7
Remarks:	

Maximum Dry Density (pcf)	**126.3**
Optimum Moisture Content (%)	**9.3**
Corrected Maximum Dry Density (pcf)	**-**
Corrected Optimum Moisture Content (%)	**-**



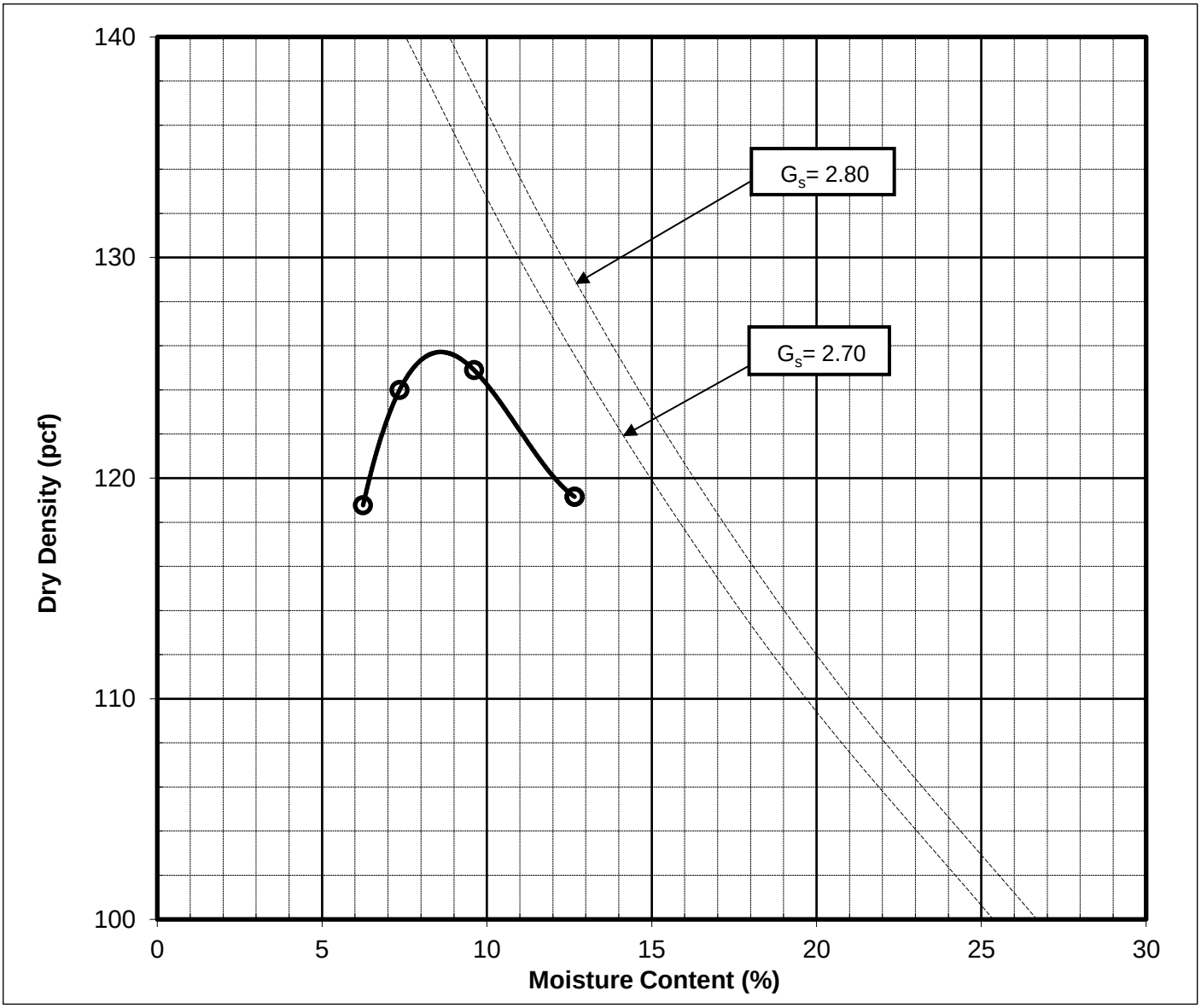
Compaction Characteristics of Soils Using Modified Effort

ASTM D1557

Client:	Golder WSP	*HAI Project No.:*	GAUI-23-002
Project:	Sunnymead MDP Line F and F-7 Flood Control Improvement	*Tested by:*	WA
Project No.:	12804B	*Checked by:*	KL
Boring Number:	B-13	*Date:*	01/11/23
Sample Number:	BS-1		
Depth (ft) :	0-5		
Soil Description:	Light Brown, Clayey Sand (SC)		

Mold size (in)	4.0
Procedure	A
Weight Retained on:	0.6
Remarks:	

Maximum Dry Density (pcf)	**125.7**
Optimum Moisture Content (%)	**8.6**
Corrected Maximum Dry Density (pcf)	**-**
Corrected Optimum Moisture Content (%)	**-**



Results Only Soil Testing for Sunnymead MDP Line F & F-7 Flood Control Improvement

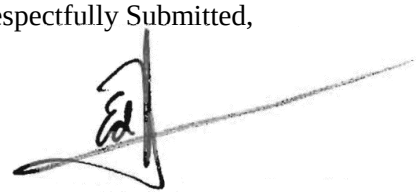
January 16, 2023

Prepared for:

Kang Lin
HAI
250 Goddard
Irvine, CA 92618
kang@haieng.com

Project X Job#: S230112H
Client Job or PO#: 12804B

Respectfully Submitted,



Eduardo Hernandez, M.Sc., P.E.
Sr. Corrosion Consultant
NACE Corrosion Technologist #16592
Professional Engineer
California No. M37102
ehernandez@projectxcorrosion.com

Soil Analysis Lab Results

Client: HAI
Job Name: Sunnymead MDP Line F & F-7 Flood Control Improvement
Client Job Number: 12804B
Project X Job Number: S230112H
January 16, 2023

	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM G51
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-		**Resistivity** As Rec'd | Minimum		**pH**
	(ft)	**(mg/kg)**	**(wt%)**	**(mg/kg)**	**(wt%)**	**(Ohm-cm)**	**(Ohm-cm)**	
B-4 Sample # BS-1	15-20	62.9	0.0063	12.2	0.0012	11,390	5,829	8.2
B-5 Sample # BS-1	20-25	74.1	0.0074	41.9	0.0042	10,720	3,484	7.9
B-8 Sample # BS-1	15-20	114.4	0.0114	120.7	0.0121	11,390	1,742	8.2
B-13 Sample # BS-1	0-5	97.1	0.0097	34.9	0.0035	10,050	2,412	8.2

Cations and Anions, except Sulfide and Bicarbonate, tested with Ion Chromatography
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
ND = 0 = Not Detected | NT = Not Tested | Unk = Unknown
Chemical Analysis performed on 1:3 Soil-To-Water extract
PPM = mg/kg (soil) = mg/L (Liquid)

APPENDIX C

Percolation Test Data

Boring Percolation Test Data Sheet

Project Name: Sunnymead MDP Line F and F-7 Flood Control Improvement Project
Project Number: 12804B
Date: 12/6/2022
Location: South of Sunnymead Boulevard (Southern Segment)
Boring ID: B-7

Test hole dimensions	
Boring Depth* (feet):	20.38
Boring Diameter (inches):	8.0
Pipe Diameter (inches):	2.0

*includes pipe stickup above top of boring

Miscellaneous Test Details	
Liquid Description:	Non-Potable Water
Measurement Method:	Water Sounder
Depth to Water Table:	> 20 feet below bottom of boring
Water Remaining In Boring:	~3 feet remaining after test
Tested By	D. Lam / A. Menchaca
Checked By	J. Cox

Pre-Soak / Pre-Test:

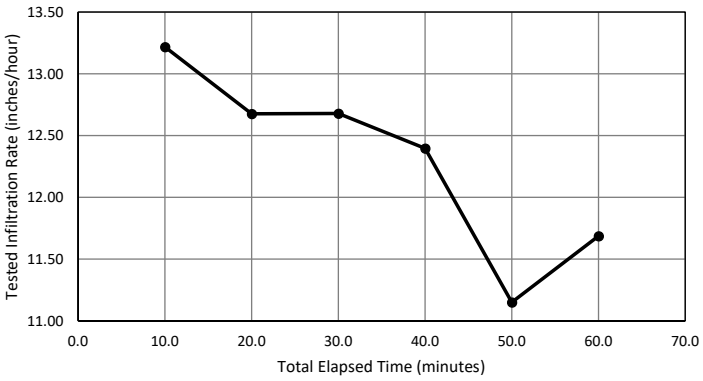
Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, d_1 (feet)	Final Depth to Water, d_2 (feet)	Total Change in Water Level, d_2-d_1 (feet)	Comments
1	8:41:00	9:06:00	25.0	13.98	19.21	5.23	Water level drop exceeded 6 inches in 25 minutes
2	9:11:00	9:36:00	25.0	13.89	19.18	5.29	Water level drop exceeded 6 inches in 25 minutes

Percolation Test Data:

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, d_1 (feet)	Final Depth to Water, d_2 (feet)	Change in Water Level, ΔH (inches)	Tested Infiltration Rate*, I_t (in/hr)	Notes/Observations
1	9:39:00	9:49:00	10.0	11.32	17.87	78.60	13.22	
2	9:52:00	10:02:00	10.0	11.37	17.71	76.08	12.68	
3	10:08:00	10:18:00	10.0	11.27	17.68	76.92	12.68	
4	10:23:00	10:33:00	10.0	11.22	17.57	76.20	12.40	
5	10:43:00	10:53:00	10.0	11.51	17.24	68.76	11.15	
6	10:57:00	11:07:00	10.0	11.35	17.37	72.24	11.69	

Percolation Test Results:

Average Tested Infiltration Rate (in/hr):	12.30
Factor of Safety (FS):	3.0
Design Infiltration Rate (in/hr):	**4.10**



*Calculated using the Porchet equation:

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t(r+2H_{avg})}$$

where:

I_t = tested infiltration rate (inches/hour)
ΔH = change in head over the selected time interval (inches)
r = radius of the borehole (inches)
Δt = time interval (minutes)
H_{avg} = average head over the time interval (inches)

**$I_d = I_t$ / FS

Boring Percolation Test Data Sheet

Project Name: Sunnymead MDP Line F and F-7 Flood Control Improvement Project
Project Number: 12804B
Date: 12/6/2022
Location: South of Sunnymead Boulevard (Southern Segment)
Boring ID: B-9

Test hole dimensions	
Boring Depth* (feet):	15.25
Boring Diameter (inches):	8.0
Pipe Diameter (inches):	2.0

*includes pipe stickup above top of boring

Miscellaneous Test Details	
Liquid Description:	Non-Potable Water
Measurement Method:	Water Sounder
Depth to Water Table:	>15 feet below bottom of boring
Water Remaining In Boring:	~4.5 feet remaining after test
Tested By	D. Lam / A. Menchaca
Checked By	J. Cox

Pre-Soak / Pre-Test:

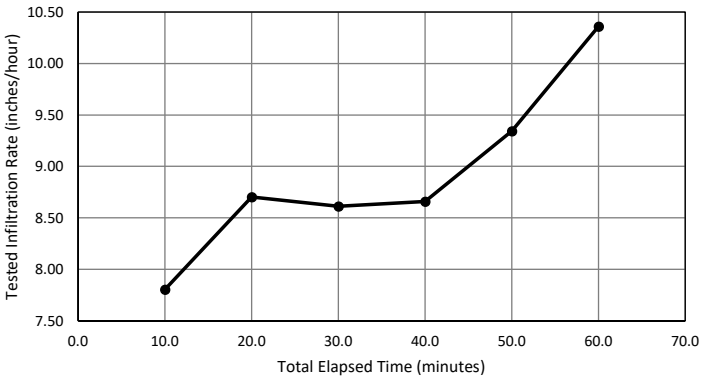
Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, d_1 (feet)	Final Depth to Water, d_2 (feet)	Total Change in Water Level, d_2-d_1 (feet)	Comments
1	11:42:00	12:07	25	9.98	11.73	1.75	Water level drop exceeded 6 inches in 25 minutes
2	12:12:00	12:37	25	7.29	11.49	4.20	Water level drop exceeded 6 inches in 25 minutes

Percolation Test Data:

Reading No.	Start Time	Stop Time	Time Interval, Δt (min)	Initial Depth to Water, d_1 (feet)	Final Depth to Water, d_2 (feet)	Change in Water Level, ΔH (inches)	Tested Infiltration Rate*, I_t (in/hr)	Notes/Observations
1	12:38:00	12:48:00	10.0	6.92	11.09	50.04	7.80	
2	12:49:00	12:59:00	10.0	5.89	10.96	60.84	8.70	
3	13:00:00	13:10:00	10.0	5.95	10.95	60.00	8.61	
4	13:12:00	13:22:00	10.0	5.95	10.97	60.24	8.66	
5	13:24:00	13:34:00	10.0	4.87	10.78	70.92	9.34	
6	13:36:00	13:46:00	10.0	3.66	10.75	85.08	10.36	

Percolation Test Results:

Average Tested Infiltration Rate (in/hr):	8.91
Factor of Safety (FS):	3.0
Design Infiltration Rate (in/hr):	**2.97**



*Calculated using the Porchet equation:

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t(r+2H_{avg})}$$

where:

I_t = tested infiltration rate (inches/hour)
ΔH = change in head over the selected time interval (inches)
r = radius of the borehole (inches)
Δt = time interval (minutes)
H_{avg} = average head over the time interval (inches)

**$I_d = I_t$ / FS

APPENDIX D

Important Information About Your 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, clients can benefit from a lowered exposure to the subsurface problems 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 below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs 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. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project 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.*

This Report May Not Be Reliable

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

- for a different client;
- for a different project;
- 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, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been 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 your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

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

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment 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 from project start to project finish, so the individual can provide 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 judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed 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 full-time 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 on hand quickly 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 observation.

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 informational 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, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. 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. 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 relate any 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 yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

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, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled 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

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