Geotechnical Services

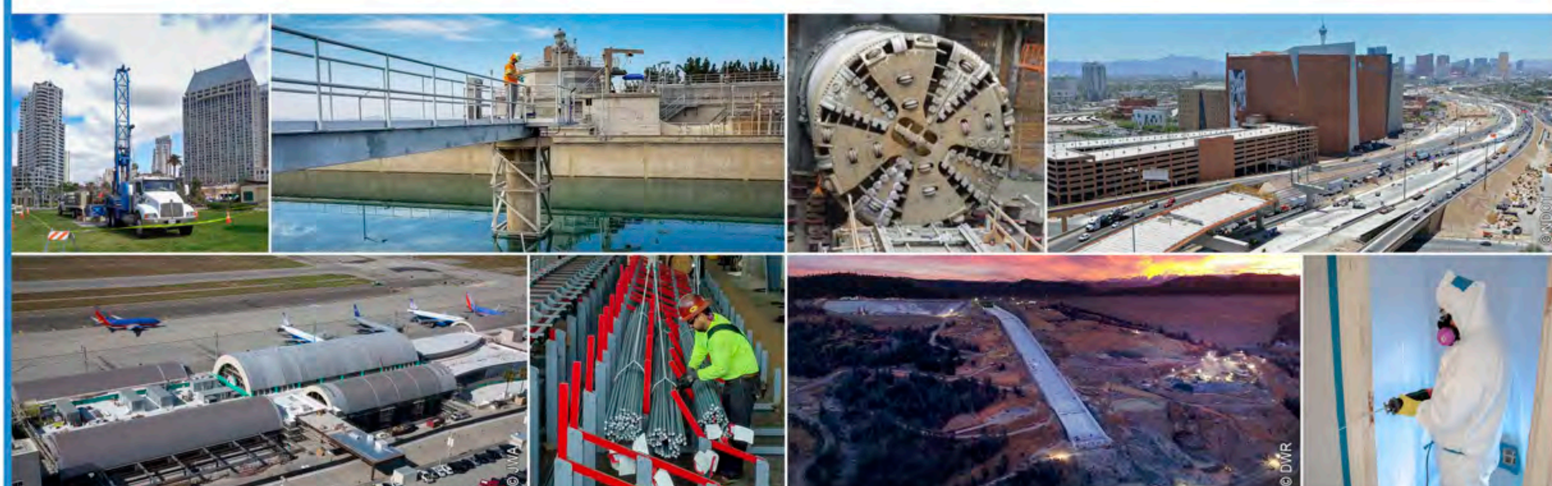
AJSD WRF Expansion
5661 South Ironwood Drive

Apache Junction, Arizona

Stantec

3133 West Frye Road, Suite 300 | Chandler, Arizona 85226

November 16, 2023 | Project No. 607723001



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Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

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AJSD WRF Expansion
5661 South Ironwood Drive
Apache Junction, Arizona

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1 INTRODUCTION

In accordance with our proposal dated April 24, 2023, and your authorization, we have performed a geotechnical evaluation for the proposed Apache Junction Sewer District (AJSD) Water Reclamation Facility (WRF) Expansion project, located in Apache Junction, Arizona. The purpose of our evaluation was to assess the subsurface conditions at the site in order to provide geotechnical recommendations for the design and construction of the project. This report presents the results of our evaluation, geotechnical considerations, and geotechnical design parameters for the project.

2 SCOPE OF SERVICES

The scope of our services for this project generally included:

- Reviewing pertinent background data including in-house geotechnical and soils data, available geotechnical and as-built data from adjacent projects, available aerial photographs, and published geologic data pertaining to the project site.

- Conducting a field trip to the site for geological reconnaissance.

- Marking out the boring locations and notifying Arizona 811 of the locations prior to drilling.

- Evaluating the presence of underground utilities at our boring locations using geophysical equipment.

- Drilling, logging, and sampling 16 exploratory soil borings to depths of approximately 19 to 30 feet below ground surface (bgs) within the main facility expansion area.

- Drilling, logging, and sampling two borings located within the future surface recharge areas to depth of 98 feet deep each. Backfilling these borings with 2-inch diameter polyvinyl chloride (PVC) casing and clean sand/gravel within the annulus space. A portion of the PVC casing was screened and a portion was solid. Stantec then conducted falling-head infiltration testing within these boreholes. After finishing of falling-head infiltration testing, we removed the PVC casing from the boreholes and backfilled the remaining space with clean sand/gravel.

- Performing laboratory tests on selected samples obtained from the borings to evaluate in-situ moisture content and dry density, gradation, Atterberg limits, maximum density, consolidation, direct shear, and corrosivity characteristics (including pH, minimum electrical resistivity, and soluble sulfate and chloride contents).

- Preparing this geotechnical engineering report that presents our findings, considerations, and recommendations regarding the design and construction of the project.

Our scope of services did not include environmental consulting services such as hazardous waste sampling or analytical testing at the site. If needed, a scope and fee for these services can be provided.

3 SITE DESCRIPTION

The proposed site is located within the existing AJSD WRF facility at 5661 South Ironwood Drive in Apache Junction, Arizona. East-west oriented paved Guadalupe Road provide access to entrance of site from Ironwood Drive. The approximate location of the site is depicted on Figure 1. The site is bounded by undeveloped desert and Ironwood Drive to the west, drainages/Weekes Wash to the south and Central Arizona Project (CAP) Aqueduct and Flood Retarding Structures to the north and east of the proposed project limits.

Presently, the AJSD WRF facility is partially developed with several existing above- and below-grade features. Ongoing construction was being performed during our site visit with several piles of spoils and piping located at the north side of the site. The main expansion site is a graded area with removed vegetation, several berms, basins, asphalt pavement and some water reclamation facilities near the site center.

According to the Desert Wells, Arizona, 7.5-Minute United States Geological Survey Topographic Quadrangle Map (2021) the site elevation ranges from approximately 1,550 to 1,560 feet relative to mean sea level (MSL), generally sloping from the northwest to the southeast. The site is relatively flat.

Several historic aerial photographs and topographic maps were reviewed for this project from the Historic Aerials website (Nationwide Environmental Title Research), and aerial photographs from Google Earth™. The Ironwood Drive alignment is depicted in a 1961 aerial photograph to the west of the site and crosses Weekes Wash to the southwest. Aerial maps from the period of 1971 to 1994 indicated no major changes in the site contours and no development on the site. The aerial photograph dated 1971 depicted the Flood Retarding Structure to the north of the site. The CAP Aqueduct is shown in a 1983 aerial photograph to the north of the site with some paths and trails traversing the site in different directions. Evidence of grading operations was observed in a 1995 aerial photograph and some water reclamation facilities are depicted in a 1997 aerial photograph. The images from 2004, 2007, 2009, 2010 and 2013 depicted ongoing construction of water reclamation facilities at the site. Aerial photographs from 2019 to 2023 depicted additional grading for several basins at the southern end of the site similar to its current condition.

4 PROJECT DESCRIPTION

We understand that the project consists of the design and construction of expansion improvements associated with the existing WRF. The new improvements will generally include the following:

- Influent Splitter Structure;
- Phase 1 And 2 Headworks;
- Headworks Odor Control;
- Electrical Building 1;
- Phase 1 And 2 Fine Screening Facility;
- Bioreactor Odor Control;
- Blower Building;
- Bioreactors 1A/1B;
- Electrical Building 2;
- Membrane Facility 1;
- Disinfection Channel 1 / Plant Water Pump Station;
- Chemical Building;
- Aerated Sludge Holding Tank;
- Belt Press Facility (Phase 1);
- Admin/Ops Building; and
- Maintenance Building.

The structural loading associated with the new construction is not known at this time, but are assumed to include column loads that are 100 kips and less. We also assume that many of these project features will be situated below grade, ranging for 5 to 20 feet deep.

5 FIELD EXPLORATION AND LABORATORY TESTING

The following sections summarize our field exploration and laboratory testing activities.

5.1 Soil Borings

Between July 10, 2023 and August 2, 2023, Ninyo & Moore conducted a subsurface exploration at the site in order to evaluate the subsurface conditions and to collect soil samples for laboratory testing. Our exploration consisted of drilling, logging, and sampling 18 small-diameter borings, denoted as shown below in Table 1. The approximate Latitude and Longitude coordinates and ground elevations at each boring location are provided in Table 1. Elevations were estimated from USGS. The approximate locations of the borings are presented on Figure 2.

Table 1 – Test Borings

Boring Designation	Approximate Location		Elevation	Boring Depth	Project Location/Feature
	Latitude	Longitude	(feet)	(feet)	
B-1	33.36336	-111.55914	1559	29	Influent Splitter Structure
B-2	33.36336	-111.55947	1558	30	Phase 1 And 2 Headworks
B-3	33.36293	-111.55938	1558	30	Headworks Odor Control
B-4	33.36287	-111.55996	1557	19	Electrical Building 1
B-5	33.36268	-111.55961	1557	29	Phase 1 And 2 Fine Screening Facility
B-6	33.36248	-111.56021	1555	29	Bioreactor Odor Control
B-7	33.3621	-111.55979	1553	30	Blower Building
B-8	33.36178	-111.56017	1553	29	Bioreactors 1A/1B
B-9	33.36167	-111.55979	1553	19	Electrical Building 2
B-10	33.362	-111.56036	1552	30	Membrane Facility 1
B-11	33.36147	-111.5604	1551	29	Disinfection Channel 1 / Plant Water Pump Station
B-12	33.36112	-111.55944	1551	30	Chemical Building
B-13	33.36089	-111.55754	1550	30	Aerated Sludge Holding Tank
B-14	33.36074	-111.55791	1550	30	Belt Press Facility (Phase 1)
B-15	33.3638	-111.56094	1560	20	Admin/Ops Building
B-16	33.3621	-111.56082	1554	29	Maintenance Building
AJ-1	33.358594	-111.555324	1549	98	Surface Recharge Area
AJ-2	33.3607	-111.553541	1557	98	Surface Recharge Area

The borings were advanced using a CME-75 truck-mounted drill rig equipped with hollow-stem auger drilling equipment. Bulk and relatively undisturbed soil samples were collected at selected intervals. Detailed descriptions of the soils encountered are presented on the boring logs in Appendix A.

5.2 Laboratory Testing

The soil samples collected from our drilling activities were transported to the Ninyo & Moore laboratory in Phoenix, Arizona. In addition, Ninyo & Moore performed laboratory tests on selected samples obtained from the borings to evaluate the in-situ moisture content and dry density, gradation, Atterberg limits, maximum density, consolidation, direct shear, and corrosivity characteristics (including pH, minimum electrical resistivity, soluble sulfate and chloride contents). The in-situ moisture content and dry density results are presented on the boring logs in Appendix A. A description of the laboratory testing as well as the remainder of the laboratory test results are presented in Appendix B.

6 GEOLOGY AND SUBSURFACE CONDITIONS

The following sections describe the geology at the site as well as potential geologic hazards.

6.1 Geologic Setting

The project site is located in the Sonoran Desert Section of the Basin and Range physiographic province, which is typified by broad alluvial valleys separated by steep, discontinuous, subparallel mountain ranges. The mountain ranges generally trend north-south and northwest-southeast. The basin floors consist of alluvium with thickness extending to several thousands of feet.

The basins and surrounding mountains were formed approximately 10 to 18 million years ago during the mid- to late-Tertiary. Extensional tectonics resulted in the formation of horsts (mountains) and grabens (basins) with vertical displacement along high-angle normal faults. Intermittent volcanic activity also occurred during this time. The surrounding basins filled with alluvium from the erosion of the surrounding mountains as well as from deposition from rivers. Coarser-grained alluvial material was deposited at the margins of the basins near the mountains.

The surficial geology of the site is mapped as by the Arizona Geologic Survey (AZGS) as Holocene to Late Pleistocene (10,000 to 250,000 years) age alluvial basin floor deposits. These deposits were described as clay, silt, sand and fine gravel, and older deposits may have Stage II (partially coated grains) to Stage III (caliche layering) calcic horizons (Pearthree, P.A., Huckleberry, G., 1994).

Our review of the United States Department of Agriculture, Natural Resource Conservation Service online web soil survey, indicated the soils at this site are mapped primarily as Mohall sandy loam as well as Carrizo family-Brios-Riverwash complex at Weekes Wash. Loam is an agricultural soil classification that refers to a soil comprised of a mixture of clay, silt, and sand. A sandy loam contains a relatively higher percentage of sand in the mixture.

6.2 Subsurface Conditions

Our knowledge of the subsurface conditions at the project site is based on the results of our explorations and our understanding of the general geology of the area. The boring logs contains our field test results, as well as our interpretation of the conditions anticipated to exist between actual samples retrieved. Therefore, the boring logs contains both factual and interpretive information. Lines delineating subsurface strata on the boring logs are intended to group soils having similar engineering properties and characteristics. They should be considered approximate, as the actual transition between soil types may be gradual. Note that relative densities of coarse-grained soils and non-elastic silts include very loose, loose, medium dense, dense and very dense. Consistency of elastic silts and clays include very soft, soft, firm, stiff, very stiff, and hard. Detailed stratigraphic information as well as a key to the soil symbols and terms used on the boring logs are provided in Appendix A.

6.2.1 Asphalt Concrete

Asphalt concrete (AC) was encountered at the surface of Borings B-13 and B-14, and had a thickness of approximately 2 inches. Aggregate base (AB) was observed underlying the AC and had a thickness of approximately 2 inches.

6.2.2 Fill

Undocumented fill soils (likely placed as part of the past site deployment) were encountered below the AB described above or at the ground surface in borings B-1 through B-5, B-11, B-12 and B-16; and ranged in thickness from approximately 3.5 to 8.5 feet. The fill generally consisted of very loose to medium dense clayey sands (SC), and silty sand (SM) and soft to very stiff sandy lean clay (CL) and silty clay (CL-ML) in our borings.

6.2.3 Alluvium

Underlying the fill described above or at surface of our remaining borings we encountered native, Holocene to late Pleistocene-age alluvium that generally consisted of heterogeneous interlayered deposits of loose to very dense/hard well graded and poorly graded sands with silt, silty sands, clayey sands, (SW-SM, SP-SM, SM, SC), sandy silts (ML), silty clays (CL-ML), sandy lean clays (CL) to the termination depths of our borings. Poorly graded gravel (GP) and clayey gravel (GC) were at depth of 75 feet in boring AJ-2. Scattered caliche nodules were observed in our borings. The loose/soft layers were encountered as shallow as 3 feet and as deep as 8 feet in our soil borings.

6.3 Groundwater

Groundwater was not encountered in our borings at the time of drilling. Well data provided by the Arizona Department of Water Resources indicates that regional groundwater has been historically encountered approximately 90 feet or more bgs. Groundwater levels may fluctuate due to the close proximity to adjacent ditches and canals, seasonal variations, irrigation, groundwater withdrawal or injection, and other factors.

6.4 Surface Water

Based on the information presented on the Federal Emergency Management Agency Online Map Viewer, the site lies within flood zone X, which is described as an area with 0.2 percent or more chance of flooding each year, in the form of sheet flow with average depths of less than 1 foot. As such, surface water flows and/or shallower groundwater levels may be encountered within the project limits during rain events, and may need to be mitigated during construction.

7 GEOLOGIC HAZARDS

The following sections describe potential geologic hazards at the site, including land subsidence and earth fissures, and faulting.

7.1 Land Subsidence and Earth Fissures

Groundwater depletion, due to groundwater pumping, has caused land subsidence and earth fissures in numerous alluvial basins in Arizona. It has been estimated that subsidence has affected more than 3,000 square miles and has caused damage to a variety of engineered structures and agricultural land (Schumann and Genualdi, 1986). From 1948 to 1983, excessive groundwater withdrawal has been documented in several alluvial valleys where groundwater levels have been reportedly lowered by up to 500 feet. With such large depletions of groundwater, the alluvium has undergone consolidation resulting in large areas of land subsidence.

This site is located within the Hawk Rock Land Subsidence Feature in the East Salt River Valley Sub-Basin of the Phoenix AMA. According to the ADWR map of Total Land Subsidence in the Hawk Rock Area, Maricopa and Pinal Counties, based on Radarsat-2 Satellite Interferometric Synthetic Aperture Radar (InSAR) Data, approximately 0.8 to 1.6 inches of subsidence has occurred in the area of this site area from May, 2010 to April, 2018.

In Arizona, earth fissures are generally associated with land subsidence and pose an on-going geologic hazard. Earth fissures generally form near the margins of geomorphic basins where significant amounts of groundwater depletion have occurred. Earth fissures have also formed due to tensional stress caused by differential subsidence of the unconsolidated alluvial materials over buried bedrock ridges and irregular bedrock surfaces. Differential subsidence can also be caused by facies changes within unconsolidated alluvial deposits, also causing tensional stress (Schumann and Genualdi, 1986).

Based on our research, the closest documented earth fissure to the site is approximately 0.3 miles southwest of the site (AZGS 2017). Continued groundwater withdrawal in the area may result in further subsidence and the formation of new fissures or the extension of existing fissures. If earth fissures are encountered during construction, Ninyo & Moore should be contacted for recommendations.

7.2 Faulting

The site lies within the Sonoran Zone, which is a relatively stable tectonic region located in southwestern Arizona, southeastern California, southern Nevada, and northern Mexico (Euge et al., 1992). This zone is characterized by sparse seismicity and few Quaternary faults. Based on our field observations, review of pertinent geologic data and analysis of aerial photographs, faults are not located on or adjacent to the property. The closest documented fault to the site is the Sugarloaf Fault Zone, located approximately 22 miles to the northeast of the site (Pearthree, 1998). The Sugarloaf fault is a 20 km (12 mile) long, northwest-to north-trending normal fault with displacement down to the east. Recent movement along this fault was approximately 750,000 years ago during the Middle Pleistocene epoch. The slip-rate category of this fault is less than 0.2 millimeters per year (Pearthree, 1998). Seismic parameters recommended for the design of the proposed improvements are presented below.

7.3 Seismic Design Considerations

Based on a Probabilistic Seismic Hazard Assessment for the conterminous United States, issued by the United States Geological Survey (USGS), the site is located in a zone where the peak ground acceleration having a 2 percent probability of being exceeded in 50 years is 0.1g.

Table 2 presents the seismic design parameters for the site in accordance with IBC guidelines and mapped spectral acceleration parameters (USGS, 2011): These ground motion values are calculated for "Very Dense Soil" sites, which correspond to a shear-wave velocity of approximately 1200 to 2500 feet per second in approximately the top 100 feet bgs. Different soil or rock types may amplify or de-amplify these values. The proposed improvements should be designed in accordance with the requirements of governing jurisdictions and applicable building codes.

Table 2 – IBC Seismic Design Criteria

Seismic Design Factors	Value
Site Class	C
Site Coefficient, F_a	1.2
Site Coefficient, F_v	1.7
Mapped Spectral Acceleration at 0.2-second Period, S_s	0.223 g
Mapped Spectral Acceleration at 1.0-second Period, S_1	0.068 g
Spectral Acceleration at 0.2-second Period Adjusted for Site Class, S_{MS}	0.267 g
Spectral Acceleration at 1.0-second Period Adjusted for Site Class, S_{M1}	0.116 g
Design Spectral Response Acceleration at 0.2-second Period, S_{DS}	0.178 g
Design Spectral Response Acceleration at 1.0-second Period, S_{D1}	0.077 g

8 CONCLUSIONS

Based on the results of our subsurface evaluation, laboratory testing, and data analysis, it is our opinion that the proposed construction is feasible from a geotechnical standpoint. Geotechnical considerations include the following:

- In general, the near-surface soils are considered to be rippable with heavy-duty excavation equipment in good working condition. However, scattered caliche nodules, and very dense/hard soils were encountered in our borings, which may be more difficult to excavate and/or will slow the rate of excavation.

- Loose fill and alluvium soils were found at the site and may be subject to sloughing and influence from vibration from construction.

- Due to the widely spaced nature of our borings, soil conditions that differ from those observed in our borings may be encountered during construction.

- An earthwork (shrinkage) factor of approximately 10 to 20 percent if the on-site soils are re-used as fill.
- Spread footings and mat foundations may be used and should be founded on a zone of adequately moisture-conditioned and compacted engineered fill.
- Concrete slab-on-grade floors, pavements, and exterior concrete flatwork should also be founded on a zone of adequately moisture-conditioned and compacted engineered fill.
- Imported soils and soils generated from on-site excavation activities that exhibit a very low-to low expansion potential can generally be used as engineered fill, provided the oversized or heavily cemented materials are either broken down or wasted. On the basis of our evaluation, some of the on-site soils will not suitable for use as engineered fill.
- Groundwater was not observed in our borings and is not expected to be a constraint to the design and construction of the project. Depending on the construction schedule and season(s) in which construction takes place, surface flows may need to be mitigated during construction.
- Corrosivity test results indicate that on-site soils are corrosive to ferrous materials and the sulfate content of the soils presents a negligible sulfate exposure to concrete.

9 RECOMMENDATIONS

The following sections present our geotechnical recommendations for the proposed construction. In general, the recommendations and guidelines outlined in the Maricopa Association of Governments Standard Specifications and Details and/or any City of Apache Junction requirements should be used unless recommended differently herein. If the proposed construction is changed from that discussed in this report, Ninyo & Moore should be contacted for additional recommendations.

9.1 Earthwork

The following sections provide our earthwork recommendations for this project. If the site grade is planned to change by more than 3 feet vertically, Ninyo & Moore should be contacted for additional recommendations.

9.1.1 Site Preparation

Vegetation, unsuitable materials, or debris from the clearing operation should be removed from the site and disposed of or placed in non-structural areas (e.g., landscaping). Obstructions that extend below finish grade, if present, should be removed and the resulting voids filled with moisture-conditioned and compacted engineered fill.

After rough grade has been achieved and prior to further earthwork, the exposed subgrade should be proof-rolled and visually observed for the presence of debris, organic matter and other unsuitable materials. If unsuitable soils are encountered at subgrade level during earthwork operations, these soils should be removed to their full depth, and be replaced with engineered fill.

The geotechnical consultant should carefully evaluate any areas of loose, soft, or wet soils prior to placement of fill or other construction. Drying or over-excavation of some materials may be appropriate.

9.1.2 Fill

As discussed in Section 6.2, undocumented fill was observed in some of our borings. We recommend that if fill is encountered in areas to receive settlement-sensitive improvements, the fill be removed, and the exposed subgrade proof-rolled, prior to the placement of engineered fill or other improvements. The geotechnical consultant should carefully evaluate these areas prior to placement of engineered fill or other construction. If engineered fill is placed in these areas, its placement should be observed by the geotechnical consultant and field density tests performed on each lift of fill. Engineered fill should be placed as described in Section 9.1.8 below.

9.1.3 Excavation Characteristics

Our evaluation of the excavation characteristics of the on-site materials is based on the results of our exploratory borings, our site observations, and our experience with similar materials. In our opinion, excavation of the near-surface on-site materials can generally be accomplished with heavy-duty earthmoving equipment in good operating condition. However, scattered caliche nodules and hard/very dense soils were observed in our borings, and may be more difficult to excavate and/or slow the rate of excavation depending on the actual degree of cementation encountered during construction.

If the proposed construction extends deeper than the extent of our test borings in any part of this project, Ninyo & Moore should be contacted for additional consultation and possible further evaluation of the subsurface materials.

Due to the heterogeneous nature of the site, and the limited access for our borings, soils different than that encountered in our borings should be anticipated during construction.

9.1.4 Temporary Slope Stability

The side slopes of new excavations and trenches should be stabilized in order to allow access and minimize damage to adjacent structures resulting from vertical or lateral movement of the soil. The side slopes may be stabilized by sloping back the sides and/or by using bracing. However, the side slopes may be difficult to stabilize in areas where loose, low cohesion, granular soils exist on site. These soils could have a potential for caving and sloughing during excavation, especially if the soils are wet or saturated. Additionally, vibrations caused by nearby traffic or construction equipment could accelerate sloughing.

Excavations that are 20 feet deep or less could be constructed using a sloped excavation in accordance with Occupational Safety and Health Administration ([OSHA], 2011) Standards, based on the soil types encountered. Soils with low cohesion were encountered during our field exploration. Due to the presence of these soils, we recommend that the OSHA soil *"Type C"* be used for the subject site. Based on OSHA standards, this corresponds to a temporary side slope of 1.5:1 (horizontal to vertical) or flatter for soils, in sloped excavations that are less than 20 feet. Upon making the excavations, soil classification, and excavation performance should be evaluated in the field by the geotechnical consultant in accordance with the OSHA regulations. These cut slope recommendations assume that no groundwater is present and no surcharge loading will be located adjacent to the top of the cut.

Temporary excavations that encounter surface or groundwater seepage may need shoring and/or stabilization by placing sandbags or gravel along the base of the seepage zone. Excavations encountering seepage should be evaluated on a case-by-case basis. Slope stability of trenches deeper than 20 feet, though not anticipated, should be evaluated by the contractor's engineer based on alignment-specific soil properties and settlement-sensitive features.

9.1.5 Temporary Shoring

In excavations where loose, low cohesion, soils are encountered we recommend that a temporary earth retention system be utilized for areas where excavations are to be performed in proximity to existing structures or other improvements. Temporary earth retention systems may include braced systems, such as trench boxes or shields with internal supports or cantilever systems (e.g., soldier piles and lagging); however, the risk of excessive lateral deflection may render a cantilevered shoring system inappropriate for the project.

Shored or braced trench excavations in loose, low cohesion, soils may be designed using the parameters on Figure 3, depending on the soil conditions. The recommended design earth pressures are based on the assumptions that the shoring system will be constructed without raising the ground surface elevation behind the shoring system, that there are no stockpiles of soil and/or construction materials, or other loads that act above a 1:1 (horizontal to vertical) plane extending up and back from the dredge line. For earth retention systems subjected to the above-mentioned surcharge loads, the contractor should include the effect of these loads on the design lateral earth pressures. In addition, where loose, low cohesion soils are encountered, the excavations may not stand open long enough to install the trench boxes. The contractor should be prepared to deal with these soil conditions and plan accordingly. Once installed, some sloughing is possible at the ends of the trench box; therefore, any loose material should be removed prior to backfilling of the trench. We recommend that an experienced structural engineer design the shoring system. The shoring parameters presented in this report should be considered as guidelines.

We anticipate that settlement of the ground surface will occur behind shoring systems during excavation. The amount of settlement will depend on the type of shoring system used, the contractor's workmanship, and soil conditions. We recommend that embankments, roadways, utilities, and other structures in the vicinity of the planned excavation be evaluated with regard to foundation support and tolerance to settlement. To reduce the potential for distress to these structures, we recommend that the shoring system be designed to limit the ground settlement behind it to ½-inch or less. Possible causes of settlement that should be addressed include settlement during excavation, construction vibrations, de-watering (if needed), and removal of the shoring system. We recommend that shoring installation be evaluated carefully by the contractor prior to construction and that ground vibration and settlement monitoring be performed during construction.

The contractor should evaluate the adequacy of the shoring parameters presented in this report, and make the appropriate modifications for their design. We recommend that the contractor take appropriate measures to protect the workers. OSHA requirements pertaining to workers' safety should be observed.

9.1.6 Protection of Existing Structures/Utilities

Lateral movement of a shored excavation will depend on the type and relative stiffness of the system used and other factors beyond the scope of this study. The shoring designer should perform a deflection analysis for the proposed shoring system. A survey of existing utilities, embankments, and structures adjacent to those portions of the proposed excavation that will be shored should also be performed prior to construction. The purpose of the analysis and survey would be to evaluate the ability of existing structures, embankments, pipelines, or conduits to withstand anticipated horizontal and vertical movements associated with a shored excavation. If movements exceed the tolerance of existing project features (utilities, embankments, structures, etc.), alternative shoring systems employing the at-rest earth pressure, tie-backs, dead-man anchors, or cross bracing may be needed to reduce deflections to acceptable levels. The contractor should anticipate repairing cracks in any improvements adjacent to shored portions of the excavation due to anticipated lateral displacements of the shoring system. Horizontal and vertical movements of the shoring system should be monitored by a surveyor and the results reviewed by the project Geotechnical Engineer.

9.1.7 Bottom Stability

The proposed excavations are not anticipated to encounter significant groundwater (with the possible exception of surface run-off or perched zones) during construction. Therefore, trench bottom stability problems during construction are generally not anticipated at this site. However, as the project site is mapped within FEMA Zone X, the site may encounter surface waters during periods of heavy precipitation. If the excavations are open during a heavy rain event, the trench material(s) might become saturated and unstable and a dewatering system may be needed for these conditions. Should this occur, further remedial measures may be needed.

Excavations that do encounter surface run-off (if any) could be dewatered by pumping the water out from the bottom and away from the excavation. However, heavily saturated units or perched groundwater zones, if encountered, may call for more aggressive means of dewatering and consultation with a qualified expert. Discharge of water from the excavations to natural drainage channels may entail securing a special permit.

9.1.8 Engineered Fill and Re-use of On-site Soils

On-site and imported soils that exhibit relatively low plasticity indices and a very low to low expansion potential are generally suitable for re-use as engineered fill. Relatively low plasticity indices, as evaluated by ASTM D4318, are defined as a plasticity index (PI) of 15 or less for this project. The Atterberg limits test performed on a soil sample obtained from our borings resulted in PI values from 0 (Non-plastic, NP) to 21. As such, it is our opinion that some of the on-site soils will not be suitable for re-use as engineered fill if supporting settlement-sensitive features or within 3-feet of the new pavement surfaces.

However, on-site soils with PI values up to 25 may be used as engineered fill within backfill zones situated 3-feet below the new pavement surface. Additional field sampling and laboratory testing may be conducted by the contractor either prior to or during construction to better understand the limits of suitable and unsuitable materials.

In addition, suitable engineered fill should not include construction debris, organic material, or other non-soil fill materials. Clay lumps and rock particles should not be larger than 4 inches in dimension. Obstructions that extend below finish grade should be removed and the resulting holes filled with compacted soil. Unsuitable fill material should be disposed of offsite or in non-structural areas.

Engineered fill material in contact with concrete should have a soluble sulfate content of less than 0.1 percent. Fill materials in contact with ferrous metals should also have low corrosion potential (minimum resistivity more than 2,000 ohm-cm, chloride content less than 25 parts per million [ppm]). In lieu of this, corrosion protection techniques (e.g., cathodic protection, pipe wrapping, etc.) can be implemented. A corrosion specialist should be consulted for recommendations of an appropriate corrosion protection technique.

9.1.9 Subgrade Preparation

As stated previously, the borings disclosed near-surface fill and alluvial deposits, consisting primarily of clayey and silty sand. These soils may be loose, soft and are sensitive to moisture content fluctuations at shallow foundation elevations. Accordingly, we recommend that new spread footings, including pad footings, and mat foundations, be supported on a zone of adequately moisture-conditioned and compacted engineered fill extending 2 feet or more below the foundation bearing elevation, or to the medium dense to very dense alluvium below the loose soils whichever is deeper. As noted in this report, loose soils were encountered up to 8 feet bgs. This overexcavated zone should extend a horizontal distance from the edge of the foundation that is equivalent to the depth of overexcavation.

New slab-on-grade floors, pavements, and exterior concrete flatwork should be supported on a zone of adequately moisture-conditioned and compacted engineered fill extending 1 foot or more bgs. The improvements in these areas should extend 1 foot or more horizontally beyond the edge of the slab-on-grade floors, pavements, and exterior concrete flatwork.

9.1.10 Fill Placement and Compaction

Following the overexcavation as described above, and prior to the placement of any new fill, the resulting exposed surface should be proof-rolled and carefully evaluated for the presence of voids and miscellaneous construction debris material by Ninyo & Moore. Based on this evaluation, additional remediation may be needed. This could include additional over-excavation or scarification of the exposed surface. This additional remediation, if needed, should be addressed by Ninyo & Moore during the earthwork operations.

Once these overexcavated zones are excavated and evaluated, they should be backfilled with engineered fill. New engineered fill should be moisture-conditioned within the moisture range shown in Table 3 below and mechanically compacted to the percent compaction shown. Fill should generally be placed in 8-inch-thick loose lifts such that each lift is firm and non-yielding under the weight of construction equipment. Engineered fill should be compacted by appropriate mechanical methods to a relative compaction of 95 percent or more, as evaluated by ASTM D698 at a moisture content generally near the optimum. Jetting and other forms of water consolidation are not recommended for this project.

Table 3 – Summary of Compaction Recommendations

Engineered Fill Description	Percent Compaction per ASTM D698	Moisture Content
Pipe Bedding	95 percent	±2 percent of optimum
Trench Backfill – Within 2 feet below pavement	100 percent	
Trench Backfill –Deeper than 2 feet below pavement	95 percent	
Engineered Fill below footings, slab-on-grade floors, pavements, and exterior concrete flatwork.	95 percent	

An earthwork (shrinkage) factor of 10 to 20 percent is estimated. This shrinkage factor range represents an average of the material tested and assumes that materials excavated from the site will be placed as fill. Potential bidders should consider this in preparing estimates and should review the available data to make their own conclusions regarding excavation conditions.

Engineered fill used to raise grade or placed within deep excavations will settle a portion of its height due to its own weight regardless of the level of compaction. The magnitude of this settlement will depend on the type of fill used. In general, the engineered fill recommended in this report is expected to settle about 1 percent of its height.

9.1.11 Pipe Bedding and Trench Backfill Materials

We recommend pipelines be supported on 6 inches or more of granular bedding material such as sand and gravel, or crushed rock meeting the MAG Section 702 Standard Specifications (pea gravel or crushed chips are not acceptable). Trench backfill material should also consist of material meeting the specifications outlined in MAG Section 702. Care should be taken not to allow voids to form beneath the pipe (i.e., the pipe haunches should be continuously supported) to avoid damaging the pipeline. This may involve fill placement by hand or small compaction equipment. The pipe bedding and trench backfill should be compacted as discussed below.

9.1.12 Modulus of Soil Reaction (E')

The modulus of soil reaction (E´) is used to characterize the stiffness of soil backfill placed on the sides of buried pipelines for the purpose of evaluating deflection caused by the weight of the backfill over the pipe. For granular backfill soils for pipes, we recommend using an E´ value of 1,200 pounds per square inch (psi). Based on MAG guidelines, the definition of "granular backfill" material is material which the sum of the PI and the percent of material passing a No. 200 sieve does not exceed 23. For granular backfill with less than 50 percent passing the # 40 sieve and 12 percent or less passing the #200 sieve, an E´ value of 2,000 psi may be used.

E' for native materials will vary with material type and stiffness of the trench sidewalls. Approximate values of E' for the materials encountered in our borings are presented in Table 4 below:

Table 4 – Modulus of Soil Reaction (E´) for Native Soils

Trench Wall Soil Classification (USCS)	Approximate E' (psi)		
	Loose / Firm	Medium Dense / Stiff	Dense - Very Dense Stiff - Hard
Sandy Silt/Clay (ML, CL)	200	500	1500
Silty/Clayey Sand and Gravel (SM, SC, SC/SM, SW-SM)	400	700	2500

9.1.13 Controlled Low Strength Material (CLSM)

It is our opinion that the backfill zone may be filled with CLSM as an alternative to the material described in this report. CLSM consists of a fluid, workable mixture of aggregate, Portland cement, and water. The use of CLSM has some advantages:

- A narrower backfill zone can be used, thereby reducing the quantity of soil to be excavated and possibly reducing disturbance to the near-by traffic.
- Relatively higher E' values may be used (E'= 3,000 psi).
- The support given to the connecting pipes is generally better.
- Because little compaction is needed to place CLSM, there is less risk of damaging the connecting pipes.
- CLSM can be batched to flow into irregularities in the trench bottom and walls.

The CLSM design mix should be in accordance with current MAG or Standard Specifications for Public Works Construction standards. Additional mix design information can be provided upon request. The 28-day strength of the material should be no less than 50 psi and no more than 120 psi.

Buoyant or uplift forces on the piping should be considered when using CLSM and prudent construction techniques may result in multiple pours to avoid inducing excessive uplift forces. Sufficient time should be provided to allow the CLSM to cure before placing additional lifts of CLSM or trench backfill.

9.1.14 Constructed Slopes

We recommend that constructed cut slopes, if any are planned for this project, and constructed embankment fill slopes be no steeper than 3:1 (horizontal to vertical). New embankment fills should be benched into existing embankments, where appropriate. Benches should be level and wide enough to allow operation of and compaction by, construction equipment. Fill slopes should be constructed in a manner (e.g., overfilling and cutting to grade) such that the recommended degree of compaction is achieved to the finished slope face. Cut and fill slopes should be protected from erosion. This should promote re-vegetation and a stable slope. Periodic maintenance of exposed slopes should be anticipated.

Unprotected slopes may rill and erode if exposed to running water. Silty soils and soils containing fine sand are more susceptible in this regard. Laying slopes back to 3:1 (horizontal to vertical) will decrease runoff velocity and decrease the likelihood of serious erosion. Adequate drainage and temporary erosion protection covering could minimize erosion problems and promote post-construction vegetation. Plating the slopes with gravelly material will reduce precipitation impact and slow the rate of erosion. Along longer slopes, brow ditches should be considered to reduce the amount of surface flow on the slope face. Where feasible, the existing vegetation should be salvaged and replaced.

9.2 Foundations

Based on the results of our field and laboratory evaluations, it is our opinion that the proposed structures can be supported on shallow spread footings and mat foundations. Foundations should be designed in accordance with structural considerations and the following recommendations. In addition, requirements of the governing jurisdictions and applicable building codes should be considered in the design of the proposed structures.

9.2.1 Spread Footings

Spread footings should bear at a depth of 24 inches or more below the adjacent finished grade, on 2 feet or more of moisture-conditioned and compacted engineered fill, as described in this report. Footings should have a width of 16 inches or more, and isolated spread footings should have a width of 24 inches or more. Spread footings should be reinforced in accordance with the recommendations of the structural engineer.

Spread and pad footings founded on engineered fill may be designed using a net allowable bearing capacity of 3,000 pounds per square foot (psf) for static conditions. The allowable bearing capacity may be increased by one-third when considering loads of short duration such as wind or seismic forces. Total and differential settlement of up to about 1 inch and 3/4 inch over a horizontal distance of 40 feet, respectively, may occur.

Foundations bearing on moisture-conditioned, compacted engineered fill or soil improved with rammed aggregate piers and subject to lateral loadings may be designed using an ultimate coefficient of friction of 0.30 (total frictional resistance equivalent to the coefficient of friction multiplied by the dead load). A passive resistance value of 330 psf per foot of depth can be used. The lateral resistance can be taken as the sum of the frictional resistance and passive resistance, provided that the passive resistance does not exceed one-half of the total allowable resistance. The passive resistance may be increased by one-third when considering loads of short duration such as wind or seismic forces. The foundations should preferably be proportioned such that the resultant force from lateral loadings falls within the kern (i.e., middle one-third).

9.2.2 Mat Foundations

Mat foundations may be used as an alternative to spread footings for some structures associated with the project. We recommend that mat foundations be supported on 2 feet or more of moisture-conditioned and compacted engineered fill, as described in section 9.1.9. A net allowable equivalent soil bearing pressure of 2,000 psf is recommended for mat foundations bearing on engineered fill. We recommend that a modulus of subgrade reaction, K, of 400 kips per cubic foot, be used for design.

Total settlements of the mat-supported area are estimated to be on the order of 1 inch. Differential settlements will depend upon the structural rigidity of the mat. We recommend that these settlements be considered during the design.

9.3 Lateral Earth Pressures Against Retaining Structures

Earth pressures are used to compute the lateral forces acting on below-grade and retaining structures and foundations. These pressures can be classified as at-rest, active, and passive. The direction and magnitude of the soil/wall movement just before failure affects the resulting pressure condition.

At-rest conditions exist when there is no movement, such as for a restrained wall. Active stresses are exerted when the wall moves out and the soil moves toward the wall away from the soil mass, thereby mobilizing the shear strength of the soil. The active pressures are fully mobilized at horizontal movements of about 0.1 percent of the wall height for cohesionless soils such as sands and gravels. Passive stresses exist when the wall moves toward the soil mass. Movement typically needed to mobilize passive pressures greatly exceeds that needed to mobilize active pressures. The passive pressures are, therefore, rarely fully mobilized and are often overestimated when used to compute resistance forces. The recommended equivalent fluid pressures in Table 5 are based on our observation of the on-site soils and assume horizontal, free-draining, compacted granular backfill, with an angle of internal friction (ϕ) of 30 degrees, a cohesion of 0 psf ,a unit weight of about 120 pcf, and static conditions.

Table 5 – Lateral Earth (Equivalent Fluid) Pressures

Soil Condition	Active Pressure (pcf)	At-rest Pressure (pcf)	Passive Pressure (pcf)
Unsaturated	45	65	350
Saturated	85	100	280

The structural engineer may include dynamic loadings, such as from ground accelerations in below-grade wall or retaining wall design. The earthquake-induced dynamic earth pressure may be approximated with a triangular pressure diagram based on an equivalent fluid pressure of 6 psf per foot of backfill depth. This dynamic earth pressure is based on a peak ground acceleration with a 2 percent probability of exceedance within 50 years.

The use of heavy compaction equipment adjacent to below-grade walls could result in lateral earth pressures well in excess of those provided in Table 6. We recommend that the upper 24 inches of soil not protected by pavement or a concrete slab, be neglected when calculating passive resistance. For frictional resistance to lateral loads, we recommend that an ultimate coefficient of friction of 0.30 be used between soil and concrete.

Measures should be taken so that moisture does not build up behind retaining walls or basement walls. These walls should be provided with a drain. Back drainage measure should include free-draining backfill material and perforated drainpipes or weepholes as shown in Figure 5. Drain pipes would outlet away from structures or into sumps, and retaining walls should be waterproofed in accordance with the recommendations of the project civil engineer or architect. To reduce the potential for water- and sulfate/salt-related damage to the retaining walls, particular care should be taken in the selection of the appropriate type of waterproofing material to be utilized and in the applications of this material.

9.4 Pavements

For the new paved areas, we understand that AC is being considered. The design parameters for the pavement sections should include a 20-year design life and a traffic load of 60,000 or less Equivalent Single-Axle Loads. The pavement sections given below are assumed to bear on imported or on-site soils with an average soil R-value of 25 or more.

An AC pavement section consisting of 3 inches or more of plant-mix asphalt (per MAG Section 710) over 6 inches or more of graded AB can be considered in the standard duty parking areas. For heavy duty driveways, the recommended pavement thickness is 4 inches of AC over 6 inches of AB. These pavement sections are in compliance with the requirements stipulated in the Roadway Design Manual by Maricopa County Department of Transportation, for residential streets.

If Portland cement concrete pavement is anticipated in the trash collection area, the concrete slab should be 6 inches thick and should be placed on 4 inches of AB. The concrete should have a 28-day strength of 3,000 pounds (psi). The pavement reinforcement should be designed by the project structural engineer. The concrete pavements should have longitudinal and transverse joints that meet the applicable requirements of the MAG Uniform Standard Specifications.

For the pavements given above, we recommend that the underlying subgrade soils be prepared as described in Sections 9.1.9. AB material should be moisture-conditioned and compacted as described in Section 9.1.10.

9.5 Corrosion

The corrosion potential of the on-site soils was tested to evaluate its potential effect on the foundations and structures. Our corrosion evaluation is based on the results of our field and laboratory testing done for this project. A corrosion specialist should perform their own analysis.

Laboratory testing consisted of pH, minimum electrical resistivity, and chloride and soluble sulfate contents. The pH and minimum electrical resistivity tests were performed in general accordance with Arizona Test 236c, while sulfate and chloride tests were performed in accordance with Arizona Test 733 and 736, respectively. The results of these corrosivity tests are presented in Appendix B.

The soil pH value of the tested samples was 8.7 to 9.9, which is considered to be alkaline. The minimum electrical resistivity values were 737 to 3,752 ohm-cm, which is considered to be corrosive to ferrous materials. The chloride contents were 11 to 123 ppm on the samples tested, which is also considered be corrosive to ferrous metals. The soluble sulfate content of the soil samples were 0.0003 to 0.0048 percent by weight, which is considered to represent negligible to sulfate exposure for concrete.

The results of the laboratory testing indicate that the on-site materials are corrosive to ferrous materials. To reduce the corrosion potential of buried metallic utilities, we recommend that topsoil, organic soils, soils, and mixtures of sand and clay not be placed adjacent to buried metallic utilities. Rather, we suggest that sand or gravel be placed around buried metal piping. Also, buried utilities of different metallic construction or operating temperatures should be electrically isolated from each other to minimize galvanic corrosion problems. In addition, new piping should be electrically isolated from old piping, if any, so that the old metal will not increase the corrosion rate of the new metal. A corrosion specialist should be consulted for further recommendations.

9.6 Concrete

Laboratory chemical tests performed on an on-site soil sample indicated the soluble sulfate content of the soil samples were 0.0003 to 0.0048 percent by dry weight of soil. Based on American Concrete Institute criteria, the on-site soils should be considered to present a negligible sulfate exposure to concrete.

Notwithstanding the sulfate test results and due to the limited number of chemical tests performed, as well as our experience with similar soil conditions and regional practice, we recommend the use of sulfate resistant cement (Type II or similar) for construction of concrete structures at this site. Due to potential uncertainties as to the use of reclaimed irrigation water, or topsoil that may contain higher sulfate contents, pozzolan or admixtures designed to increase sulfate resistance may be considered.

Table 6 – ACI Requirements for Concrete Exposed to Sulfate-Containing Soil

Sulfate Exposure	Water-Soluble Sulfate (SO_4) in Soil, Percentage by Weight	Cement Type	Water-Cementitious Materials Ratio, by Weight, Normal-Weight Aggregate Concrete[1]	f'c, Normal-Weight and Lightweight Aggregate Concrete, psi x 0.00689 for MPa
Negligible	0.00 - 0.10	--	--	--
Moderate[2]	0.10 - 0.20	II, IP(MS), IS (MS)	0.50 or less	4,000 or more
Severe	0.20 - 2.00	V	0.45 or less	4,500 or more
Very severe	Over 2.00	V plus pozzolan[3]	0.45 or less	4,500 or more

Notes:

[1] A lower water-cementitious materials ratio or higher strength may be needed for low permeability or for protection against corrosion of embedded items or freezing and thawing (ACI Table 4.2.2).

[2] Seawater.

[3] Pozzolan that has been evaluated by test or service record to improve sulfate resistance when used in concrete containing Type V cement.

We recommend that the structural concrete have a water-cementitious materials ratio no more than 0.50 by weight for normal weight aggregate concrete. The structural engineer should ultimately select the concrete design strength based on the project specific loading conditions. Higher strength concrete may be selected for increased durability and resistance to slab curling and shrinkage cracking.

9.7 Site Drainage

The results of our evaluation indicate that the subsurface soils encountered in our borings are collapsible upon inundation. The long-term performance of the foundation system depends, in part, on maintaining positive surface drainage during the life of the structure. Adequate drainage should be provided to reduce variations in the moisture content of foundation soils. Finished grade within 5 feet of the structure should be adjusted to slope away from the structure at a slope of 2 percent, or more.

Landscaping, including planters, should not be placed in close proximity to the perimeter of the structures. Irrigation associated with landscaping may introduce significant amounts of water to the foundation soils.

Significant moisture variation within expansive soils may induce soil-related movements that can adversely affect the performance of ground-supported foundations or slabs. The following recommendations are intended to aid in maintaining relatively stable moisture conditions for the foundation soils, thus reducing the risk for significant expansive soil-related movement of shallow foundations:

- Post-construction movement of pavement and other flatwork is common and should be anticipated. Normal maintenance should include evaluation of paving and sidewalk joints, etc. and resealing where needed.

- Surface paving of exterior areas adjacent to the structures should be installed to provide an adequate seal to prohibit moisture migration into foundation soils.

- Provide positive drainage away from the planned structures to prohibit water ponding around foundations.

- Downspouts should drain 5 feet or more away from the structures. If possible, they should drain into closed conduits and be routed to suitable discharge facilities.

- A relatively impervious material should be used as backfill for utility trenches within a zone that extends laterally from the inside of the perimeter of the structures, to 5 feet outside of the proposed structures. Relatively pervious materials (i.e., sands and gravels) used as backfill may provide an avenue for water to migrate along utility trenches and should be avoided.

- Landscaping should not be placed in close proximity to the perimeter of the structures. Irrigation associated with landscaping may introduce significant amounts of water to the foundation soils.

- Trees and shrubs should not be placed closer to the foundations than a horizontal distance of about half of their mature height. Depending on their nature, trees are capable of removing significant amounts of water from the foundation soils, resulting in soil movement (shrinkage), particularly during periods of low rainfall.
- If trees are to be placed near the proposed structures, we recommend installing root barriers to aid in keeping the root system away from foundation elements.

Ponding of water in planters, in unpaved areas, and/or around joints in paving and sidewalks can cause slab movements beyond those predicted in this report. Regular maintenance should include re-grading and/or repair of areas where ponding occurs.

9.8 Pre-Construction Conference

We recommend that a pre-construction conference be held. Representatives of the owner, civil engineer, the geotechnical consultant, and the contractor should be in attendance to discuss the project plans and schedule. Our office should be notified if the project description included herein is incorrect, or if the project characteristics are significantly changed.

9.9 Construction Observation and Testing

During construction operations, we recommend that a qualified geotechnical consultant perform observation and testing services for the project. These services should be performed to evaluate exposed subgrade conditions, including the extent and depth of overexcavation, to evaluate the suitability of the proposed borrow materials for use as fill and to observe placement and test compaction of fill soils. If another geotechnical consultant is selected to perform observation and testing services for the project, we request that the selected consultant provide a letter to the owner, with a copy to Ninyo & Moore, indicating that they fully understand our recommendations and they are in full agreement with the recommendations contained in this report. Qualified subcontractors utilizing appropriate techniques and construction materials should perform construction of the proposed improvements.

10 LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our recommendations and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

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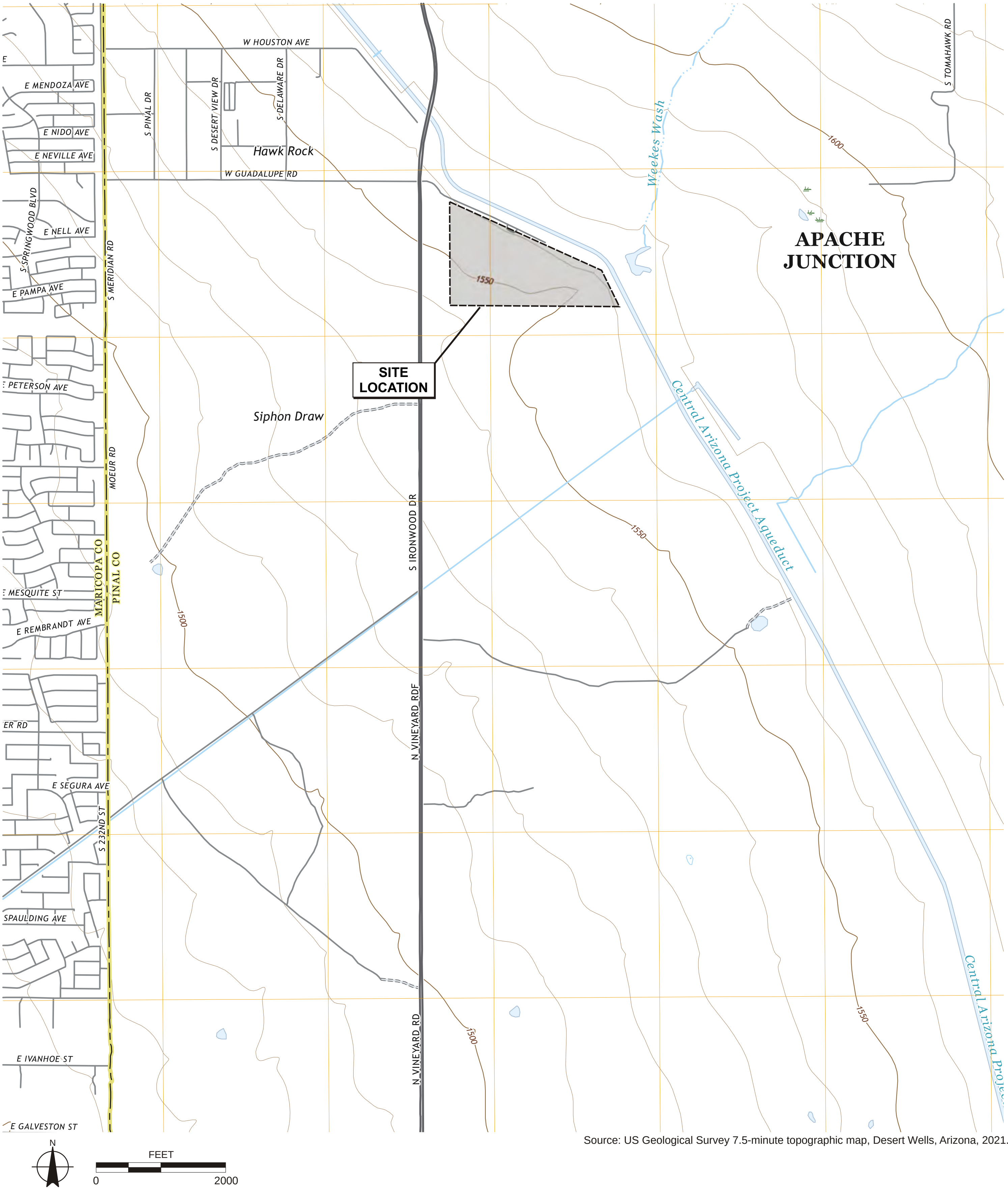
FIGURES



Source: US Geological Survey 7.5-minute topographic map, Desert Wells, Arizona, 2021.

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

FIGURE 1

SITE LOCATION

AJSD WRF EXPANSION
APACHE JUNCTION, ARIZONA

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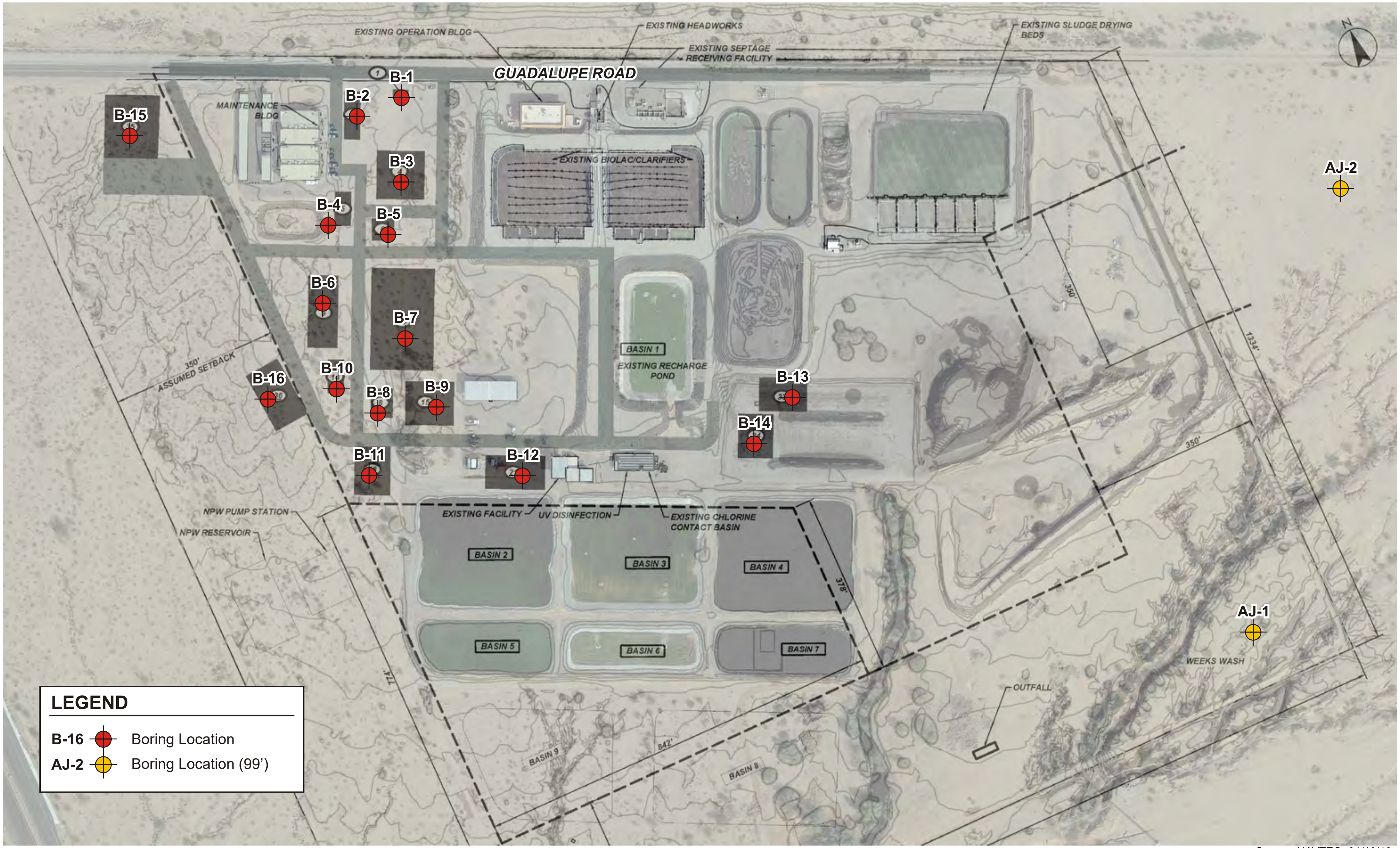
bsm file no: 7723vmap0923



Source: NAVTEQ, 01/13/18.

FEET
0 280

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

bsm file no: 7723blm0923

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FIGURE 2

BORING LOCATIONS

AJSD WRF EXPANSION
APACHE JUNCTION, ARIZONA

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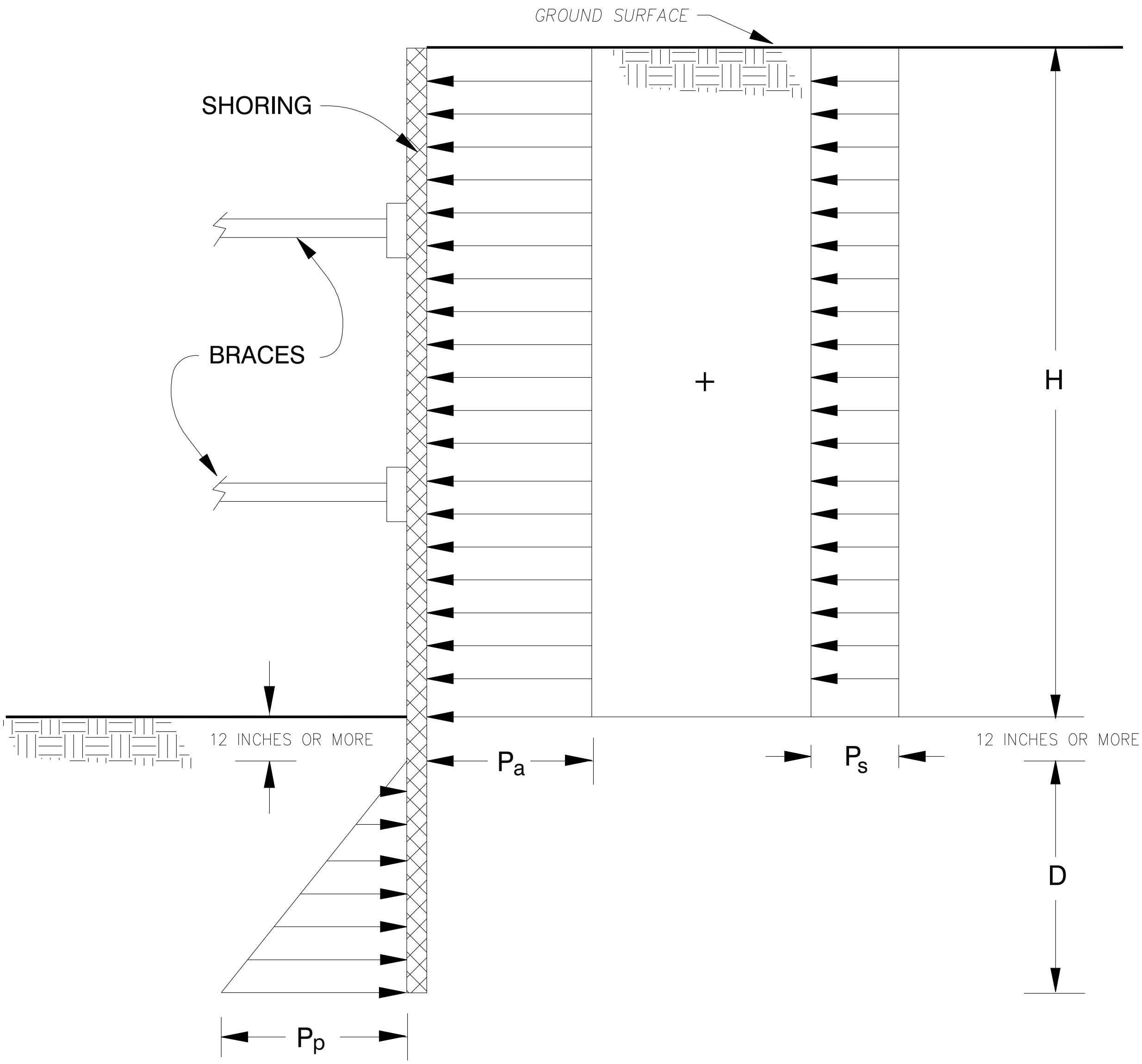

NOTES:

1. APPARENT LATERAL EARTH PRESSURE, P_a
   P_a = 33H psf
2. CONSTRUCTION TRAFFIC INDUCED SURCHARGE PRESSURE, P_s
   P_s = 120 psf
3. PASSIVE LATERAL EARTH PRESSURE, P_p
   P_p = 275 D psf
4. ASSUMES EXCAVATION DEWATERED TO 5 FEET BELOW EXCAVATION BOTTOM
5. SURCHARGES FROM EXCAVATED SOIL OR CONSTRUCTION MATERIALS ARE NOT INCLUDED
6. H AND D ARE IN FEET

FIGURE 3

LATERAL EARTH PRESSURES FOR BRACED EXCAVATIONS

AJSD WRF EXPANSION
APACHE JUNCTION, ARIZONA

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bsm file no: 7723lep0923

APPENDIX A

Boring Logs

APPENDIX A

BORING LOGS

Field Procedure for the Collection of Disturbed Samples
Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples
Bulk samples of representative earth materials were obtained from the exploratory borings. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test Spoon
Disturbed drive samples of earth materials were obtained by means of a Standard Penetration Test spoon sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of 1-3/8 inches. The spoon was driven up to 18 inches into the ground with a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D1586. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were observed and removed from the spoon, bagged, sealed, and transported to the laboratory for testing.

Field Procedure for the Collection of Relatively Undisturbed Samples
Relatively undisturbed soil samples were obtained in the field using the following method.

The Modified Split-Barrel Drive Sampler
The sampler, with an external diameter of 3.0 inches, was lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sample barrel was driven into the ground with the weight of a hammer or the kelly bar of the drill rig in general accordance with ASTM D3550. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer or bar, and the number of blows per foot of driving are presented on the boring logs as an index to the relative resistance of the materials sampled. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

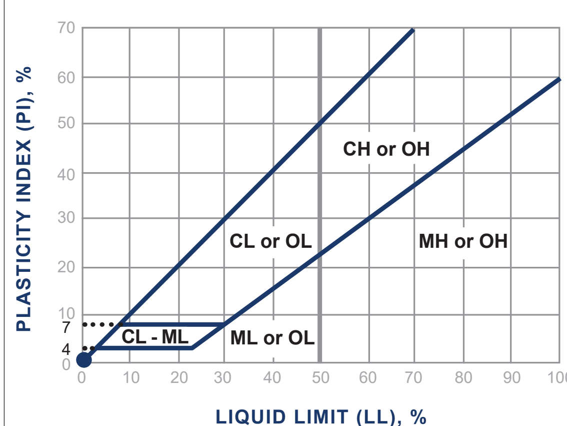
Soil Classification Chart Per ASTM D 2488

Primary Divisions			Secondary Divisions	
			Group Symbol	Group Name
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	GRAVEL more than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVEL less than 5% fines	GW	well-graded GRAVEL
			GP	poorly graded GRAVEL
		GRAVEL with DUAL CLASSIFICATIONS 5% to 12% fines	GW-GM	well-graded GRAVEL with silt
			GP-GM	poorly graded GRAVEL with silt
			GW-GC	well-graded GRAVEL with clay
			GP-GC	poorly graded GRAVEL with
		GRAVEL with FINES more than 12% fines	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND 50% or more of coarse fraction passes No. 4 sieve	CLEAN SAND less than 5% fines	SW	well-graded SAND
			SP	poorly graded SAND
		SAND with DUAL CLASSIFICATIONS 5% to 12% fines	SW-SM	well-graded SAND with silt
			SP-SM	poorly graded SAND with silt
			SW-SC	well-graded SAND with clay
			SP-SC	poorly graded SAND with clay
		SAND with FINES more than 12% fines	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS 50% or more passes No. 200 sieve	SILT and CLAY liquid limit less than 50%	INORGANIC	CL	lean CLAY
			ML	SILT
			CL-ML	silty CLAY
		ORGANIC	OL (PI > 4)	organic CLAY
			OL (PI < 4)	organic SILT
	SILT and CLAY liquid limit 50% or more	INORGANIC	CH	fat CLAY
			MH	elastic SILT
		ORGANIC	OH (plots on or above "A"-line)	organic CLAY
			OH (plots below "A"-line)	organic SILT
	Highly Organic Soils		PT	Peat

Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		> 12"	> 12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	Coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	Fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	Coarse	#10 - #4	0.079 - 0.19"	Rock-salt-sized to pea-sized
	Medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock-salt-sized
	Fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized
Fines		Passing #200	< 0.0029"	Flour-sized and smaller

Plasticity Chart



Apparent Density - Coarse-Grained Soil

Apparent Density	Spooling Cable or Cathead		Automatic Trip Hammer	
	SPT (blows/foot)	Modified Split Barrel (blows/foot)	SPT (blows/foot)	Modified Split Barrel (blows/foot)
Very Loose	≤ 4	≤ 8	≤ 3	≤ 5
Loose	5 - 10	9 - 21	4 - 7	6 - 14
Medium Dense	11 - 30	22 - 63	8 - 20	15 - 42
Dense	31 - 50	64 - 105	21 - 33	43 - 70
Very Dense	> 50	> 105	> 33	> 70

Consistency - Fine-Grained Soil

Consis-tency	Spooling Cable or Cathead		Automatic Trip Hammer	
	SPT (blows/foot)	Modified Split Barrel (blows/foot)	SPT (blows/foot)	Modified Split Barrel (blows/foot)
Very Soft	< 2	< 3	< 1	< 2
Soft	2 - 4	3 - 5	1 - 3	2 - 3
Firm	5 - 8	6 - 10	4 - 5	4 - 6
Stiff	9 - 15	11 - 20	6 - 10	7 - 13
Very Stiff	16 - 30	21 - 39	11 - 20	14 - 26
Hard	> 30	> 39	> 20	> 26

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USCS METHOD OF SOIL CLASSIFICATION

BORING LOG EXPLANATION SHEET

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	
0								Bulk sample.
								Modified split-barrel drive sampler.
								No recovery with modified split-barrel drive sampler.
								Sample retained by others.
								Standard Penetration Test (SPT).
5								No recovery with a SPT.
			XX/XX					Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.
								No recovery with Shelby tube sampler.
								Continuous Push Sample.
								Seepage.
10								Groundwater encountered during drilling.
								Groundwater measured after drilling.
							SM	MAJOR MATERIAL TYPE (SOIL): Solid line denotes unit change.
							CL	Dashed line denotes material change.
15								Attitudes: Strike/Dip b: Bedding c: Contact j: Joint f: Fracture F: Fault cs: Clay Seam s: Shear bss: Basal Slide Surface sf: Shear Fracture sz: Shear Zone sbs: Shear Bedding Surface
20								The total depth line is a solid line that is drawn at the bottom of the boring.

DATE DRILLED 7/12/23	BORING NO. B-1
GROUND ELEVATION 1,559' ± (MSL)	SHEET 1 OF 1
METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)	
DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer)	DROP 30"
SAMPLED BY LPS LOGGED BY LPS	REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL-ML	FILL: Brown, dry, very stiff, sandy, silty CLAY.
	Driven	20	2.7	113.4			
	Driven	14					
						CL	ALLUVIUM: Brown, dry, very stiff, lean CLAY with sand.
	Driven	17	4.9	93.7			
	Driven	72					Hard; scattered caliche nodules.
10	Bulk						
	Driven	94/8"					
						CL-ML	Brown, dry, hard, silty CLAY with sand; scattered caliche nodules; few gravel.
	Driven	50/3"					
20							
	Driven	50/2"					
	Driven	50/3"					
30							Total Depth = 29.3 feet. Groundwater not encountered during drilling. Backfilled on 7/23/23 shortly after completion of drilling.
40							

Total Depth = 29.3 feet.
Groundwater not encountered during drilling.
Backfilled on 7/23/23 shortly after completion of drilling.

Notes:
Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.

DATE DRILLED	8/9/23	BORING NO.	B-2		
GROUND ELEVATION	1,558' ± (MSL)	SHEET	1	OF	1
METHOD OF DRILLING	CME-75, 8" Diameter Hollow-Stem Auger (GSI)				
DRIVE WEIGHT	140 lbs. (Automatic Trip Hammer)	DROP	30"		
SAMPLED BY	LPS	LOGGED BY	LPS	REVIEWED BY	SDN

DEPTH (feet)	SAMPLES Bulk / Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	Bulk					CL-ML	FILL: Brown, dry, stiff, sandy, silty CLAY.
	Driven	8					
	Driven	15	4.9	102.5			Very stiff; trace gravel.
						SC	ALLUVIUM: Brown, dry, dense, clayey SAND.
	Driven	22					
	Driven	50/5"	5.3	101.3			Very dense.
10							
						CL-ML	Brown, dry, hard, silty CLAY with sand.
	Driven	61					
	Driven	50/5"					
20							
	Driven	50/4"					Scattered caliche nodules.
	Driven	52	3.4	113.7		SM	Brown, dry, dense, silty SAND; few fine gravel.
30							Total Depth = 30 feet. Groundwater not encountered during drilling. Backfilled on 8/9/23 shortly after completion of drilling.
40							

Notes:

Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.

DATE DRILLED 7/12/23 BORING NO. B-3

GROUND ELEVATION 1,558' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)

DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30"

SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk / Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL-ML	FILL: Brown, dry, very stiff, sandy, silty CLAY.
		21	2.8	117.8			
		5				SM	ALLUVIUM: Brown, dry, loose, silty SAND; few gravel.
		6					
		22					Dense; scattered caliche nodules.
10							
		39	2.5	108.8			Medium dense; coarser sands; few to little gravel.
		50/3"					Light brown; very dense.
20							
		50/3"					Few gravel.
		90					
30							Total Depth = 30 feet. Groundwater not encountered during drilling. Backfilled on 7/12/23 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
40							

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APACHE JUNCTION, ARIZONA

DEPTH (feet)	SAMPLES Bulk / Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL-ML	FILL: Brown, dry, very stiff, sandy, silty CLAY; few gravel.
		14					
		12	3.6	107.2			Stiff.
						SM	ALLUVIUM: Brown, dry, medium dense, silty SAND; few gravel.
		10					
		35	10.5	112.7			Scattered caliche nodules.
10							
						CL	Brown, dry, hard, sandy lean CLAY; few gravel.
		37					
		50/2"					
20							Total Depth = 19.2 feet. Groundwater not encountered during drilling. Backfilled on 7/12/23 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
30							
40							

DATE DRILLED 7/12/23 BORING NO. B-4

GROUND ELEVATION 1,557' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)

DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30"

SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN

FIGURE A- 4

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DATE DRILLED 7/12/23 BORING NO. B-5

GROUND ELEVATION 1,557' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)

DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30"

SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk / Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0		12	2.4	115.2		CL-ML	FILL: Brown, dry, stiff, silty CLAY with sand.
		11				ML	ALLUVIUM: Brown, dry, medium dense, sandy SILT.
		21					Scattered caliche filaments.
		23					Dense.
10							
		61	4.5	93.6			
		71				SC	Light brown, dry, very dense, clayey SAND; scattered caliche filaments.
20							
		50/3"	6.2				Scattered caliche nodules.
		50/3"					
30							Total Depth = 29.3 feet. Groundwater not encountered during drilling. Backfilled on 7/12/23 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
40							

DATE DRILLED	7/11/23	BORING NO.	B-6
GROUND ELEVATION	1,555' ± (MSL)	SHEET	1 OF 1
METHOD OF DRILLING	CME-75, 8" Diameter Hollow-Stem Auger (GSI)		
DRIVE WEIGHT	140 lbs. (Automatic Trip Hammer)	DROP	30"
SAMPLED BY	LPS	LOGGED BY	LPS
REVIEWED BY	SDN		

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SM	ALLUVIUM: Brown, dry, medium dense, silty SAND.
		74					
		12	3.1	98.9			Loose; few gravel.
		22					Dense.
		32					Medium dense.
10							
		95/10"				SW-SM	Brown, dry, very dense, well-graded SAND with silt; scattered caliche filaments.
		50/4"	5.9				Few gravel.
20							
		85/10"					
		50/3"					
30							Total Depth = 29.3 feet. Groundwater not encountered during drilling. Backfilled on 7/11/23 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
40							

DATE DRILLED	7/11/23	BORING NO.	B-7
GROUND ELEVATION	1,553' ± (MSL)	SHEET 1 OF 1	
METHOD OF DRILLING	CME-75, 8" Diameter Hollow-Stem Auger (GSI)		
DRIVE WEIGHT	140 lbs. (Automatic Trip Hammer)	DROP	30"
SAMPLED BY	LPS	LOGGED BY LPS	REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	Bulk					SC	ALLUVIUM: Brown, dry, dense, clayey SAND; few gravel; scattered caliche filaments.
	Driven	55					
	Driven	11					Medium dense.
	Driven	12	2.7	107.7			Loose.
10	Driven	64					Very dense; few to little gravel.
						SW-SM	Brown, dry, medium dense, well-graded SAND with silt.
	Driven	36	2.0	109.5			
20	Driven	50/4"					Very dense.
	Driven	50/4"					
30	Driven	81/9"					
							Total Depth = 29.8 feet. Groundwater not encountered during drilling. Backfilled on 7/11/23 shortly after completion of drilling.
40							Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.

DATE DRILLED	7/11/23	BORING NO.	B-8
GROUND ELEVATION	1,553' ± (MSL)	SHEET 1 OF 1	
METHOD OF DRILLING	CME-75, 8" Diameter Hollow-Stem Auger (GSI)		
DRIVE WEIGHT	140 lbs. (Automatic Trip Hammer)	DROP	30"
SAMPLED BY	LPS	LOGGED BY LPS	REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	ALLUVIUM: Brown, dry, medium dense, silty SAND.
			10					
			10	2.4	111.9			Loose.
			16					Medium dense, few gravel.
			85/10"	5.9	109.1		ML	Brown, dry, very dense, sandy SILT; few gravel; scattered caliche nodules.
10								
			67					
			15					Medium dense.
20								
			82/10"					Very dense.
			50/3"					
30								Total Depth = 29.3 feet. Groundwater not encountered during drilling. Backfilled on 7/11/23 shortly after completion of drilling.
40								

Notes:
Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.

FIGURE A- 8

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DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 7/11/23 BORING NO. B-9 GROUND ELEVATION 1,553' ± (MSL) SHEET 1 OF 1 METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI) DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30" SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN **DESCRIPTION/INTERPRETATION**
0			33	3.2	113.5		SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND; scattered caliche filaments.
			14					
			33				ML	Brown, dry, medium dense, sandy SILT; scattered caliche nodules.
			89/10"					Very dense.
10								
			64	2.6	112.7			Dense.
			50/4"					Very dense.
								Total Depth = 18.8 feet. Groundwater not encountered during drilling. Backfilled on 7/11/23 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
20								
30								
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DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	ALLUVIUM: Brown, dry, medium dense, silty SAND.
		X	18					
		X	25	2.2	109.3			Scattered caliche filaments.
		X	40					Very dense.
							SW-SM	Brown, dry, medium dense, well-graded SAND with silt; few gravel.
		X	41	1.8	111.8			
10	X							
		X	40					Very dense.
		X	50/3"					no recovery.
20								
		X	33					Dense; few to little gravel.
		X	16					Medium dense; trace clay.
30								Total Depth = 30 feet. Groundwater not encountered during drilling. Backfilled on 7/11/23 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
40								

DATE DRILLED 7/11/23 BORING NO. B-10

GROUND ELEVATION 1,552' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)

DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30"

SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN

DATE DRILLED 7/11/23 BORING NO. B-11

GROUND ELEVATION 1,551' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)

DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30"

SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	FILL: Brown, dry, loose, silty SAND.
			11	3.1	109.0			
			7					
							ML	ALLUVIUM: Brown, dry, medium dense, sandy SILT; scattered caliche filaments.
			25					
			64					Very dense; few gravel.
10								
			69	4.7	111.5			Dense; scattered caliche nodules.
			50/3"					Very dense.
20								
			50/3"					
			50/4"					
30								
40								

Total Depth = 29.3 feet.
Groundwater not encountered during drilling.
Backfilled on 7/11/23 shortly after completion of drilling.

Notes:
Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.

DATE DRILLED 7/10/23 BORING NO. B-12

GROUND ELEVATION 1,551' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)

DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30"

SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0			6				SC	FILL: Brown, dry, loose, clayey SAND; few gravel.
			7	13.5	94.2			
			7				ML	ALLUVIUM: Brown, dry, loose, SILT with sand; scattered caliche filaments; few gravel.
			41					Medium dense.
10								
			16				CL	Brown, dry, very stiff, lean CLAY with sand; scattered caliche filaments.
			90/10"	14.3	99.5		SC	Brown, dry, very dense, clayey SAND; few gravel; scattered caliche nodules.
20								
			50				CL	Brown, dry, hard, sandy lean CLAY; trace gravel.
			72					
30								Total Depth = 30 feet. Groundwater not encountered during drilling. Backfilled on 7/10/23 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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FIGURE A- 12

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DATE DRILLED 7/10/23 BORING NO. B-13

GROUND ELEVATION 1,550' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)

DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30"

SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk / Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SC	ASPHALT CONCRETE: Approximately 2 inches thick.
							AGGREGATE BASE: Approximately 2 inches thick.
		9	8.6	107.8			FILL: Brown, dry, loose, clayey SAND.
		2					Very loose.
		9	5.2	102.6		SM	Brown, dry, loose, silty SAND; few gravel.
10		24				SC	ALLUVIUM: Brown, dry, dense, clayey SAND with gravel; scattered caliche nodules.
		52					
20		55					
		50/3"	11.9				Very dense.
30		21					Light brown; dense.
							Total Depth = 30 feet. Groundwater not encountered during drilling. Backfilled and asphalt concrete patched on 7/10/23 shortly after completion of drilling.
							Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
40							

FIGURE A- 13

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DATE DRILLED	7/10/23	BORING NO.	B-14
GROUND ELEVATION	1,550' ± (MSL)	SHEET 1 OF 1	
METHOD OF DRILLING	CME-75, 8" Diameter Hollow-Stem Auger (GSI)		
DRIVE WEIGHT	140 lbs. (Automatic Trip Hammer)	DROP	30"
SAMPLED BY LPS	LOGGED BY LPS	REVIEWED BY	SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 2 inches thick.
								AGGREGATE FILL: Approximately 2 inches thick.
							CL	FILL: Brown, dry, firm, sandy lean CLAY; few gravel.
			4					
			7					Stiff.
			3					Soft.
			35				SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND with gravel; scattered caliche filaments.
10								
			19					
			50/4"	8.3	108.1			Very dense; scattered caliche nodules.
20								
			66					
			66					Dense.
30								Total Depth = 30 feet. Groundwater not encountered during drilling. Backfilled and asphalt concrete patched on 7/10/23 shortly after completion of drilling.
								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
40								

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
								DATE DRILLED 7/12/23 BORING NO. B-15 GROUND ELEVATION 1,560' ± (MSL) SHEET 1 OF 1 METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI) DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30" SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN
0			22	2.4	116.0		SM	ALLUVIUM: Brown, dry, medium dense, silty SAND with gravel.
			19					
			22					
			50				SC	Brown, dry, very dense, clayey SAND; trace gravel; scattered caliche nodules.
10								
			50/2"	6.5				
			47					Few gravel.
20								Total Depth = 20 feet. Groundwater not encountered during drilling. Backfilled on 7/12/23 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
30								
40								

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0			8				SC	FILL: Brown, dry, medium dense, clayey SAND; few gravel.
			27	4.5	82.3		SC	ALLUVIUM: Brown, dry, medium dense, clayey SAND; few gravel; scattered caliche filaments.
			16					
10			76/10"	1.1	118.2		SM	Light brown, dry, very dense, silty SAND; few to little gravel; scattered caliche nodules.
			64				SC	Light brown, dry, very dense, clayey SAND; few gravel; scattered caliche nodules.
20			98/10"	8.1	94.3			
			67					
			50/4"					Total Depth = 28.8 feet. Groundwater not encountered during drilling. Backfilled on 7/10/23 shortly after completion of drilling.
30								
40								

DATE DRILLED 7/10/23 BORING NO. B-16

GROUND ELEVATION 1,554' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)

DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30"

SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN

Notes:
Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ML	ALLUVIUM: Brown, dry, medium dense, sandy SILT.
		■	27					
		■	50/2"					Very dense; scattered caliche filaments.
10								
		■	50/5"				CL	Brown, dry, hard, sandy lean CLAY; few gravel; scattered caliche nodules.
		■	50/5"					
20								
							SC	Brown, dry, dense, clayey SAND; few gravel; scattered caliche nodules.
		■	68					
		■	65					
30								
		■	50/5"					Very dense.
		■	90/8"					
40								

DATE DRILLED 7/31/23 BORING NO. AJ-1

GROUND ELEVATION 1,549' ± (MSL) SHEET 1 OF 3

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)

DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30"

SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN

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607723001 | 11/23

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	

DATE DRILLED 7/31/23 BORING NO. AJ-1

GROUND ELEVATION 1,549' ± (MSL) SHEET 2 OF 3

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)

DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30"

SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN

DESCRIPTION/INTERPRETATION

Depth	Blows/Foot	Classification	Description/Interpretation
40		SC	ALLUVIUM: (Continued) Brown, dry, very dense, clayey SAND; few gravel; scattered caliche nodules.
	50/5"	SP-SM	Light brown, dry, very dense, poorly graded SAND with silt and gravel.
	50/5"		No ring recovery.
50			
	50/5"	SC	Brown, dry, very dense, clayey SAND; few gravel; scattered caliche filaments.
	50/3"		
60			
		CL	Brown, dry, hard, sandy lean CLAY; trace gravel.
	50/5"		
	50/5"		Scattered caliche nodules.
70			
		SC	Brown, dry, very dense, clayey SAND with gravel; scattered caliche nodules.
	50/5"		
	50/3"		
80			

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
80							SC	ALLUVIUM: (Continued) Brown, dry, very dense, clayey SAND; few gravel; scattered caliche nodules.
		■	50/5"					
		■	50/5"					
90								
							CL	Brown, dry, hard, sandy lean CLAY; trace gravel.
		■	50/5"					
	■	☒	50/5"					No ring recovery.
								Total Depth = 98.4 feet. Groundwater not encountered during drilling. Backfilled on 7/31/23 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
100								
110								
120								

DATE DRILLED 7/31/23 BORING NO. AJ-1

GROUND ELEVATION 1,549' ± (MSL) SHEET 3 OF 3

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)

DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30"

SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION

DATE DRILLED 8/1/23 & 8/2/23 BORING NO. AJ-2

GROUND ELEVATION 1,557' ± (MSL) SHEET 1 OF 3

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)

DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30"

SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN

DEPTH (feet)	Driven	BLOWS/FOOT	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0			CL	ALLUVIUM: Brown, dry, hard, sandy lean CLAY; scattered caliche filaments.
	■	84/11"		
	■	50/5"		
10				
			SC	Brown, dry, very dense, clayey SAND; few gravel; scattered caliche nodules.
	■	50/5"		
	■	50/5"		
20				
	■	50/4"		
	■	47		Dense; few gravel.
30				
	■	30		Medium dense.
	■	89/10"		Very dense.
40				

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DATE DRILLED	8/1/23 & 8/2/23	BORING NO.	AJ-2
GROUND ELEVATION	1,557' ± (MSL)	SHEET	2 OF 3
METHOD OF DRILLING	CME-75, 8" Diameter Hollow-Stem Auger (GSI)		
DRIVE WEIGHT	140 lbs. (Automatic Trip Hammer)	DROP	30"
SAMPLED BY	LPS	LOGGED BY	LPS
REVIEWED BY	SDN		

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40							SC	ALLUVIUM: (Continued) Brown, dry, very dense, clayey SAND; scattered caliche nodules; few gravel.
		X	72/9"				CL	Brown, dry, hard, sandy lean CLAY; trace gravel; scattered caliche nodules.
	X	X	50/5"					No ring recovery.
50								
		X	50/5"				SC	Brown, dry, very dense, clayey SAND; few to little gravel; scattered caliche nodules.
	X	X	50/1"					No ring recovery.
60								
	X	X	50/1"					No ring recovery; with gravel.
	X	X	50/5"					
70								
	X	X	50/3"				GC	Brown, dry, very dense, clayey GRAVEL with sand; scattered caliche nodules; no ring recovery.
	X	X	50/2"					No spoon recovery.
80								

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
80							GC	ALLUVIUM: (Continued) Brown, dry, very dense, clayey GRAVEL with sand; scattered caliche nodules.
			50/1"				GP-GC	Light brown/gray, dry, very dense, poorly graded GRAVEL with clay. Spoon recovery.
			50/2"					
90								
			50/3"				SC	Brown, dry, very dense, clayey SAND with gravel, no spoon recovery.
			50/2"					No spoon recovery. Total Depth = 98 feet. Groundwater not encountered during drilling. Backfilled on 8/2/23 shortly after completion of drilling. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
100								
110								
120								

DATE DRILLED 8/1/23 & 8/2/23 BORING NO. AJ-2

GROUND ELEVATION 1,557' ± (MSL) SHEET 3 OF 3

METHOD OF DRILLING CME-75, 8" Diameter Hollow-Stem Auger (GSI)

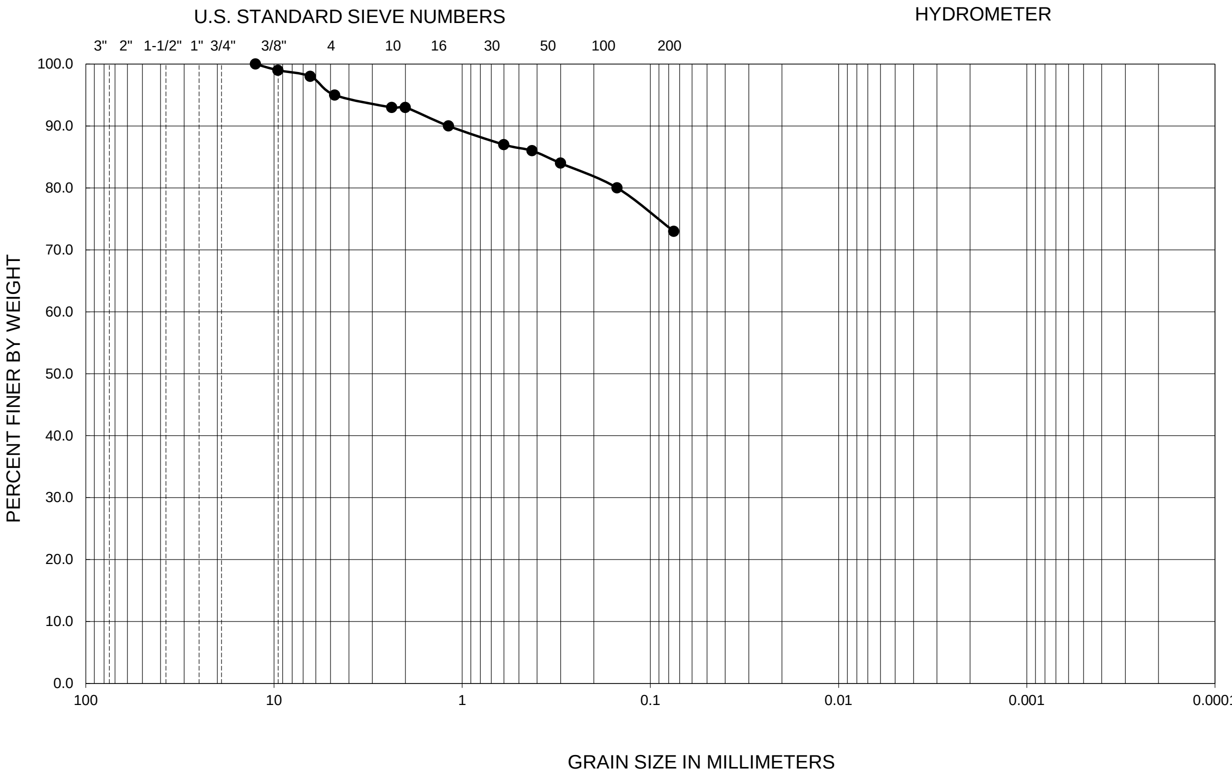
DRIVE WEIGHT 140 lbs. (Automatic Trip Hammer) DROP 30"

SAMPLED BY LPS LOGGED BY LPS REVIEWED BY SDN

APPENDIX B

Laboratory Testing

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-1	8.5-10.0	32	15	17	--	--	--	--	--	73.0	CL

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FIGURE B-1

GRADATION TEST RESULTS

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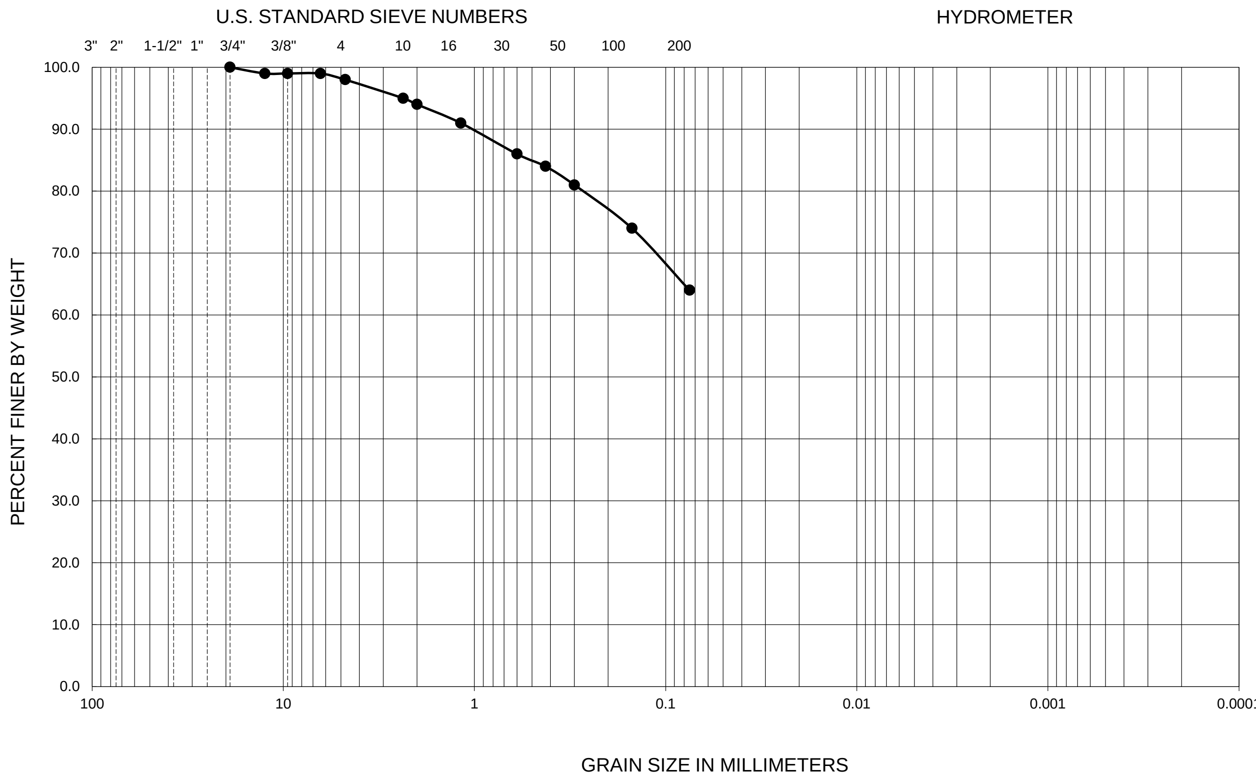
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-2	3.5-5.0	27	21	6	--	--	--	--	--	64.0	CL-ML

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FIGURE B-2

GRADATION TEST RESULTS

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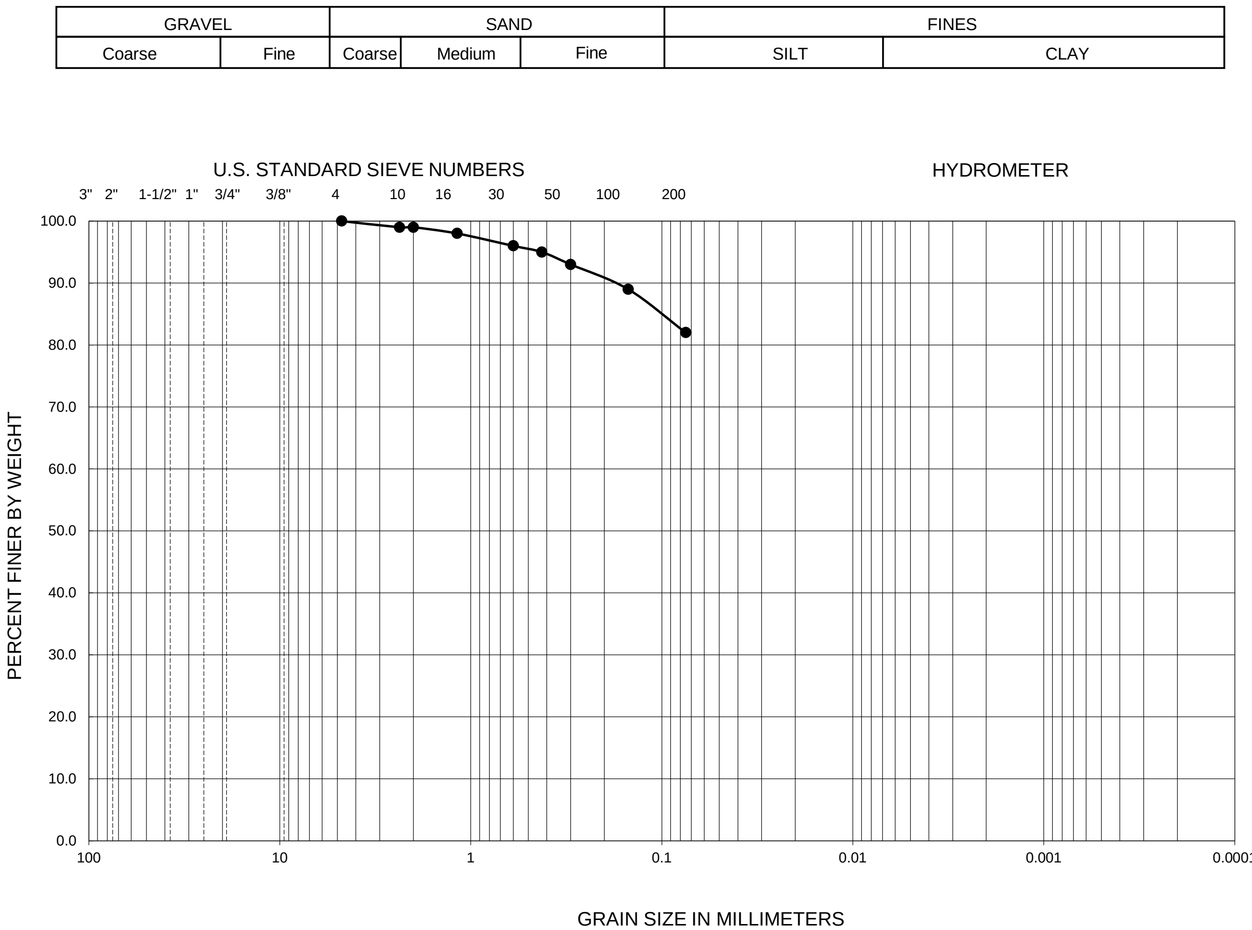

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-2	8.5-10.0	22	16	6	--	--	--	--	--	82.0	CL-ML

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FIGURE B-3

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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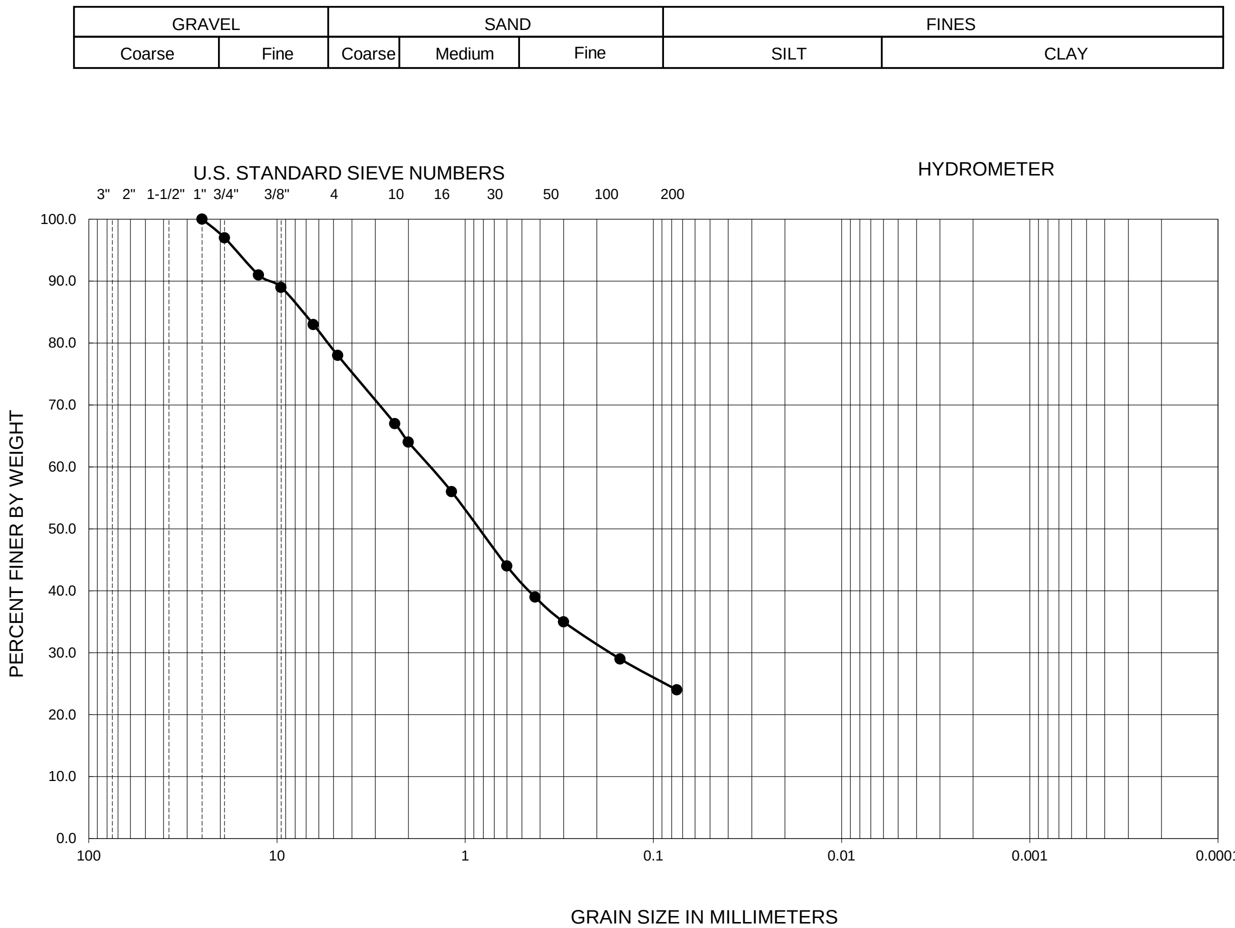

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-3	6.0-7.5	--	--	NP	--	0.169	1.55	--	--	24.0	SM

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FIGURE B-4

GRADATION TEST RESULTS

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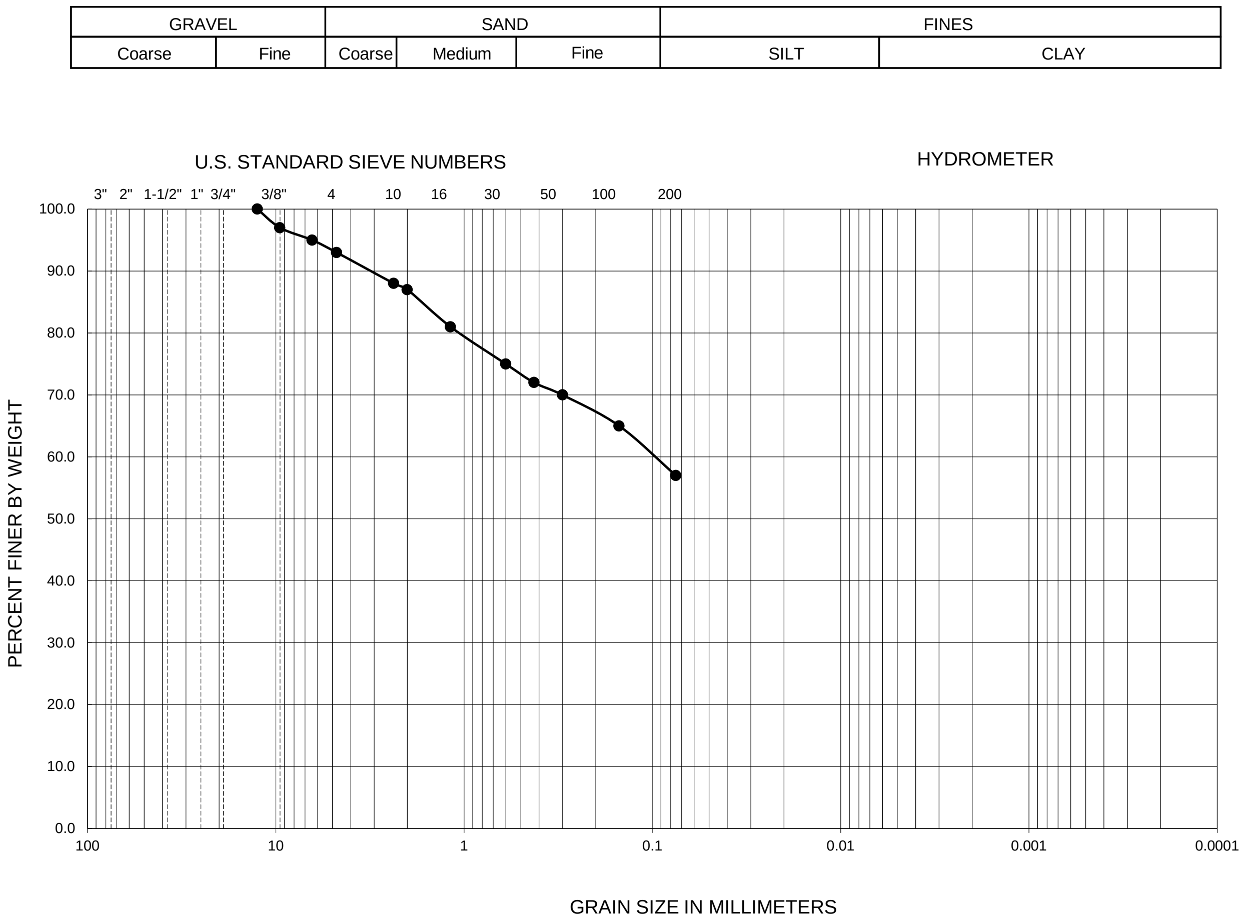

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-4	13.5-15.0	38	17	21	--	--	0.10	--	--	57.0	CL

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FIGURE B-5

GRADATION TEST RESULTS

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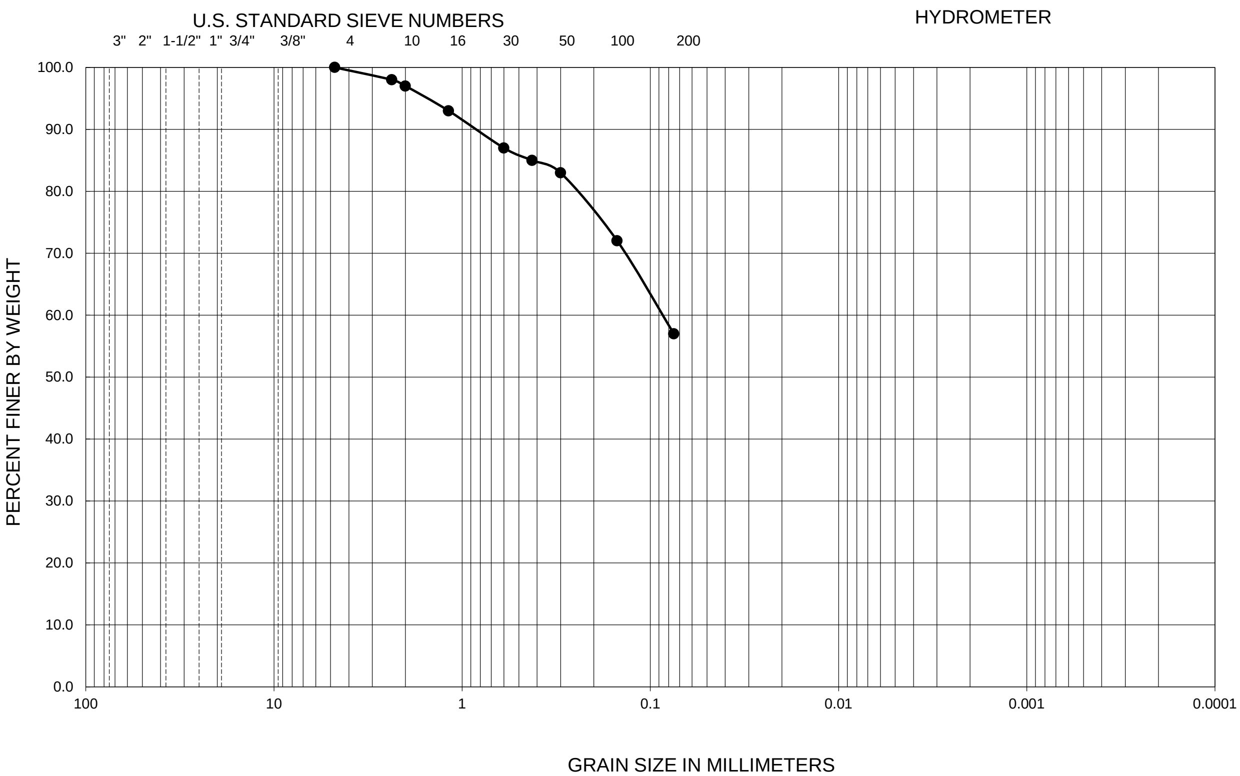
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-5	6.0-7.5	23	20	3	--	--	0.09	--	--	57.0	ML

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FIGURE B-6

GRADATION TEST RESULTS

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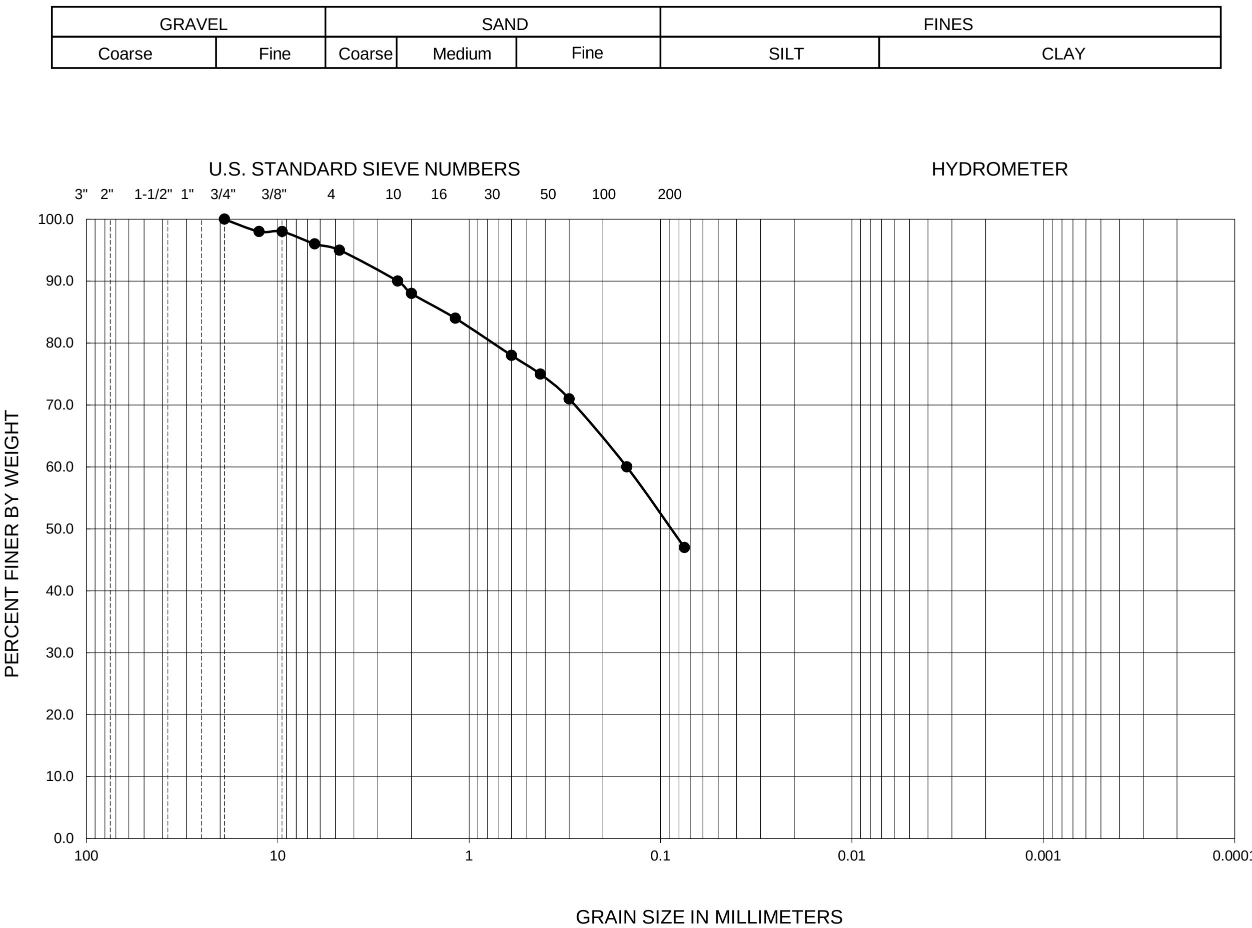

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-6	3.5-5.0	--	--	NP	--	--	0.15	--	--	47.0	SM

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FIGURE B-7

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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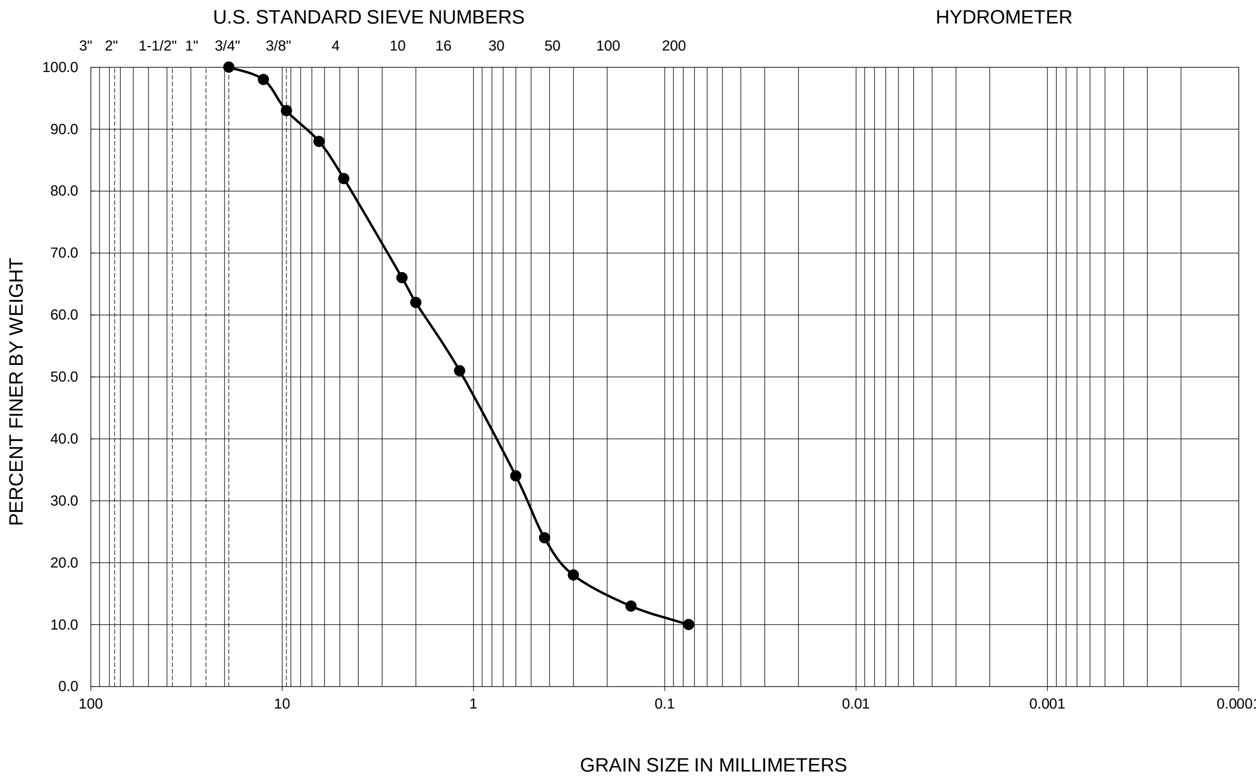
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-7	13.5-15.0	--	--	NP	0.074	0.518	1.83	24.7	2.0	10.0	SW-SM

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FIGURE B-8

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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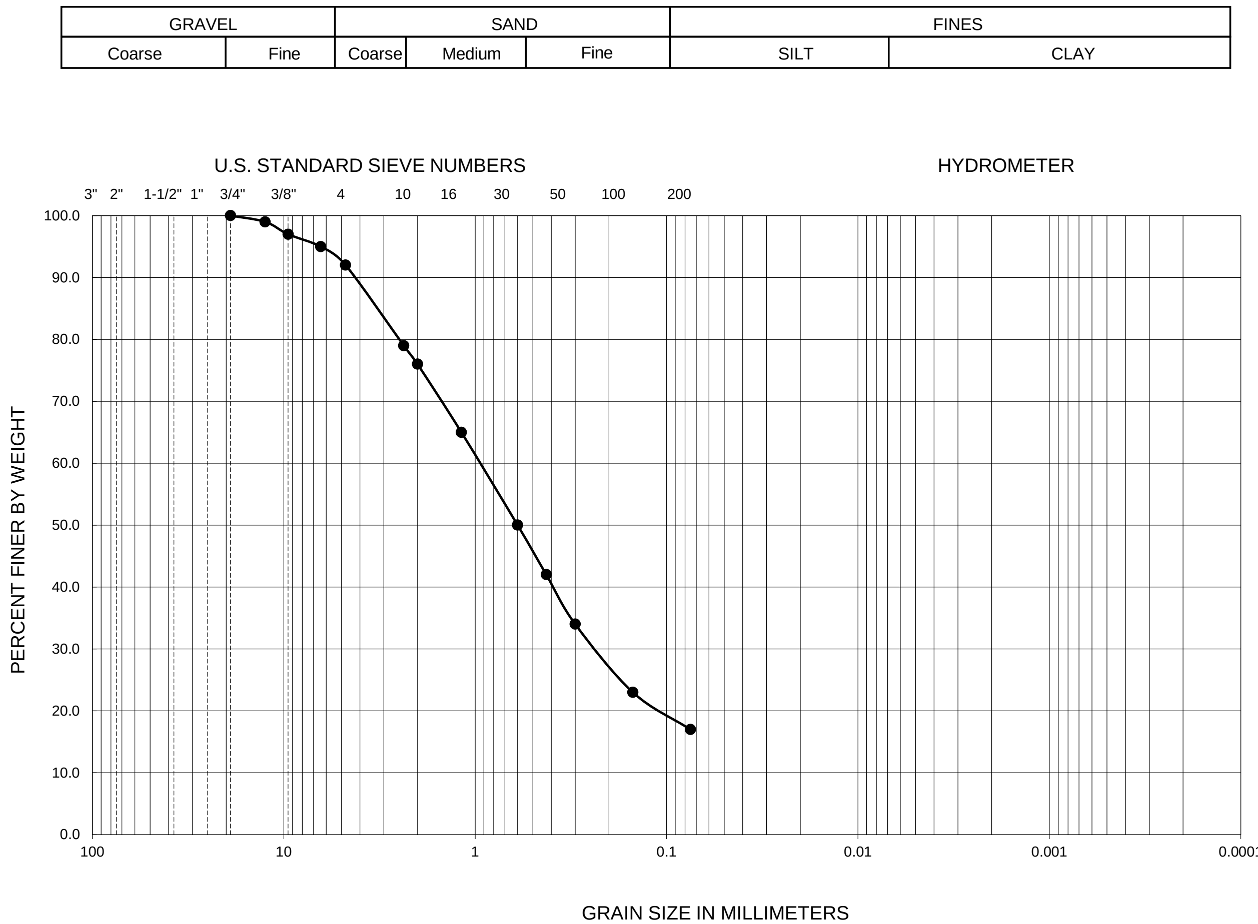

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-8	3.5-5.0	--	--	NP	--	0.235	0.94	--	--	17.0	SM

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FIGURE B-9

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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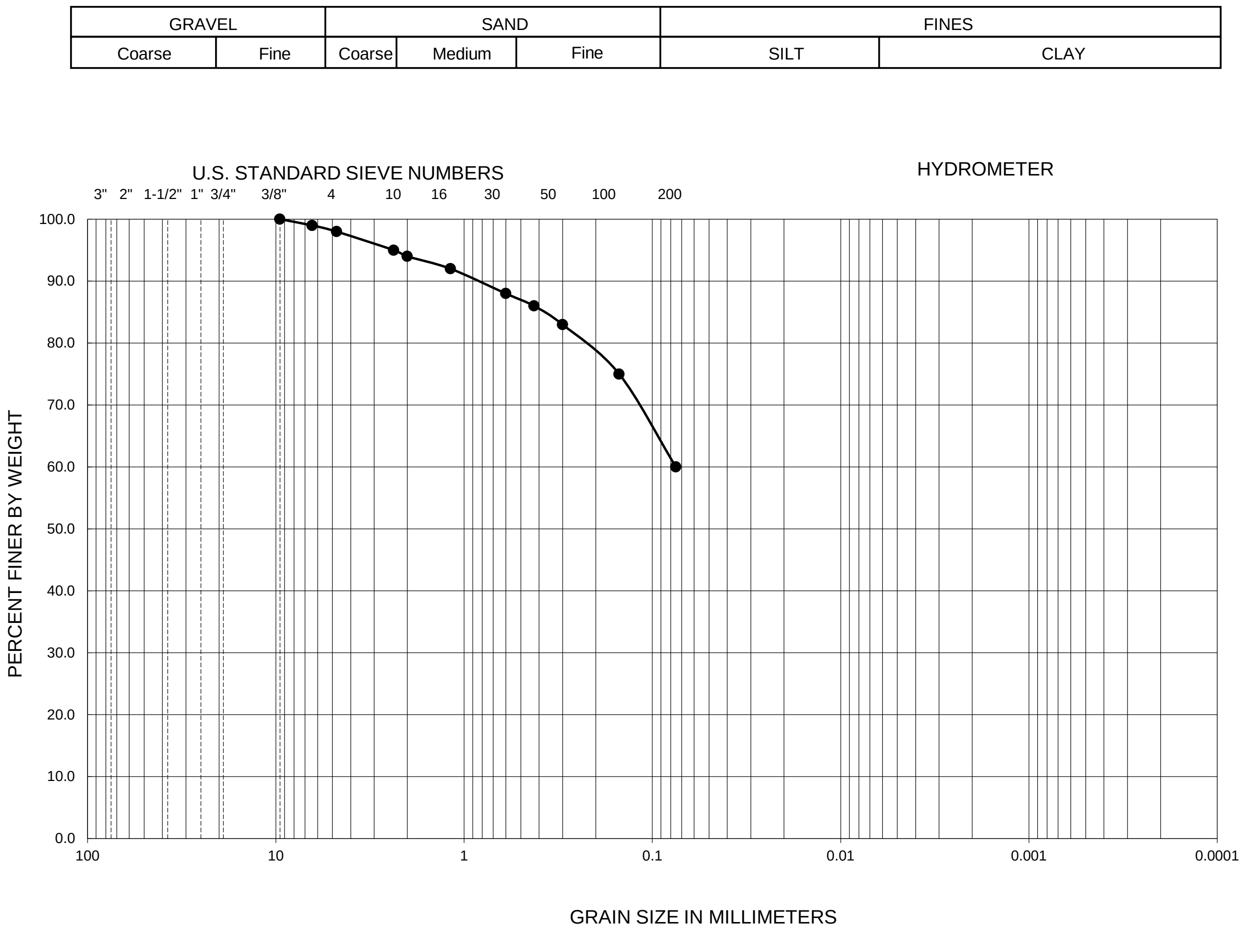

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-9	13.5-15.0	24	22	2	--	--	0.07	--	--	60.0	ML

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FIGURE B-10

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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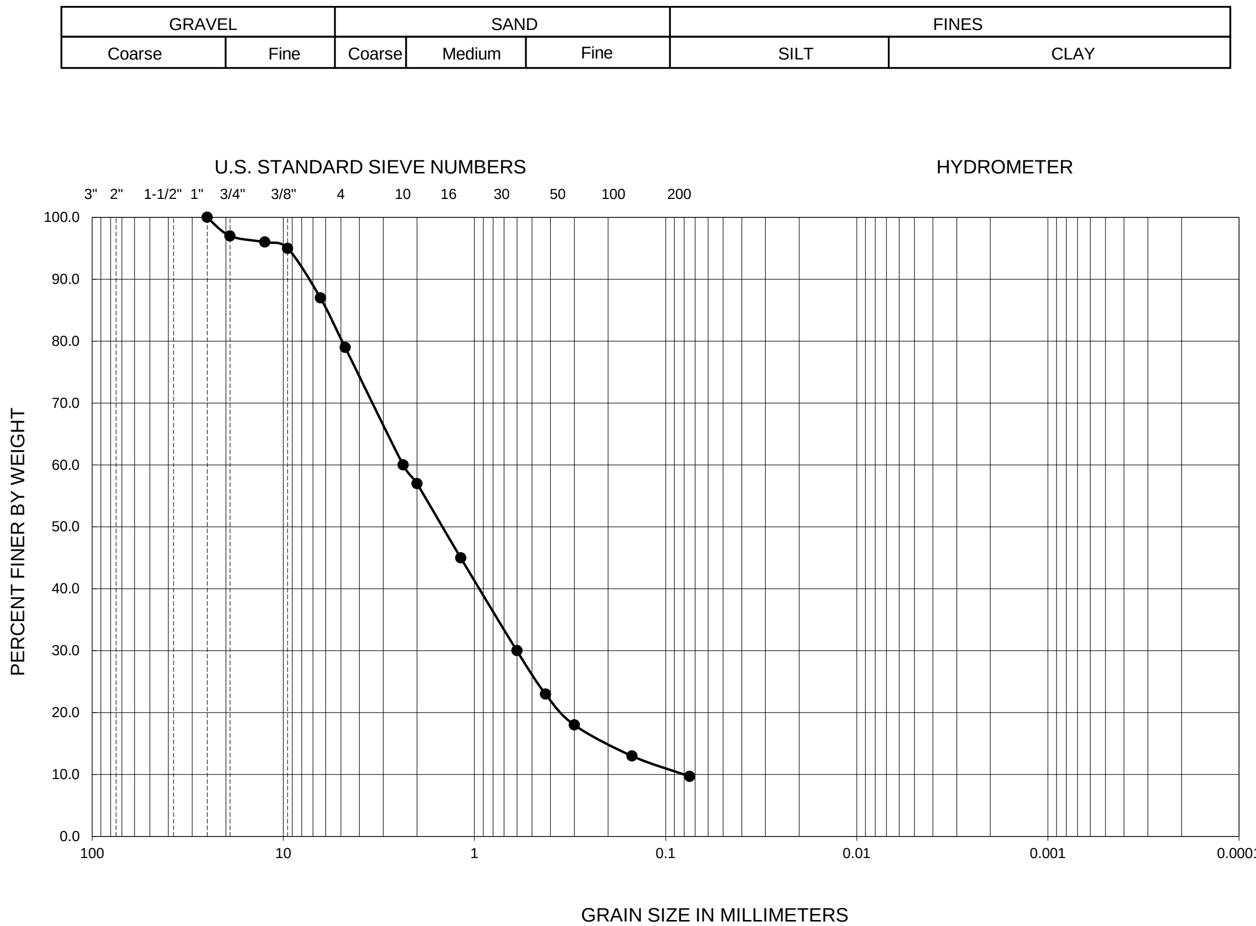

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-10	8.5-10.0	--	--	NP	0.079	0.584	2.39	30.2	1.8	9.7	SW-SM

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FIGURE B-11

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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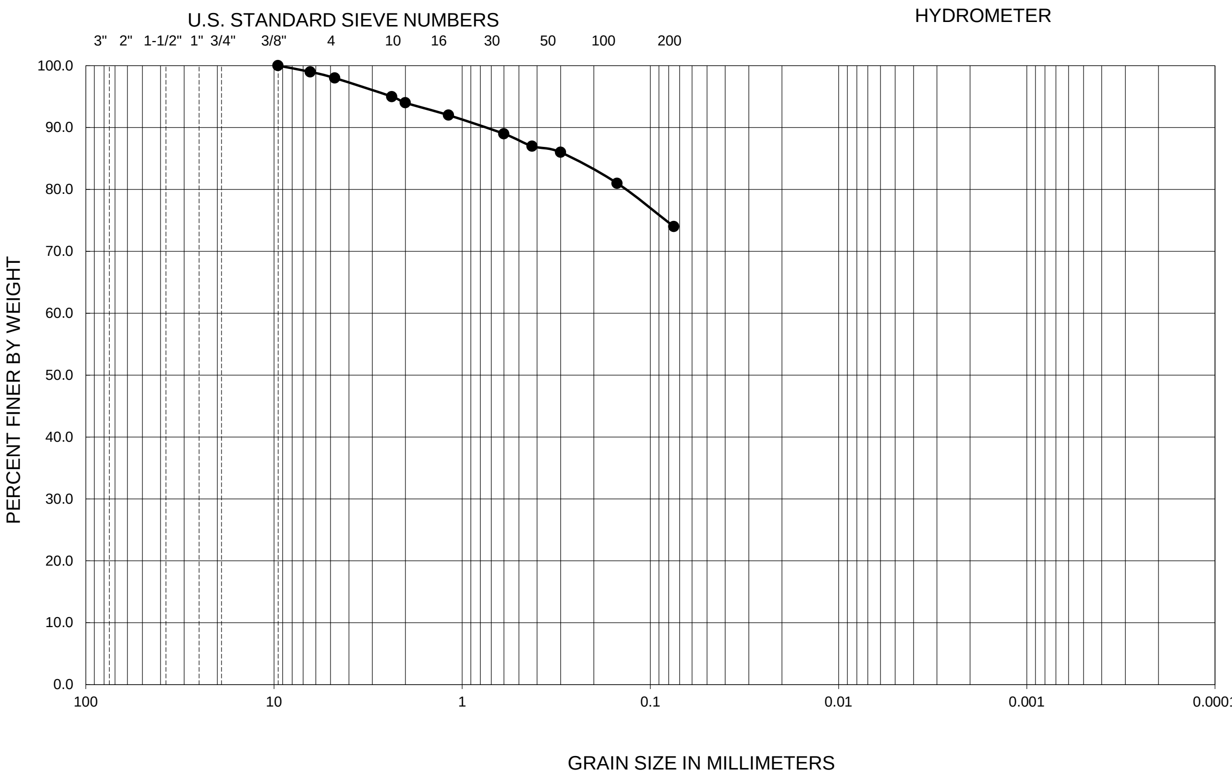
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-12	6.0-7.5	26	22	4	--	--	--	--	--	74.0	ML

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FIGURE B-12

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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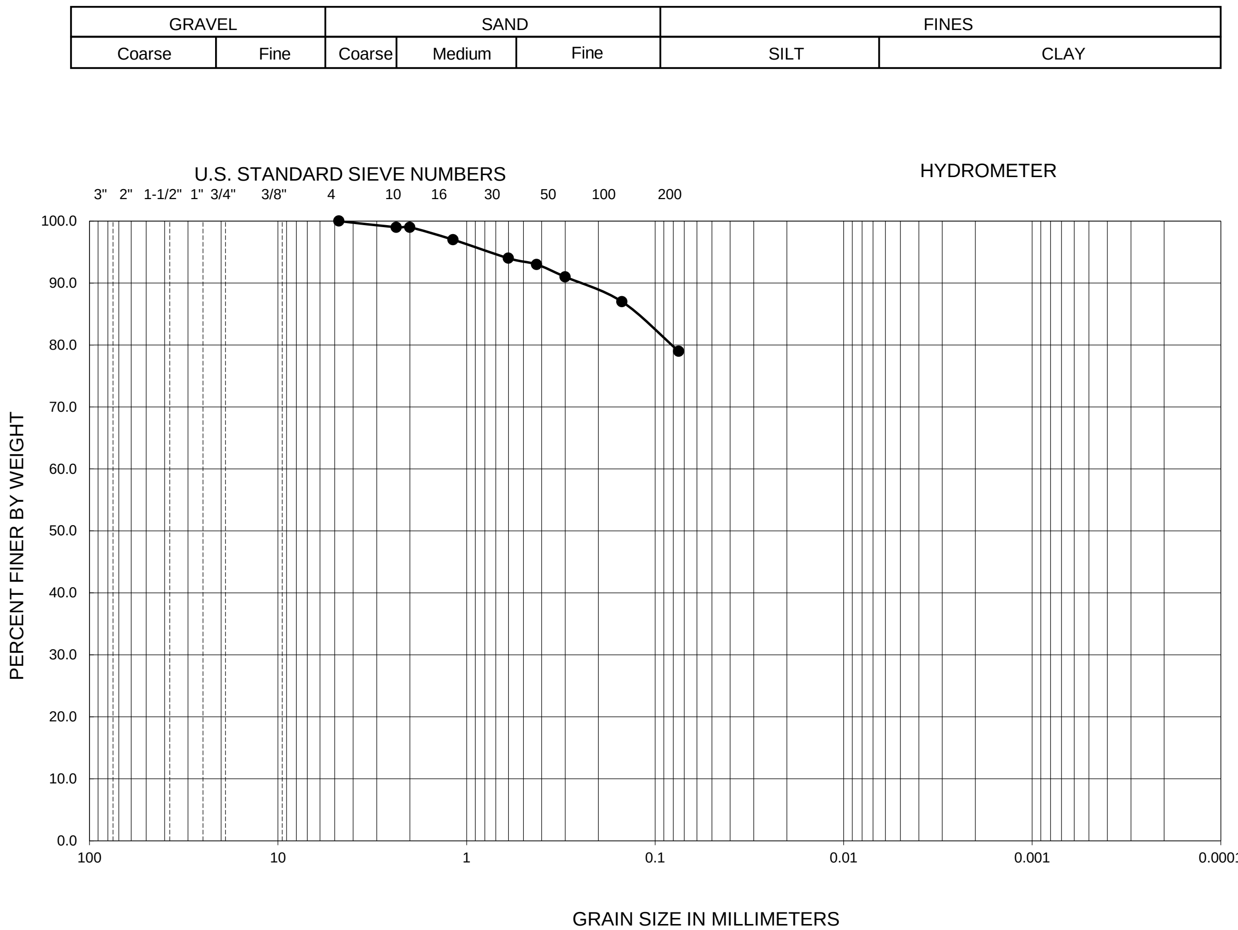

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-12	13.5-15.0	30	10	20	--	--	--	--	--	79.0	CL

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FIGURE B-13

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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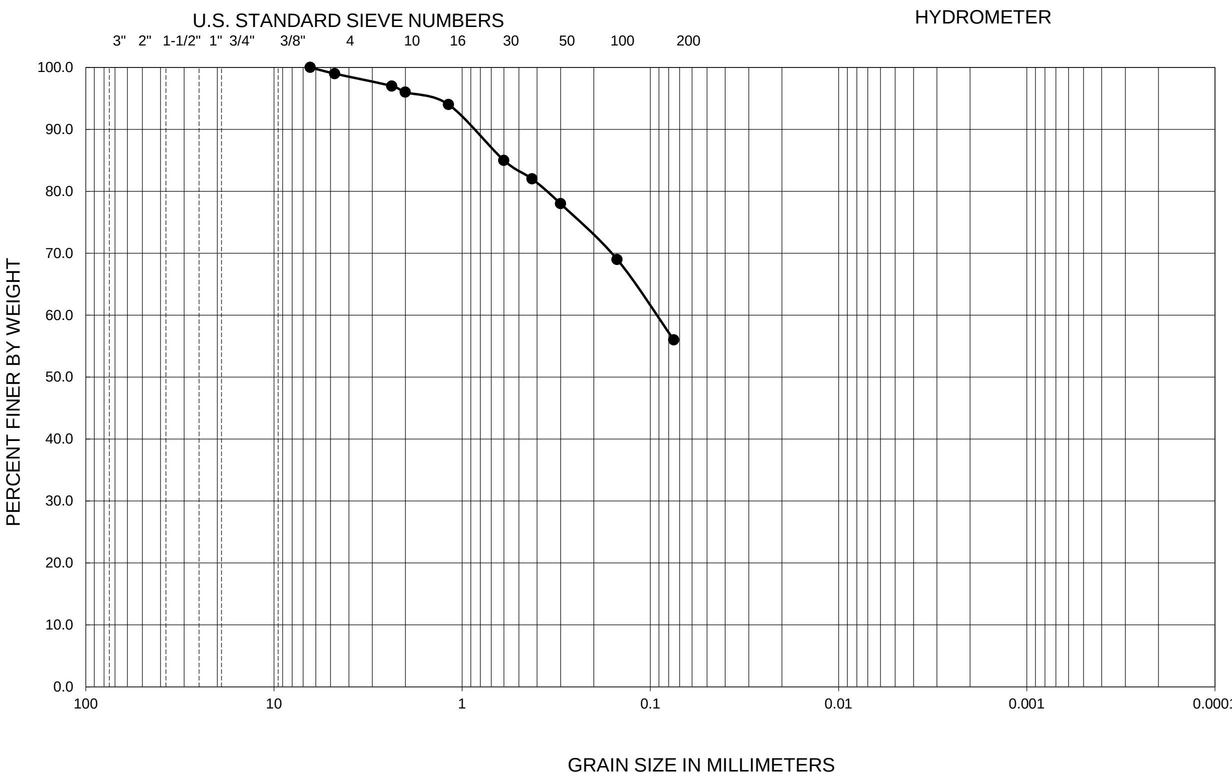
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-12	23.5-25.0	36	23	13	--	--	0.09	--	--	56.0	CL

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FIGURE B-14

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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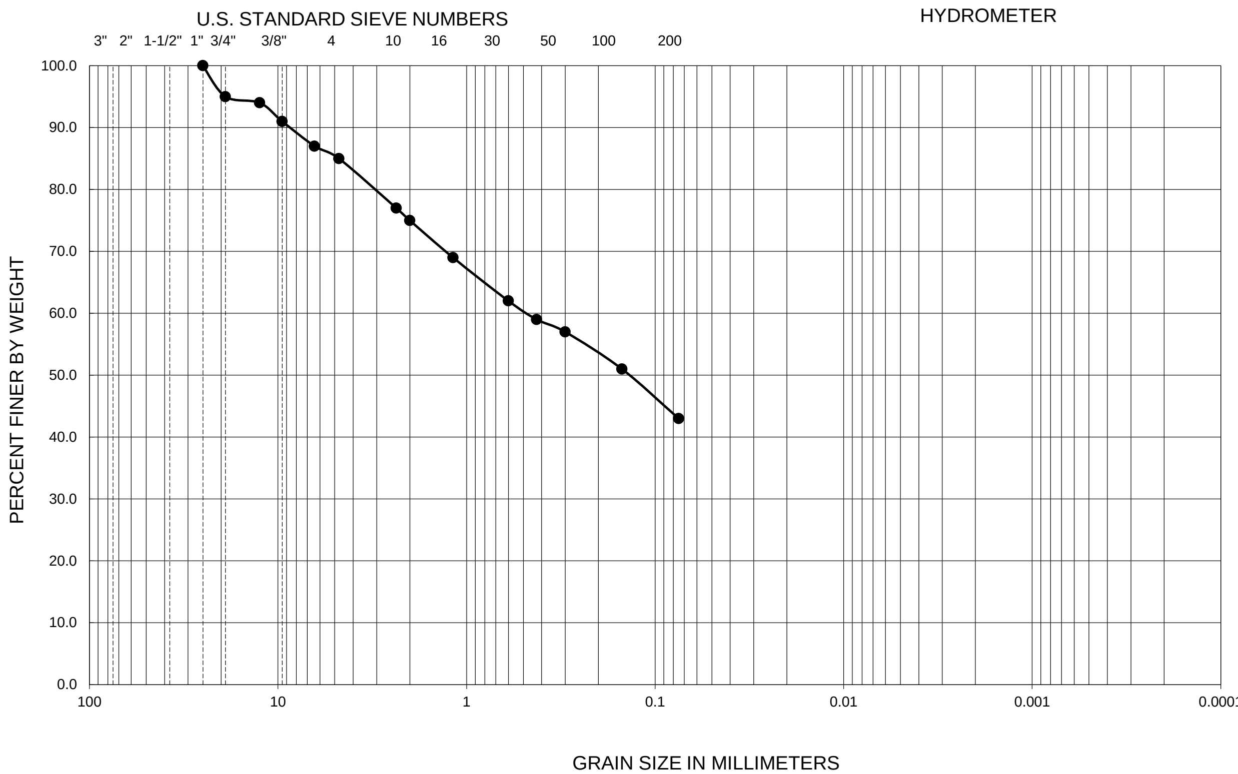
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-13	8.5-10.0	34	21	13	--	--	0.48	--	--	43.0	SC

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FIGURE B-15

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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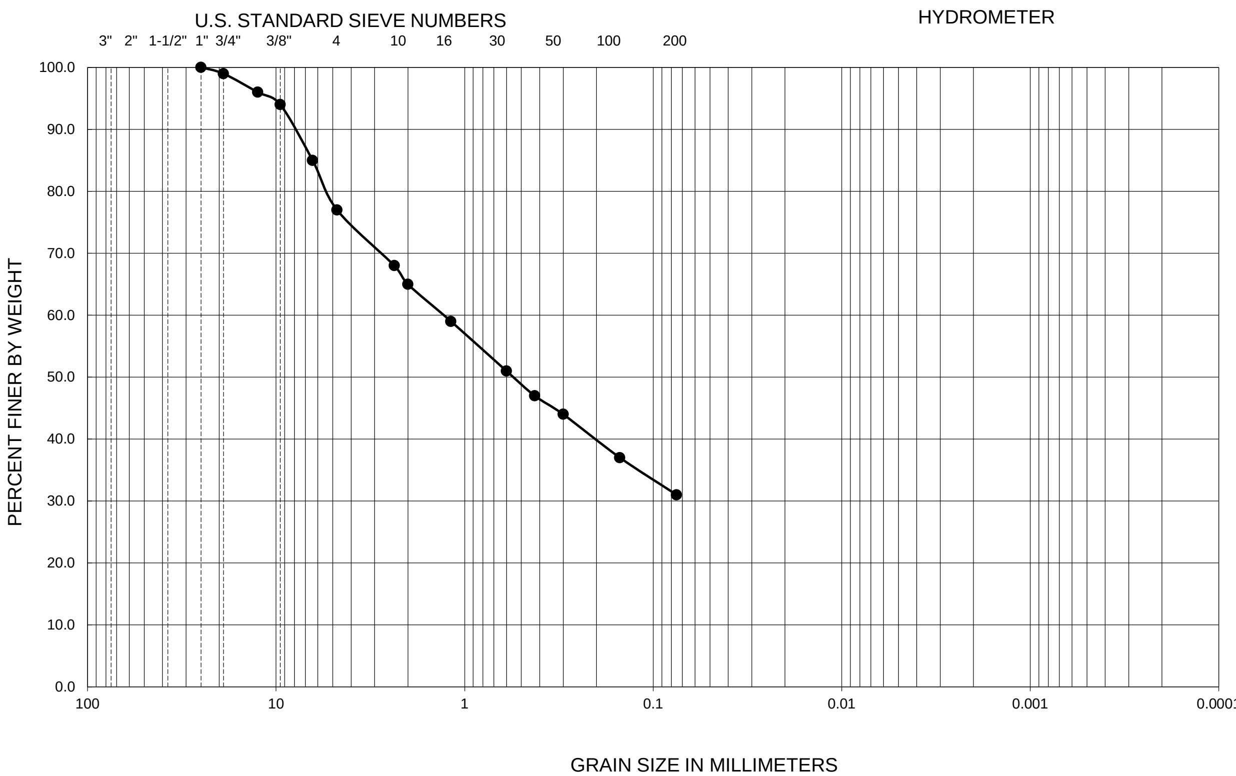
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-13	18.5-20.0	39	21	18	--	--	1.30	--	--	31.0	SC

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FIGURE B-16

GRADATION TEST RESULTS

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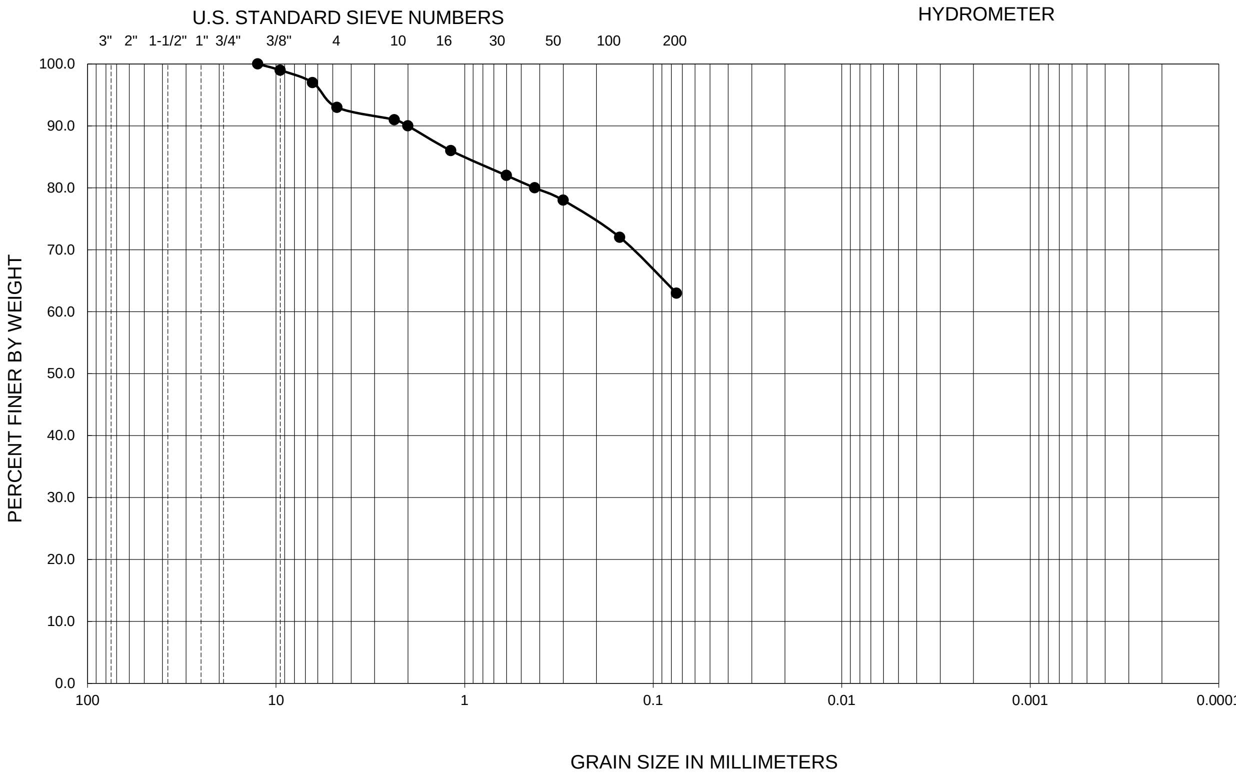
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-14	1.0-2.5	29	15	14	--	--	--	--	--	63.0	CL

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FIGURE B-17

GRADATION TEST RESULTS

AJSD WRF EXPANSION

APACHE JUNCTION, ARIZONA

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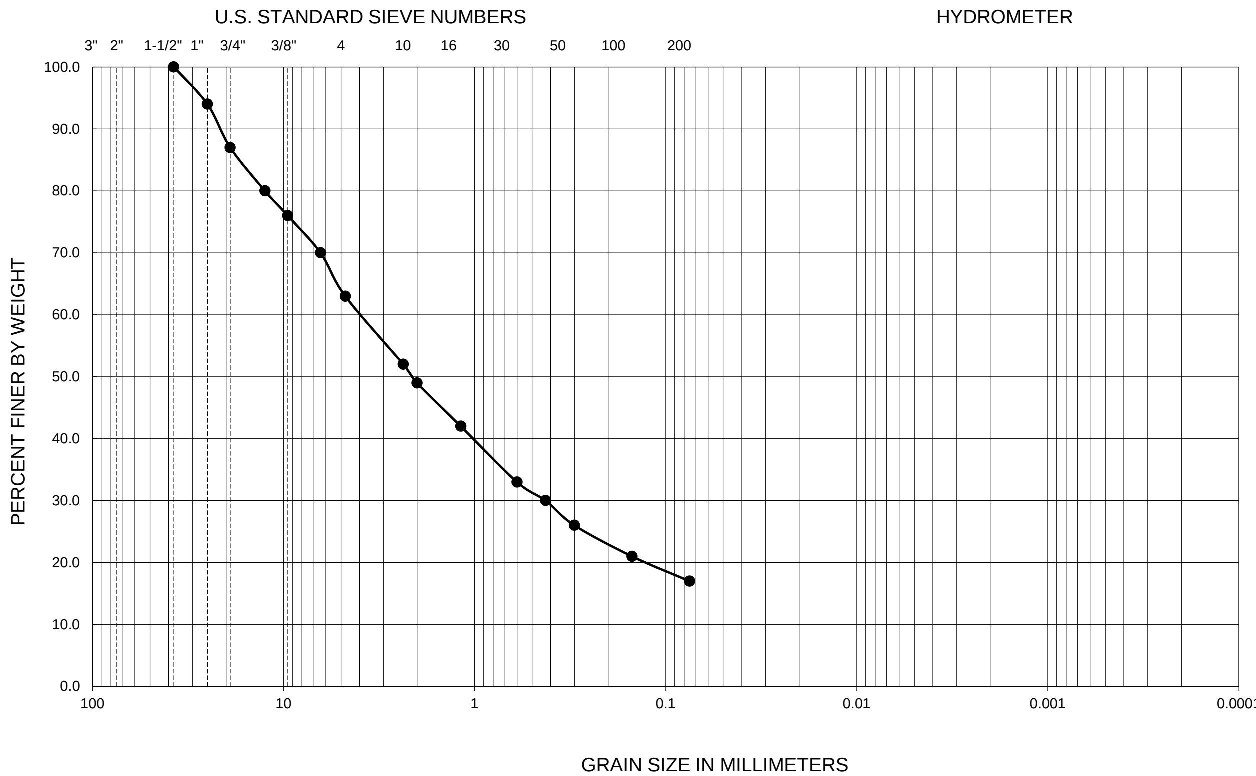
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-14	18.5-19.3	44	23	21	--	0.432	3.98	--	--	17.0	SC

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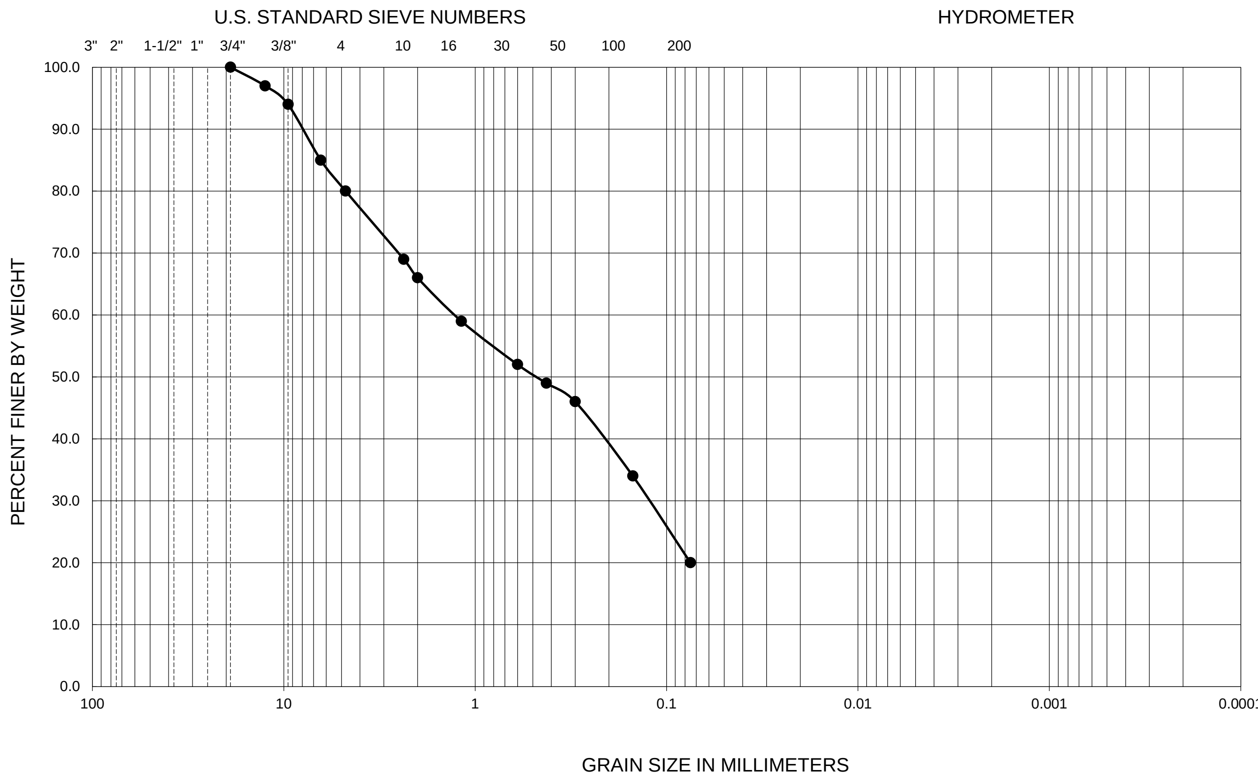
FIGURE B-18

GRADATION TEST RESULTS

AJSD WRF EXPANSION

APACHE JUNCTION, ARIZONA

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-15	3.5-5.0	--	--	NP	--	0.122	1.29	--	--	20.0	SM

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FIGURE B-19

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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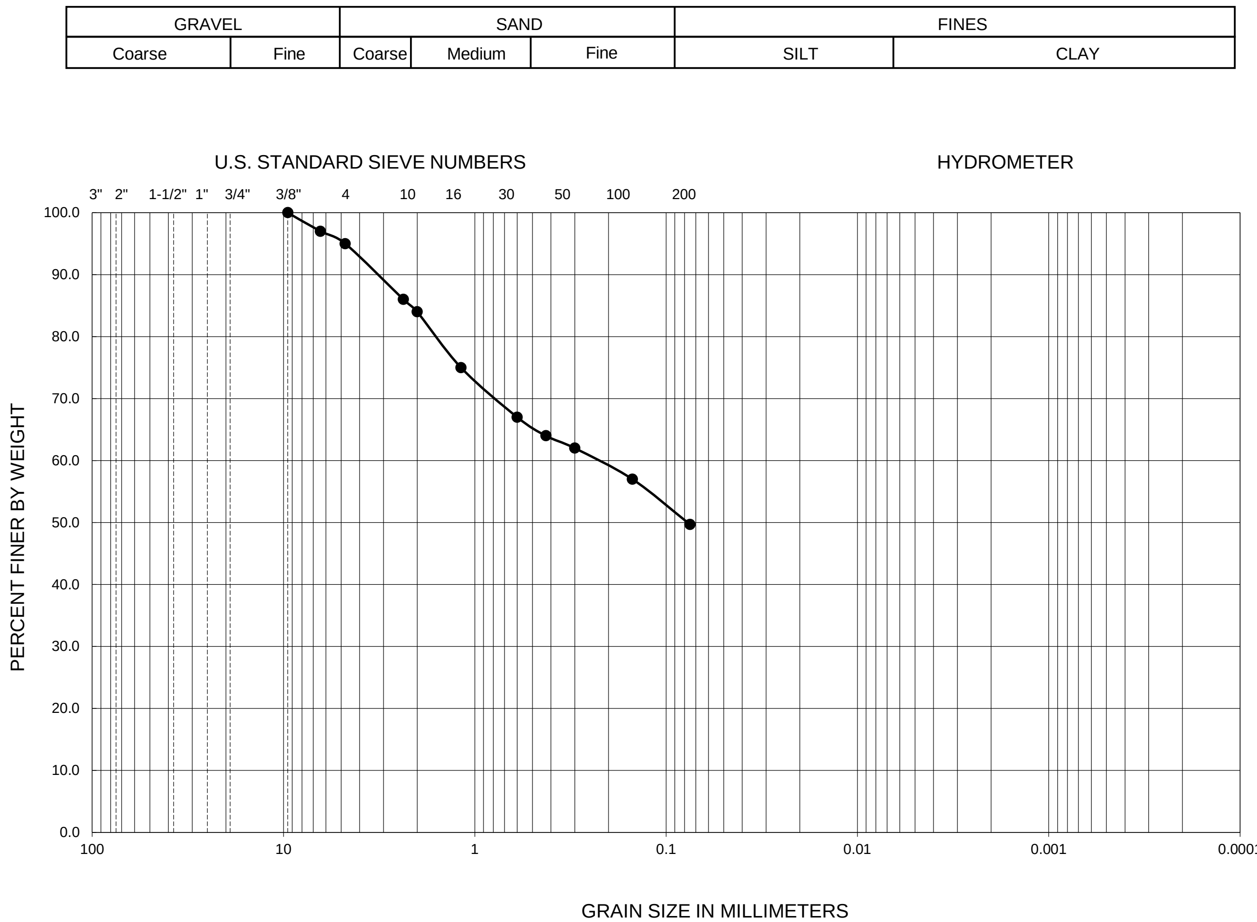

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-15	13.5-14.2	41	22	19	--	--	0.23	--	--	49.7	SC

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FIGURE B-20

GRADATION TEST RESULTS

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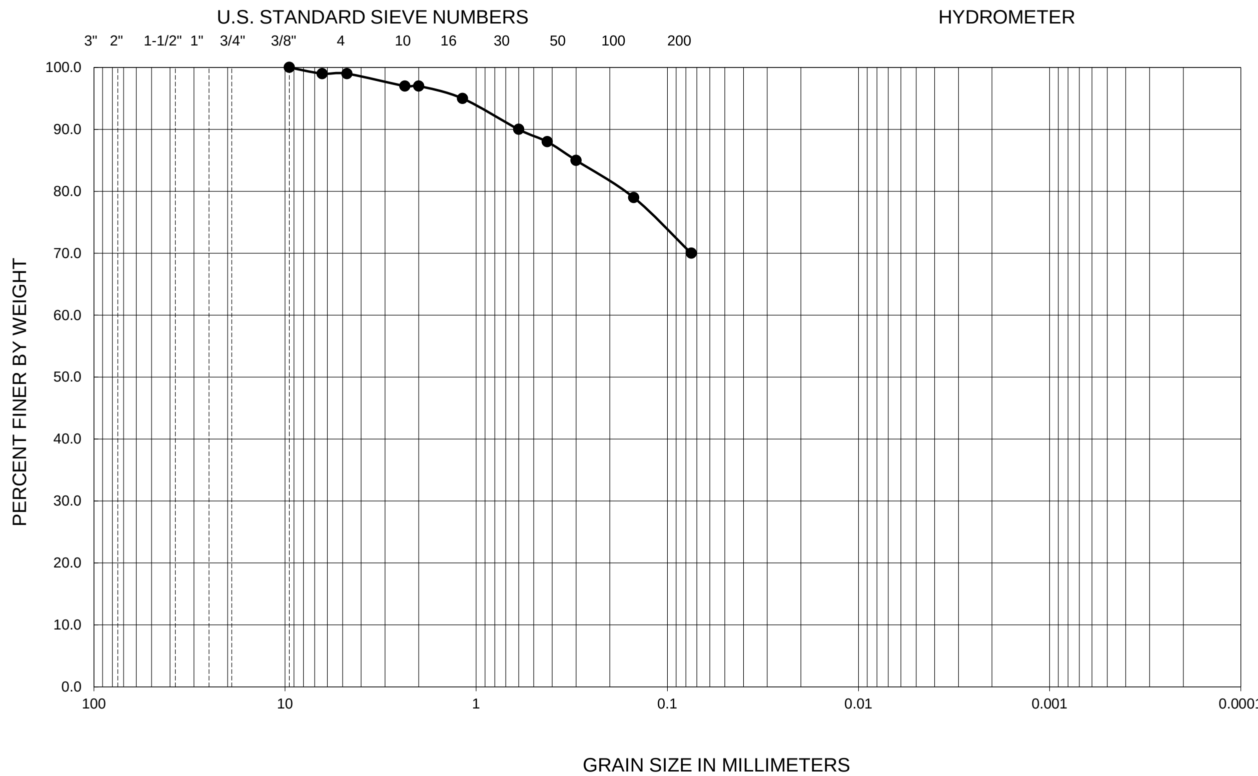
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-1	3.5-5.0	--	--	--	--	--	--	--	--	70.0	--

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FIGURE B-21

GRADATION TEST RESULTS

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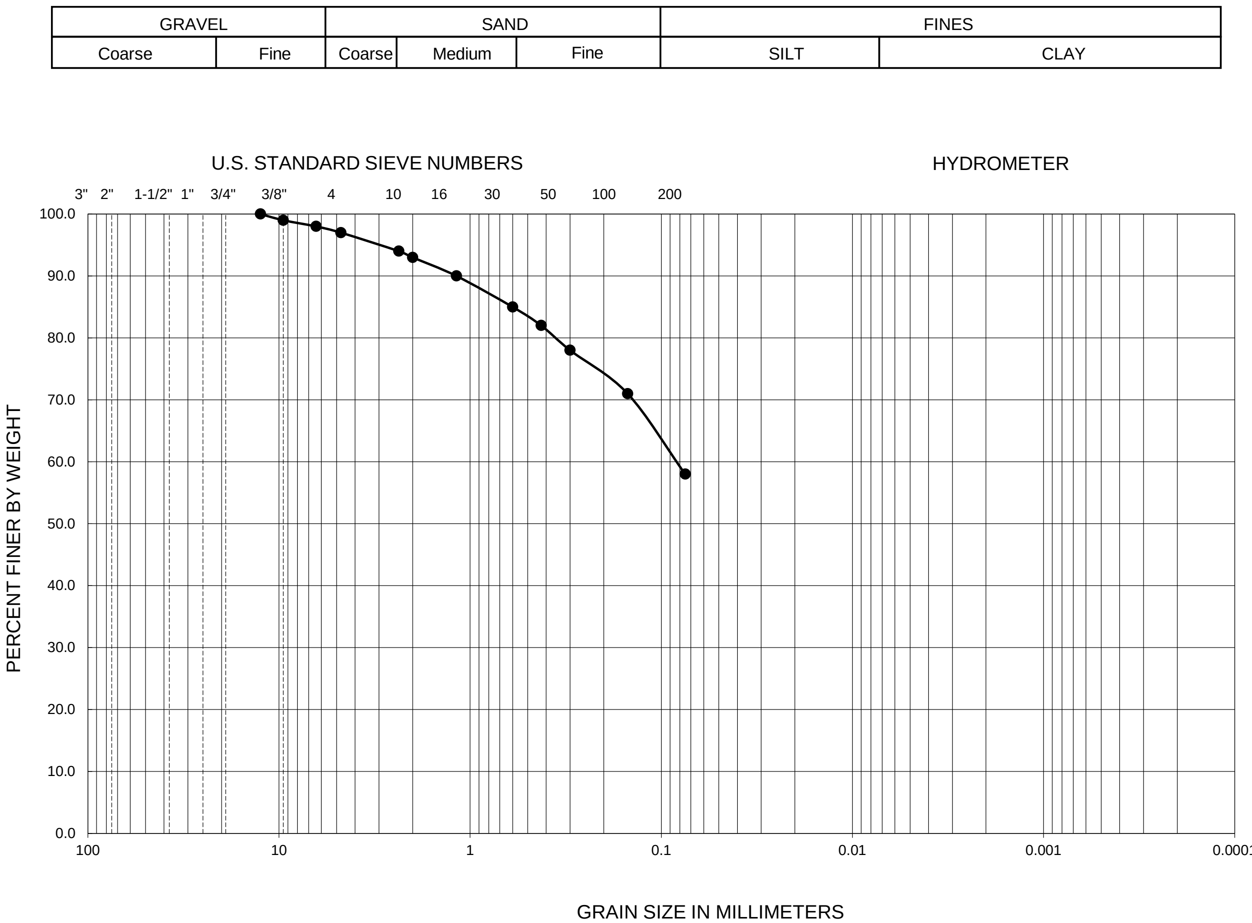

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-1	13.5-14.4	--	--	--	--	--	0.08	--	--	58.0	--

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FIGURE B-22

GRADATION TEST RESULTS

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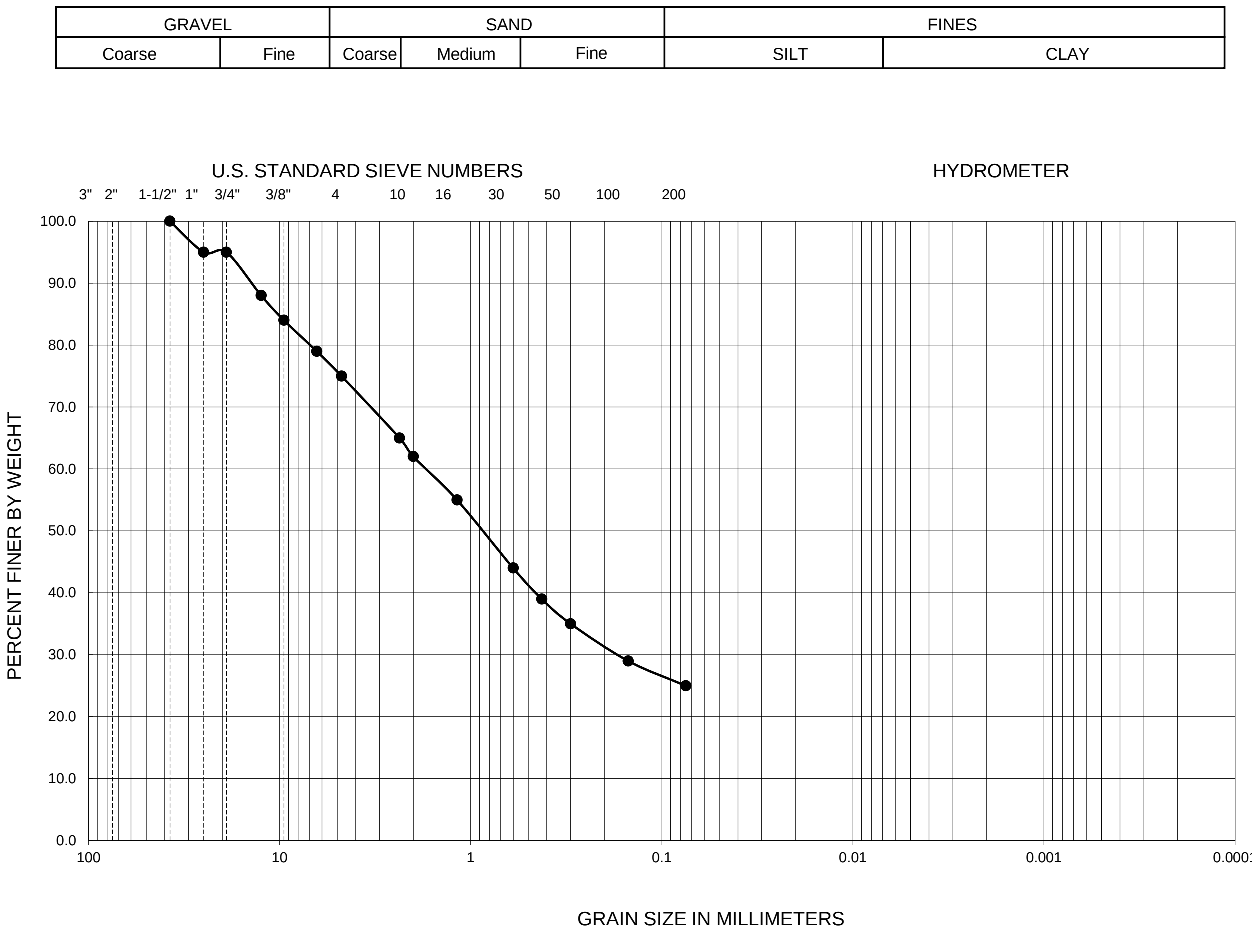

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-1	23.5-25.0	--	--	--	--	0.169	1.73	--	--	25.0	--

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FIGURE B-23

GRADATION TEST RESULTS

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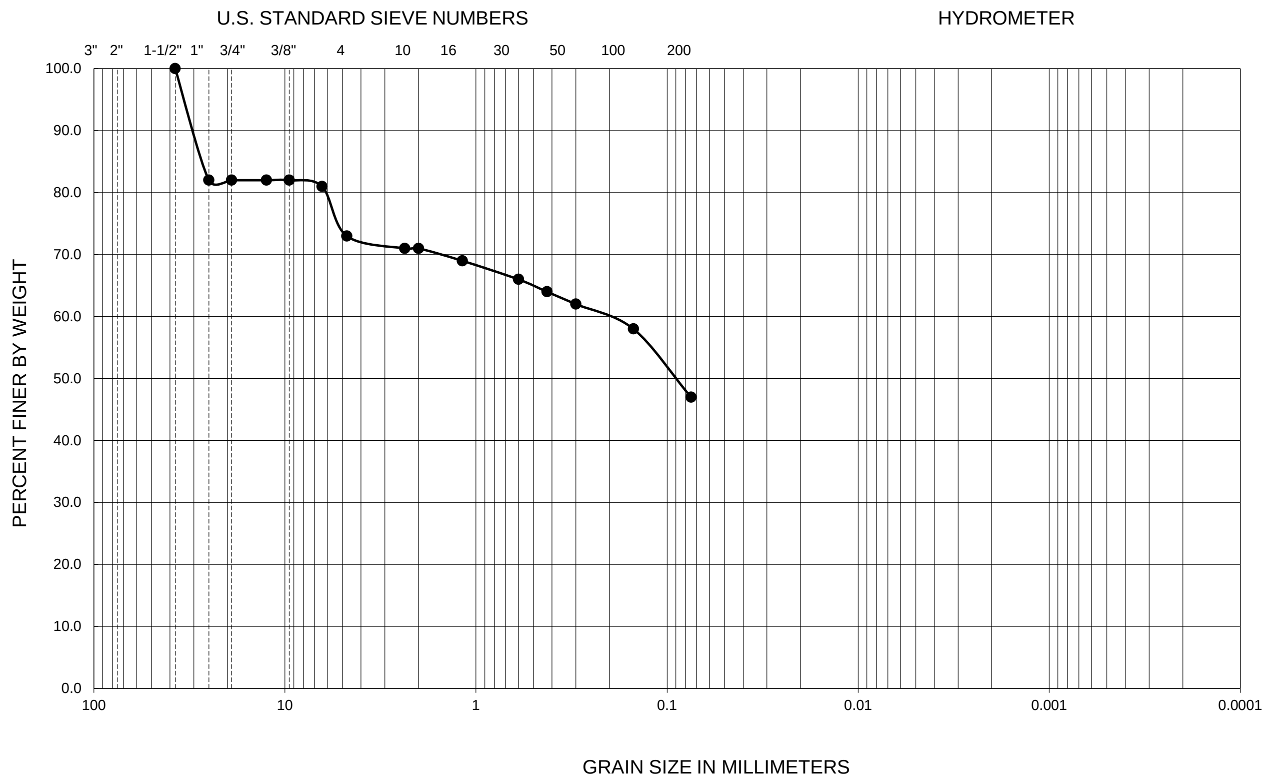
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-1	33.5-34.4	--	--	--	--	--	0.21	--	--	47.0	--

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FIGURE B-24

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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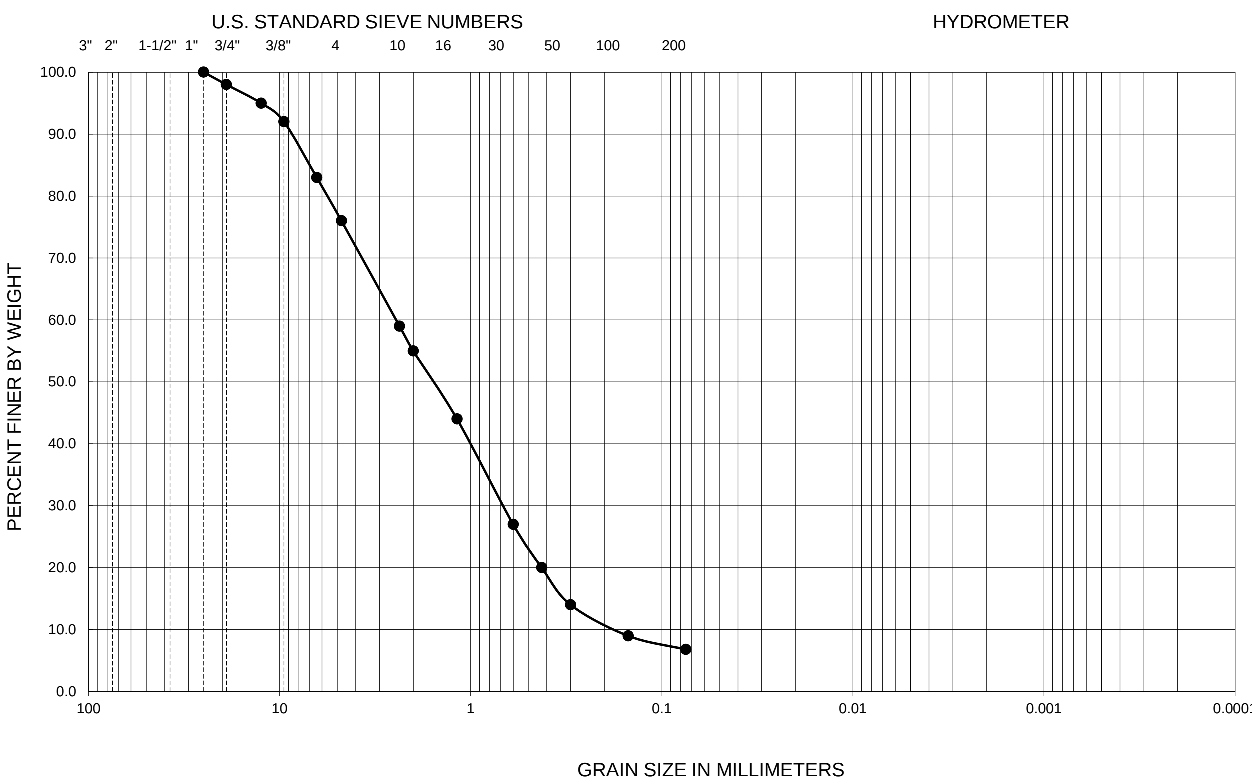
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-1	43.5-44.4	--	--	--	0.173	0.663	2.49	14.4	1.0	6.8	--

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FIGURE B-25

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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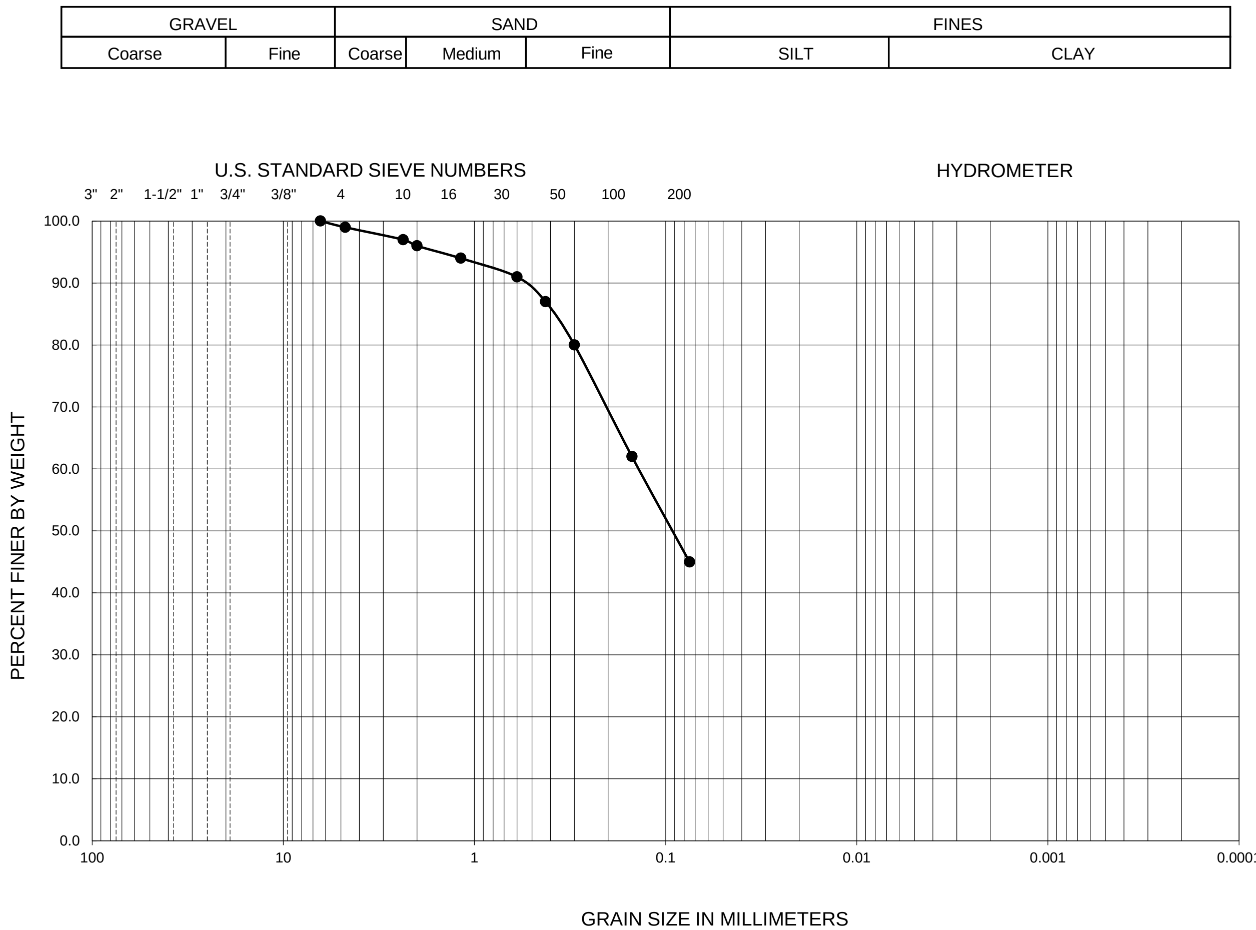

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-1	53.5-54.4	--	--	--	--	--	0.14	--	--	45.0	--

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FIGURE B-26

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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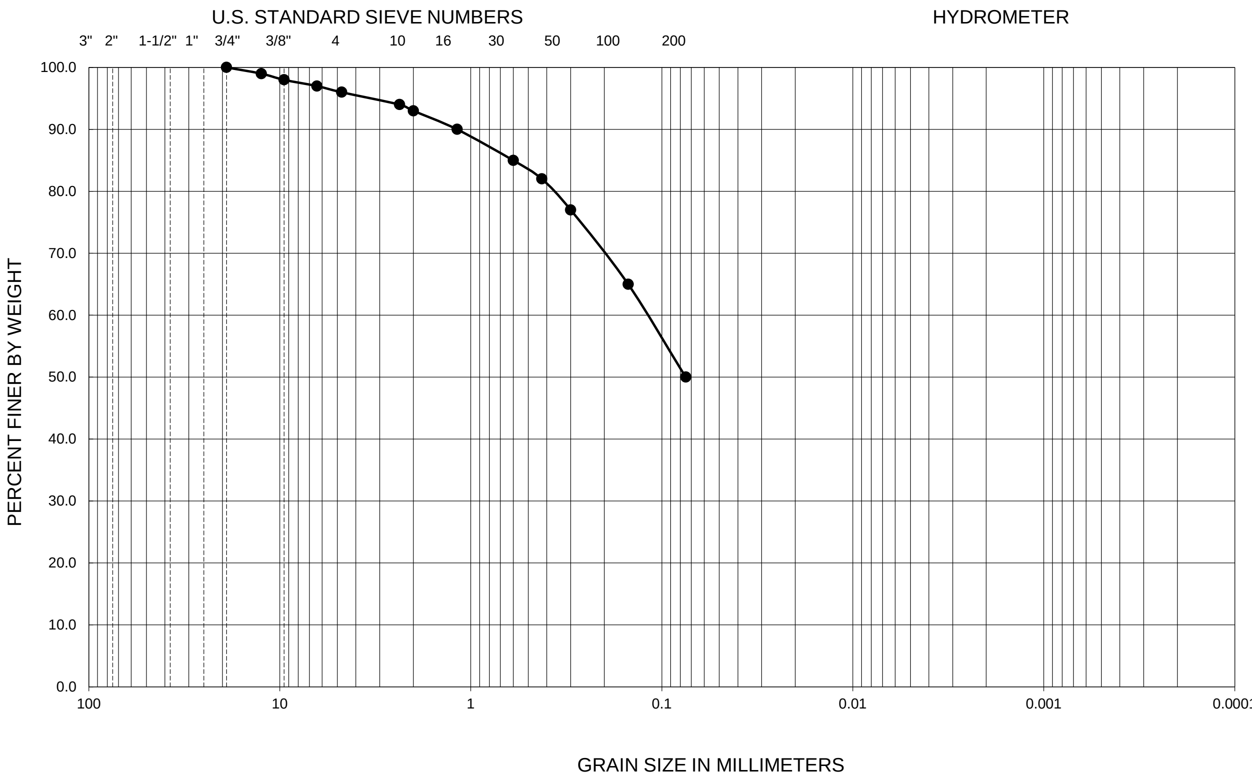
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-1	63.5-63.9	--	--	--	--	--	0.12	--	--	50.0	--

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FIGURE B-27

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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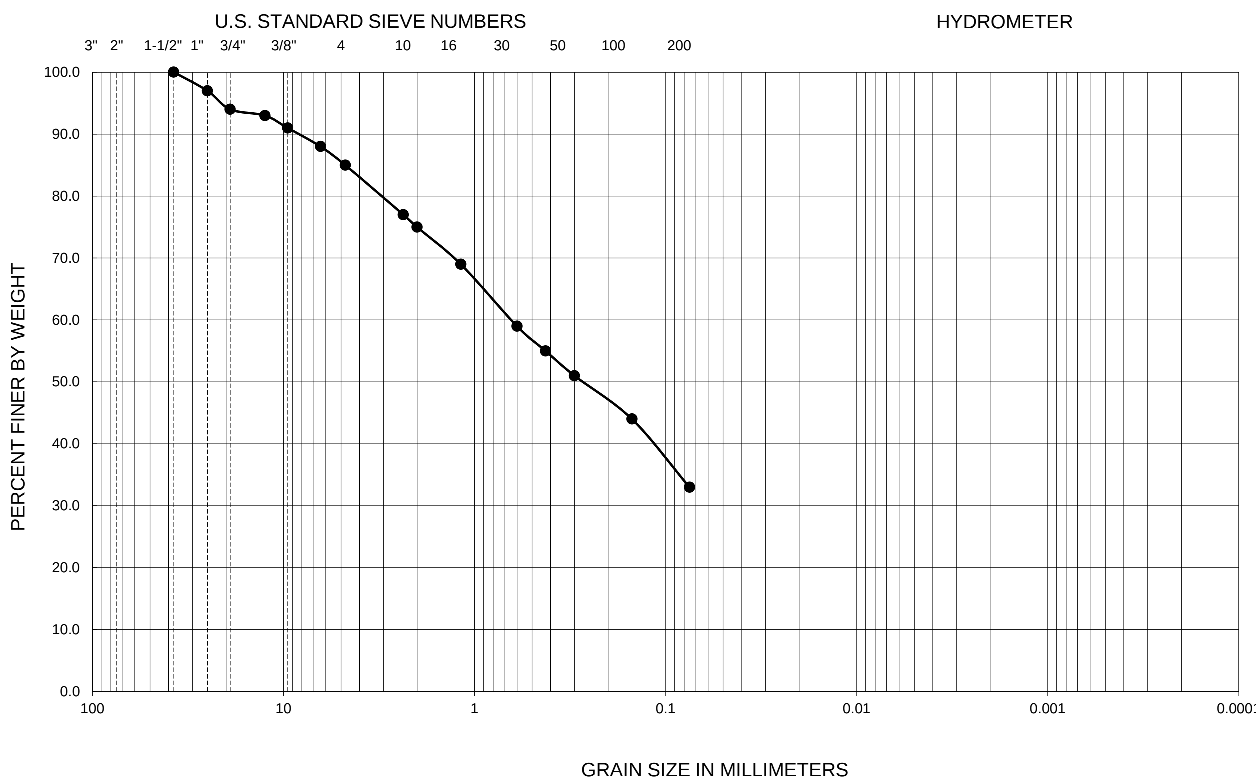
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-1	73.5-74.4	--	--	--	--	--	0.63	--	--	33.0	--

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FIGURE B-28

GRADATION TEST RESULTS

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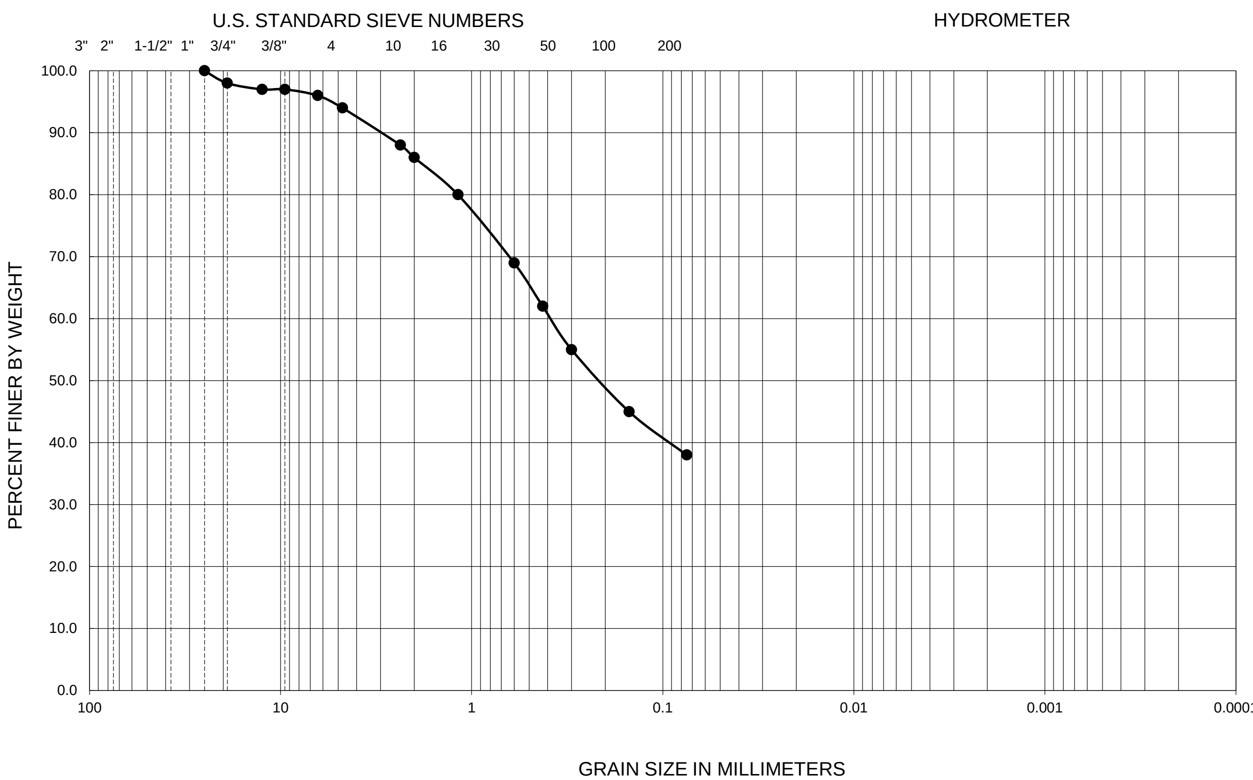
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-1	83.5-84.4	--	--	--	--	--	0.39	--	--	38.0	--

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FIGURE B-29

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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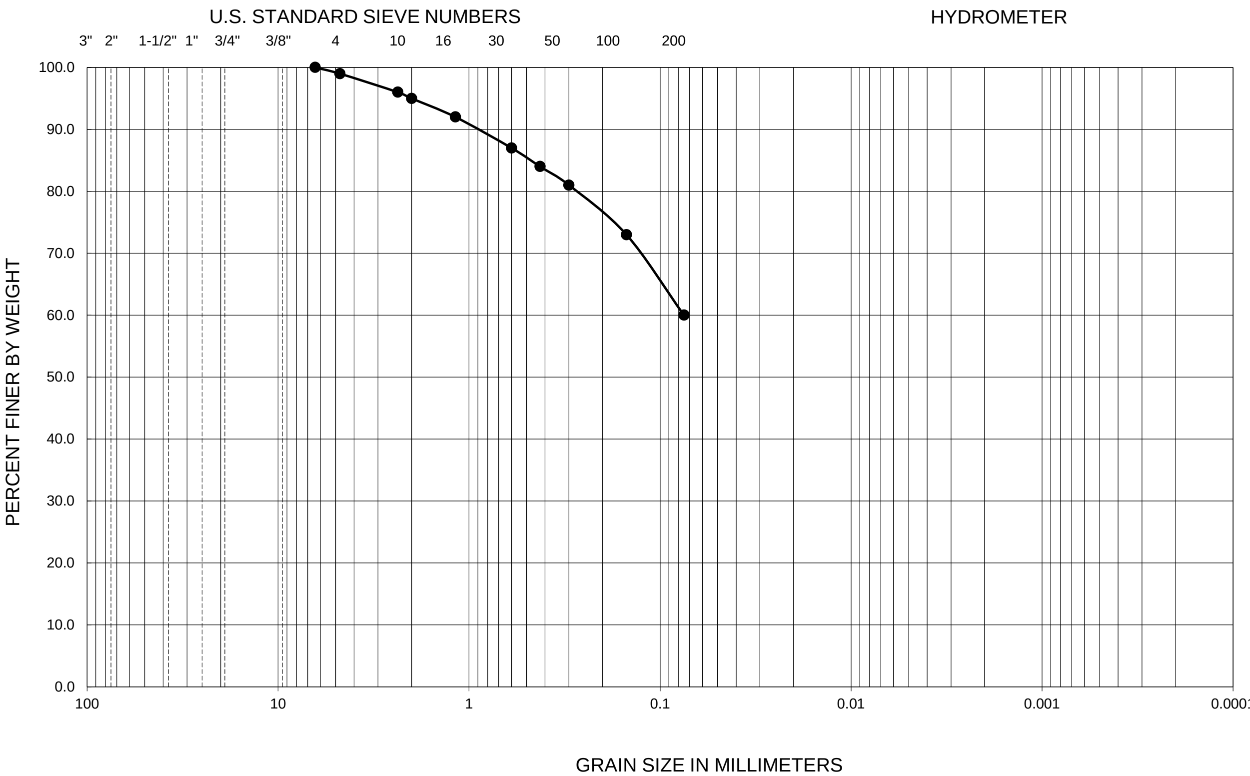
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-1	93.5-94.4	--	--	--	--	--	0.07	--	--	60.0	--

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FIGURE B-30

GRADATION TEST RESULTS

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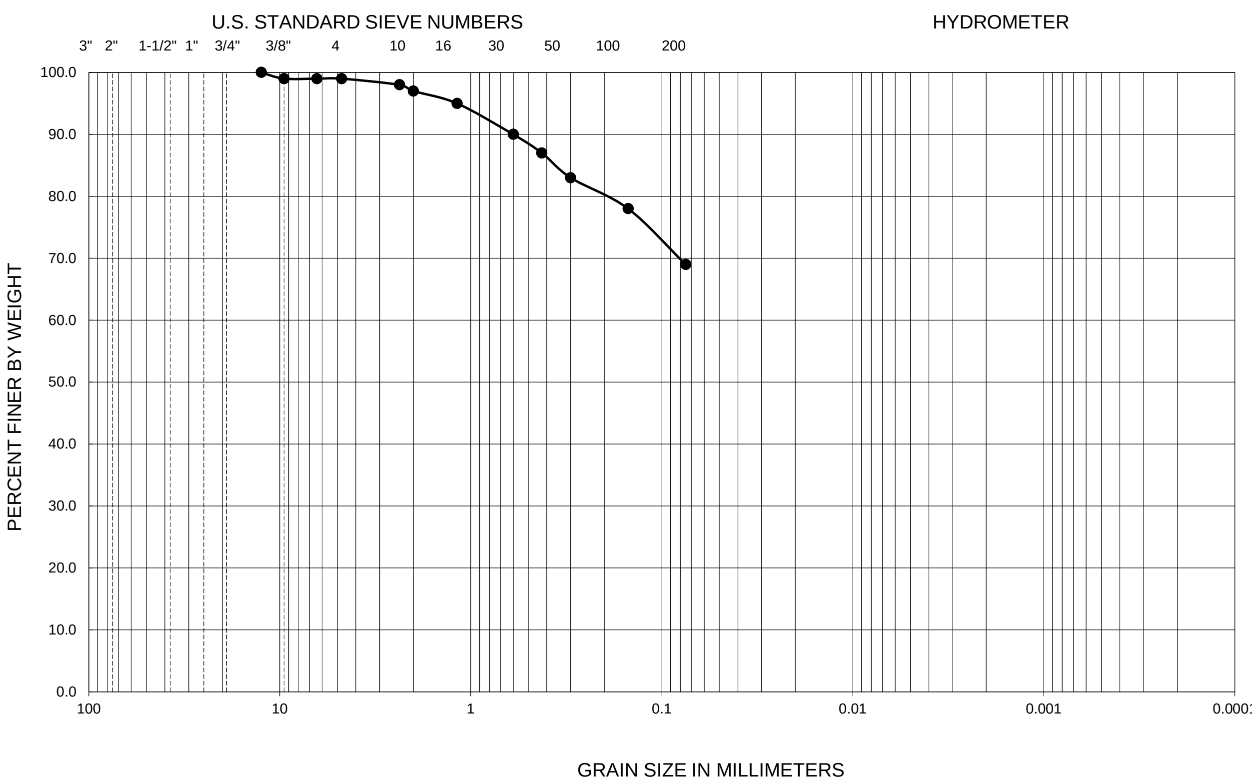
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-2	3.5-4.9	--	--	--	--	--	--	--	--	69.0	--

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FIGURE B-31

GRADATION TEST RESULTS

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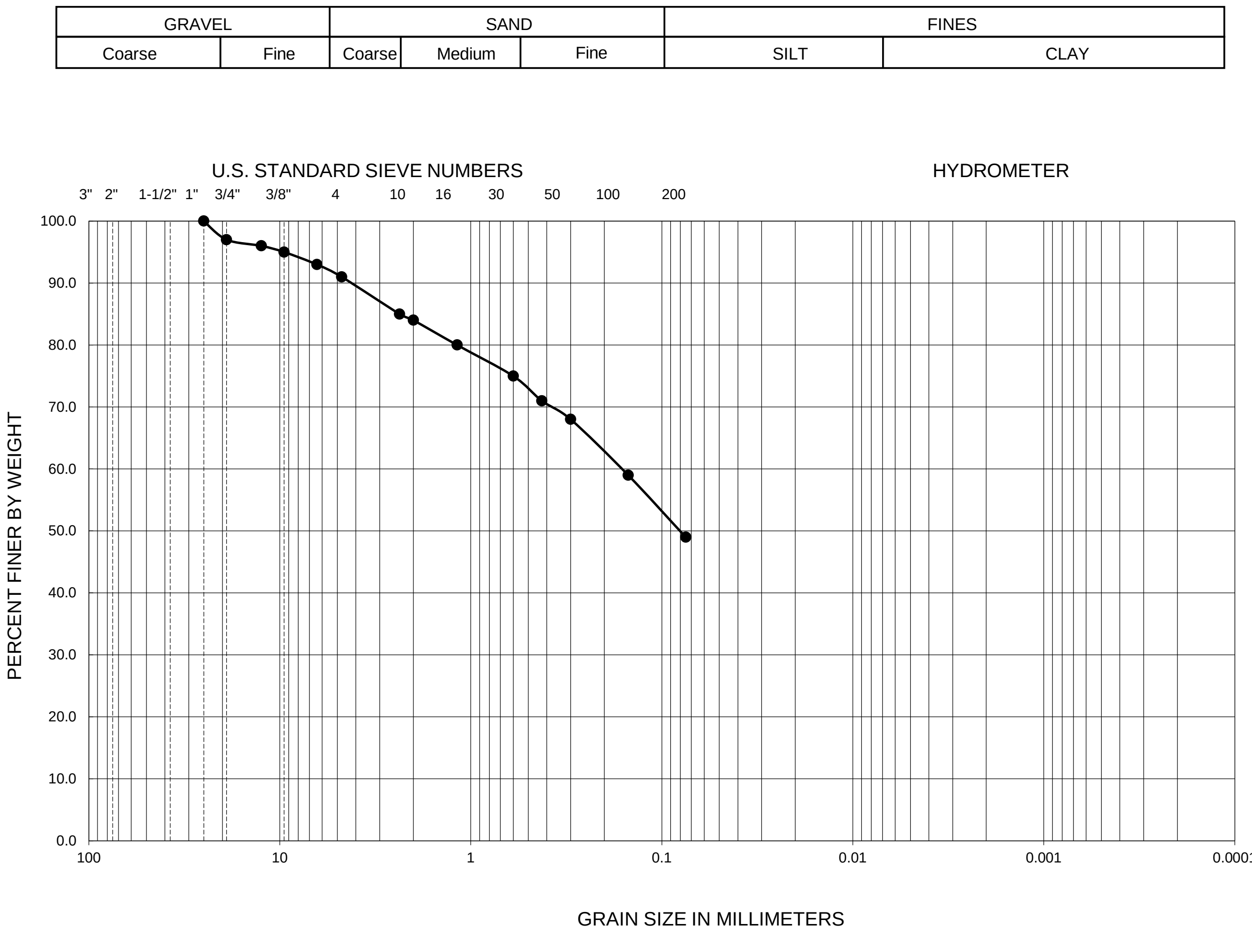

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-2	13.5-14.4	--	--	--	--	--	0.16	--	--	49.0	--

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FIGURE B-32

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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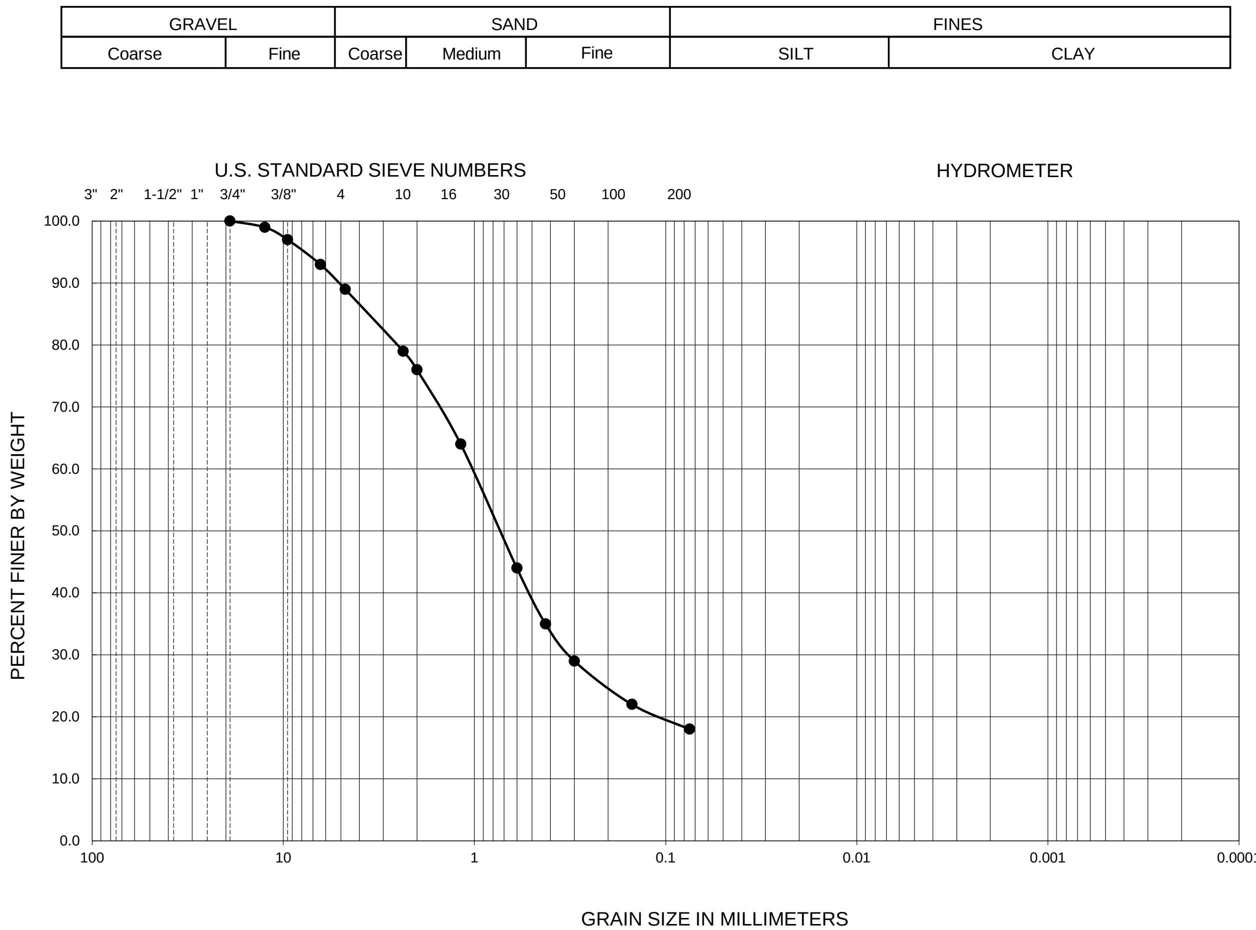

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-2	23.5-23.8	--	--	--	--	0.323	1.04	--	--	18.0	--

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FIGURE B-33

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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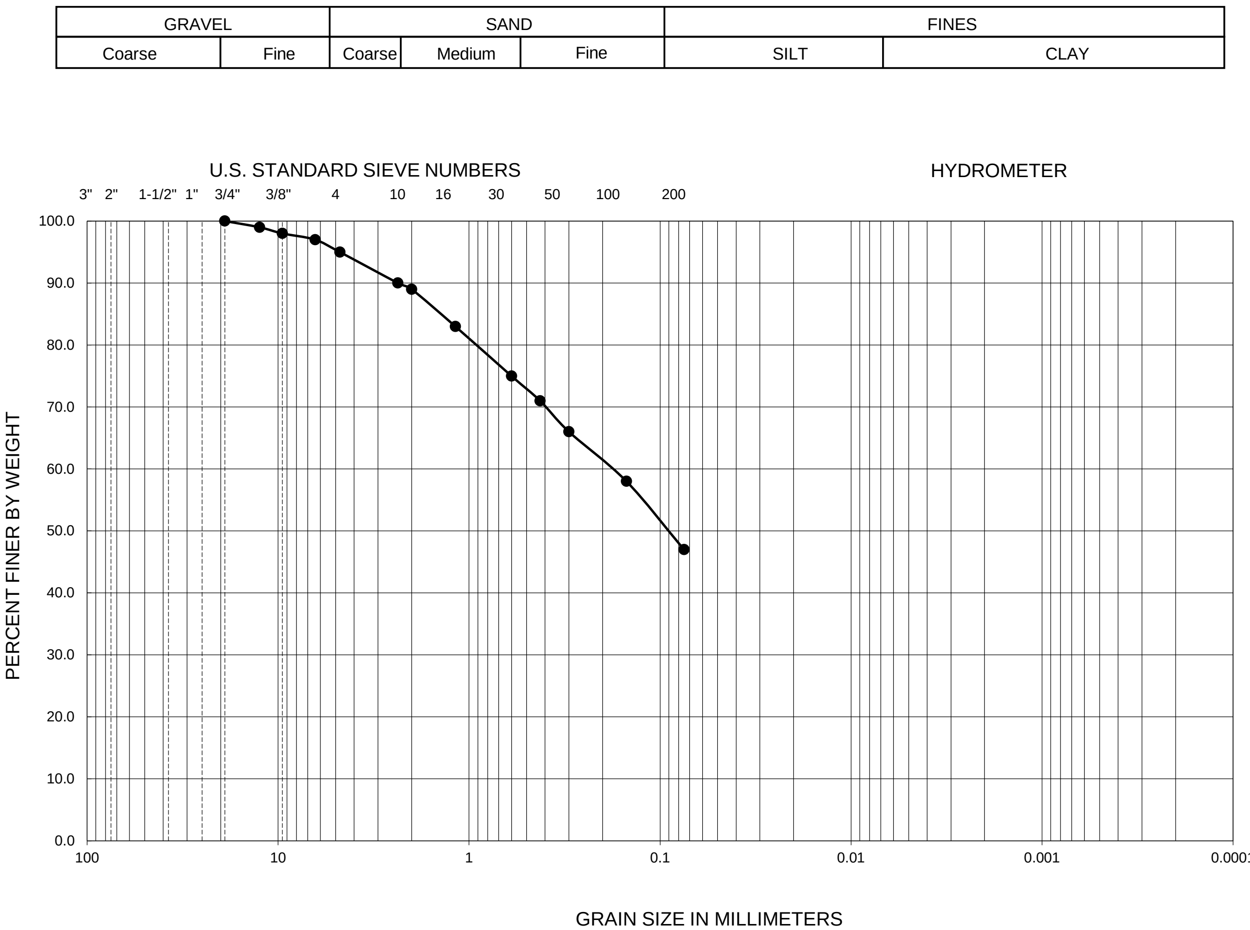

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-2	33.5-35.0	--	--	--	--	--	0.18	--	--	47.0	--

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FIGURE B-34

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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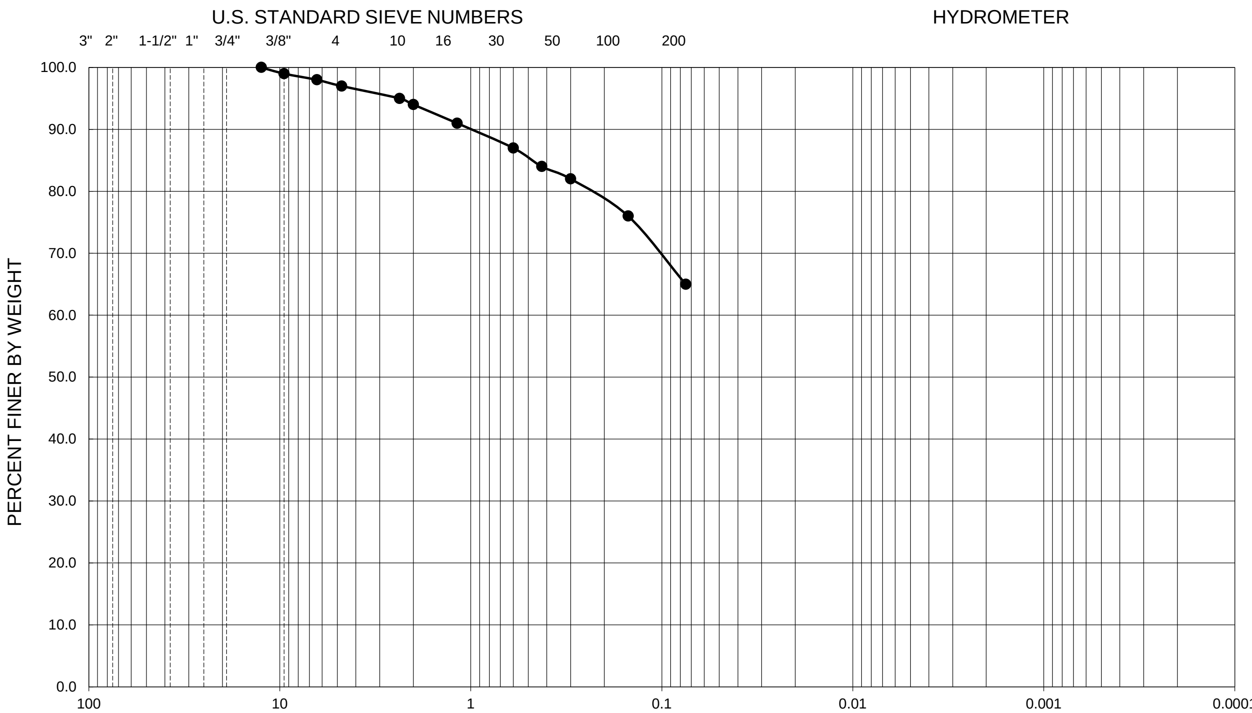
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-2	43.5-44.75	--	--	--	--	--	--	--	--	65.0	--

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FIGURE B-35

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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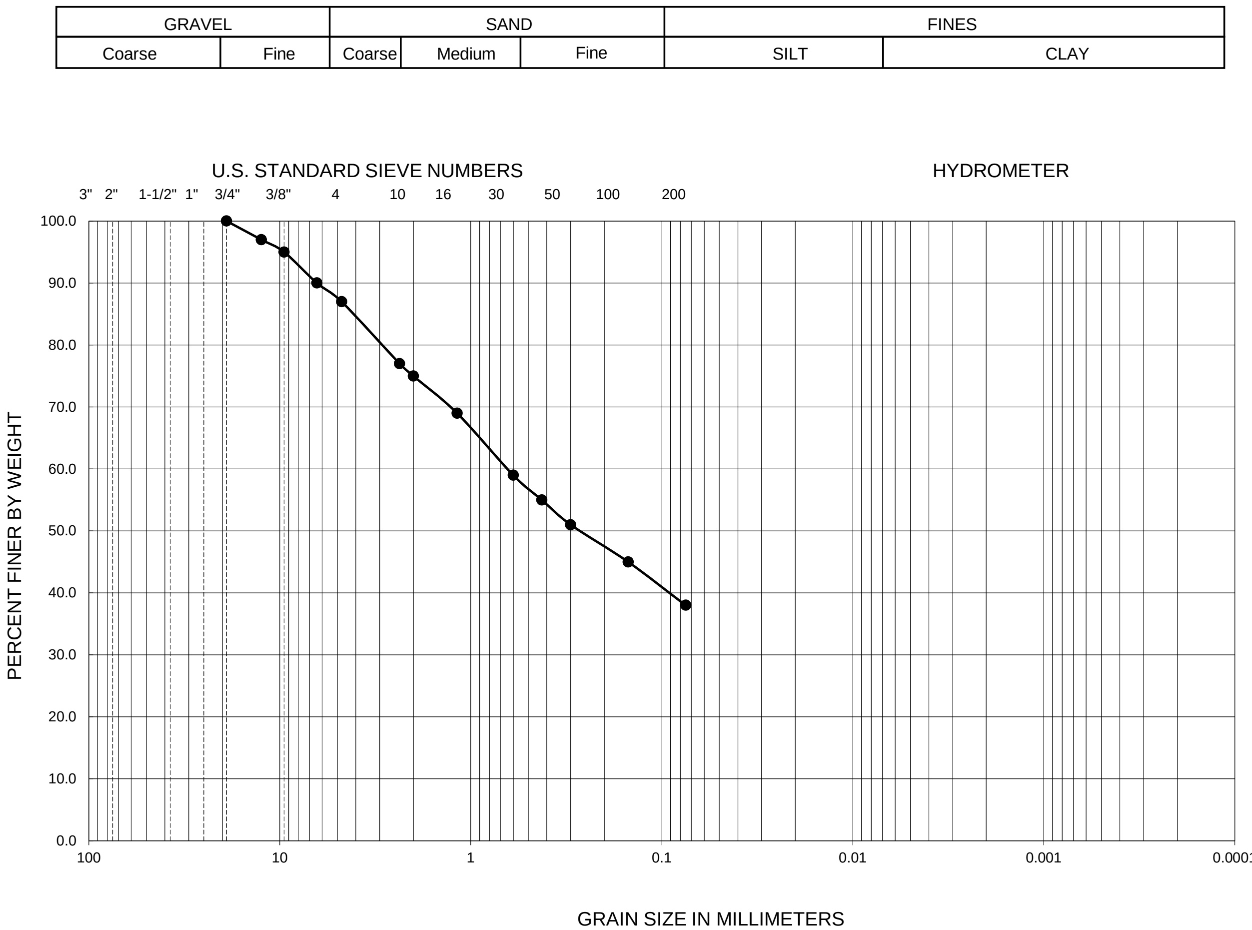

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-2	53.5-54.4	--	--	--	--	--	0.63	--	--	38.0	--

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FIGURE B-36

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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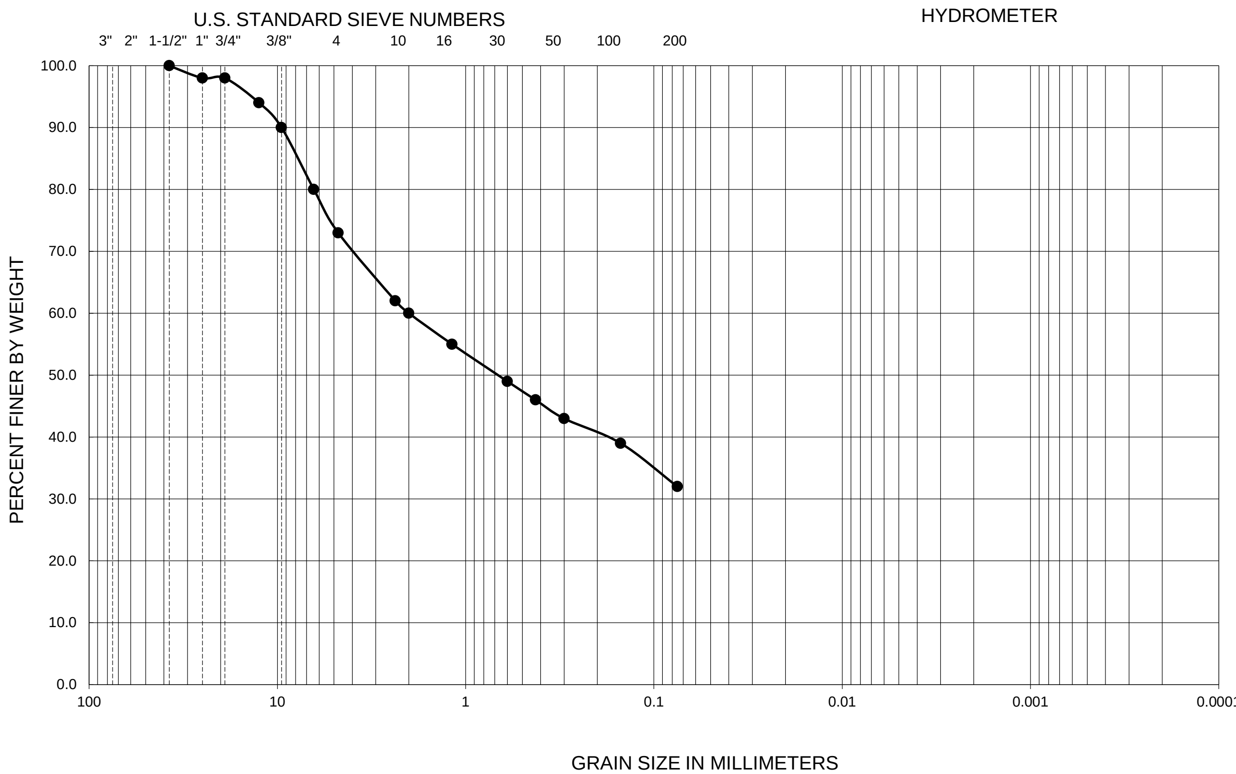
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-2	63.0-65.0	--	--	--	--	--	2.01	--	--	32.0	--

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FIGURE B-37

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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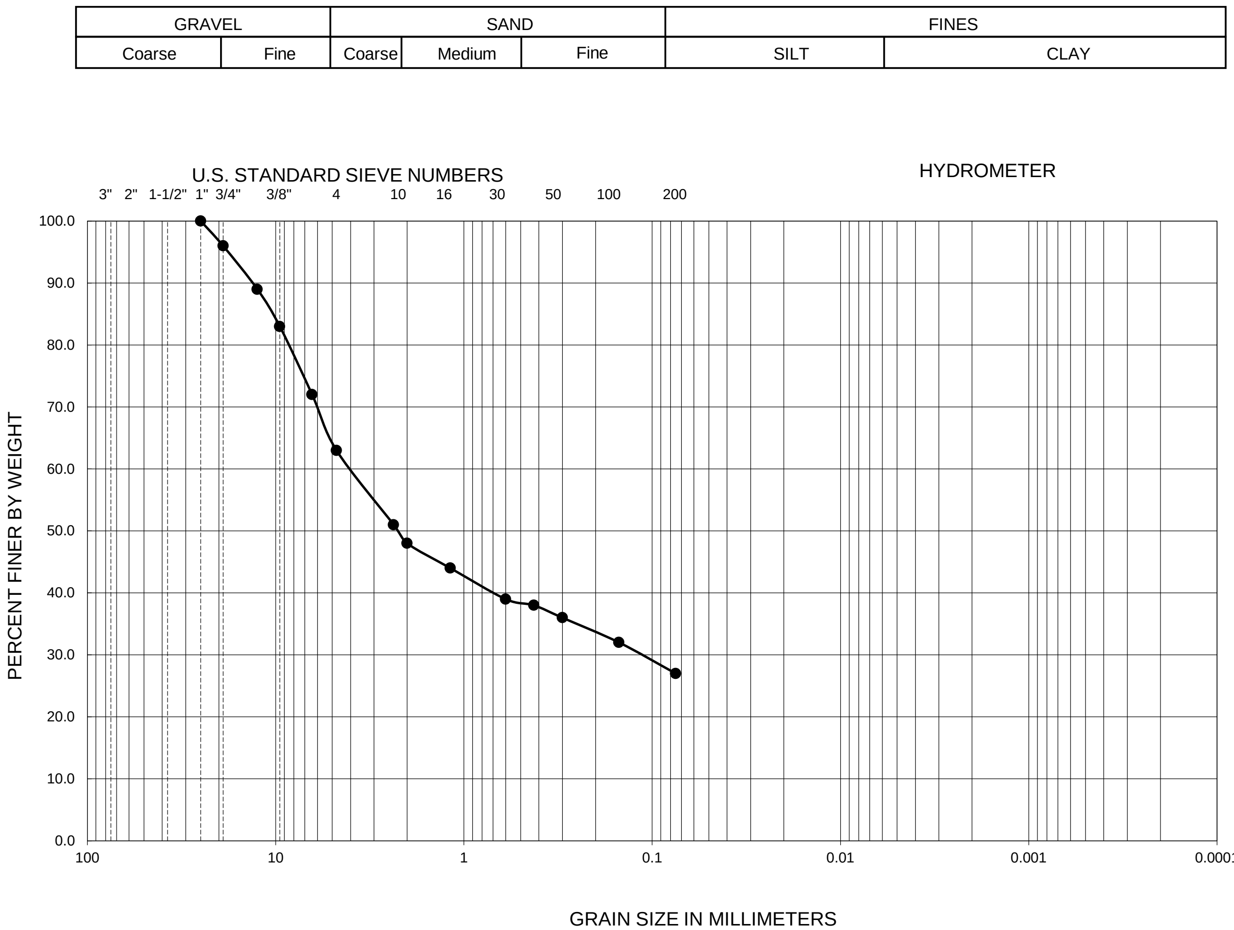

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-2	73.0-75.0	--	--	--	--	0.113	4.05	--	--	27.0	--

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FIGURE B-38

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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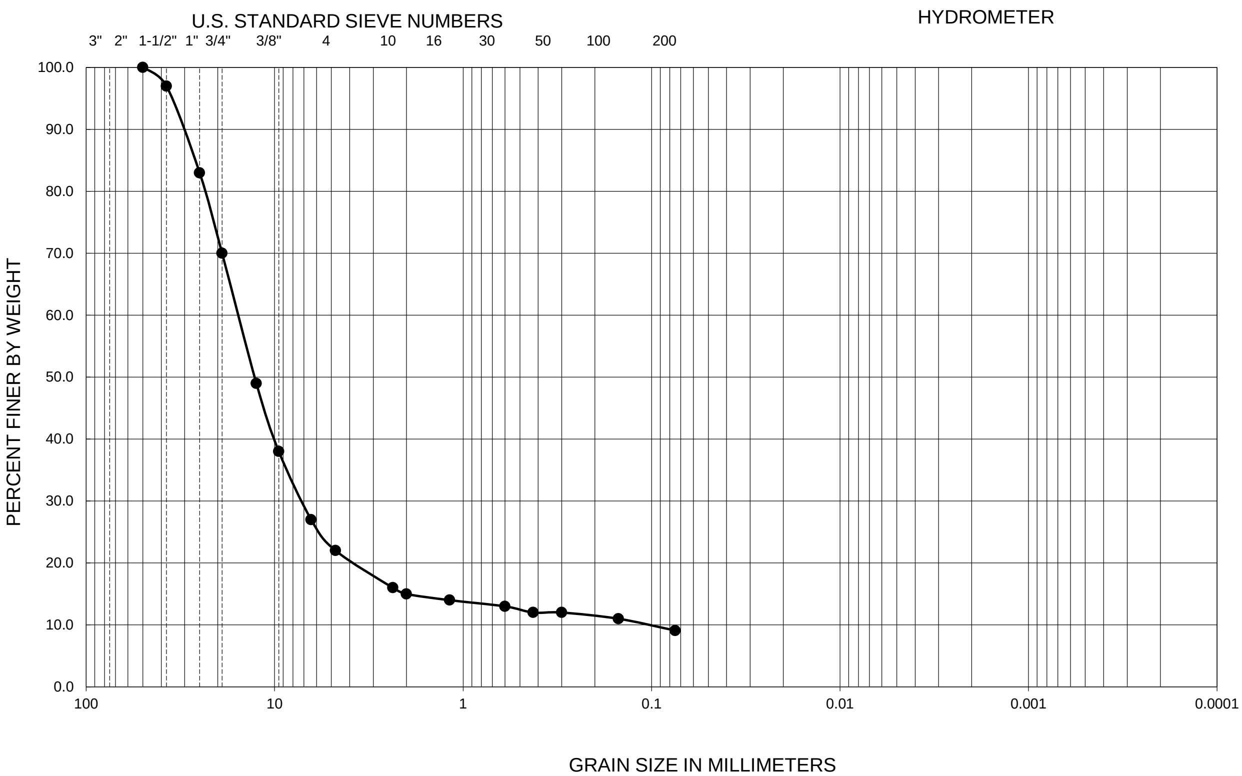
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-2	83.0-85.0	--	--	--	0.103	7.092	15.71	152.5	31.1	9.1	--

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FIGURE B-39

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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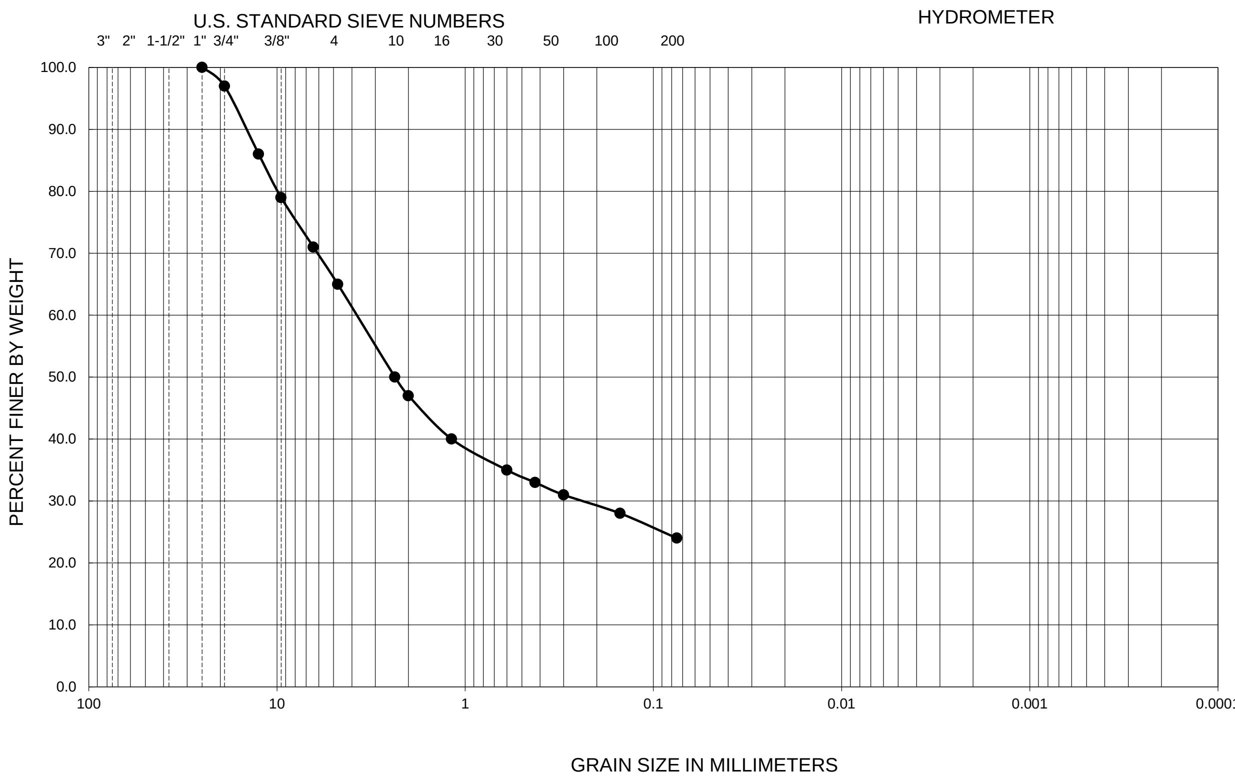
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	AJ-2	93.0-95.0	--	--	--	--	0.241	3.82	--	--	24.0	--

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FIGURE B-40

GRADATION TEST RESULTS

AJSD WRF EXPANSION

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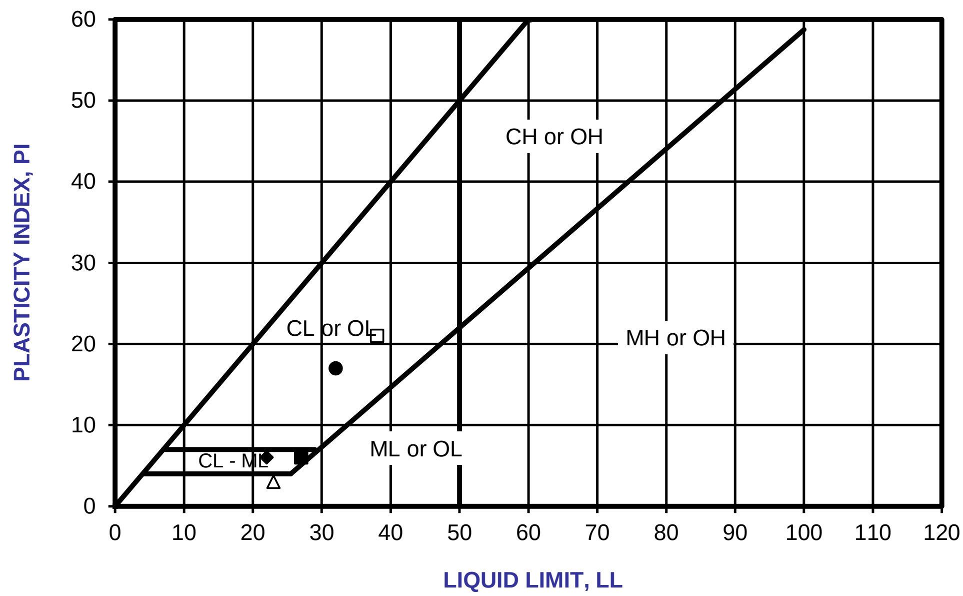
SYMBOL	LOCATION	DEPTH (ft)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS
●	B-1	8.5-10.0	32	15	17	CL	CL
■	B-2	3.5-5.0	27	21	6	CL-ML	CL-ML
◆	B-2	8.5-10.0	22	16	6	CL-ML	CL-ML
○	B-3	6.0-7.5	0	0	0	ML	SM
□	B-4	13.5-15.0	38	17	21	CL	CL
Δ	B-5	6.0-7.5	--	--	NP	ML	ML
X	B-6	3.5-5.0	--	--	NP	ML	SM
+	B-7	13.5-15.0	--	--	NP	ML	SW-SM

NP - INDICATES NON-PLASTIC



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

FIGURE B-41

ATTERBERG TEST RESULTS

AJSD WRF EXPANSION

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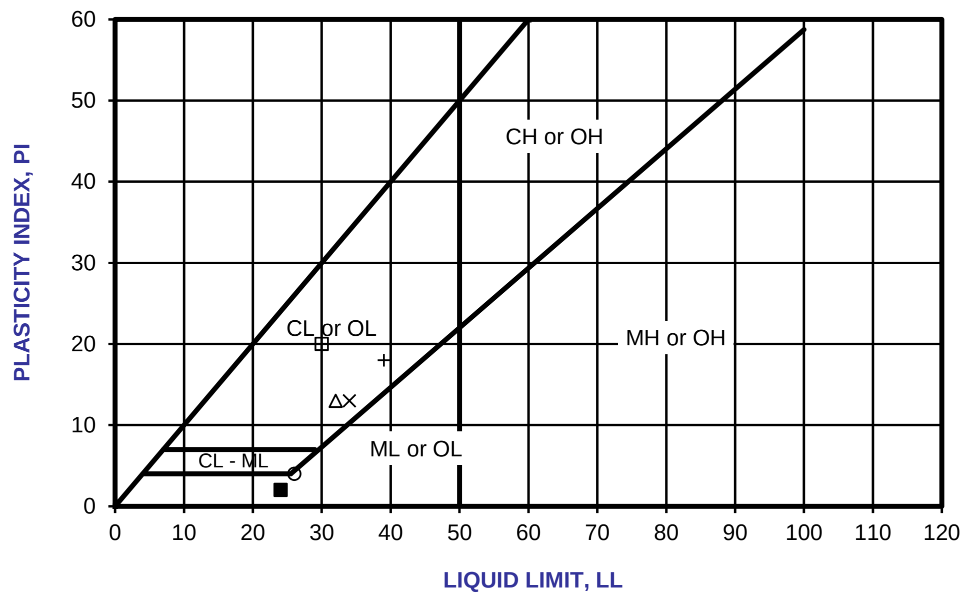
SYMBOL	LOCATION	DEPTH (ft)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS
●	B-8	3.5-5.0	0	0	0	ML	SM
■	B-9	6.0-7.5	--	--	NP	ML	ML
◆	B-10	8.5-10.0	0	0	0	ML	SW-SM
○	B-12	6.0-7.5	26	22	4	ML	ML
□	B-12	13.5-15.0	30	10	20	CL	CL
Δ	B-12	23.5-25.0	32	23	13	CL	CL
X	B-13	8.5-10.0	34	21	13	CL	SC
+	B-13	18.5-20.0	39	21	18	CL	SC

NP - INDICATES NON-PLASTIC



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

FIGURE B-42

ATTERBERG TEST RESULTS

AJSD WRF EXPANSION

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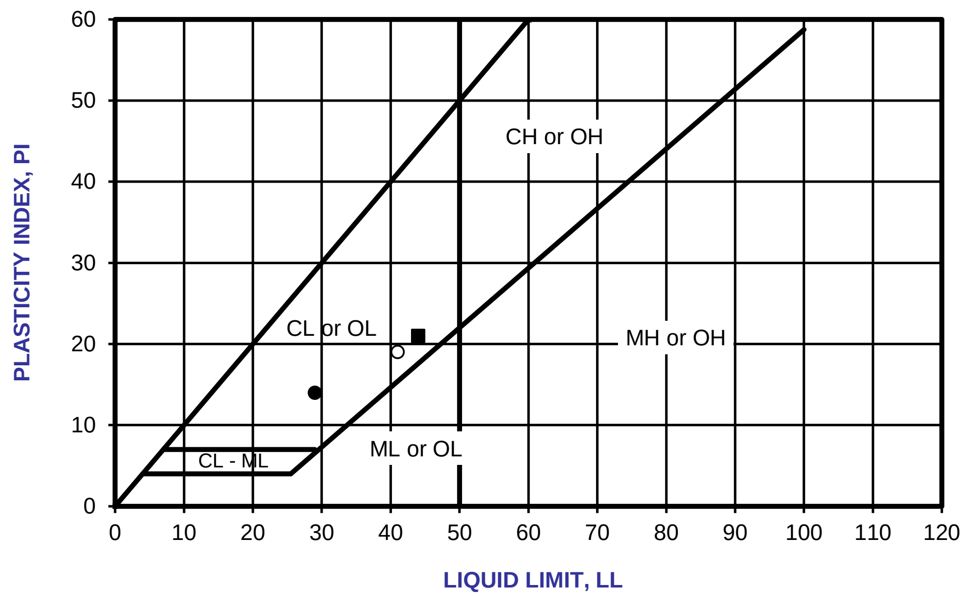
SYMBOL	LOCATION	DEPTH (ft)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS
●	B-14	1.0-2.5	29	15	14	CL	CL
■	B-14	18.5-19.3	--	--	NP	CL	SC
◆	B-15	3.5-5.0	0	0	0	ML	SM
○	B-15	13.5-14.2	41	22	19	CL	SC

NP - INDICATES NON-PLASTIC



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

FIGURE B-43

ATTERBERG TEST RESULTS

AJSD WRF EXPANSION

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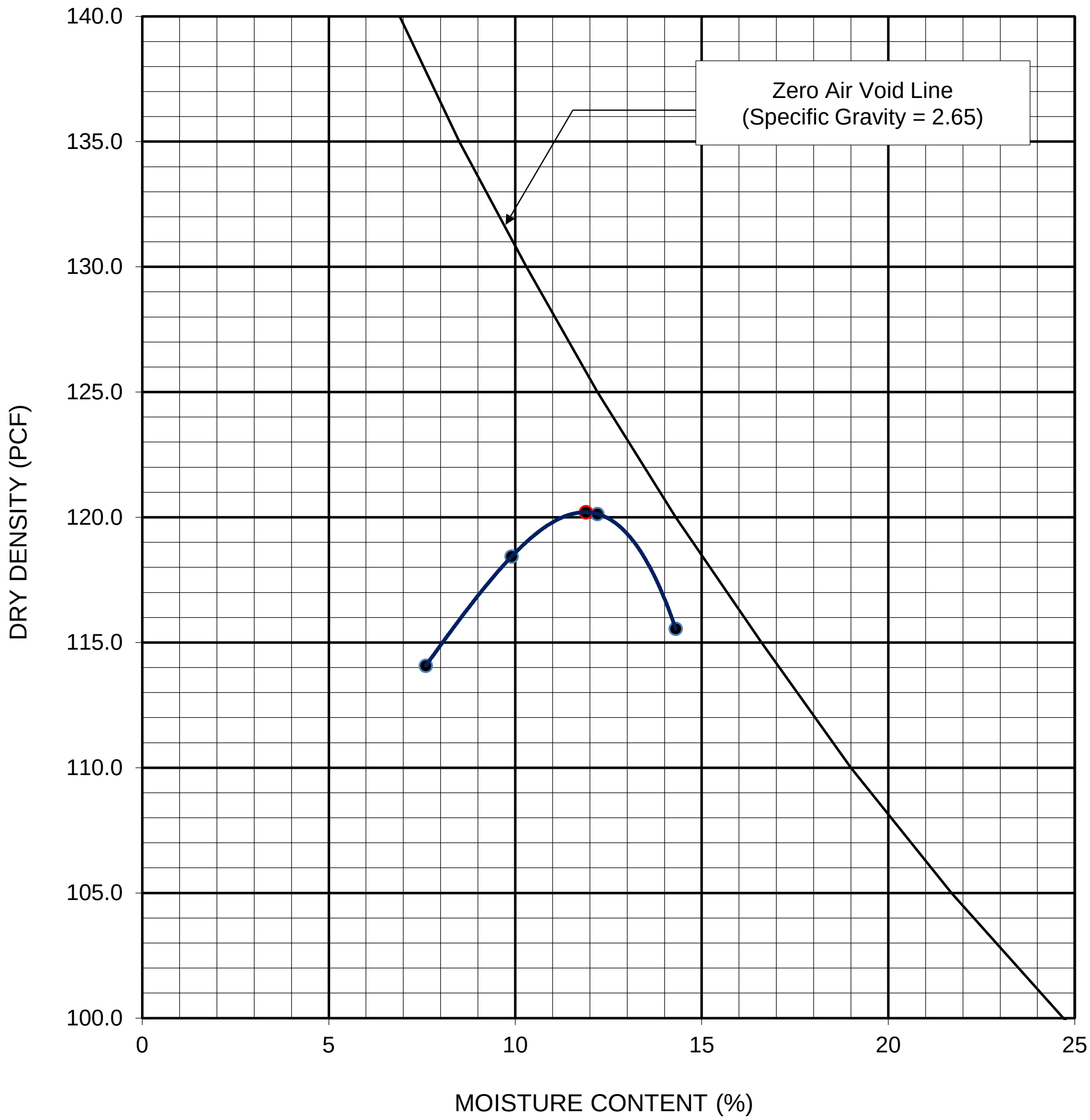

Sample Location	Depth (ft)	Soil Description	Maximum Dry Density (pcf)	Optimum Moisture Content (percent)
B-2	0.0-5.0	CL-ML	120.2	11.9
Dry Density and Moisture Content Values Corrected for Oversize (ASTM D 4718)			123	11

PERFORMED IN GENERAL ACCORDANCE WITH ☐ ASTM D 1557 ☑ ASTM D 698 METHOD ☑ A ☐ B ☐ C

FIGURE B-44

MAXIMUM DENSITY RESULTS

AJSD WRF EXPANSION

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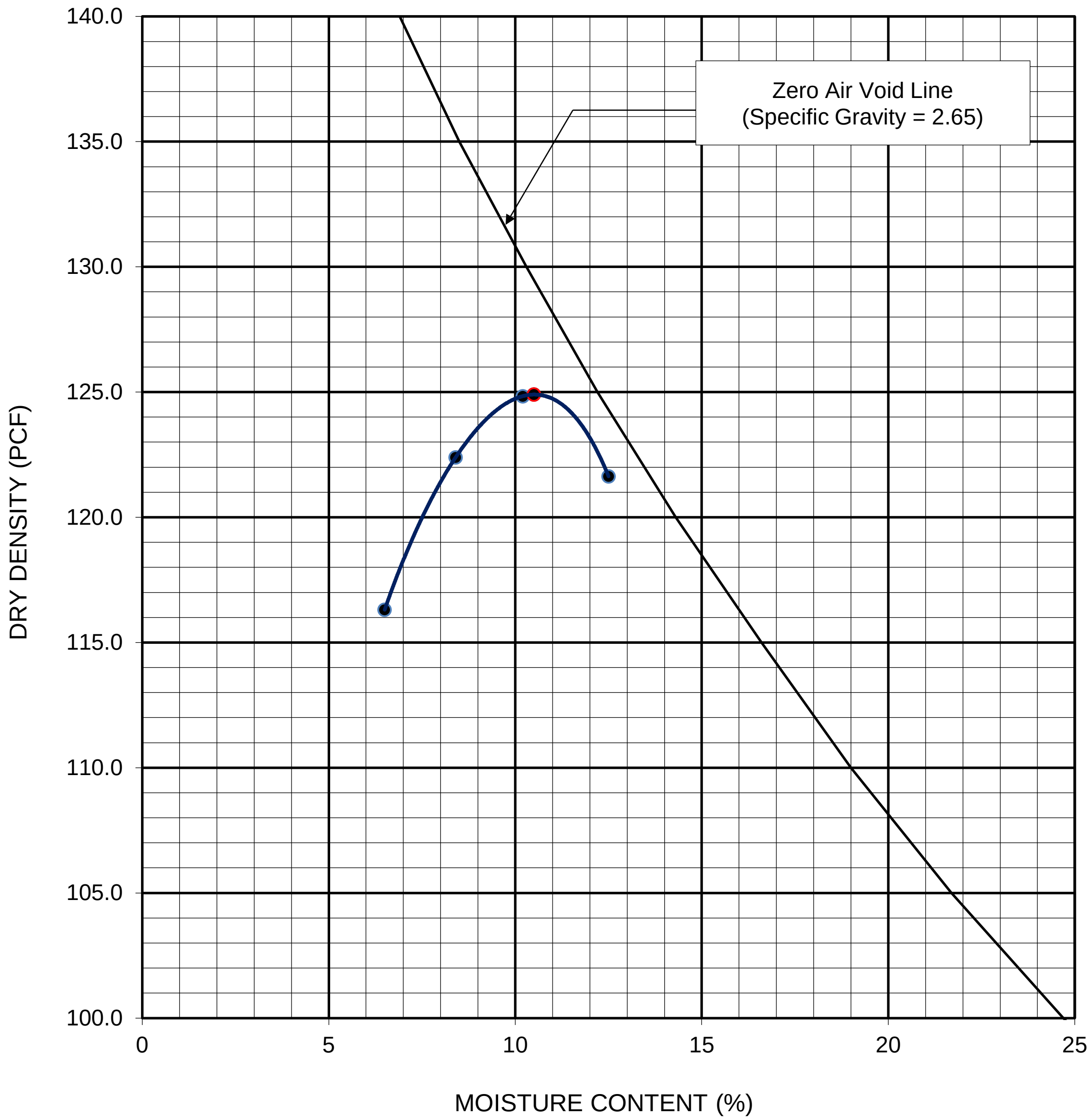

Sample Location	Depth (ft)	Soil Description	Maximum Dry Density (pcf)	Optimum Moisture Content (percent)
B-9	0.0-5.0	SC	124.9	10.5
Dry Density and Moisture Content Values Corrected for Oversize (ASTM D 4718)			128	9.5

PERFORMED IN GENERAL ACCORDANCE WITH ☐ ASTM D 1557 ☑ ASTM D 698 METHOD ☑ A ☐ B ☐ C

FIGURE B-45

MAXIMUM DENSITY RESULTS

AJSD WRF EXPANSION

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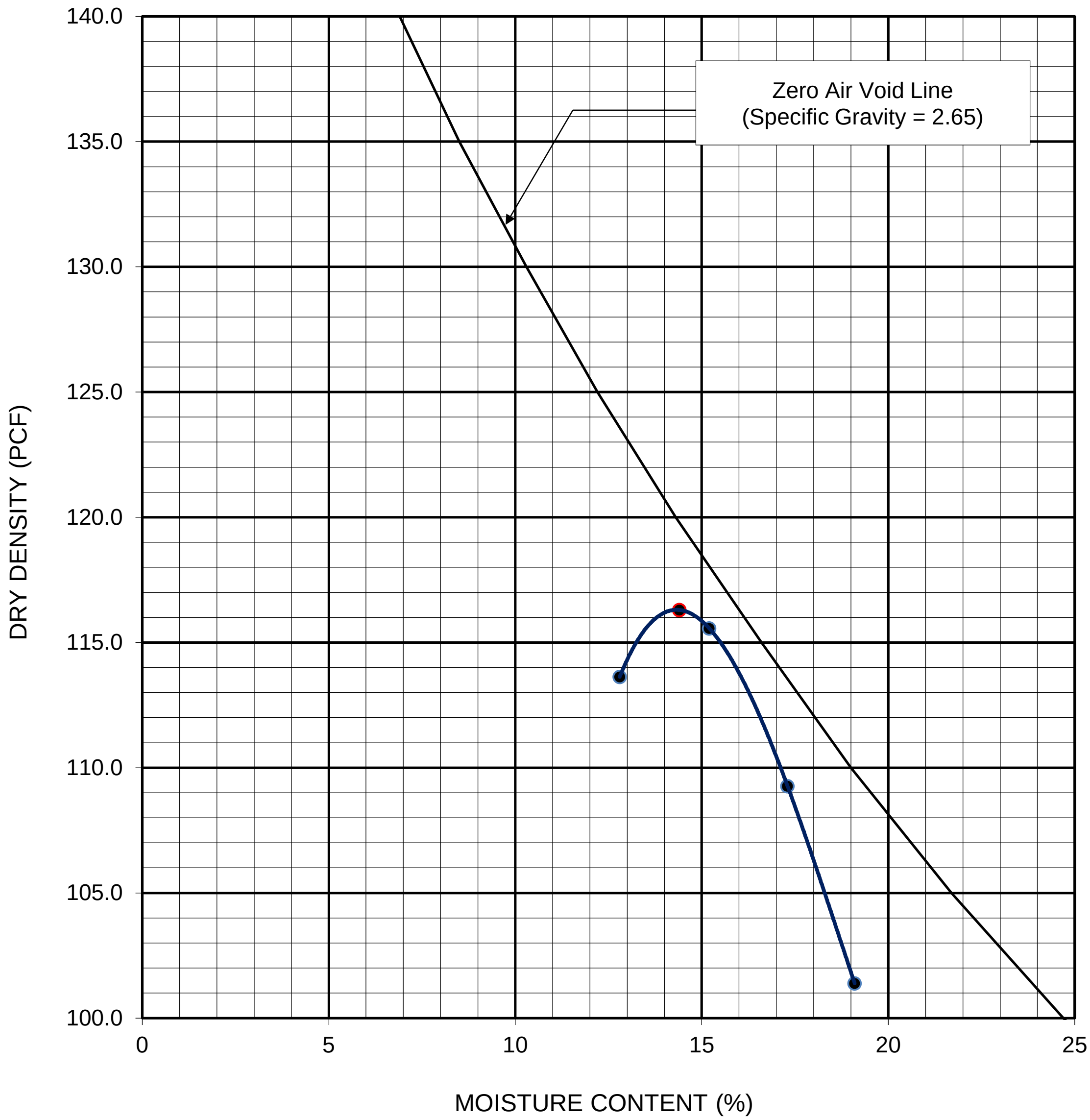

Sample Location	Depth (ft)	Soil Description	Maximum Dry Density (pcf)	Optimum Moisture Content (percent)
B-14	0.3-5.0	CL	116.3	14.4
Dry Density and Moisture Content Values Corrected for Oversize (ASTM D 4718)			118.5	13.5

PERFORMED IN GENERAL ACCORDANCE WITH ☐ ASTM D 1557 ☑ ASTM D 698 METHOD ☑ A ☐ B ☐ C

FIGURE B-46

MAXIMUM DENSITY RESULTS

AJSD WRF EXPANSION

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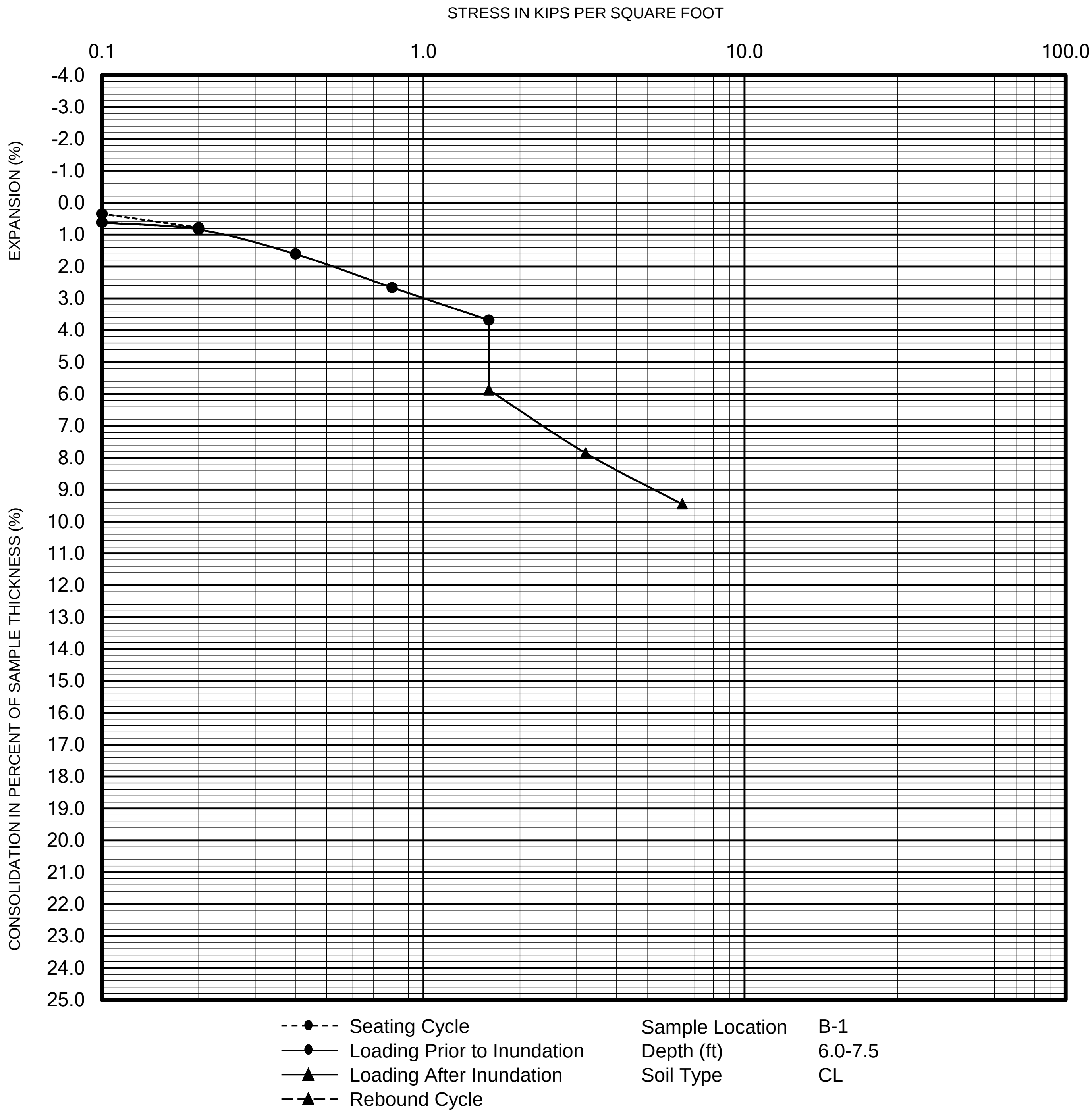

Sample Location	B-1
Depth (ft)	6.0-7.5
Soil Type	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435/4546

FIGURE B-47

CONSOLIDATION TEST RESULTS

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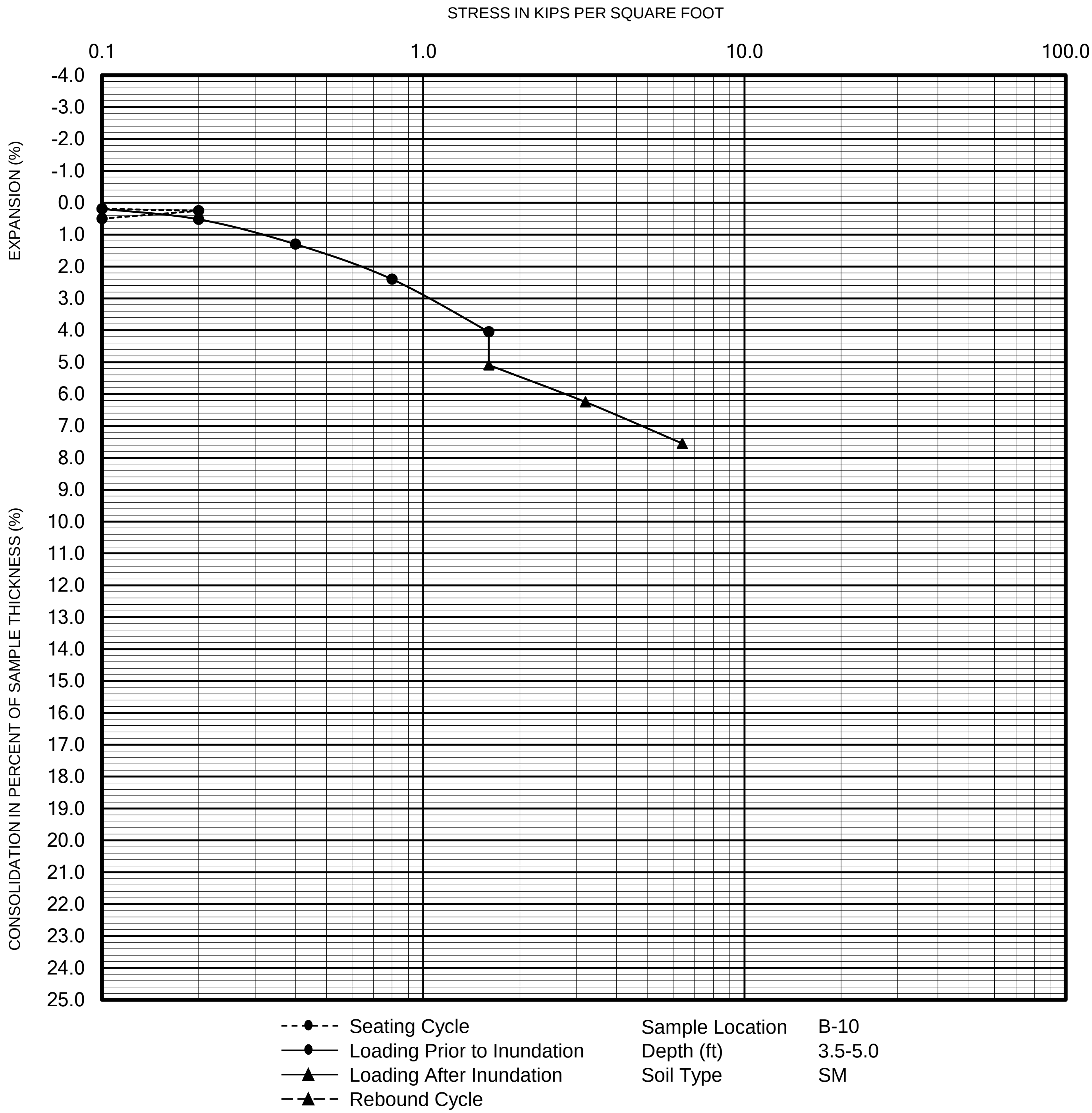

Sample Location	B-10
Depth (ft)	3.5-5.0
Soil Type	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435/4546

FIGURE B-48

CONSOLIDATION TEST RESULTS

AJSD WRF EXPANSION

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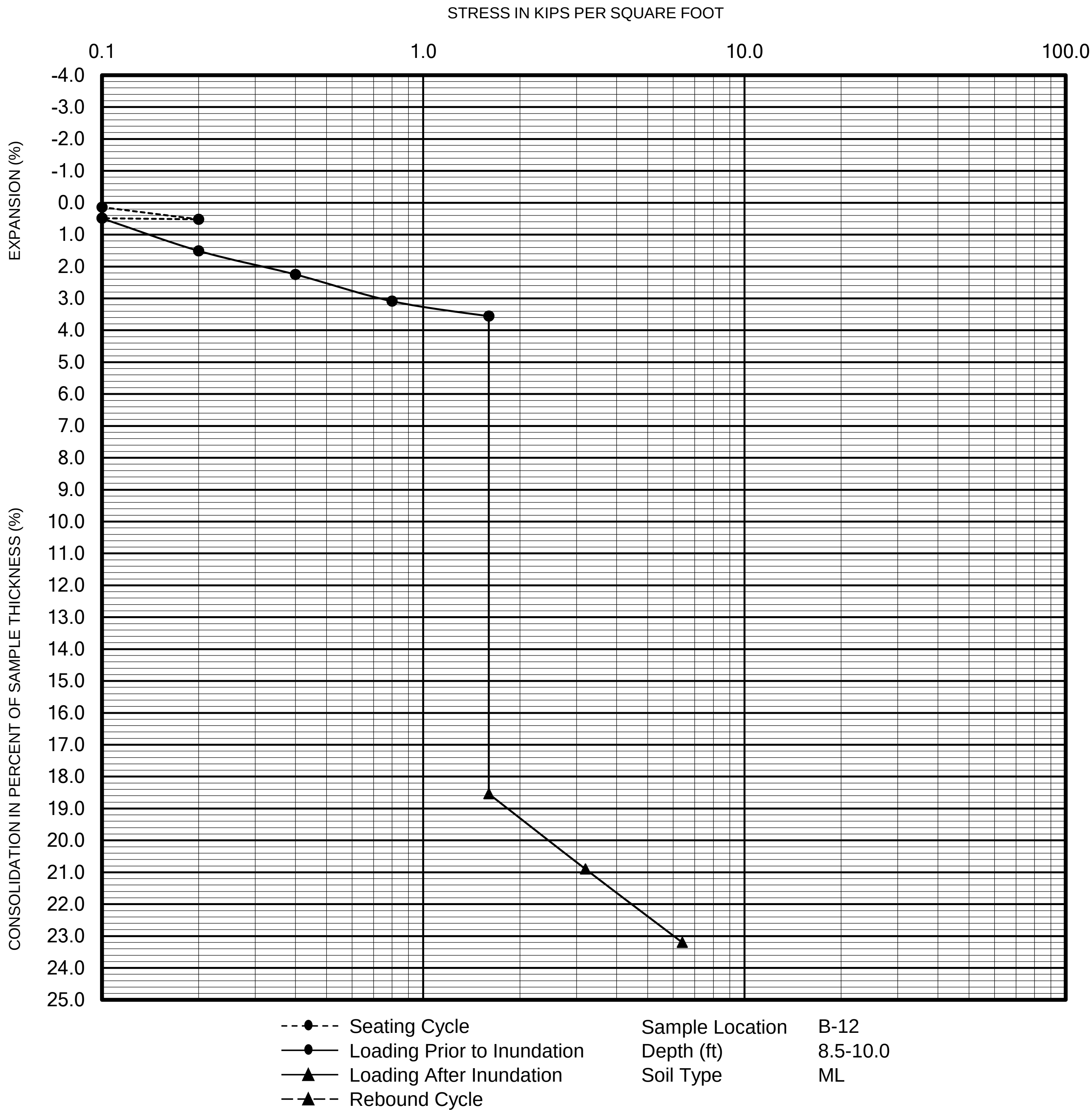

Sample Location	B-12
Depth (ft)	8.5-10.0
Soil Type	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435/4546

FIGURE B-49

CONSOLIDATION TEST RESULTS

AJSD WRF EXPANSION

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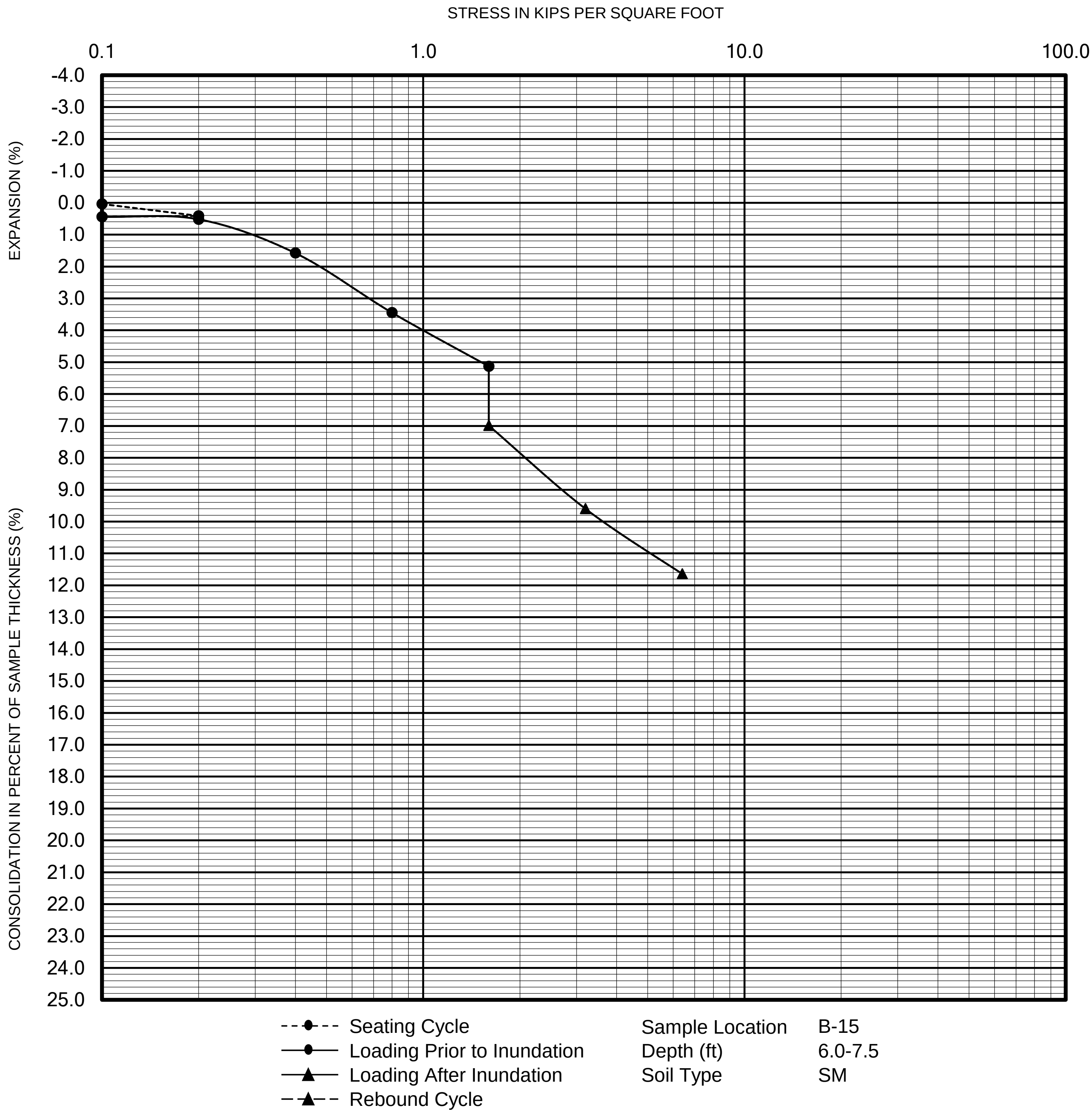

Sample Location	B-15
Depth (ft)	6.0-7.5
Soil Type	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435/4546

FIGURE B-50

CONSOLIDATION TEST RESULTS

AJSD WRF EXPANSION

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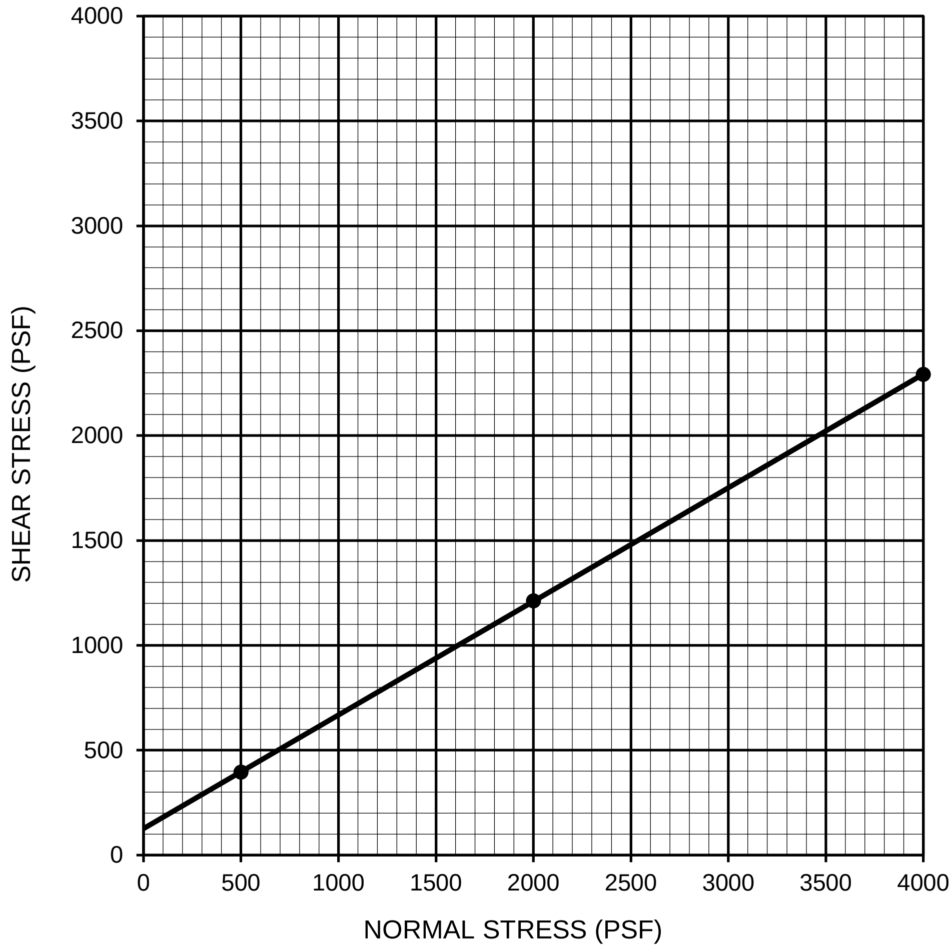

Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion (psf)	Friction Angle (degrees)	Soil Type
RELATIVELY UNDISTURBED	—●—	B-1	6.0-7.5	Peak	126	28	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080

FIGURE B-51

DIRECT SHEAR TEST RESULTS

AJSD WRF EXPANSION

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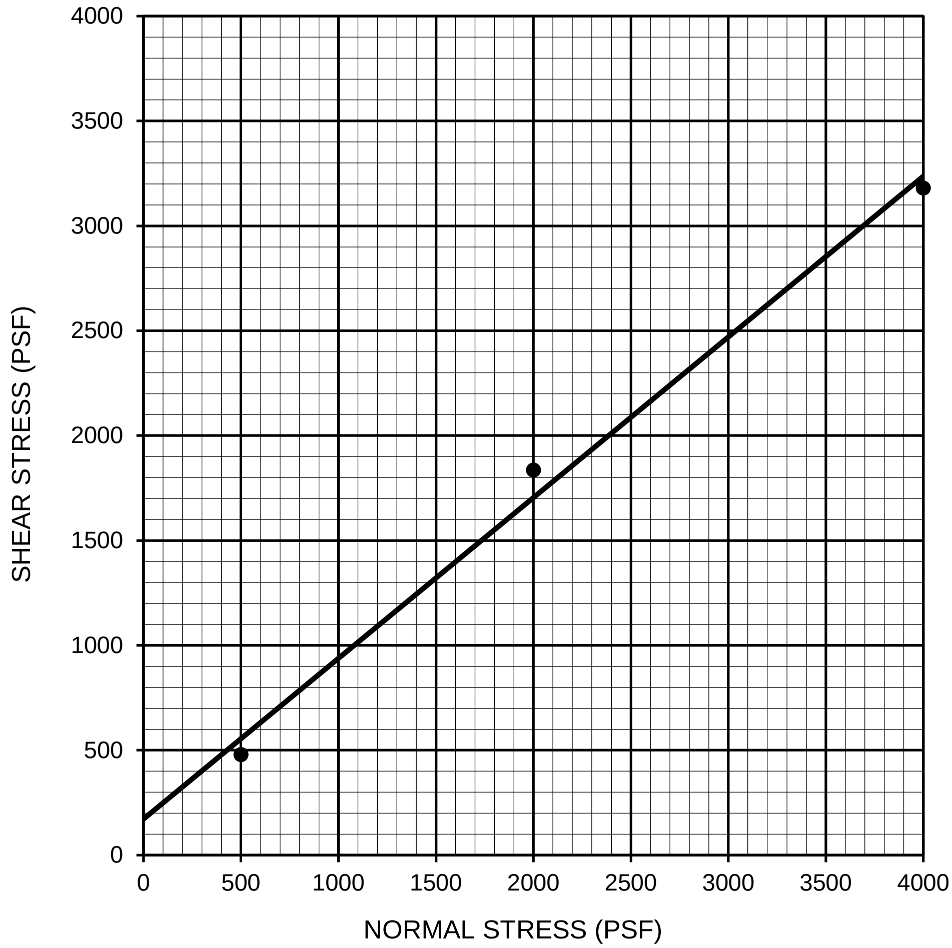

Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion (psf)	Friction Angle (degrees)	Soil Type
RELATIVELY UNDISTURBED	—●—	B-10	3.5-5.0	Peak	172	37	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080

FIGURE B-52

DIRECT SHEAR TEST RESULTS

AJSD WRF EXPANSION

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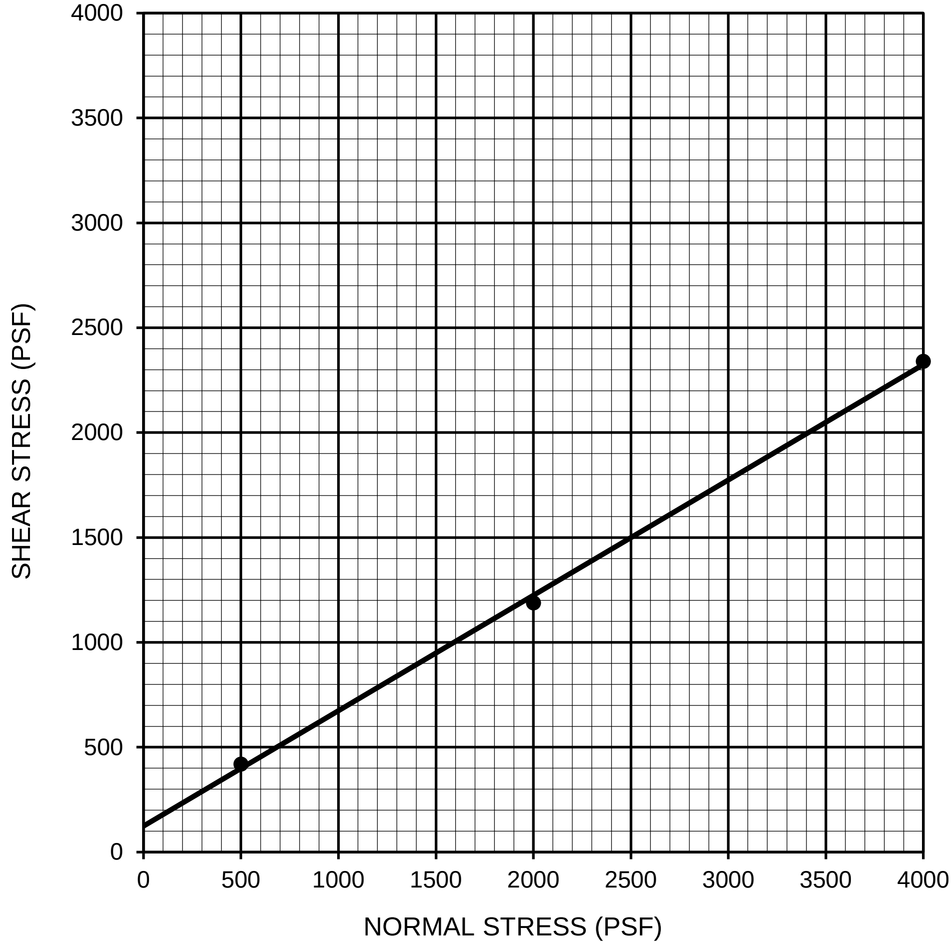

Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion (psf)	Friction Angle (degrees)	Soil Type
RELATIVELY UNDISTURBED	—●—	B-12	8.5-10.0	Peak	124	29	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080

FIGURE B-53

DIRECT SHEAR TEST RESULTS

AJSD WRF EXPANSION

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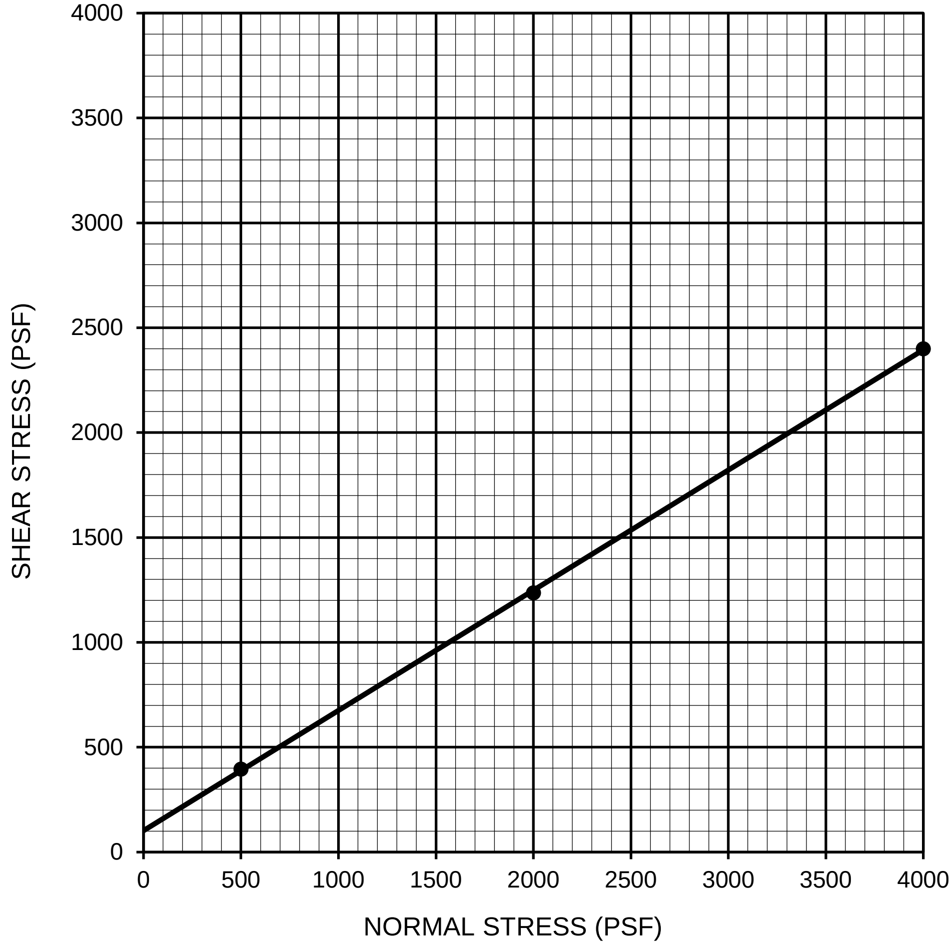

Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion (psf)	Friction Angle (degrees)	Soil Type
RELATIVELY UNDISTURBED	—●—	B-15	6.0-7.5	Peak	102	30	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080

FIGURE B-54

DIRECT SHEAR TEST RESULTS

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SAMPLE LOCATION	SAMPLE DEPTH (ft)	pH [1]	RESISTIVITY [1] (Ohm-cm)	SULFATE CONTENT [2] (ppm)	(%)	CHLORIDE CONTENT [3] (ppm)
B-1	10.0-15.0	9.1	871	4	0.0004	123
B-4	0.0-5.0	8.5	1,474	6	0.0006	39
B-8	0.0-5.0	8.7	2,479	3	0.0003	14
B-11	10.0-15.0	9.9	1,206	3	0.0003	81
B-13	0.3-5.0	8.2	737	48	0.0048	100
B-15	0.0-5.0	8.7	3,752	4	0.0004	11

[1] PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD 236e
[2] PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD 733b
[3] PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD 736b

APPENDIX B

Laboratory Testing

Classification
Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D2488-00. Soil classifications are indicated on the logs of the exploratory borings in Appendix B.

In-Place Moisture and Density Tests
The moisture content and dry density of relatively undisturbed samples obtained from the exploratory borings were evaluated in general accordance with ASTM D2937-04. The test results are presented on the logs of the exploratory borings in Appendix A.

Gradation Analysis
A gradation analysis test was performed on a selected representative soil sample in general accordance with ASTM D422. The grain-size distribution curve is shown on Figures B-1 through B-40. The test results were used in evaluating the soil classifications in accordance with the USCS.

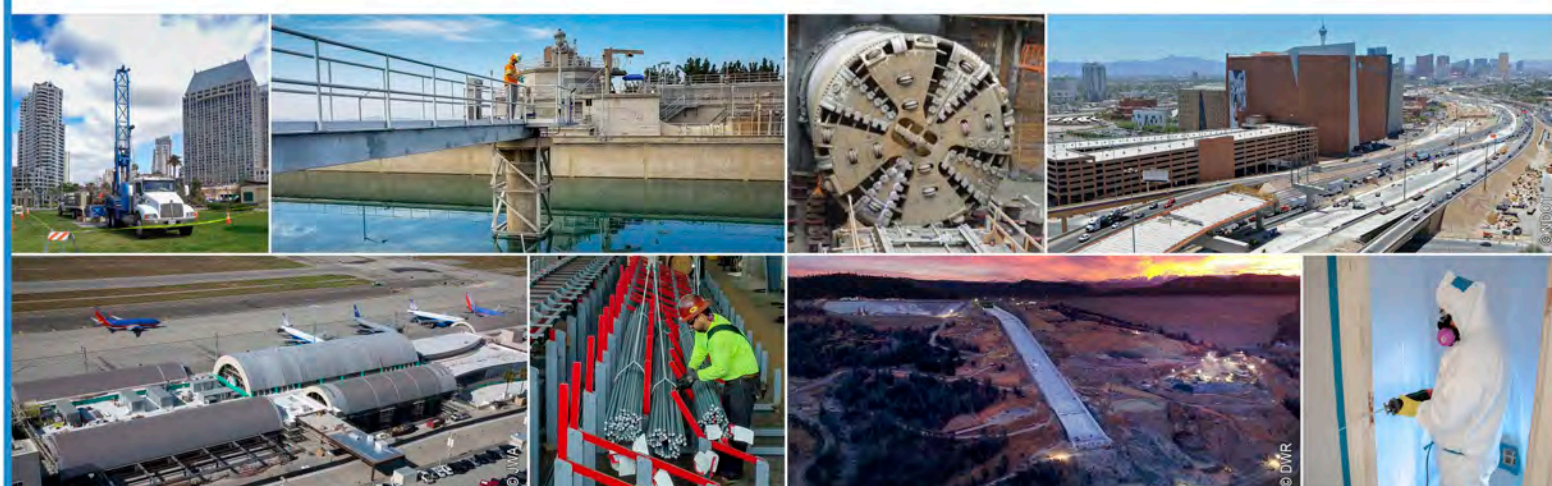
Atterberg Limits
Tests were performed on selected representative fine-grained soil samples to evaluate the liquid limit, plastic limit, and plasticity index in general accordance with ASTM D4318. These test results were utilized to evaluate the soil classification in accordance with the Unified Soil Classification System (USCS). The test results are presented on Figures B-41 through B-43.

Maximum Density Tests
The maximum dry density and optimum moisture content of selected representative soil samples were evaluated using the Standard Proctor method in general accordance with ASTM D698. The results of these tests are summarized on Figures B-44 through B-46.

Consolidation Tests
Consolidation tests were performed on selected relatively undisturbed soil samples in general accordance with ASTM D2435-04. The samples were inundated during testing to represent adverse field conditions. The percent of consolidation for each load cycle was recorded as a ratio of the amount of vertical compression to the original height of the sample. The results of the tests are summarized on Figures B-47 through B-50

Direct Shear Strength Test
A shear strength test was performed on a relatively undisturbed sample in general accordance with ASTM D3080-04 to evaluate the shear strength characteristics of selected materials. The sample was inundated during shearing to represent adverse field conditions. The test results are shown on Figures B-51 through B-54.

Soil Corrosivity Tests
Soil pH and minimum resistivity tests were performed on a representative soil sample in general accordance with Arizona Test 236b. The sulfate content was evaluated in general accordance with Arizona Test 733. The chloride content was evaluated in general accordance with Arizona Test 736. The test results are presented on Figure B-55.



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