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Geotechnical Investigation for:

Jordan Valley Water Conservancy District
Proposed Water Line
11800 South and U-111
Herriman and South Jordan, Utah

IGES Job No. 00301-025

November 14, 2016

Prepared for:
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Geotechnical Investigation Report
JVWCD Waterline
Herriman and South Jordan, Utah

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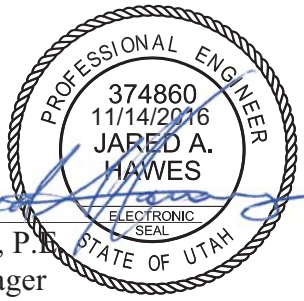
Prepared by:



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APPENDICES

1.0 EXECUTIVE SUMMARY

This report presents the results of a geotechnical investigation conducted for installation of a proposed Jordan Valley Water Conservancy District (JVWCD) water line in Herriman and South Jordan, Utah. The purposes of this investigation were to assess subsurface soil/ groundwater conditions, and the nature and engineering properties of the subsurface soils at the proposed site in order to provide soil parameters for installation of approximately 21,000 linear feet of water transmission piping to be installed in the right-of-way of 11800 South and U-111. The project will actually pass through small portions of unincorporated Salt Lake County (near the intersection of 11800 South and U-111) and terminate in West Jordan as it crosses north of Old Bingham Highway.

IGES Inc. conducted a subsurface investigation of the site between September 29 and October 31, 2016. Exploration of the subsurface soil conditions was accomplished by advancing 18 soil borings in locations along the proposed pipe line alignment. Borings were completed on the south shoulder of 11800 South and east and west shoulders of U-111, typically utilizing unpaved areas in order to reduce damage to existing pavement and disruption to traffic on the existing roads. Boring locations were selected in coordination with CH2M personnel. Some locations were adjusted in the field to avoid existing utilities. Based on current project plans, we believe all of the borings are located within 50 ft of the proposed alignment. The approximate locations of the borings are shown on the Site Vicinity/Exploration Map (Plate A-1). The depths of borings ranged from 16.5 to 30 feet below the existing site grade. The materials encountered during drilling were observed and logged by our field engineers and are presented on the Boring Logs in Appendix A (Plates A-2 through A-19). A Key to Soil Symbols and Terminology is located on Plate A-20.

In addition to conventional subsurface investigation described above, IGES directed field direct current (DC) electrical resistivity testing to assess the corrosion potential of native soils with respect to buried steel within the shallow subsurface (0-30 ft). In this testing, earth resistivity properties are obtained by introducing a DC or low frequency electrical current into the ground and measuring the potential drop between electrodes over a range of electrode spacings. Tests were performed at 16 locations in accordance with IEEE and ASTM standards for performing Wenner 4-pin resistivity measurements. Field resistivity

testing showed that soils along U-111 may be severely corrosive to steel. We recommend consultation with a corrosion engineer to protect buried metal.

The scope of our work did not include a thorough evaluation of potentially contaminated soils throughout the proposed alignment. IGES did perform sampling and cursory environmental testing of the primary constituents of concern (COC), lead and arsenic, in conjunction with our geotechnical evaluation of soils. Laboratory testing did not indicate COC in excess of previously established Action Levels; however, based on the extensive testing associated with previous work, we anticipate that soils with elevated COC will be encountered. We recommend development of a Soil Management Work Plan to address potentially impacted soils that may be encountered during installation of the proposed water line.

Based on the subsurface conditions encountered at the site, it is our opinion that the subject site is suitable for the proposed construction provided that the recommendations contained in this report are complied with.

NOTICE: The scope of services provided within this report are limited to the assessment of the subsurface conditions at the subject site. The executive summary is provided solely for purposes of overview and is not intended to replace the report of which it is part and should not be used separately from the report.

2.0 INTRODUCTION

2.1 PURPOSE AND SCOPE OF WORK

This report presents the results of a geotechnical investigation conducted for installation of a proposed Jordan Valley Water Conservancy District (JVWCD) water line located largely in Herriman and South Jordan, Utah. The purposes of this investigation were to assess subsurface soil/ groundwater conditions, and the nature and engineering properties of the subsurface soils in order to provide soil parameters for installation of approximately 21,000 linear feet of water transmission piping to be installed in the right-of-way of 11800 South and U-111. The project will pass through small portions of unincorporated Salt Lake County (near the intersection of 11800 South and U-111) and terminate in West Jordan as it crosses to the north side of Old Bingham Highway. The scope of work completed for this study included subsurface exploration with a truck mounted drill rig, soil sampling, laboratory testing, engineering analyses, field resistivity testing, and preparation of this report. Our services were performed in accordance with our proposal, dated May 11, 2016. The recommendations contained in this report are subject to the limitations presented in the "Limitations" section of this report.

2.2 PROJECT DESCRIPTION

At present the planned alignment of the proposed water line begins near Herriman High School (~5900 West) and runs westward along 11800 South, parallel to the south shoulder. Near U-111 (Bacchus Hwy) the pipeline installation will turn north, crossing under 11800 South and continuing north along the east shoulder of U-111 through South Jordan. It will cross the Bingham Creek Drainage near the Trans-Jordan Landfill and continue into West Jordan on the north side of Old Bingham Highway. It is our understanding that the majority of piping will be installed in open trench cuts at depths near 15 feet below existing site grade.

Exploration locations are shown on the Site Vicinity/Exploration Map included in Appendix A (Plate A-1). Investigation locations are numbered from B-1 to B-18

beginning at the southeast end of the alignment near the intersection of 5900 West and 11800 South.

3.0 METHODS OF STUDY

3.1 SUBSURFACE INVESTIGATION

IGES Inc. conducted a subsurface investigation of the site between September 29 and October 5, 2016. Exploration of the subsurface soil conditions was accomplished by advancing 16 soil borings in locations along the proposed pipe line alignment. Borings were completed on the south shoulder of 11800 South and east and west shoulders of U-111, typically utilizing unpaved areas in order to reduce damage to existing pavement and disruption to traffic on the existing roads. Boring locations were selected to avoid utility conflicts and in coordination with CH2M personnel. Some locations were adjusted in the field to avoid existing utilities. Based on current project plans, we believe all of the borings are located within 100 ft of the proposed alignment. BH-15 and BH-16 were located on the west side of U-111 and are likely the furthest from the proposed alignment. The approximate locations of the borings are shown on the Site Vicinity/Exploration Map (Plate A-1). The depths of borings ranged from 16.5 to 30 feet below the existing site grade. The materials encountered during drilling were observed and logged by our field engineers and are presented on the Boring Logs in Appendix A (Plates A-2 through A-19). A Key to Soil Symbols and Terminology is located on Plate A-20.

Drilling was accomplished with a truck-mounted CME-55 drill rig equipped with 8-inch hollow-stem augers. Samples were collected and classified by the field engineer, and representative portions of each sample were packaged and transported to our laboratory for testing.

3.2 LABORATORY INVESTIGATION

Representative soil samples were tested in the laboratory to evaluate pertinent physical and engineering properties. Both disturbed and relatively undisturbed samples were obtained for laboratory testing via a Split Spoon or “U” type sampler. Laboratory soil

tests conducted by IGES consisted of moisture, density, gradation analyses, #200 wash, Atterberg Limits, direct shear and unconfined compression testing to aid in characterizing the soils and their pertinent engineering properties. The results of the laboratory tests are presented on the Boring Logs in Appendix A (Plates A-2 to A-19), in the lab results in Appendix B and in the Summary of Laboratory Test Results Table (Plate B-1).

3.3 ENGINEERING ANALYSIS

Engineering analyses were performed using data obtained from the laboratory investigation and the subsurface exploration. Additionally this data was used to derive soil properties based on empirical correlations. The following engineering analyses were performed;

- Excavation Methods
- Earth Work Considerations

4.0 GEOLOGIC CONDITIONS

4.1 GEOLOGIC SETTING

The approximate surface elevation of the pipe alignment ranges between approximately 4,925 and 5,210 feet. The site is located within the western portion of the Salt Lake Valley near the foothills of the Oquirrh Mountains. The Salt Lake Valley is a deep, sediment-filled structural basin of Tertiary and Quaternary age flanked by two uplifted blocks, the Wasatch Range on the east and the Oquirrh Mountains to the west (Hintze, 1980; UGS, 2003). The Wasatch Range is the eastern edge of Basin and Range extension in north-central Utah.

Quaternary alluvium and Lake Bonneville sediments are the main source of soils along two roads where the pipe will be installed (Biek et al, 2007). Geologic mapping indicates that the U-111 roughly parallels the shoreline of prehistoric Lake Bonneville through South Jordan. Soils along the alignment are reported to include deep-water (lacustrine) sand and gravel related to Bonneville (transgressive) phase of the Bonneville lake cycle (Qlbg and Qlsb), and alluvial fan deposits (Qafy and Qafo) related to debris flows emanating from drainages of the Oquirrh Mountains. The Bingham Creek channel is generally mapped as “disturbed land” (Qfd) influenced by mining and mining reclamation activities identified by aerial photography taken in 1997.

4.2 SEISMICITY AND FAULTING

Review of the "Selected Critical Facilities and Geologic Hazards, Salt Lake County, Utah” map (UGS 1993) and other published maps indicate that the proposed alignment is approximately 12-13 miles west of the Salt Lake Section of the Wasatch Fault zone and 7-9 miles east of the Oquirrh fault zone (UGS, 2003). Both zone trends in a north-northwest to south-southeast orientation and are located on the western flanks of the Wasatch and Oquirrh Mountains, respectively. The greatest contribution to the seismic hazard for project will be dependent on the location on the pipeline alignment and the

distance to either the Wasatch or Oquirrh fault zones. A site specific study which incorporates probabilistic ground motions along the proposed alignment was beyond the scope of services for this project. It is our opinion that such a study should be performed commensurate with the exposure or level of risk the owners are willing to accept for the pipeline. Preliminary ground motion values are discussed below.

Seismic hazard maps depicting probabilistic ground motions and spectral response have been developed for the United States by the U. S. Geological Survey as part of NEHRP/NSHMP (Frankel, et. al., 1996). These maps have been incorporated into both *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures* (FEMA, 1997) and the *International Building Code* (IBC) (International Code Council, 2015). Spectral responses for the Maximum Considered Earthquake (MCE) are shown in the table below. These values generally correspond to a two percent probability of exceedance in 50 years (2PE50) for a "firm rock" site which would represent a return period of 2475 years. To account for site effects, site coefficients which vary with the magnitude of spectral acceleration are used. Sites are classified based on the average properties of the soil profile within the top 100 feet. For the pipeline construction IGES was requested to explore conditions in only the upper 15-30 feet. Based on the soils encountered in our relatively shallow investigations site classifications could vary from Class C: "very dense soil and soft rock" to Class D: "Stiff soil" depending on the location. The site class designations and corresponding spectral accelerations are generally required for structural design. To our understanding, no above-grade, habitable structures are proposed with this project, buried pipeline design would not fall under the jurisdiction of the IBC. The spectral accelerations are calculated based on the site's central latitude of 40.536925˚N and longitude -112.068431˚W. Based on IBC, the site coefficients for a Site Class D are Fa=1.141 and Fv= 1.792. From this procedure the peak ground acceleration (PGA) is estimated to be 0.409g. These preliminary values presented in this report represent a central location (near the intersection of U-111 and 11800 South) and may not be representative of every location along the alignment. If seismic design parameters are required for a specific location along the proposed alignment, IGES can respond according to correlate conditions encountered in our shallow

investigations and assumptions of average soil properties in the top 100 feet based on our experience and available geologic mapping of the area.

MCE Seismic Response Spectrum Spectral Acceleration Values for IBC Site Class D [a]

Site Location: Latitude = 40.54^0 N Longitude = -112.07^0 W	**Site Class D Site Coefficients: Fa = 0.90 Fv = 1.79**
Spectral Period (sec)	**Response Spectrum Spectral Acceleration (g)**
PGA	0.323
0.2	1.141xFa = 1.203
1.0	1.792xFv = 0.545

4.3 OTHER GEOLOGIC HAZARDS

Geologic hazards can be defined as naturally occurring geologic conditions or processes that could present a danger to human life and property. These hazards must be considered before development of the site. There are several hazards in addition to seismicity and faulting that, if present at the site, should be considered in the design and construction of habitable structures and other critical infrastructure. Potential hazards considered for this site include canal flooding, liquefaction, problematic soil or rock, and shallow groundwater.

4.3.1 Liquefaction

Certain areas within the intermountain region also possess a potential for liquefaction during seismic events. Liquefaction is a phenomenon whereby loose, saturated, granular soil deposits lose a significant portion of their shear strength due to excess pore water pressure buildup resulting from dynamic loading, such as that caused by an earthquake. Among other effects, liquefaction can result in densification of such deposits causing rapid settlements of overlying layers after an earthquake as excess pore water pressures are dissipated. In the case of a buried structure or utilities, increased pore water pressures create excess uplift forces acting on the buried entity. The primary factors affecting

liquefaction potential of a soil deposit are: (1) level and duration of seismic ground motions; (2) soil type and consistency; and (3) depth to groundwater.

Referring to the "Select Critical Facilities and Geologic Hazards, Salt Lake County, Utah" map published by the Utah Geological Survey, the subject site is located in an area designated as "very low" for liquefaction potential. Based on field observations at this site and laboratory testing of collected samples the soil deposits along the alignment consist of silts (ML), silty clays (CL-ML), clays (CL, CH), poorly-graded sands (SP, SM and SP-SM) and poorly-graded gravels (GP, GP-GC and GP-GM) with medium to high density. Some of the soils may have been imported to the site for use in road construction. Groundwater was not encountered in any or our explorations and based on experience in the area, we do not expect that it will be within 40-50 feet of the surface at any point along the alignment. Soils with high/saturated moisture conditions were generally cohesive and it is our observation that soils generally have a very low potential for liquefaction.

4.3.3 Problematic Soil or Rock

Problematic soils in Utah can occur as shrinking or swelling clays, hydro-collapsible soils, organic peat, andesite weathering to clay, amongst others. Soils deposited by debris flows are frequently susceptible to hydro-collapse, losing their bearing capacity and volume upon contact with water. Debris flows can also deposit boulders and vegetation or organic matter that can decay and form voids in the soil structure. While portions of the site are mapped as young or older alluvial deposits, no visual indications of debris flow were observed. No problematic bedrock has been identified in the vicinity, and the planned excavation is not expected to encounter bedrock (Mulvey, 1992).

4.3.4 Groundwater

Groundwater was not encountered in any of the 18 explorations completed for this assessment and soil moisture content was typically low. Given the location and elevation of the project, we do not anticipate that groundwater will impact proposed construction.

Seasonal fluctuations in precipitation, irrigation, surface runoff from adjacent properties, or other sources may also increase moisture conditions below the surface. Due to the season of our investigation, we anticipate groundwater will be near seasonal low levels. It is also possible that some water may flow into open excavations depending on the factors outlined above and the length of time that excavations remain open.

5.0 GENERALIZED SITE CONDITIONS

5.1 SURFACE CONDITIONS

The proposed alignment runs within the existing 11800 South and U-111 road right-of-way. Based on drawings provided by CH2MHill, the majority of the proposed pipeline will be constructed in un-paved road shoulders or adjacent fields; only occasional crossing of roadways will cause the waterline to be located below existing asphalt. All borings were advanced in unpaved areas and asphalt thickness was not measured. Adjacent property to the south of 11800 South and east of U-111 consists mainly of undeveloped land with few commercial and industrial properties.

5.2 SUBSURFACE CONDITIONS

As previously mentioned, the subsurface soil conditions were explored at various locations by advancing 18 soil borings along the proposed pipe line alignment. The depths of the soil borings ranged between 15 to 30 feet below the existing site grade. Subsurface soil conditions were logged at the time of drilling and are included on the Boring Logs in Appendix A (Plates A-2 through A-19). The soil and moisture conditions encountered during our investigation are discussed below.

5.2.1 Soils

Soils encountered along the alignment consisted of silts (ML), silty clays (CL-ML), clays (CL and CH), poorly graded sands (SP, SM and SP-SM) and poorly-graded gravels (GP, GP-GC and GP-GM) with medium to high density. The stratification lines shown on the enclosed Boring Logs represent the approximate boundary between soil types in the exploratory borings. The actual in-situ transition may be gradual. It is also possible that variations in material and moisture conditions will be encountered between and beyond the 18 exploration locations. The nature and extent of these variations will not be evident until excavation work commences.

Due to the nature and depositional characteristics of the native soils, care should be taken in interpolating subsurface conditions between and beyond the exploration locations. Additionally, site grading work performed in association with previous road construction and utility installation may result in unique soil deposits at various locations throughout the alignment. IGES has utilized geologic mapping in conjunction with our boring explorations to provided a more detailed description of anticipated conditions.

5.2.2 Groundwater

Groundwater was not encountered in any of our explorations and soil moisture content was measured to be relatively low. Seasonal fluctuations in precipitation, irrigation, surface runoff from adjacent properties, or other sources may also increase groundwater levels and moisture contents below the surface. Due to the season of our investigation, we anticipate groundwater levels to be at or near seasonal lows; however it unlikely that groundwater levels and soil moisture contents will be higher at the time of construction. It is also possible that some water may flow into open excavations depending on the factors outlined above and the length of time that excavations remain open.

5.2.3 Potentially Contaminated Soils

The pipeline alignment is located within the Kennecott South Zone and passes through the general areas associated with Operable Unit 1 (OU1: Bingham Creek), Operable Unit 5 (OU 5: Arco Tailings) and Operable Unit 6 (OU 6: Lark Waste Rock and Tailings. Lead and arsenic are the primary constituents of concern (COC) for soils within the Kennecott South Zone, as determined by the Utah Department of Environmental Quality (DEQ), Division of Environmental Response and Remediation (DERR) and the US Environmental Protection Agency (EPA) Region 8. Mr. Doug Bacon (UDEQ-DERR) and Ms. Kerri Fiedler (EPA Region 8) are the project managers for the Kennecott South Zone. Action levels previously established for other utility installation in the area were **2,000 mg/kg total lead and 100 mg/kg total arsenic**. These action levels are consistent with the industrial land use standard for lead and the residential standard for arsenic in OU 1. The arsenic residential land use standard has been proposed as the Action Level

because a specific arsenic industrial standard has not been established for the area. These Action Levels are also consistent with the action levels used by the Utah Department of Transportation (UDOT) during roadway construction, and by the Utah Transit Authority (UTA) during light rail construction within the Kennecott South Zone.

Recent installation of a 12-inch high-pressure gas line by Questar (Feeder Line 36 Phase #1) was completed parallel and west of U-111 in 2015. Excavation for the proposed water line will essentially run parallel to the gas line along U-111; however, excavation for the gas line was typically less than five feet below the natural grade. Additional recent water line installation along the south shoulder of 11800 South by Herriman City have also passed through the Kennecott South Zone. The scope of our work did not include a thorough evaluation of potentially contaminated soils throughout the proposed alignment. IGES did perform sampling and cursory environmental testing of the primary COC's in conjunction with our geotechnical evaluation of soils. Laboratory testing did not indicate COC's in excess of the previously established Action Levels; however, based on the extensive testing associated with previous work, we anticipate that soils with elevated COC's will be encountered. We recommend development of a Soil Management Work Plan to address potentially impacted soils that may be encountered during installation of the proposed water line.

6.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS

6.1 GENERAL CONCLUSIONS

Based on the subsurface conditions encountered at the site, it is our opinion that the subject site is suitable for the proposed construction provided that the recommendations contained in this report are complied with.

Supporting data upon which the following recommendations are based have been presented in the previous sections of this report. The recommendations presented herein are governed by the physical properties of the soils encountered in the exploratory borings and the anticipated construction. If subsurface conditions other than those described herein are encountered in conjunction with construction, and/or if design and layout changes are initiated, IGES should be informed so that our recommendations can be reviewed and revised as changes or conditions may require.

6.2 EARTHWORK

6.2.1 Trench Excavations

Excavations will consist of open trench excavation for installation of a water transmission line along the proposed alignment. In most areas the excavation will extend to approximately 10-15 feet below the existing grade.

Excavation will encounter varying soil types throughout the proposed alignment. Because the majority of trenching will take place within the existing public right-of-way we anticipate that surface disturbance will be minimized by utilizing trench boxes or other means of excavation support in lieu of sloping or benching of cut walls. If sloping/benching methods are utilized we recommend that recommendations for OSHA Type C soils be followed. For excavations deeper than 5 feet, the walls of the excavation should be constructed with side slopes no steeper than one and one-half horizontal to one

vertical (1.5H:1V). We recommend that temporary shoring or shielding be used to provide protection to persons in the trench.

Conditions were relatively dry throughout our explorations and we do not anticipate the need for installation of long-term dewatering measures prior to or during pipeline installation. It is likely that moisture conditions will vary from those encountered during our investigation depending on the gradation of soils in the open section of trench and the level of precipitation/infiltration from nearby sources at the time of construction. We anticipate that dewatering, if needed, can be accomplished by sloping the floor of the trench away from work areas and excavating a slightly deeper collection area (sump) from which a small pump can remove water from the trench.

A qualified person should inspect all excavations frequently to evaluate stability. The contractor is ultimately responsible for trench and site safety. Pertinent OSHA requirements should be met to provide a safe work environment. If site specific conditions arise that require engineering analysis in accordance with OSHA regulations, IGES can respond and provide recommendations as needed.

We recommend that the contractor clear all temporary slopes of loose soils and that in areas of deeper excavations (i.e. greater than 10 feet in depth) a 3 to 5 foot buffer zone be provided near the toe of temporary slopes for worker safety. Adequate setback from the excavation crest of all stored materials and heavy equipment should be maintained during construction.

Soft or pumping soils can result in equipment or personnel mobility problems. If encountered, these soils should be stabilized prior to the placement of piping and compaction of bedding material and trench backfill. Stabilization of the subgrade soils can be accomplished using a clean, coarse angular material worked into the soft subgrade.

We recommend the material utilized for subgrade stabilization be greater than 2 inches in nominal diameter, but less than 6 inches. Locally available pit-run gravel may be suitable but should contain a high percentage of particles larger than 2 inches and have less than 10 percent fines (material passing the No. 200 sieve). Pit-run gravel may not be as effective as a coarse, angular material in stabilizing the soft soils and will likely require more material be placed. The stabilization material should be worked (pushed) into the soft or loose subgrade soils until a firm unyielding surface is established. Once a firm, unyielding surface is achieved, piping an backfill can be placed.

Due to the nature and depositional characteristics of native soils, care should be taken in interpolating subsurface conditions between and beyond the exploration locations. The descriptions provided in the previous paragraphs are based on IGES explorations, experience and available geologic mapping of the area. The changes between soil types will likely be gradual and not evident until excavation exposes subgrade conditions completely. Our description of anticipated conditions has been provided for information only to aid contractors in planning for equipment needs and scheduling to accomplish the necessary trenching for pipeline installation.

6.2.2 Excavation Support/Lateral Earth Pressures

Long term excavation support is not anticipated during the majority of pipeline installation. However, depending on scheduling, construction of thrust blocks at bends or other connections to structures along the alignment may require wider excavations and more permanent support than can be provided by trench boxes. Details regarding potential location and depth of excavation for such conditions were not available at the time of this report. Methods of excavation support may be proposed by the contractor. Evaluation of lateral earth pressures should be performed by a qualified professional engineer once a shoring method is selected by the contractor. If requested, IGES can prepare plans and recommendations for excavation support under a separate submittal. The following soil properties and appropriate lateral earth pressure coefficients should be incorporated into design of excavation support and permanent buried structures:

Type of Analysis & Soil	Unit Weight (pcf)	Earth Pressure Coefficient		
		Active	At-Rest	Passive
Static – Lean Clay	122	0.35	0.52	2.88
Static – Silt/Silty Clay	108	0.31	0.47	3.25
Static – Silty Sand	100	0.28	0.44	3.54
Static – Poorly-graded Gravel	120	0.26	0.41	3.85
Static – Poorly-graded Sand	113	0.25	0.40	4.02

Allowable lateral earth pressures will be utilized in the design and sizing of thrust blocks and thrust restraints for the pipeline. Resistance to lateral movement will vary depending on the soil type encountered along the alignment, depth to groundwater and the depth of pipe embedment; all three factors combine to determine the effective vertical and horizontal stresses acting on the pipe. In general, we anticipate that the pipe trench will be less than 2 pipe diameters wider than the water line, and that trench side walls, not the pipe backfill, will provide resistance to lateral movement. Thrust blocks will likely be constructed in contact with relatively undisturbed native soils and lateral forces applied to the thrust blocks from the pressurized aqueduct will be resisted by the passive earth pressures mobilized from the thrust blocks. The allowable bearing pressure will vary with the factors listed previously depending on the location of the thrust block within the alignment.

Variations in soil strata and depth to groundwater will influence the vertical stress and therefore the available resisting force. It should also be noted that a certain amount of lateral movement of the thrust block will be necessary to mobilize the full passive resistance of soils. If additional support is needed, or if the required deflection is too large for the pipe to withstand, mechanical supports of the thrust blocks should be considered.

6.2.3 Backfill and Compaction

The major fill requirement for this project will be that of excavation backfill within excavated trenches. Small segments of the backfill will be in areas that are to be repaved or in unpaved portions of road right-of-ways and will likely be carefully scrutinized by the Cities in terms of allowable gradation, placement and compaction.

Based on our understanding of most public works requirements, native soils may be utilized as trench backfill provided that they meet the classification A-1-a as defined by AASHTO M 145, well graded with a maximum particle size of 2 inches. Based on our gradation analysis of native soils some of the granular deposits encountered in the South Jordan portions of the alignment (along U-111 from 11800 South to Old Bingham Hwy) may meet the South Jordan City's gradation requirements and be suitable for use as trench backfill. It should be noted that our gradation analysis are performed on samples collected with $\leq$2.5 inch sampling equipment and may underestimate the presence of gravel larger than 2 inches. Fill materials whether native or imported will need to be approved by the City and geotechnical engineer prior to their use as trench backfill.

We recommend that trench backfill be placed in 12 inch loose lifts and compacted to a minimum of 96% of the maximum dry density as determined by ASTM D-1557. IGES further recommends that fill be compacted on a horizontal plane. The moisture content should be within 2 percent of optimum at the time of compaction. Care should be taken in compacting soils within the pipe zone. Overcompaction of these soils can cause distress and overstressing of the pipe.

IGES recommends that trenches in landscape areas or other non-pavement areas should be backfilled and compacted to approximately 90 percent of the maximum dry density. In the case of some fine-grained soils the time and effort to moisture condition and compact them in the trench may not offset the costs of importing granular fill. However, when appropriately moisture conditioned and compacted IGES does not see any reason for the

Cities to prohibit their use as trench backfill in landscape areas based on the engineering properties of soils.

6.2.3.1 Pipe Deflection - E' Values

Vertical deflection of installed pipeline is largely a function of the backfill material selected and the degree to which it is compacted above/around the pipe. IGES used the document "The Reclamation E' Table, 25 Years Later" to obtain values of E' for use in calculation of pipe deflection. These values should be used only with the Reclamation Equation presented in that document for estimation of vertical deflection; noting that horizontal deflection is generally 25% to 50% of the vertical deflection.

Backfill properties will vary along the alignment depending on the use of native/imported material as backfill and native soil conditions in the exposed trench side walls. We anticipate that, given the relatively large diameter of the planned aqueduct piping that trench walls will be closer than two pipe diameters from the installed piping at the spring-line. Depending on location and depth of installed piping, trench sidewalls could consist of clay, silt, sand or gravel and may not be as stiff as imported and compacted backfill material. In these instances we recommend a composite E' value be calculated using values provided for native soils in the Summary of Laboratory Results Table (Plates B-1 and B-2). If native soils are reused as trench backfill the 'compacted' values from Plates B-1 and B-2 should be used. For imported backfill materials consisting of Sands and Gravels having less than 12% fines, an E' value of 4,000 psi should be used. If imported granular backfill contains 13% or more fines a value of 2,500 psi should be used. All the 'compacted' values shown for site soil re-use on Plate B-1 and B-2, and the values given above for imported granular backfill assume a degree of compaction greater than 95% of the maximum dry density measured by ASTM D-698 or AASHTO T-99 (Standard Proctor).

6.3 SOIL CHEMISTRY

Because the proposed pipeline alignment covers nearly 4 miles along 11800 South and U-111, soil corrosivity is expected to vary along the alignment as subsurface conditions change with location. Field resistivity testing showed values between 1,526 and 27,732 Ω-cm. The lowest measured resistivity values indicate a severe potential for corrosion of normal grade steels (500 Ω-cm $\leq$ resistivity $\leq$ 2,000 Ω-cm) between explorations BH-10 and BH-15 along U-111 (see Appendix C for full report).

Based on soil chemistry evaluation performed in our laboratory, corrosion potential is somewhat variable. Soil pH values of approximately 8 to 8.7 do not indicate a significant corrosion concerns, and laboratory test results indicate that in-situ soils have only low to moderate potential for sulfate attack with respect to concrete (soluble sulfate contents varied from 15.9 ppm to 137 ppm). We recommend that Type II cement be used for any planned concrete structures, flowable fill and/or thrust blocks.

Additional laboratory testing of electrical resistivity (196 to 349 Ω-cm) and soluble chlorides (427 to 2,280 ppm) indicate a severe potential for corrosion of steel in some portions of the alignment. It should be noted that laboratory resistivity tests are performed on samples that were relatively fine-grained and that these tests indicate a minimum level of resistivity from soils saturated in the laboratory, a condition not likely to be replicated at this site over long periods of time in the field. However, when viewed in conjunction with field resistivity testing, it is our opinion that soils should be considered severely corrosive to metal between BH-10 and BH-17 (the majority of the alignment parallel to U-111). We recommend a qualified corrosion engineer be retained for further evaluation as necessary; specifically in the design of protection for metal pipes, rebar in concrete, thrust restraints and any other steel fittings that will be in contact with native soils.

6.3.1 Lead and Arsenic – Bingham Creek

As mentioned previously, the proposed pipeline alignment will pass through the Kennecott South Zone, OU1, OU5 and OU6. Bingham Creek (OU1) is a natural drainage channel which historically transported sediment containing elevated levels of Lead and Arsenic as a result of mining/ore processing operations at Kennecott. Approximately 1.12 Myd^3 of contaminated soil were removed from the drainage channel as part of remedial work in 1998. However, subsequent environmental sampling and testing performed in conjunction with construction to increase capacity of culverts through West Jordan City has encountered soils with lead levels in excess of the 2,000 ppm action level (AGEC, 1999).

Near 10200 South where the proposed pipeline will cross the channel, the existing drainage path has been routed through a culvert beneath U-111. It is likely that contaminated soils (if present) were at least partially removed during the installation of this culvert. However, it is also possible that this culvert was not placed in the natural drainage path of Bingham Creek and that contaminated soils may be encountered during installation of the proposed pipeline. Cursory sampling of these soils was performed as part of our geotechnical investigation. Maximum Lead and Arsenic contents of 279 ppm and 40.7 ppm, respectively were measured in the collected soils. It is possible that contaminated soils with COC levels higher than those shown are present between and beyond the points explored in this investigation. Recent utility installation (Questar, Herriman and South Jordan) may provide additional information and mapping of areas where contaminated soils were encountered during their excavations.

During construction, a soil management plan will be needed to coordinate and document testing efforts, backfill placement and disposal of contaminated soils (if encountered). It should also include health and safety concerns as well as requirements for decontamination of equipment and personnel as well as measures to minimize spreading the COC to other areas. Coordination with the Utah Division of Environmental Quality and possibly the U.S. Environmental Protection Agency will likely be required in order

to appropriately work with and document contaminated soils encountered during construction.

6.4 FOUNDATIONS

At present, details of planned structures requiring foundations (if any) along the alignment have not been provided. We anticipate that any booster pump stations, meter vaults etc. will be lightly loaded structures. Based on this assumption, conventional strip and spread footings may be used for support of such structures. Because foundation soils will vary depending on the location of structures along the planned alignment the following recommendations are based on the perceived “worst case” bearing capabilities of soils encountered during our investigation.

Footings should be a minimum of 18 inches wide and designed with a net allowable bearing capacity of 1,500 psf. All foundation elements should be constructed on a zone of compacted structural fill that is at least 12 inches thick. Structural fill may consist of select on-site fill soils or an approved imported well graded granular soil with a maximum of 50 percent passing the No. 4 mesh sieve and a maximum fines content (minus No.200 mesh sieve) of 20 percent. All soils obtained from on-site sources or imported as structural fill should be approved by the Geotechnical Engineer prior to their use.

7.0 CLOSURE

7.1 LIMITATIONS

The recommendations contained in this report are based on our limited field exploration, laboratory testing, and understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the explorations made for this investigation. It is possible that variations in the soil and groundwater conditions could exist between the points explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, IGES should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, our firm should also be notified.

This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, expressed or implied, is made.

It is the client's responsibility to see that all parties to the project including the designer, contractor, subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

7.2 ADDITIONAL SERVICES

The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be made during the construction. IGES staff should be on site to verify compliance with these recommendations. These tests and observations should include, but not necessarily be limited to, the following:

- Observations and testing during site preparation, earthwork and select/general/embankment fill placement.
- Consultation as may be required during construction.
- Quality control and observation of concrete placement.

We also recommend that project plans and specifications be reviewed by us to verify compatibility with our conclusions and recommendations. Additional information concerning the scope and cost of these services can be obtained from our office.

We appreciate the opportunity to be of service on this project. Should you have any questions regarding the report or wish to discuss additional services, please do not hesitate to contact us at your convenience (801) 270-9400.

8.0 REFERENCES CITED

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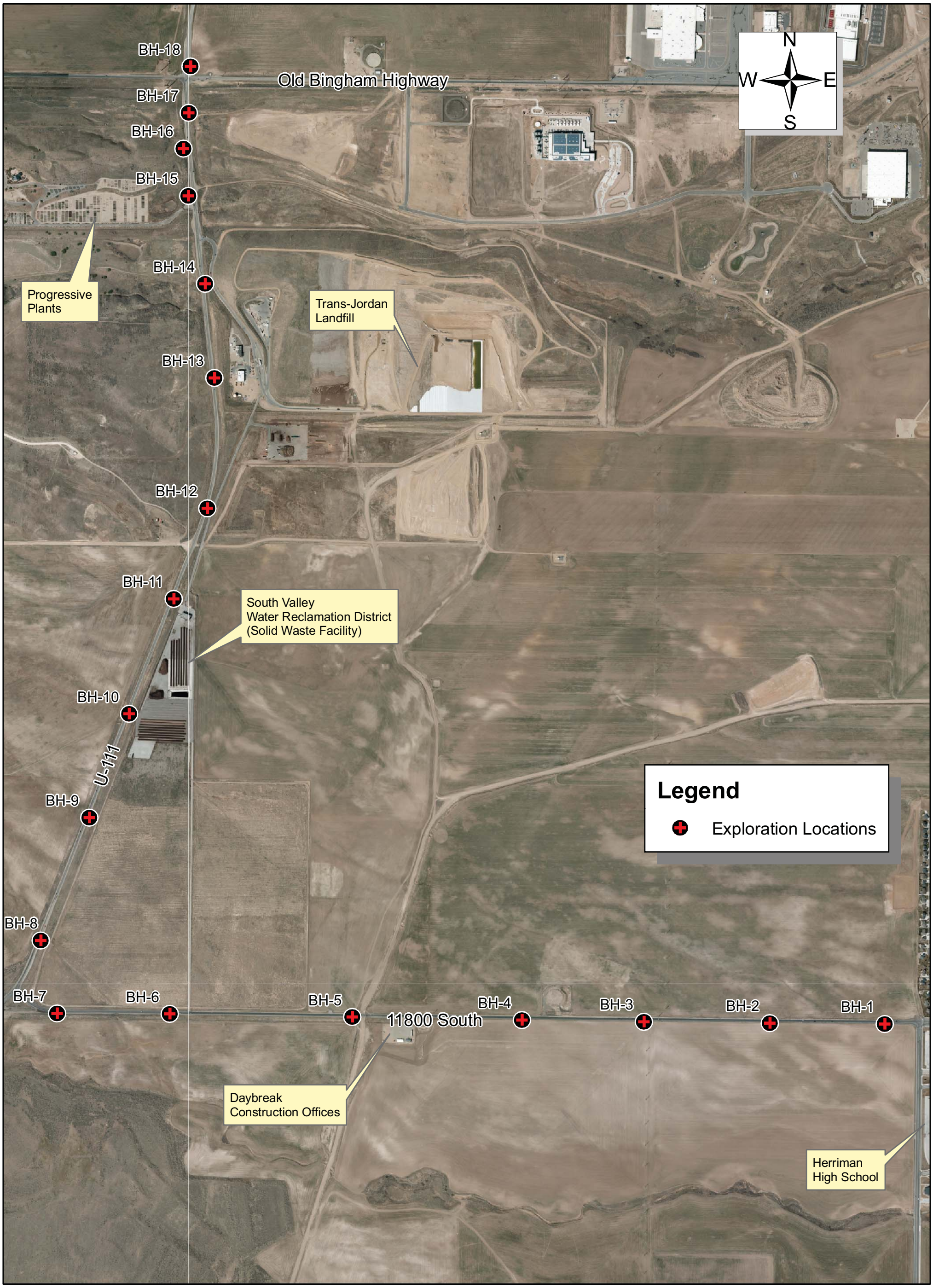
APPENDIX A



BASE IMAGERY
2012 HRO
Utah Automated Geographic Reference Center (AGRC)

Feet
0 500 1,000 2,000 3,000 4,000
1:12,000

Plate A-1

Geotechnical Investigation
JVWCD Waterline
11800 South and U-111
Herriman and South Jordan, Utah

SITE VICINITY/EXPLORATION MAP

IGES®

Project Number - 00301-025

DATE
STARTED: 9/30/16
COMPLETED: 9/30/16
BACKFILLED: 9/30/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-1**
Sheet 1 of 1

LOCATION
LATITUDE 40.5368 LONGITUDE -112.0344 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit (10 20 30 40 50 60 70 80 90)
0	0				GP-GM	Poorly graded GRAVEL with silt and sand									
1					ML	SILT with gravel - very stiff, moist, brown	10 13 16	29	●						
5					CL	Lean CLAY with sand - very stiff, moist, brown	9 12 20	21	●	111	17				●
2					SP-SM	Poorly graded SAND with silt and gravel - very dense, moist, light brown	13 25 25	50	●		6				●
3	10				SM	Silty SAND with gravel - very dense, moist, light brown	28 40 37	77	●		6	19			●
4															
15					SP-SM	Poorly graded SAND with silt and gravel - very dense, moist, brown	23 75/5								
5						Bottom of Boring @ 16 Feet									
6	20														
7															
25															
8															
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-2

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

DATE
STARTED: 9/30/16
COMPLETED: 9/30/16
BACKFILLED: 9/30/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-2**
Sheet 1 of 1

LOCATION
LATITUDE 40.5368 LONGITUDE -112.0398 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0														
1															
	5	☒					20 38 40	78	●		3				●
2															
3	10	▮			GP-GM	Poorly graded GRAVEL with silt and sand - very dense, moist, brown	40 75/3								
4															
	15	☒					37 50/4				5				●
5						Bottom of Boring @ 16 Feet									
6	20														
7															
	25														
8															
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

SAMPLE TYPE
- ☒ 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- ☒ 3.25" O.D./2.42" I.D. U SAMPLER
- ⍁ 3" O.D. THIN-WALLED SHELBY SAMPLER
- ▯ GRAB SAMPLE
- ▯ 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ▯ SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-3

DATE
STARTED: 9/29/16
COMPLETED: 9/29/16
BACKFILLED: 9/29/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-3**
Sheet 1 of 1

LOCATION
LATITUDE 40.5369 LONGITUDE -112.0450 ELEVATION

METERS	FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0				ML	SILT with sand - medium dense, moist, light brown	7 6 8	14	●						
1															
5					GM	Silty GRAVEL with sand - medium dense, moist, light brown	18 22 22	29	●		5	19			●
2															
						SILT with sand and gravel - stiff, moist, brown	6 5 6	11	●						
3	10				ML	SILT with sand - loose, moist, light brown	5 5 6	7	●	84	32				●
4															
15					SP-SM	Poorly graded SAND with silt and gravel - very dense, moist, light brown	14 25 50/3				7				●
5						Bottom of Boring @ 16.5 Feet									
6	20														
7															
25															
8															
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-4

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

DATE
STARTED: 9/29/16
COMPLETED: 9/29/16
BACKFILLED: 9/29/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-4**
Sheet 1 of 1

LOCATION
LATITUDE 40.5369 LONGITUDE -112.0506 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0				SP-SM	Poorly graded SAND with silt and gravel									
1	5				SM	Silty SAND with gravel - medium dense, moist, light brown	4 4 19	23	●						
2	10				GP-GM	Poorly graded GRAVEL with silt and sand - very dense, moist, light brown	35 68 58	84	●		4	9			●
3	15				SP-SM	Poorly graded SAND with silt and gravel - very dense, moist, light brown	30 50/5				4				●
4					GP-GM	Poorly graded GRAVEL with silt and sand - very dense, moist, light brown									
5						Bottom of Boring @ 16 Feet									
6	20														
7															
8	25														
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-5

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

DATE
STARTED: 9/29/16
COMPLETED: 9/29/16
BACKFILLED: 9/29/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-5**
Sheet 1 of 1

LOCATION
LATITUDE 40.5369 LONGITUDE -112.0558 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0														
1					GC	Clayey GRAVEL with sand - medium dense, moist, brown	7 9 10	19			6	24			
	5				CL	Lean CLAY with sand - hard, moist, light brown	6 37 43	53							
2					SP-SM	Poorly graded SAND with silt and gravel - very dense, moist, light brown	14 26 37	63			6				
3	10				SM	Silty SAND with gravel - very dense, moist, light brown	21 36 50/5				5	19			
4					GP-GM	Poorly graded GRAVEL with silt and sand - very dense, moist, brown	40 42 45	58							
5	15					Bottom of Boring @ 16.5 Feet									
6	20														
7															
	25														
8															
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-6

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

DATE
STARTED: 9/29/16
COMPLETED: 9/29/16
BACKFILLED: 9/29/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-6**
Sheet 1 of 1

LOCATION
LATITUDE 40.5369 LONGITUDE -112.0613 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0														
1	5	☒			SM	Silty SAND - medium dense, dry, light brown	3 4 7	11	●						
2															
3	10	▥			ML	SILT - stiff, moist, light brown	5 5 13	12	●	84	25	90			●
4															
5	15	☒			CL	Lean CLAY - very stiff, moist, brown	5 8 14	22	●		20				●
6	20					Bottom of Boring @ 16.5 Feet									
7															
8	25														
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

SAMPLE TYPE
- ☒ 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- ☒ 3.25" O.D./2.42" I.D. U SAMPLER
- ▨ 3" O.D. THIN-WALLED SHELBY SAMPLER
- ▯ GRAB SAMPLE
- ▯ 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- ▯ SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-7

DATE
STARTED: 9/29/16
COMPLETED: 9/29/16
BACKFILLED: 9/29/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-7**
Sheet 1 of 1

LOCATION
LATITUDE 40.5369 LONGITUDE -112.0683 ELEVATION

METERS	FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0					Silty SAND with gravel - medium dense, moist, brown	9 8 6	14							
1	5				SM	Silty SAND - loose, moist, light brown	3 3 8	7							
2							3 5 5	10			20				
3	10				ML	SILT - stiff, moist, brown	4 7 8	10			23	89			
4															
5	15				SP-SM	Poorly graded SAND with silt and gravel - dense, moist, light brown	17 21 23	44			5				
6	20				SM	Silty SAND									
					GP-GM	Poorly graded GRAVEL with silt and sand - dense, moist, brown	10 33 40	49			5	10			
7	25				SP-SM	Poorly graded SAND with silt and gravel - very dense, moist, brown	14 50/4				6				
8															
9	30				GP-GM	Poorly graded GRAVEL with silt and sand - very dense, moist, brown	50/5								
						Bottom of Boring @ 31 Feet									

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-8

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

DATE
STARTED: 10/4/16
COMPLETED: 10/4/16
BACKFILLED: 10/4/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-8**
Sheet 1 of 1

LOCATION
LATITUDE 40.5390 LONGITUDE -112.0689 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0					Asphalt									
					SP-SM	Poorly graded SAND with silt and gravel - dense, moist, brown									
1															
	5				CL	Lean CLAY with gravel - very stiff, moist, brown	5 14 21	23	●						
2															
3	10				GM	Silty GRAVEL with sand - very dense, moist, brown	9 23 27	50	●		9	18			●
4															
	15				SP-SM	Poorly graded SAND with silt and gravel - dense, moist, brown	13 21 26	31	●						
5						Bottom of Boring @ 16.5 Feet									
6	20														
7															
	25														
8															
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-9

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

DATE
STARTED: 10/4/16
COMPLETED: 10/4/16
BACKFILLED: 10/4/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-9**
Sheet 1 of 1

LOCATION
LATITUDE 40.5428 LONGITUDE -112.0670 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0				SP-SM	Poorly graded SAND with silt and gravel									
1															
	5				CL	Lean CLAY - stiff, moist, brown	2 5 9	13					41	24	
2															
3	10					Lean CLAY with gravel - hard, moist, brown	9 22 32	36		106	21				
4															
	15					Lean CLAY with gravel - very stiff, moist, brown	5 10 16	26			13				
5						Bottom of Boring @ 16.5 Feet									
6	20														
7															
	25														
8															
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-10

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

DATE
STARTED: 10/4/16
COMPLETED: 10/4/16
BACKFILLED: 10/4/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO:
BH-10
Sheet 1 of 1

LOCATION
LATITUDE 40.5463 LONGITUDE -112.0653 ELEVATION

METERS	FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0				CL	Lean CLAY - stiff, moist, brown	5 4 5	9	●						
1															
	5					Lean CLAY with sand - very stiff, moist, brown	6 15 15	20	●						
2						Lean CLAY - very stiff, moist, brown	3 6 10	16	●						
3	10					Lean CLAY with gravel - stiff, moist, brown	6 22 49	47	●						
4					SM	Silty SAND with gravel - dense, moist, light brown	17 23 18	41	●		6	17			●
5	15					Bottom of Boring @ 16.5 Feet									
6	20														
7															
	25														
8															
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-11

DATE
STARTED: 10/4/16
COMPLETED: 10/4/16
BACKFILLED: 10/4/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-11**
Sheet 1 of 1

LOCATION
LATITUDE 40.5498 LONGITUDE -112.0635 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0				SC	Clayey SAND									
1															
5					GP-GC	Poorly graded GRAVEL with clay and sand - medium dense, moist, brown	20 13 10	23	●						
2															
3	10				SM	Silty SAND - medium dense, moist, brown	7 8 9	11	●		15	50			●
4															
15					CL	Lean CLAY with gravel - very stiff, moist, brown	3 8 14	22	●				35	19	● ●
5						Bottom of Boring @ 16.5 Feet									
6	20														
7															
25															
8															
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-12

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

DATE
STARTED: 10/4/16
COMPLETED: 10/4/16
BACKFILLED: 10/4/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-12**
Sheet 1 of 1

LOCATION
LATITUDE 40.5526 LONGITUDE -112.0622 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0														
1	5				CL	Sandy lean CLAY - very stiff, moist, brown	7 14 23	25	●	110	17				●
2	10				CH	Fat CLAY with gravel - hard, moist, dark brown	13 19 24	43	●				55	37	
4					GP-GM	Poorly graded GRAVEL with silt and sand - dense, moist, brown									
5	15				SP-SM	Poorly graded SAND with silt and gravel - medium dense, moist, brown	14 16 11	18	●						
6	20					Bottom of Boring @ 16.5 Feet									
7															
8	25														
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-13

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

DATE
STARTED: 10/4/16
COMPLETED: 10/4/16
BACKFILLED: 10/4/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO:
BH-13
Sheet 1 of 1

LOCATION
LATITUDE 40.5567 LONGITUDE -112.0620 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0				SP-SM	Poorly graded SAND with silt and gravel - dense, moist, brown									
1															
5		X			GP-GM	Poorly graded GRAVEL with silt and sand - very dense, moist, grey and brown	21 23 27	50	●						
2															
3	10				SC	Clayey SAND with gravel - medium dense, moist, dark brown	6 15 15	20	●		13	49			●
4															
15		X			SP-SC	Poorly graded SAND with clay and gravel - medium dense, moist, brown	13 13 15	28	●						
5						Bottom of Boring @ 16.5 Feet									
6	20														
7															
25															
8															
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-14

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

DATE
STARTED: 10/4/16
COMPLETED: 10/4/16
BACKFILLED: 10/4/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO:
BH-14
Sheet 1 of 1

LOCATION
LATITUDE 40.5591 LONGITUDE -112.0624 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0				GP-GM	Poorly graded GRAVEL with silt and sand									
					ML	SILT with sand - very stiff, moist, black and yellow	8 10 10	20							
1	5				CL	Sandy lean CLAY - stiff, moist, brown	4 5	15							
2					GP	Poorly graded GRAVEL with sand - dense, moist, brown	18								
					GM	Silty GRAVEL with sand - medium dense, moist, light brown	9 12 12	24			7	18			
3	10				SP-SM	Poorly graded SAND with silt and gravel - medium dense, moist, brown	8 10 11	14							
4															
5	15				SM	Silty SAND - medium dense, moist, yellowish brown	3 6 7	13							
						Bottom of Boring @ 16.5 Feet									
6	20														
7															
8	25														
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-15

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

DATE
STARTED: 10/31/16
COMPLETED: 10/31/16
BACKFILLED: 10/31/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-15**
Sheet 1 of 1

LOCATION
LATITUDE 40.5623 LONGITUDE -112.0631 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0														
					SP-SM	Poorly graded SAND with silt and gravel - dense, moist, brown	9 13 20	33							
1															
	5					Poorly graded SAND with silt and gravel - medium dense, moist, brown	16 16 15	21							
2					SP-SC	Poorly graded SAND with clay and gravel - medium dense, moist, brown	5 12 12	24			11	28			
3	10				CL	Sandy lean CLAY - stiff, moist, dark brown	11 7 8	9		111	16	57			
4					GP-GC	Poorly graded GRAVEL with clay and sand - medium dense, moist, brown	20 11 9	20				12			
5	15				CL	Lean CLAY - stiff, moist, brown									
						Bottom of Boring @ 16.5 Feet									
6	20														
7															
	25														
8															
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-16

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

DATE
STARTED: 10/31/16
COMPLETED: 10/31/16
BACKFILLED: 10/31/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO:
BH-16
Sheet 1 of 1

LOCATION
LATITUDE 40.5636 LONGITUDE -112.0632 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0				SP-SM	Poorly graded SAND with silt and gravel, medium dense, moist, brown	10 10 13	23	●						
1															
5					GP-GM	Poorly graded GRAVEL with silt and sand - dense, moist, brown	27 33 30	42	●		4	16			●
2							13 15 18	33	●						
3	10				SP-SM	Poorly graded SAND with silt and gravel - dense, moist, brown	9 15 30	30	●		6	17			●
4															
15						Poorly graded SAND with silt and gravel - very dense, moist, brown	31 50/5					25			
5						Bottom of Boring @ 16.5 Feet									
6	20														
7															
25															
8															
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-17

DATE
STARTED: 10/4/16
COMPLETED: 10/4/16
BACKFILLED: 10/4/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-17**
Sheet 1 of 1

LOCATION
LATITUDE 40.5649 LONGITUDE -112.0632 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0				SP-SM	Poorly graded SAND with silt and gravel - dense, dry, light brown	10 21 23	44							
1															
	5					SILT with sand - hard, moist, light brown	9 42 48	60		118	10				
2					ML		24 29 33	62							
	10					SILT with sand - soft, moist, brown	4 3 3	4			19	75			
3															
4															
	15				GP-GM	Poorly graded GRAVEL with silt and sand - very dense, moist, brown	20 37 40	77							
5															
6	20						18 45 62	71			6	10			
						Bottom of Boring @ 21.5 Feet									
7															
	25														
8															
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT
* N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT
FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-18

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

DATE
STARTED: 9/30/16
COMPLETED: 9/30/16
BACKFILLED: 9/30/16

Geotechnical Investigation
JVWCD Waterline
U111 and 11800 South
Herriman and South Jordan, UT

IGES Rep: JDF
Rig Type: CME
Boring Type: Hollow Stem Auger
Project Number: 00301-025

BORING NO: **BH-18**
Sheet 1 of 1

LOCATION
LATITUDE 40.5664 LONGITUDE -112.0632 ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	SPT BLOW COUNT 10 20 30 40 50 60 70 80 90	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits: Plastic Limit / Moisture Content / Liquid Limit 10 20 30 40 50 60 70 80 90
0	0				CL	Lean CLAY with gravel - stiff, moist, brown and yellow	4 5 8	13	●						
1															
5					SP-SM	Poorly graded SAND with silt and gravel - dense, moist, light brown	19 32 35	45	●						
2						Poorly graded SAND with silt and gravel - very dense, moist, light brown	14 26 29	55	●						
3	10				GP-GM	Poorly graded GRAVEL with silt and sand - very dense, moist, brown	19 31 48	53	●		5	12			●
4															
15					SP-SM	Poorly graded SAND with silt and gravel - very dense, moist, brown	16 21 38	59	●						
5															
6	20				GP-GM	Poorly graded GRAVEL with silt and sand - very dense, moist, brown	47 75/5								
						Bottom of Boring @ 21 Feet									
7															
25															
8															
9	30														

N - OBSERVED UNCORRECTED BLOW COUNT * N - UNCORRECTED, EQUIVALENT SPT BLOW COUNT FR - FIELD REFUSAL

SAMPLE TYPE
- 2" O.D./1.38" I.D. SPLIT SPOON SAMPLER
- 3.25" O.D./2.42" I.D. U SAMPLER
- 3" O.D. THIN-WALLED SHELBY SAMPLER
- GRAB SAMPLE
- 3" O.D./2.38" I.D. CALIFORNIA SAMPLER
- SAMPLE FROM AUGER CUTTINGS

NOTES:
No ground water encountered

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
A-19

BORING LOG (NEW) (A) (4 LINE HEADER) 00301-025.GPJ IGES.GDT 11/11/16

APPENDIX B

SUMMARY OF LABORATORY TEST RESULTS TABLE
JVWCD Waterline - 11800 South and U-111

Project Number:00301-025

Sample Location ID	Depth (ft)	Dry Density (pcf)	Water Content (%)	% Gravel >#4 & <3"	% Sand >#200 & <#4	% Fines <#200	Liquid Limit	PI	Direct Shear		Lead (mg/kg)	Arsenic (mg/kg)	Soluble Sulfate (mg/kg)	Soluble Chloride (mg/kg)	Resistivity Laboratory (Minimum) (Ω-cm)	pH	Modulus of Soil Reaction (E') [1]		UNIFIED SOILS CLASSIFICATION
									c (psf)	phi (degrees)							Native (psi)	Compacted (psi)	
BH-1	5	111	16.6														400	1500	SILT with gravel
BH-1	7.5		5.8														700	4000	Poorly-graded SAND with silt and gravel
BH-1	10		5.5	37	43.8	19.1											400	2500	Silty SAND with gravel
BH-2	5		3.4														2000	4000	Poorly-graded GRAVEL with silt and sand
BH-2	15		4.5														2000	4000	Poorly-graded GRAVEL with silt and sand
BH-3	5		4.9	54.1	27.2	18.6											1000	2500	Silty GRAVEL with sand
BH-3	10	83.5	31.9						155	36							400	2500	SILT with sand
BH-3	15		7.2														700	4000	Poorly-graded SAND with silt and gravel
BH-4	10		4.3	48.4	42.6	9											2000	4000	Poorly-graded GRAVEL with silt and sand
BH-4	15		4.4														700	4000	Poorly-graded SAND with silt and gravel
BH-5	2.5		6.1	41	34.7	24.3											1000	2500	Clayey GRAVEL with sand
BH-5	7.5		6														700	4000	Poorly-graded SAND with silt and gravel
BH-5	10		5.3	36.4	44.7	18.9											700	4000	Silty SAND with gravel
BH-6	5										83.8	15.1					700	4000	Silty SAND
BH-6	10	84.2	25.4	0	9.6	90.4											400	1500	SILT
BH-6	15		19.5														200	1500	Lean CLAY
BH-7	5										64.2	15.8					700	4000	Silty SAND
BH-7	7.5		19.8														700	4000	Silty SAND
BH-7	10		22.9	0.1	11.1	88.8											400	1500	SILT
BH-7	15		5.1														700	4000	Poorly-graded SAND with silt and gravel
BH-7	20		5.3	58.4	31.3	10.3											2000	4000	Poorly-graded GRAVEL with silt and sand
BH-7	25		6.4														700	4000	Poorly-graded SAND with silt and gravel
BH-8	10		8.5	41.6	40.6	17.8											1000	2500	Silty GRAVEL with sand
BH-9	5						41	24									200	1500	Lean CLAY
BH-9	10	106.2	20.7						334	39							200	1500	Lean CLAY
BH-9	15		12.5														200	1500	Lean CLAY
BH-10	5												137	2280	196	8.41	200	1500	Lean CLAY
BH-10	15		5.6	40.5	42.1	17.4											700	4000	Silty SAND with gravel
BH-11	10		14.6	4.6	45.8	49.8											700	4000	Silty SAND
BH-11	15						35	19									200	1500	Lean CLAY
BH-12	5	110.2	16.7														200	1500	Lean CLAY
BH-12	10						55	37									DO NOT USE		Fat CLAY
BH-12	15										157	19.7					700	4000	Poorly-graded SAND with silt and gravel
BH-13	10		12.8	16.1	34.7	49.1											1000	2500	Clayey SAND with gravel
BH-14	5												15.9	1180	245	8	200	1500	Sandy Lean CLAY
BH-14	7.5		7.2	42.1	39.6	18.3											1000	2500	Silty GRAVEL with sand
BH-14	15										279	40.7					700	2500	Silty SAND
BH-15	5										160	28.8					700	4000	Poorly-graded SAND with silt and gravel
BH-15	7.5		10.8	32.8	39.5	27.6											700	4000	Poorly-graded SAND with clay and gravel
BH-15	10	111.1	16.4	15	28.4	56.6											200	1500	Sandy Lean CLAY

SUMMARY OF LABORATORY TEST RESULTS TABLE
JVWCD Waterline - 11800 South and U-111

Project Number:00301-025

Sample Location ID	Depth (ft)	Dry Density (pcf)	Water Content (%)	% Gravel >#4 & <3"	% Sand >#200 & <#4	% Fines <#200	Liquid Limit	PI	Direct Shear		Lead (mg/kg)	Arsenic (mg/kg)	Soluble Sulfate (mg/kg)	Soluble Chloride (mg/kg)	Resistivity Laboratory (Minimum) (Ω-cm)	pH	Modulus of Soil Reaction (E') [1]		UNIFIED SOILS CLASSIFICATION
									c (psf)	phi (degrees)							Native (psi)	Compacted (psi)	
BH-15	15		4.8	57.1	31.3	11.6											2000	4000	Poorly-graded GRAVEL with clay and sand
BH-16	5		4.1	51.5	32.7	15.8											2000	4000	Poorly-graded GRAVEL with silt and sand
BH-15	7.5										143	17.0					2000	4000	Poorly-graded GRAVEL with silt and sand
BH-16	10		5.9	56.5	56.7	16.8											700	4000	Poorly-graded SAND with silt and gravel
BH-16	15		5.0	33.3	42.2	24.5											700	4000	Poorly-graded SAND with silt and gravel
BH-17	5	118	9.7														700	4000	Poorly-graded SAND with silt and gravel
BH-17	10		19.0	1.8	22.9	75.2							29.9	1600	263	8.07	400	1500	SILT with sand
BH-17	20		5.8	52.4	38.2	9.5											2000	4000	Poorly-graded GRAVEL with silt and sand
BH-18	5												21.9	427	349	8.73	700	4000	Poorly-graded SAND with silt and gravel
BH-18	10		5.3	47.3	40.9	11.9											2000	4000	Poorly-graded GRAVEL with silt and sand

(1) - Values derived from field observations, laboratory testing and 2006 Reclamation Table of E' Values (Howard, 2006)

Water Content and Unit Weight of Soil

(In General Accordance with ASTM D7263 Method B and D2216)

Project: **JVWCD-U111 & 11800 South**
No: **00301-025**
Location: U111 and 11800 south
Date: 10/19/2016
By: NB

Sample Info.	Boring No.	BH-1	BH-1	BH-2	BH-2	BH-3	BH-4	BH-5	BH-6
	Sample								A
	Depth	5.0'	7.5'	5.0'	15.0'	15.0'	15.0'	7.5'	10.0'
	Split	No	No	No	No	No	No	No	No
	Split sieve								
Total sample (g)									
Moist coarse fraction (g)									
Moist split fraction (g)									
Unit Weight Data	Sample height, H (in)	5.000							6.000
	Sample diameter, D (in)	2.416							2.416
	Mass rings + wet soil (g)	1006.96							1027.95
	Mass rings/tare (g)	228.40							265.64
	Moist unit wt., γ_m (pcf)	129.4							105.6
	Wet soil + tare (g)								
	Dry soil + tare (g)								
	Tare (g)								
	Water content (%)								
Water Content Data	Wet soil + tare (g)	898.80	663.08	570.76	549.01	588.00	648.79	657.56	1034.89
	Dry soil + tare (g)	791.06	633.62	556.26	530.97	557.16	626.42	629.12	880.75
	Tare (g)	140.86	122.64	127.60	127.34	126.97	120.90	153.28	273.24
	Water content (%)	16.6	5.8	3.4	4.5	7.2	4.4	6.0	25.4
Water Content, w (%)		**16.6**	**5.8**	**3.4**	**4.5**	**7.2**	**4.4**	**6.0**	**25.4**
Dry Unit Wt., γ_d (pcf)		**111.0**							**84.2**

Entered by:_____
Reviewed:_____

Water Content and Unit Weight of Soil

(In General Accordance with ASTM D7263 Method B and D2216)

Project: **JVWCD-U111 & 11800 South**
No: **00301-025**
Location: U111 and 11800 south
Date: 10/24/2016
By: NB

Sample Info.	Boring No.	BH-6	BH-7	BH-7	BH-7	BH-9	BH-9	BH-12	BH-17
	Sample								
	Depth	15.0'	7.5'	15.0'	25.0'	10.0'	15.0'	5.0'	5.0'
	Split	No	No	No	No	No	No	No	No
	Split sieve								
	Total sample (g)								
	Moist coarse fraction (g)								
	Moist split fraction (g)								
Unit Weight Data	Sample height, H (in)					4.000		3.000	5.000
	Sample diameter, D (in)					2.416		2.416	2.416
	Mass rings + wet soil (g)					793.40		594.77	1001.39
	Mass rings/tare (g)					176.18		130.31	222.45
	Moist unit wt., γ_m (pcf)					128.2		128.7	129.5
	Wet soil + tare (g)								
	Dry soil + tare (g)								
	Tare (g)								
	Water content (%)								
Water Content Data	Wet soil + tare (g)	443.91	408.04	505.07	509.76	497.10	334.33	586.51	1314.03
	Dry soil + tare (g)	394.69	361.59	486.87	486.29	433.56	311.38	520.21	1232.83
	Tare (g)	141.74	126.84	127.99	120.01	126.48	127.37	123.58	393.04
	Water content (%)	19.5	19.8	5.1	6.4	20.7	12.5	16.7	9.7
	Water Content, w (%)	**19.5**	**19.8**	**5.1**	**6.4**	**20.7**	**12.5**	**16.7**	**9.7**
	Dry Unit Wt., γ_d (pcf)					**106.2**		**110.2**	**118.0**

Entered by:_____
Reviewed:_____

Water Content and Unit Weight of Soil

(In General Accordance with ASTM D7263 Method B and D2216)

Project: **JVWCD-U111 & 11800 South**
No: **00301-025**
Location: U111 and 11800 south
Date: 10/19/2016
By: NB

Sample Info.	Boring No.	BH-18							
	Sample								
	Depth	10.0'							
	Split	Yes							
	Split sieve	3/8"							
Total sample (g)		2378.96							
Moist coarse fraction (g)		805.03							
Moist split fraction (g)		1573.93							
	Sample height, H (in)								
	Sample diameter, D (in)								
	Mass rings + wet soil (g)								
	Mass rings/tare (g)								
	Moist unit wt., γ_m (pcf)								
Coarse Fraction	Wet soil + tare (g)	1115.24							
	Dry soil + tare (g)	1088.47							
	Tare (g)	310.21							
	Water content (%)	3.4							
Split Fraction	Wet soil + tare (g)	726.94							
	Dry soil + tare (g)	692.29							
	Tare (g)	127.31							
	Water content (%)	6.1							
Water Content, w (%)		**5.2**							
Dry Unit Wt., γ_d (pcf)									

Entered by:_____

Reviewed:_____

Water Content and Unit Weight of Soil

(In General Accordance with ASTM D7263 Method B and D2216)

Project: **JVWCD-U111 & 11800 South**
No: **00301-025**
Location: U111 and 11800 south
Date: 11/9/2016
By: BRR

Sample Info.	Boring No.	BH-15	BH-15	BH-16	BH-16				
	Sample								
	Depth	7.5'	10.0'	5.0'	10.0'				
	Split			Yes	Yes				
	Split sieve			3/8"	3/8"				
Total sample (g)				1643.25	1627.89				
Moist coarse fraction (g)				601.88	724.90				
Moist split fraction (g)				1041.37	902.99				
Unit Weight Data	Sample height, H (in)		4.000						
	Sample diameter, D (in)		2.416						
	Mass rings + wet soil (g)		792.01						
	Mass rings/tare (g)		169.65						
	Moist unit wt., γ_m (pcf)		129.3						
Coarse Fraction	Wet soil + tare (g)			1037.95	1097.01				
	Dry soil + tare (g)			1028.33	1075.51				
	Tare (g)			391.14	331.44				
	Water content (%)			1.5	2.9				
Split Fraction	Wet soil + tare (g)	672.64	1180.06	468.70	564.55				
	Dry soil + tare (g)	619.54	1052.32	450.13	530.75				
	Tare (g)	128.19	273.25	124.75	126.45				
	Water content (%)	10.8	16.4	5.7	8.4				
Water Content, w (%)		**10.8**	**16.4**	**4.1**	**5.9**				
Dry Unit Wt., γ_d (pcf)			**111.1**						

Entered by:_____

Reviewed:_____

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/24/2016
By: BRR

Boring No.: BH-9
Sample:
Depth: 5.0'
Description: Brown lean clay

Preparation method: Wet
Liquid limit test method: Multipoint

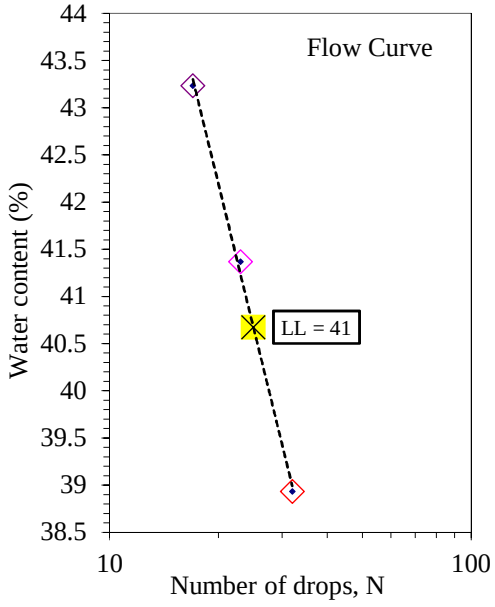
Plastic Limit

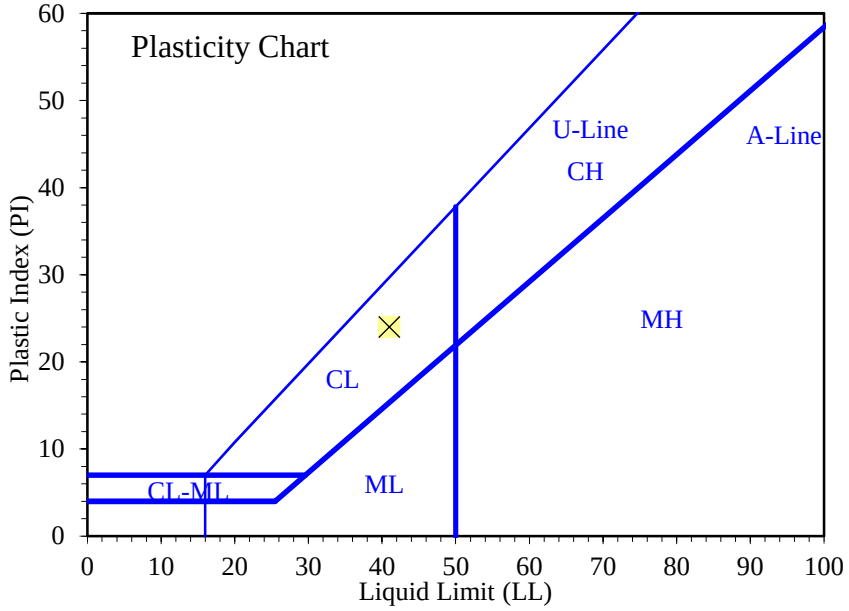
Determination No	1	2				
Wet Soil + Tare (g)	27.41	27.56				
Dry Soil + Tare (g)	26.53	26.66				
Water Loss (g)	0.88	0.90				
Tare (g)	21.37	21.40				
Dry Soil (g)	5.16	5.26				
Water Content, w (%)	17.05	17.11				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	32	23	17			
Wet Soil + Tare (g)	30.93	30.02	30.25			
Dry Soil + Tare (g)	28.45	27.60	27.79			
Water Loss (g)	2.48	2.42	2.46			
Tare (g)	22.08	21.75	22.10			
Dry Soil (g)	6.37	5.85	5.69			
Water Content, w (%)	38.93	41.37	43.23			
One-Point LL (%)		41				

Liquid Limit, LL (%)	**41**
Plastic Limit, PL (%)	**17**
Plasticity Index, PI (%)	**24**





Entered by:_____
Reviewed:_____

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/24/2016
By: BRR

Boring No.: BH-11
Sample:
Depth: 15.0'
Description: Brown lean clay

Preparation method: Wet
Liquid limit test method: Multipoint

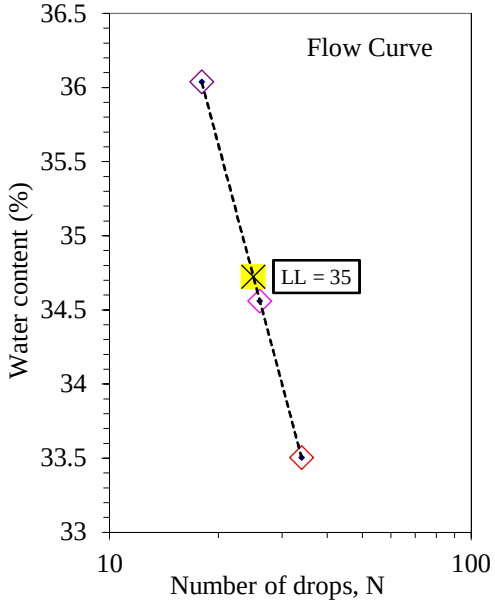
Plastic Limit

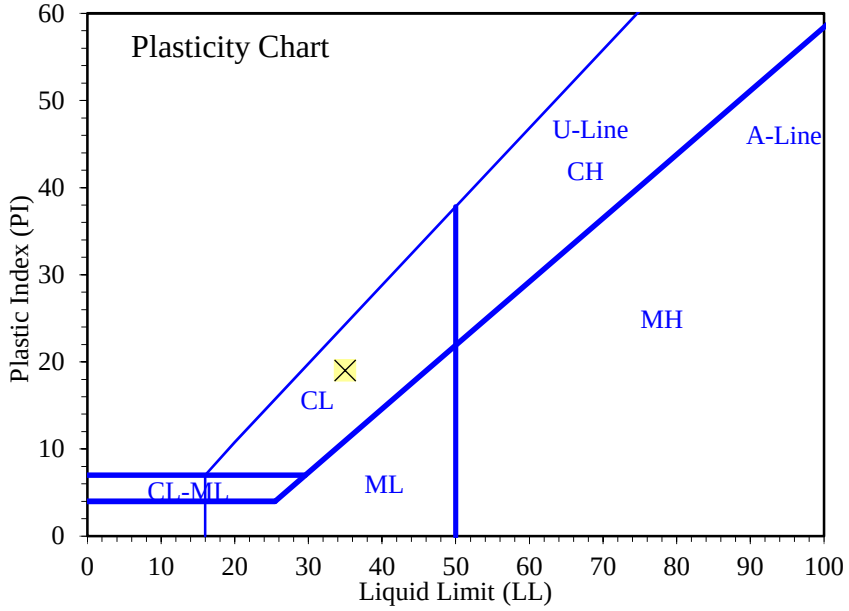
Determination No	1	2				
Wet Soil + Tare (g)	28.59	28.74				
Dry Soil + Tare (g)	27.67	27.80				
Water Loss (g)	0.92	0.94				
Tare (g)	21.93	22.22				
Dry Soil (g)	5.74	5.58				
Water Content, w (%)	16.03	16.85				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	34	26	18			
Wet Soil + Tare (g)	29.78	30.50	30.88			
Dry Soil + Tare (g)	27.82	28.34	28.57			
Water Loss (g)	1.96	2.16	2.31			
Tare (g)	21.97	22.09	22.16			
Dry Soil (g)	5.85	6.25	6.41			
Water Content, w (%)	33.50	34.56	36.04			
One-Point LL (%)		35				

Liquid Limit, LL (%)	**35**
Plastic Limit, PL (%)	**16**
Plasticity Index, PI (%)	**19**





Entered by:_____
Reviewed:_____

Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/24/2016
By: BRR

Boring No.: BH-12
Sample:
Depth: 10.0'
Description: Brown fat clay

Preparation method: Wet
Liquid limit test method: Multipoint

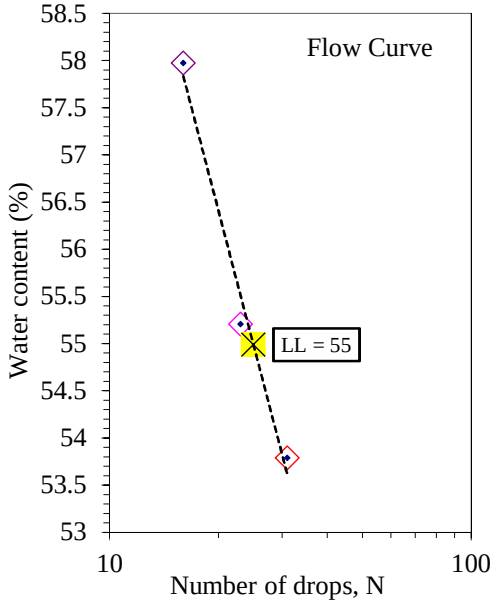
Plastic Limit

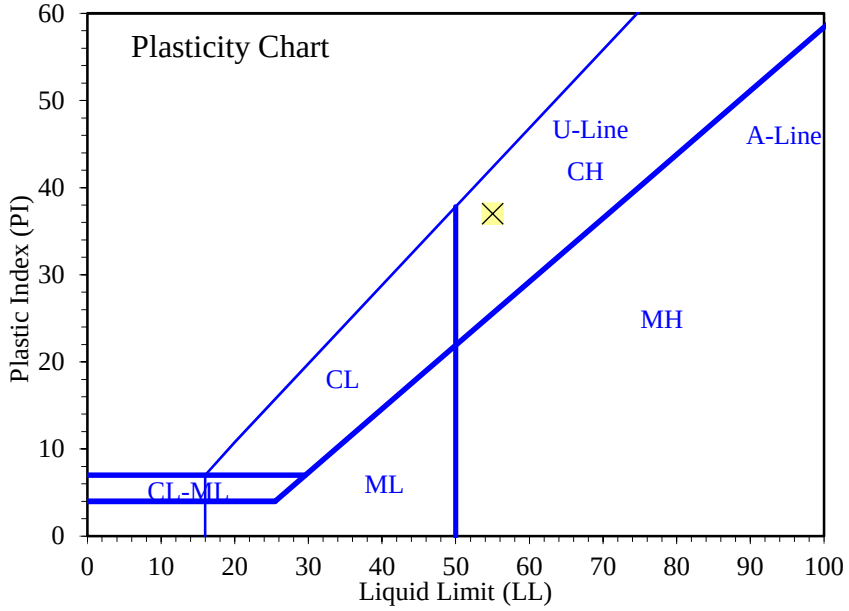
Determination No	1	2				
Wet Soil + Tare (g)	27.93	28.09				
Dry Soil + Tare (g)	26.98	27.09				
Water Loss (g)	0.95	1.00				
Tare (g)	21.71	21.57				
Dry Soil (g)	5.27	5.52				
Water Content, w (%)	18.03	18.12				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	31	23	16			
Wet Soil + Tare (g)	30.34	29.36	30.75			
Dry Soil + Tare (g)	27.50	26.71	27.66			
Water Loss (g)	2.84	2.65	3.09			
Tare (g)	22.22	21.91	22.33			
Dry Soil (g)	5.28	4.80	5.33			
Water Content, w (%)	53.79	55.21	57.97			
One-Point LL (%)		55				

Liquid Limit, LL (%)	**55**
Plastic Limit, PL (%)	**18**
Plasticity Index, PI (%)	**37**





Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

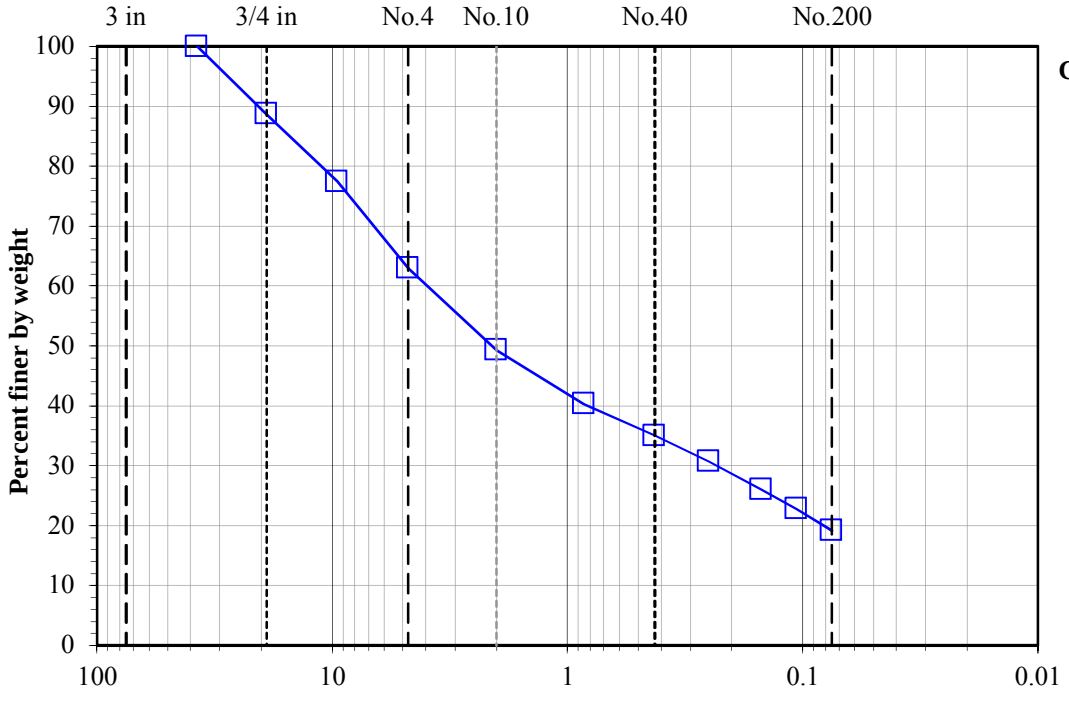
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

Boring No.: BH-1
Sample:
Depth: 10.0'
Description: Light brown silty sand with gravel

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	646.20	612.40
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	768.28
Dry soil + tare (g):	-	734.48
Tare (g):	-	122.08
Water content (%):	0.0	5.5

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	69.08	19	88.7
3/8"	138.12	9.5	77.4
No.4	226.76	4.75	63.0
No.10	310.68	2	49.3
No.20	365.68	0.85	40.3
No.40	397.86	0.425	35.0
No.60	424.30	0.25	30.7
No.100	453.08	0.15	26.0
No.140	472.85	0.106	22.8
No.200	495.14	0.075	19.1



Gravel (%): 37.0
Sand (%): 43.8
Fines (%): 19.1

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

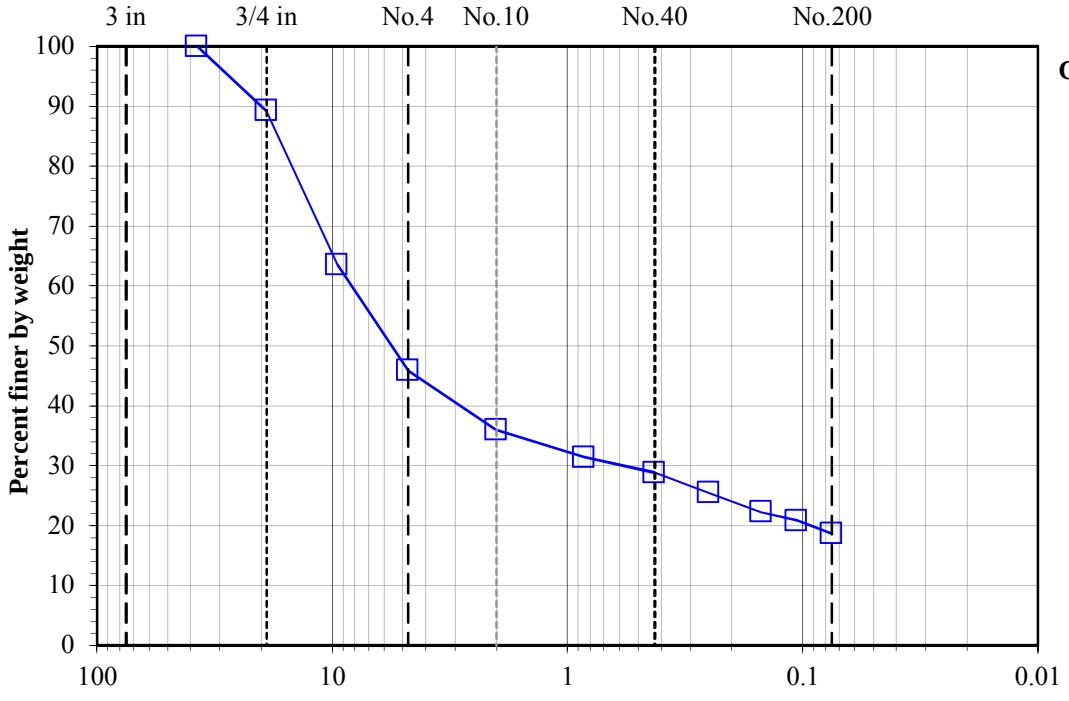
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

Boring No.: BH-3
Sample:
Depth: 5.0'
Description: Light brown silty gravel with sand

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	1823.18	1738.39
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	2149.84
Dry soil + tare (g):	-	2065.05
Tare (g):	-	326.66
Water content (%):	0.0	4.9

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	187.06	19	89.2
3/8"	634.03	9.5	63.5
No.4	941.03	4.75	45.9
No.10	1113.84	2	35.9
No.20	1192.56	0.85	31.4
No.40	1237.78	0.425	28.8
No.60	1295.74	0.25	25.5
No.100	1351.45	0.15	22.3
No.140	1376.62	0.106	20.8
No.200	1414.26	0.075	18.6



Gravel (%): 54.1
Sand (%): 27.2
Fines (%): 18.6

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

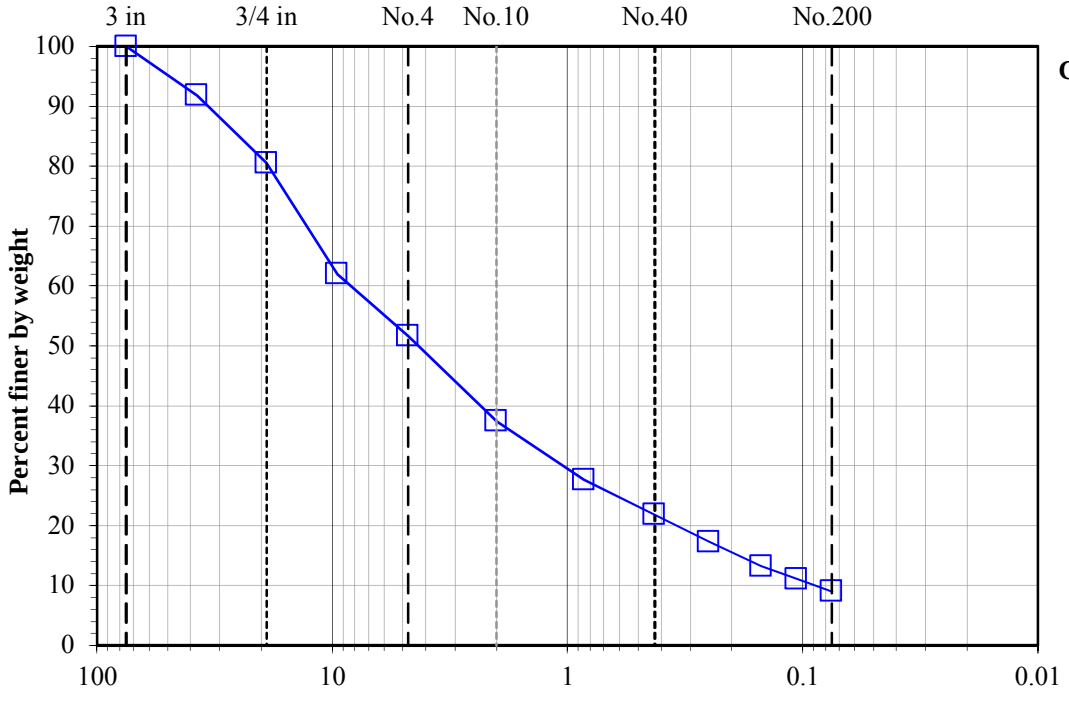
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

Boring No.: BH-4
Sample:
Depth: 10.0'
Description: Light brown gravel with silt and sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	2559.98	2454.12
+3/8" Coarse fraction (g):	960.71	932.94
-3/8" Split fraction (g):	377.42	358.99
Split fraction:	0.620	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1340.28	504.71
Dry soil + tare (g):	1307.96	486.28
Tare (g):	222.02	127.29
Water content (%):	3.0	5.1

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	201.64	37.5	91.8	
3/4"	478.49	19	80.5	
3/8"	932.94	9.5	62.0	←Split
No.4	60.00	4.75	51.6	
No.10	142.35	2	37.4	
No.20	198.75	0.85	27.7	
No.40	232.66	0.425	21.8	
No.60	258.95	0.25	17.3	
No.100	282.37	0.15	13.2	
No.140	294.94	0.106	11.1	
No.200	307.01	0.075	9.0	



Gravel (%): 48.4
Sand (%): 42.6
Fines (%): 9.0

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

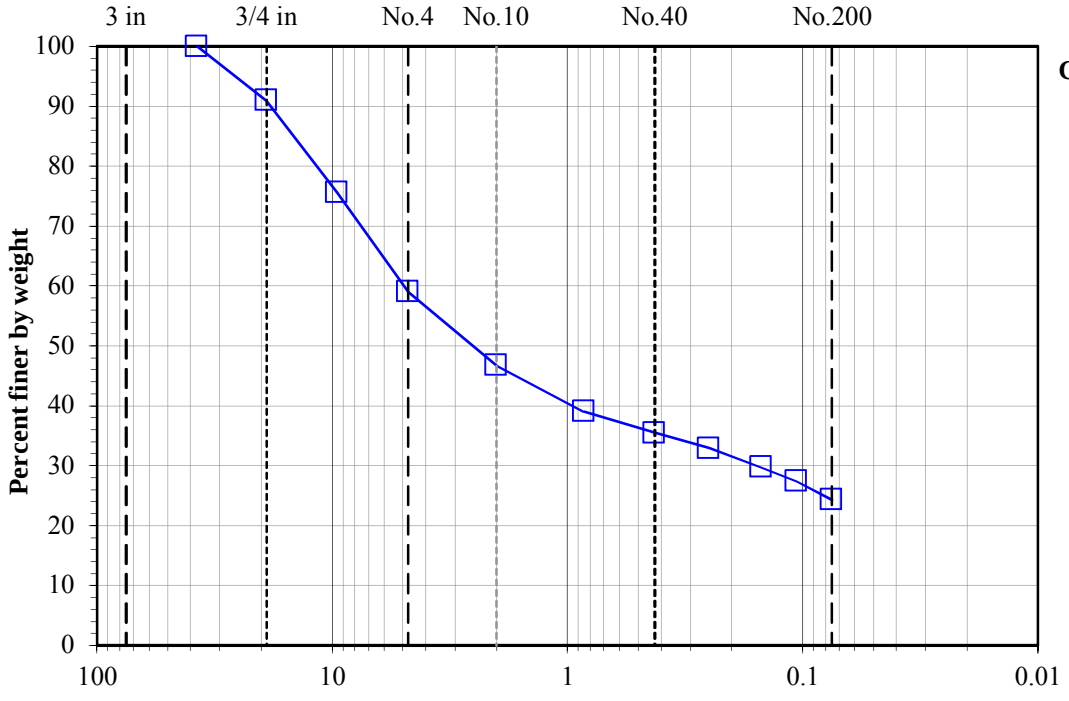
Boring No.: BH-5
Sample:
Depth: 2.5'
Description: Brown clayey gravel with sand

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	334.10	314.85
Split fraction:	1.000	

Water content data

Moist soil + tare (g):	-	453.99
Dry soil + tare (g):	-	434.74
Tare (g):	-	119.89
Water content (%):	0.0	6.1

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	28.50	19	90.9
3/8"	76.91	9.5	75.6
No.4	129.16	4.75	59.0
No.10	167.75	2	46.7
No.20	192.07	0.85	39.0
No.40	203.33	0.425	35.4
No.60	211.29	0.25	32.9
No.100	221.20	0.15	29.7
No.140	228.71	0.106	27.4
No.200	238.40	0.075	24.3



Gravel (%): 41.0
Sand (%): 34.7
Fines (%): 24.3

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

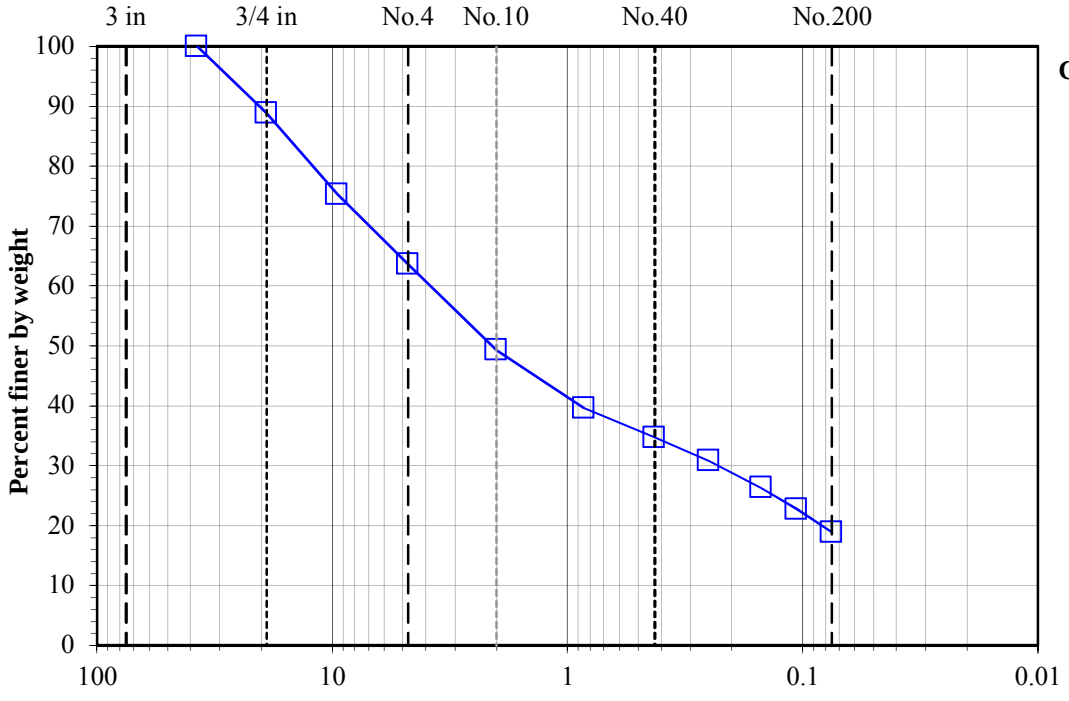
Boring No.: BH-5
Sample:
Depth: 10.0'
Description: Light brown silty sand with gravel

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	628.36	596.88
Split fraction:	1.000	

Water content data

Moist soil + tare (g):	-	916.74
Dry soil + tare (g):	-	885.26
Tare (g):	-	288.38
Water content (%):	0.0	5.3

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	66.34	19	88.9
3/8"	147.54	9.5	75.3
No.4	217.38	4.75	63.6
No.10	302.86	2	49.3
No.20	360.38	0.85	39.6
No.40	389.79	0.425	34.7
No.60	412.99	0.25	30.8
No.100	439.76	0.15	26.3
No.140	461.07	0.106	22.8
No.200	484.10	0.075	18.9



Gravel (%): 36.4
Sand (%): 44.7
Fines (%): 18.9

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

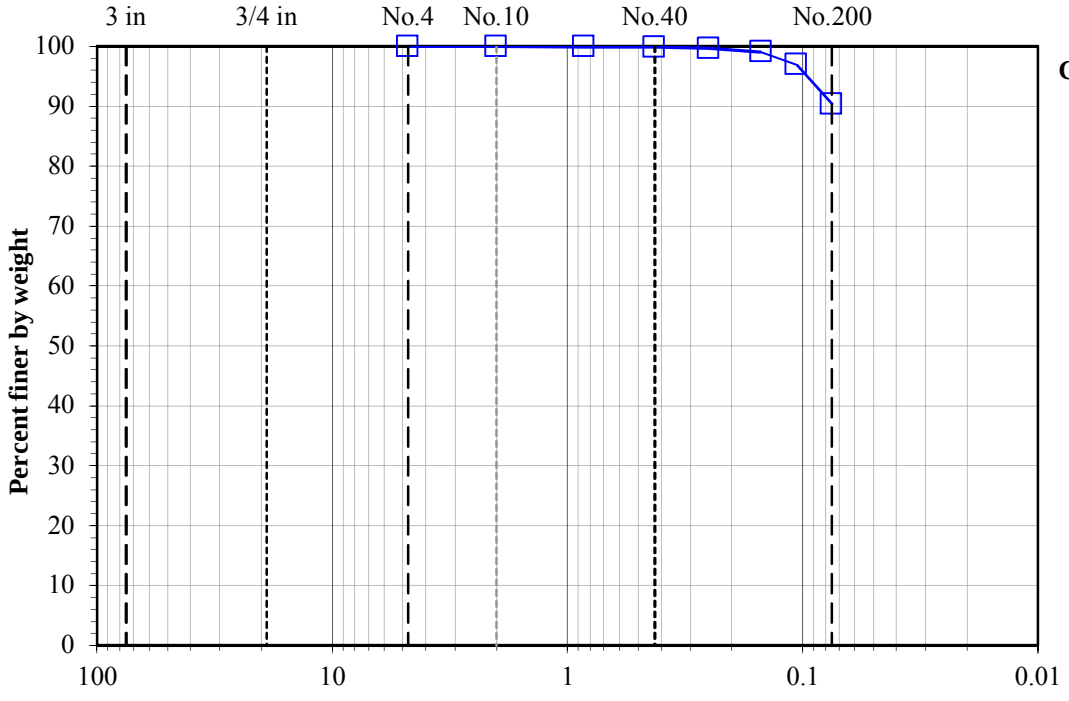
Boring No.: BH-6
Sample: A
Depth: 10.0'
Description: Light brown silt

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	761.65	607.51
Split fraction:	1.000	

Water content data

Moist soil + tare (g):	-	1034.89
Dry soil + tare (g):	-	880.75
Tare (g):	-	273.24
Water content (%):	0.0	25.4

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	-
3/8"	-	9.5	-
No.4	-	4.75	100.0
No.10	0.15	2	100.0
No.20	0.35	0.85	99.9
No.40	0.93	0.425	99.8
No.60	2.00	0.25	99.7
No.100	5.60	0.15	99.1
No.140	18.66	0.106	96.9
No.200	58.57	0.075	90.4



Gravel (%): 0.0
Sand (%): 9.6
Fines (%): 90.4

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

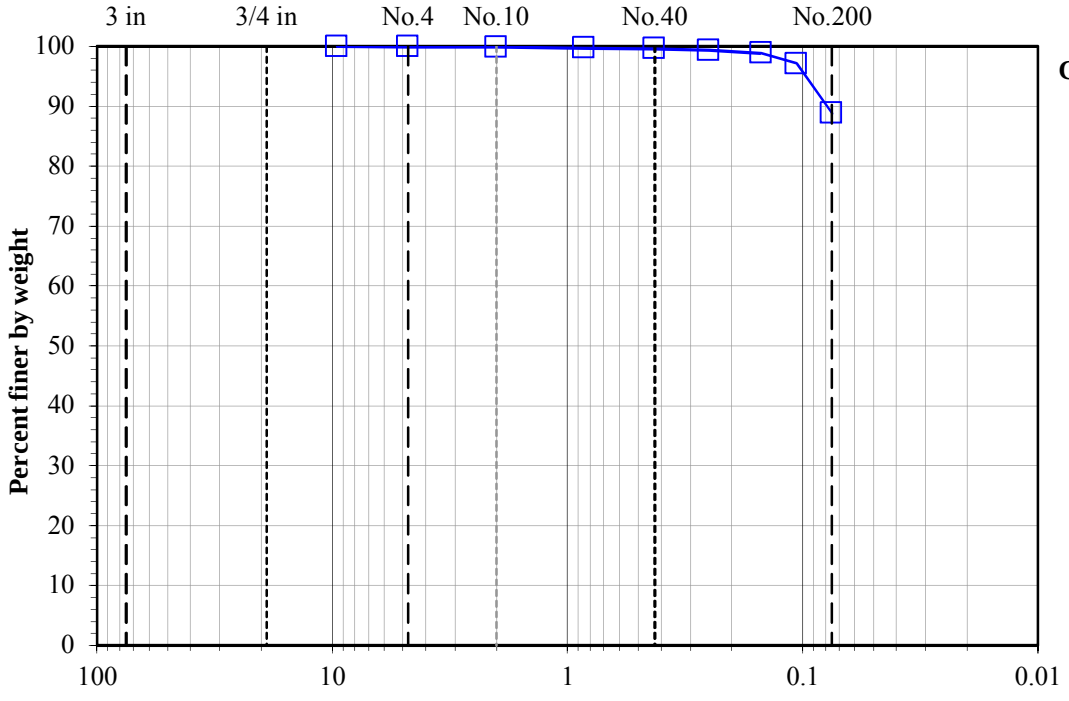
Boring No.: BH-7
Sample:
Depth: 10.0'
Description: Brown silt

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	485.76	395.35
Split fraction:	1.000	

Water content data

Moist soil + tare (g):	-	614.12
Dry soil + tare (g):	-	523.71
Tare (g):	-	128.36
Water content (%):	0.0	22.9

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	-
3/8"	-	9.5	100.0
No.4	0.22	4.75	99.9
No.10	0.62	2	99.8
No.20	1.10	0.85	99.7
No.40	1.66	0.425	99.6
No.60	2.61	0.25	99.3
No.100	4.55	0.15	98.8
No.140	11.54	0.106	97.1
No.200	44.23	0.075	88.8



Gravel (%): 0.1
Sand (%): 11.1
Fines (%): 88.8

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

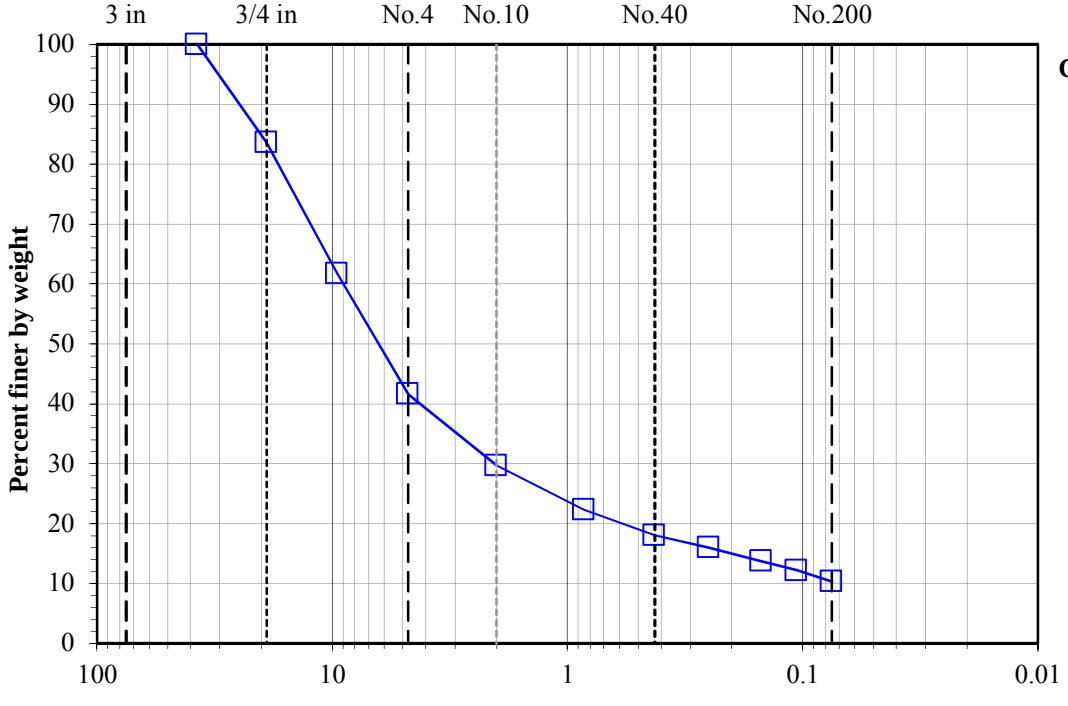
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

Boring No.: BH-7
Sample:
Depth: 20.0'
Description: Light brown gravel with silt and sand

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	2000.32	1900.32
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	2408.26
Dry soil + tare (g):	-	2308.26
Tare (g):	-	407.94
Water content (%):	0.0	5.3

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	310.87	19	83.6
3/8"	727.86	9.5	61.7
No.4	1109.90	4.75	41.6
No.10	1336.72	2	29.7
No.20	1476.82	0.85	22.3
No.40	1557.80	0.425	18.0
No.60	1597.21	0.25	16.0
No.100	1639.48	0.15	13.7
No.140	1669.11	0.106	12.2
No.200	1704.02	0.075	10.3



Gravel (%): 58.4
Sand (%): 31.3
Fines (%): 10.3

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

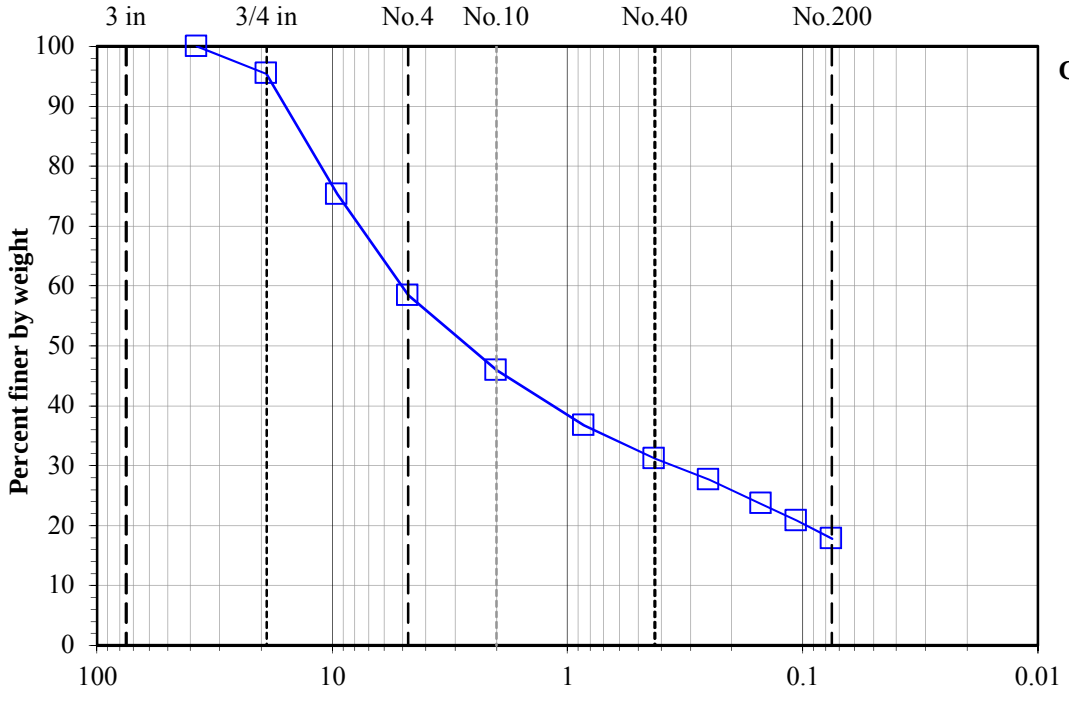
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

Boring No.: BH-8
Sample:
Depth: 10.0'
Description: Brown silty gravel with sand

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	540.35	510.56
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	664.98
Dry soil + tare (g):	-	635.19
Tare (g):	-	124.63
Water content (%):	0.0	5.8

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	23.26	19	95.4
3/8"	126.04	9.5	75.3
No.4	212.27	4.75	58.4
No.10	276.01	2	45.9
No.20	323.01	0.85	36.7
No.40	351.46	0.425	31.2
No.60	369.36	0.25	27.7
No.100	389.97	0.15	23.6
No.140	404.32	0.106	20.8
No.200	419.55	0.075	17.8



Gravel (%): 41.6
Sand (%): 40.6
Fines (%): 17.8

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

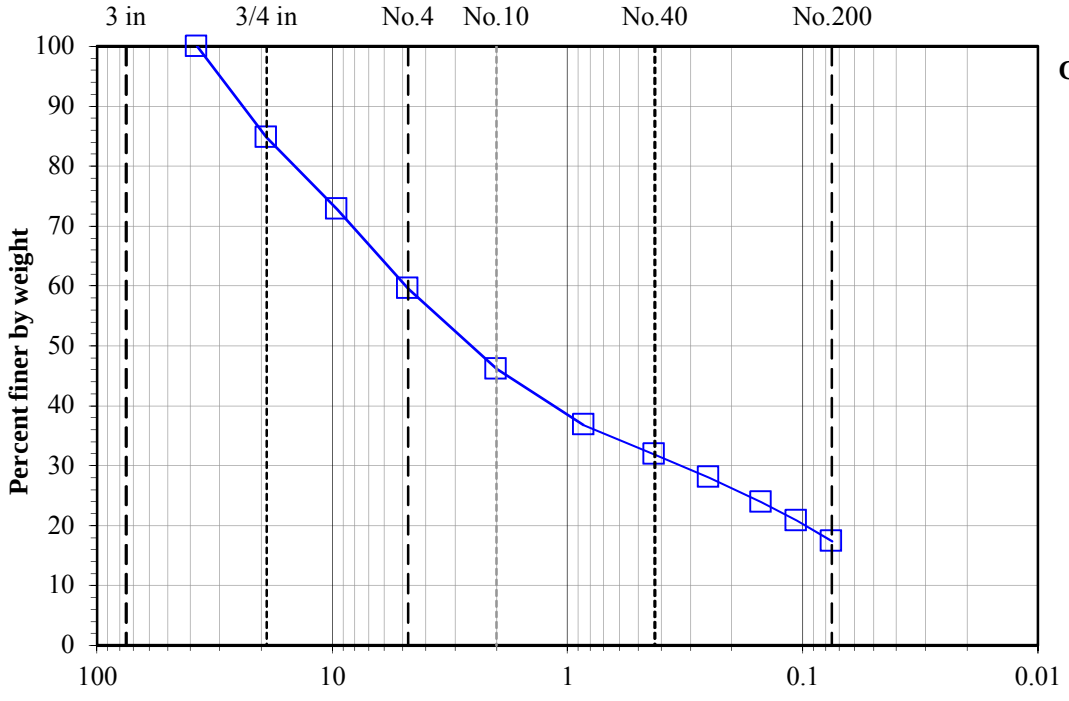
Boring No.: BH-10
Sample:
Depth: 15.0'
Description: Light brown silty sand with gravel

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	437.40	414.31
Split fraction:	1.000	

Water content data

Moist soil + tare (g):	-	560.81
Dry soil + tare (g):	-	537.72
Tare (g):	-	123.41
Water content (%):	0.0	5.6

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	63.05	19	84.8
3/8"	112.69	9.5	72.8
No.4	167.69	4.75	59.5
No.10	223.23	2	46.1
No.20	261.94	0.85	36.8
No.40	282.20	0.425	31.9
No.60	298.28	0.25	28.0
No.100	315.37	0.15	23.9
No.140	328.20	0.106	20.8
No.200	342.18	0.075	17.4



Gravel (%): 40.5
Sand (%): 42.1
Fines (%): 17.4

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

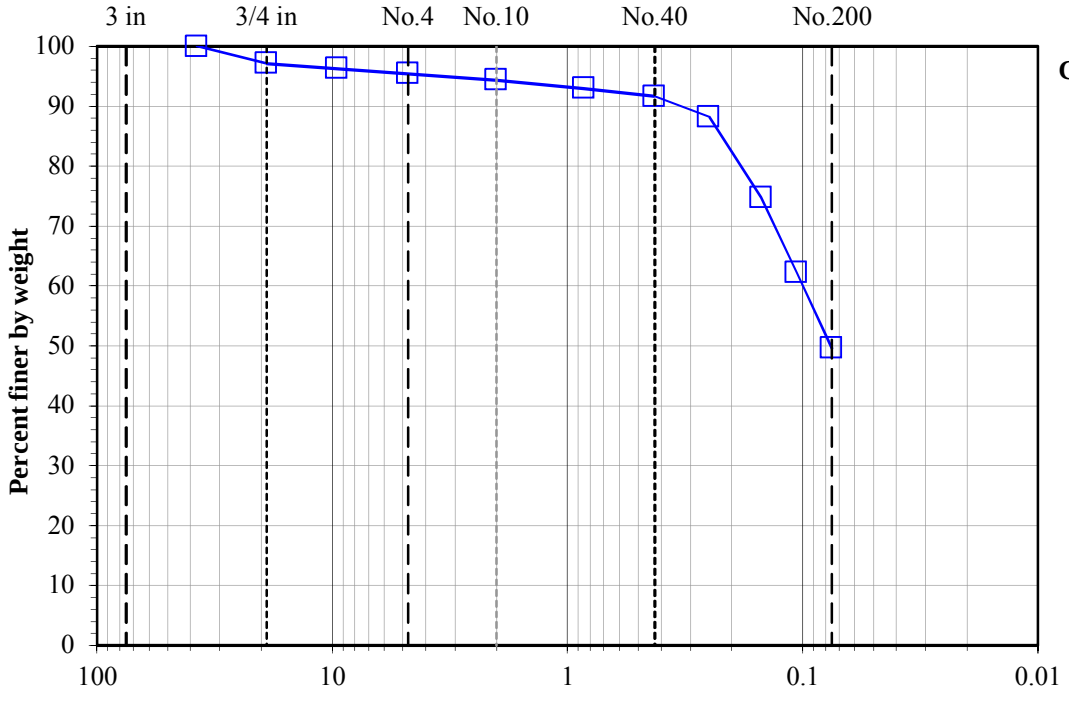
Boring No.: BH-11
Sample:
Depth: 10.0'
Description: Brown silty sand

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	656.34	572.69
Split fraction:	1.000	

Water content data

Moist soil + tare (g):	-	778.20
Dry soil + tare (g):	-	694.55
Tare (g):	-	121.86
Water content (%):	0.0	14.6

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	16.40	19	97.1
3/8"	21.29	9.5	96.3
No.4	26.16	4.75	95.4
No.10	32.34	2	94.4
No.20	40.19	0.85	93.0
No.40	47.91	0.425	91.6
No.60	67.37	0.25	88.2
No.100	144.49	0.15	74.8
No.140	216.59	0.106	62.2
No.200	288.65	0.075	49.6



Gravel (%): 4.6
Sand (%): 45.8
Fines (%): 49.6

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

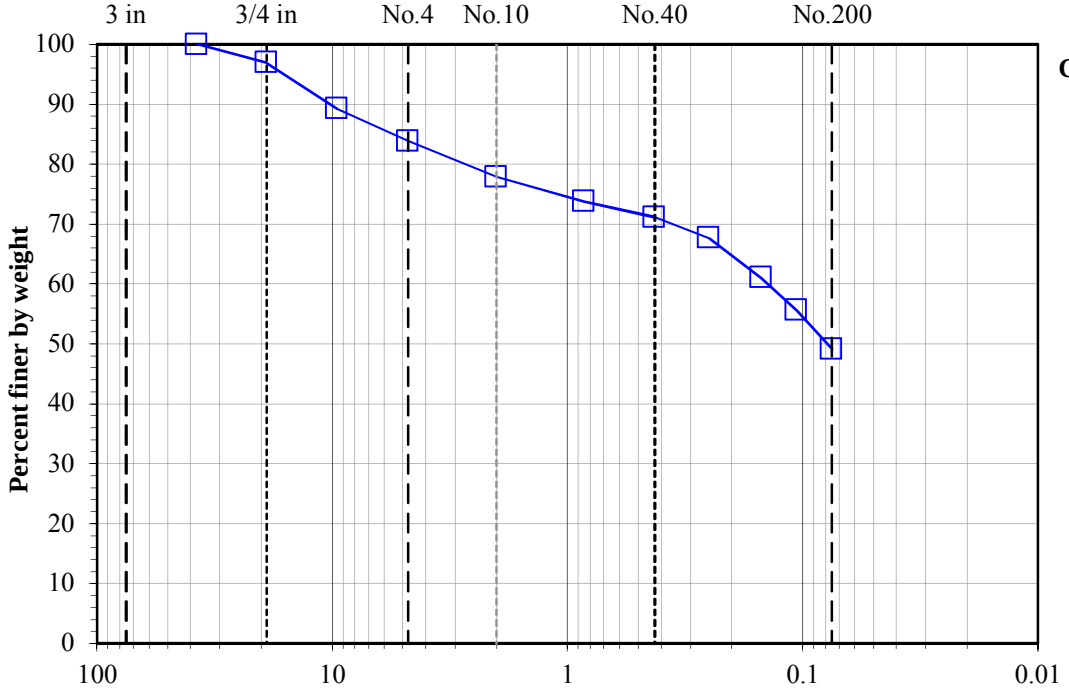
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

Boring No.: BH-13
Sample:
Depth: 10.0'
Description: Dark brown clayey sand with gravel

	Moist	Dry
Split:	Yes	
Split sieve:	3/8"	
Total sample wt. (g):	2271.85	2013.48
+3/8" Coarse fraction (g):	224.16	216.25
-3/8" Split fraction (g):	494.22	433.77
Split fraction:	0.893	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	417.59	622.73
Dry soil + tare (g):	407.34	562.28
Tare (g):	127.01	128.51
Water content (%):	3.7	13.9

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
3/4"	62.24	19	96.9	
3/8"	216.25	9.5	89.3	←Split
No.4	26.25	4.75	83.9	
No.10	55.46	2	77.8	
No.20	75.39	0.85	73.7	
No.40	88.06	0.425	71.1	
No.60	104.96	0.25	67.7	
No.100	137.20	0.15	61.0	
No.140	163.76	0.106	55.6	
No.200	195.01	0.075	49.1	



Gravel (%): 16.1
Sand (%): 34.7
Fines (%): 49.1

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

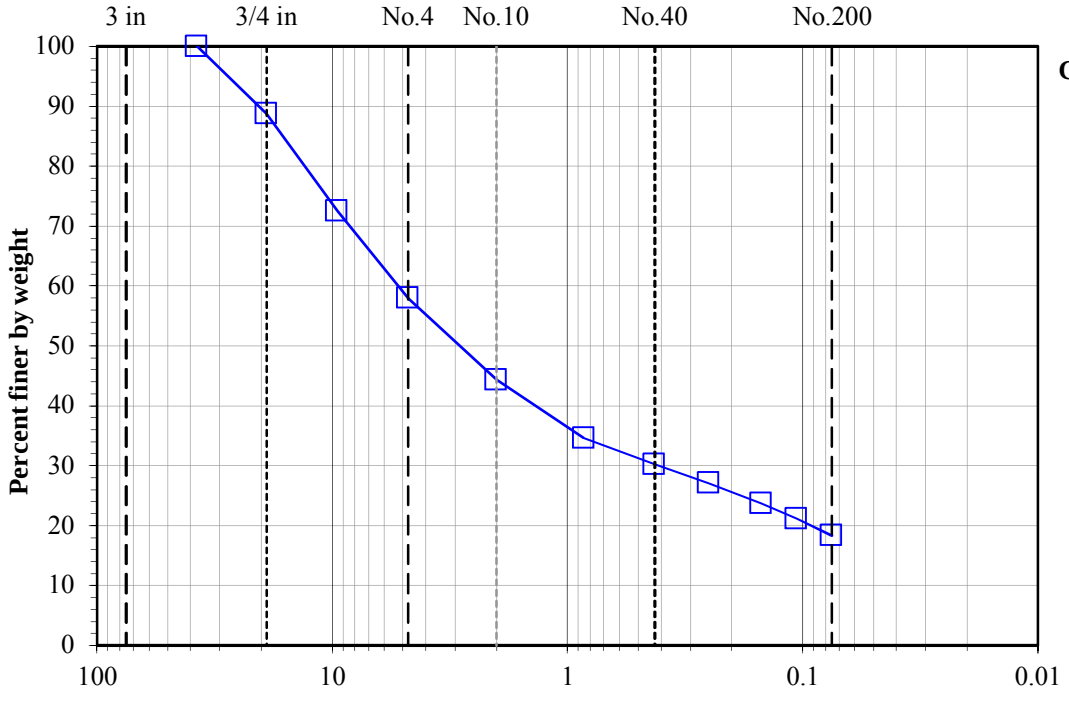
Boring No.: BH-14
Sample:
Depth: 7.5'
Description: Light brown silty gravel with sand

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	475.53	443.53
Split fraction:	1.000	

Water content data

Moist soil + tare (g):	-	599.22
Dry soil + tare (g):	-	567.22
Tare (g):	-	123.69
Water content (%):	0.0	7.2

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	49.93	19	88.7
3/8"	121.95	9.5	72.5
No.4	186.51	4.75	57.9
No.10	247.05	2	44.3
No.20	290.12	0.85	34.6
No.40	309.53	0.425	30.2
No.60	323.61	0.25	27.0
No.100	338.53	0.15	23.7
No.140	349.90	0.106	21.1
No.200	362.16	0.075	18.3



Gravel (%): 42.1
Sand (%): 39.6
Fines (%): 18.3

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

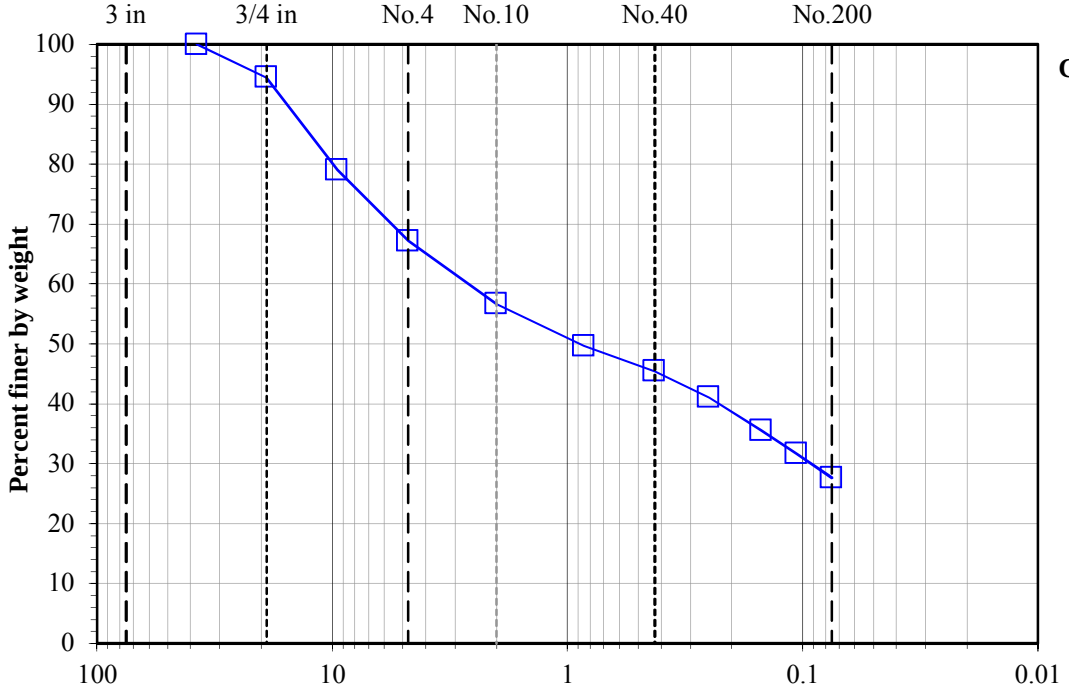
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 11/9/2016
By: BRR

Boring No.: BH-15
Sample:
Depth: 7.5'
Description: Brown silty sand with gravel

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	544.45	491.35
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	672.64
Dry soil + tare (g):	-	619.54
Tare (g):	-	128.19
Water content (%):	0.0	10.8

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	27.18	19	94.5
3/8"	103.00	9.5	79.0
No.4	161.34	4.75	67.2
No.10	213.05	2	56.6
No.20	247.42	0.85	49.6
No.40	268.19	0.425	45.4
No.60	289.75	0.25	41.0
No.100	316.80	0.15	35.5
No.140	335.82	0.106	31.7
No.200	355.57	0.075	27.6



Gravel (%): 32.8
Sand (%): 39.5
Fines (%): 27.6

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

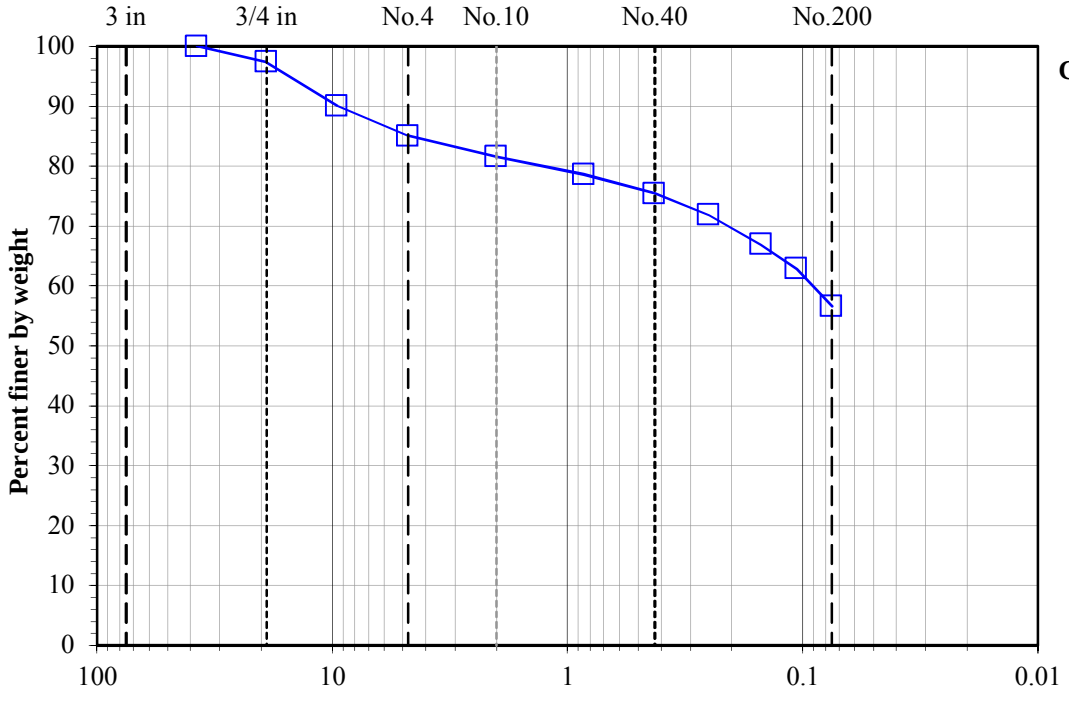
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 11/9/2016
By: BRR

Boring No.: BH-15
Sample:
Depth: 10.0'
Description: Brown sandy clay with gravel

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	942.81	815.07
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	1180.06
Dry soil + tare (g):	-	1052.32
Tare (g):	-	237.25
Water content (%):	0.0	15.7

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	21.41	19	97.4
3/8"	81.36	9.5	90.0
No.4	121.96	4.75	85.0
No.10	150.53	2	81.5
No.20	174.27	0.85	78.6
No.40	200.38	0.425	75.4
No.60	229.50	0.25	71.8
No.100	269.54	0.15	66.9
No.140	302.86	0.106	62.8
No.200	353.81	0.075	56.6



Gravel (%): 15.0
Sand (%): 28.4
Fines (%): 56.6

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

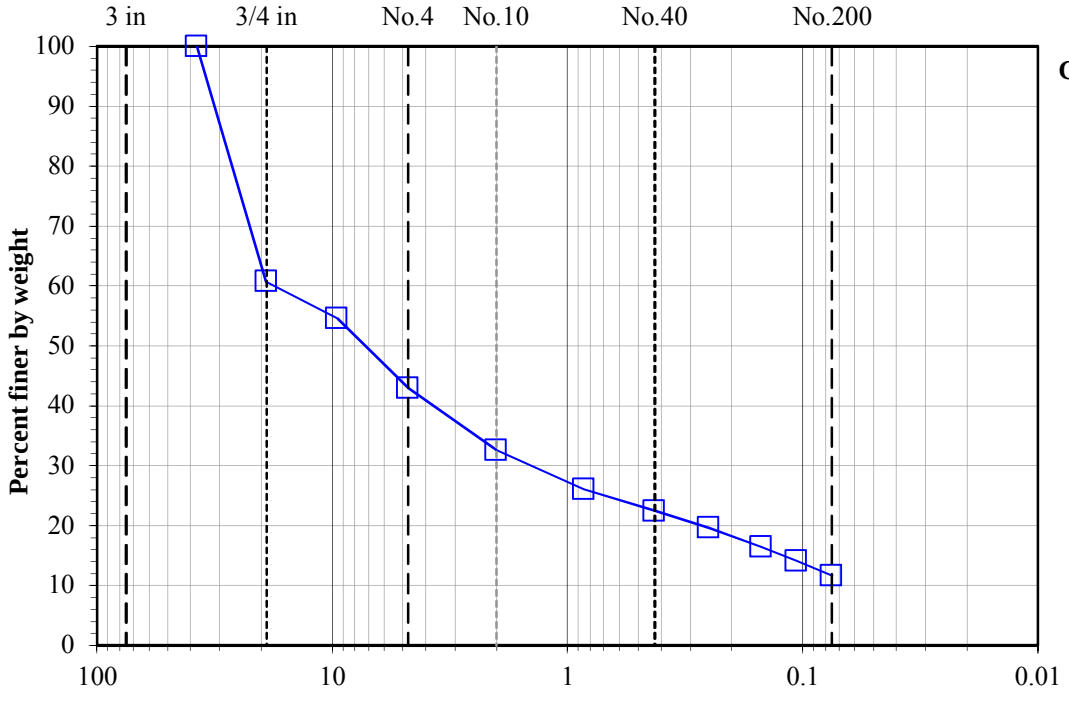
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 11/9/2016
By: BRR

Boring No.: BH-15
Sample: A
Depth: 15.0'
Description: Brown gravel with silt and sand

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	280.58	267.64
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	408.46
Dry soil + tare (g):	-	395.52
Tare (g):	-	127.88
Water content (%):	0.0	4.8

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	105.14	19	60.7
3/8"	121.54	9.5	54.6
No.4	152.79	4.75	42.9
No.10	180.44	2	32.6
No.20	197.96	0.85	26.0
No.40	207.70	0.425	22.4
No.60	215.21	0.25	19.6
No.100	223.67	0.15	16.4
No.140	229.97	0.106	14.1
No.200	236.48	0.075	11.6



Gravel (%): 57.1
Sand (%): 31.3
Fines (%): 11.6

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

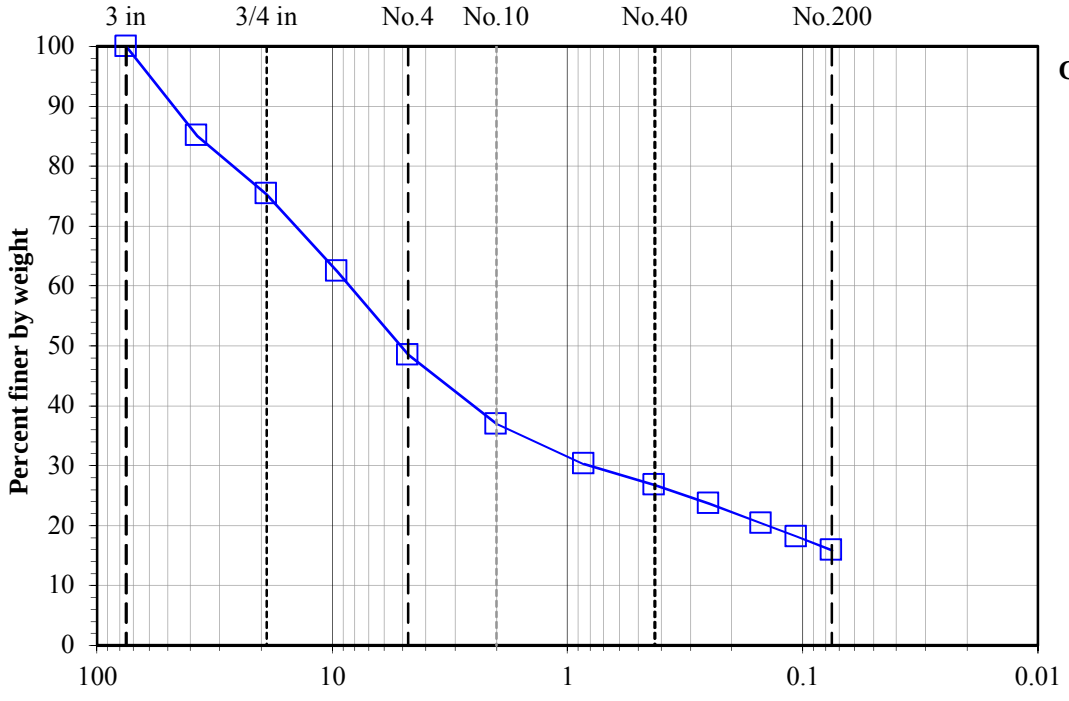
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 11/9/2016
By: BRR

Boring No.: BH-16
Sample:
Depth: 5.0'
Description: Brown clayey gravel with sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	1643.25	1578.07
+3/8" Coarse fraction (g):	601.88	592.93
-3/8" Split fraction (g):	343.95	325.38
Split fraction:	0.624	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1037.95	468.70
Dry soil + tare (g):	1028.33	450.13
Tare (g):	391.41	124.75
Water content (%):	1.5	5.7

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	235.27	37.5	85.1	
3/4"	388.92	19	75.4	
3/8"	592.93	9.5	62.4	←Split
No.4	72.67	4.75	48.5	
No.10	132.81	2	36.9	
No.20	167.53	0.85	30.3	
No.40	186.10	0.425	26.7	
No.60	202.24	0.25	23.6	
No.100	219.29	0.15	20.4	
No.140	230.77	0.106	18.2	
No.200	242.92	0.075	15.8	



Gravel (%): 51.5
Sand (%): 32.7
Fines (%): 15.8

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

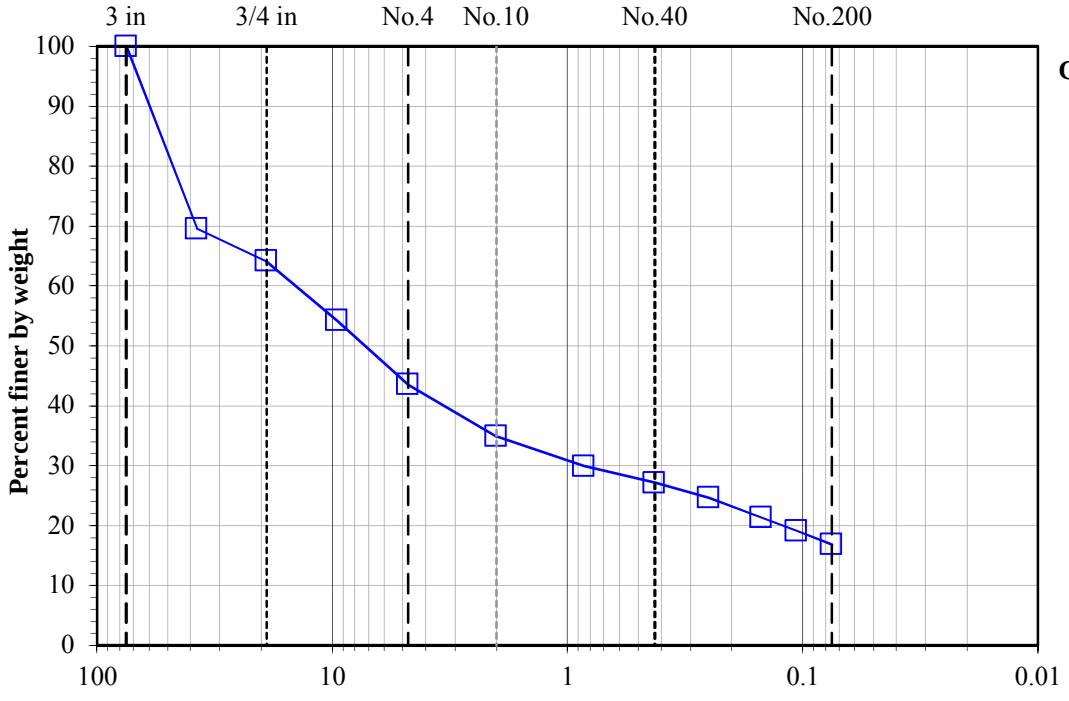
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 11/9/2016
By: BRR

Boring No.: BH-16
Sample:
Depth: 10.0'
Description: Brown clayey gravel with sand

	Moist	Dry
Split:	Yes	
Split sieve:	3/8"	
Total sample wt. (g):	1627.89	1537.87
+3/8" Coarse fraction (g):	724.90	704.54
-3/8" Split fraction (g):	438.10	404.30
Split fraction:	0.542	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1097.01	564.55
Dry soil + tare (g):	1075.51	530.75
Tare (g):	331.44	126.45
Water content (%):	2.9	8.4

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	100.0	
1.5"	468.60	37.5	69.5	
3/4"	551.78	19	64.1	
3/8"	704.54	9.5	54.2	←Split
No.4	79.74	4.75	43.5	
No.10	144.21	2	34.9	
No.20	181.32	0.85	29.9	
No.40	201.92	0.425	27.1	
No.60	220.81	0.25	24.6	
No.100	244.92	0.15	21.4	
No.140	261.64	0.106	19.1	
No.200	278.78	0.075	16.8	



Gravel (%): 56.5
Sand (%): 26.7
Fines (%): 16.8

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

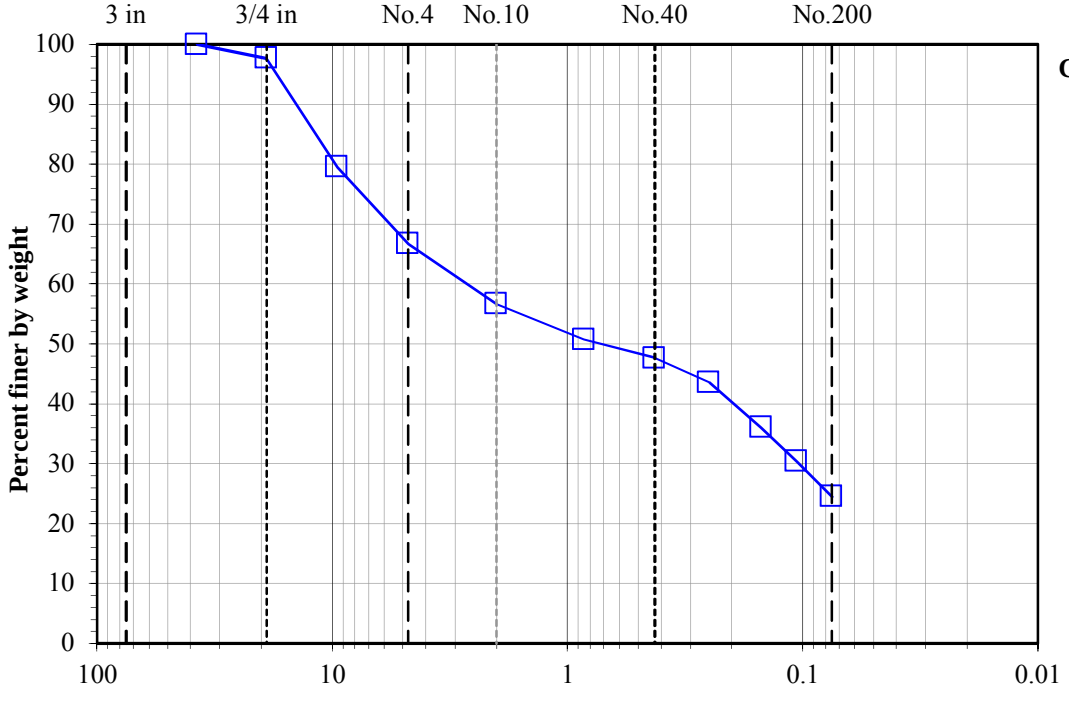
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 11/9/2016
By: BRR

Boring No.: BH-16
Sample:
Depth: 15.0'
Description: Brown silty sand with gravel

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	542.66	516.76
Split fraction:	1.000	

Water content data		
Moist soil + tare (g):	-	671.05
Dry soil + tare (g):	-	645.15
Tare (g):	-	128.39
Water content (%):	0.0	5.0

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	100.0
3/4"	12.05	19	97.7
3/8"	105.78	9.5	79.5
No.4	172.17	4.75	66.7
No.10	223.95	2	56.7
No.20	254.61	0.85	50.7
No.40	270.56	0.425	47.6
No.60	291.53	0.25	43.6
No.100	330.55	0.15	36.0
No.140	359.75	0.106	30.4
No.200	390.09	0.075	24.5



Gravel (%): 33.3
Sand (%): 42.2
Fines (%): 24.5

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

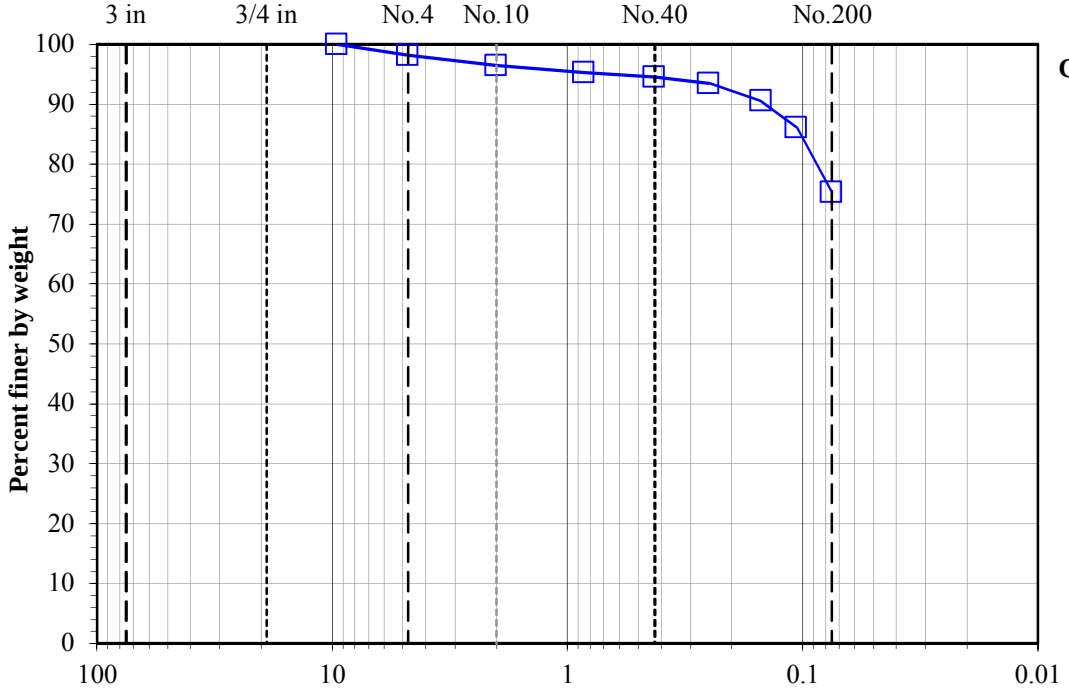
Boring No.: BH-17
Sample:
Depth: 10.0'
Description: Brown silt with sand

Split:	No	
	-	
	Moist	Dry
Total sample wt. (g):	513.71	431.69
Split fraction:	1.000	

Water content data

Moist soil + tare (g):	-	654.02
Dry soil + tare (g):	-	572.00
Tare (g):	-	140.31
Water content (%):	0.0	19.0

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	-
1.5"	-	37.5	-
3/4"	-	19	-
3/8"	-	9.5	100.0
No.4	7.98	4.75	98.2
No.10	15.33	2	96.4
No.20	20.52	0.85	95.2
No.40	23.71	0.425	94.5
No.60	28.17	0.25	93.5
No.100	40.86	0.15	90.5
No.140	60.05	0.106	86.1
No.200	106.85	0.075	75.2



Gravel (%): 1.8
Sand (%): 22.9
Fines (%): 75.2

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

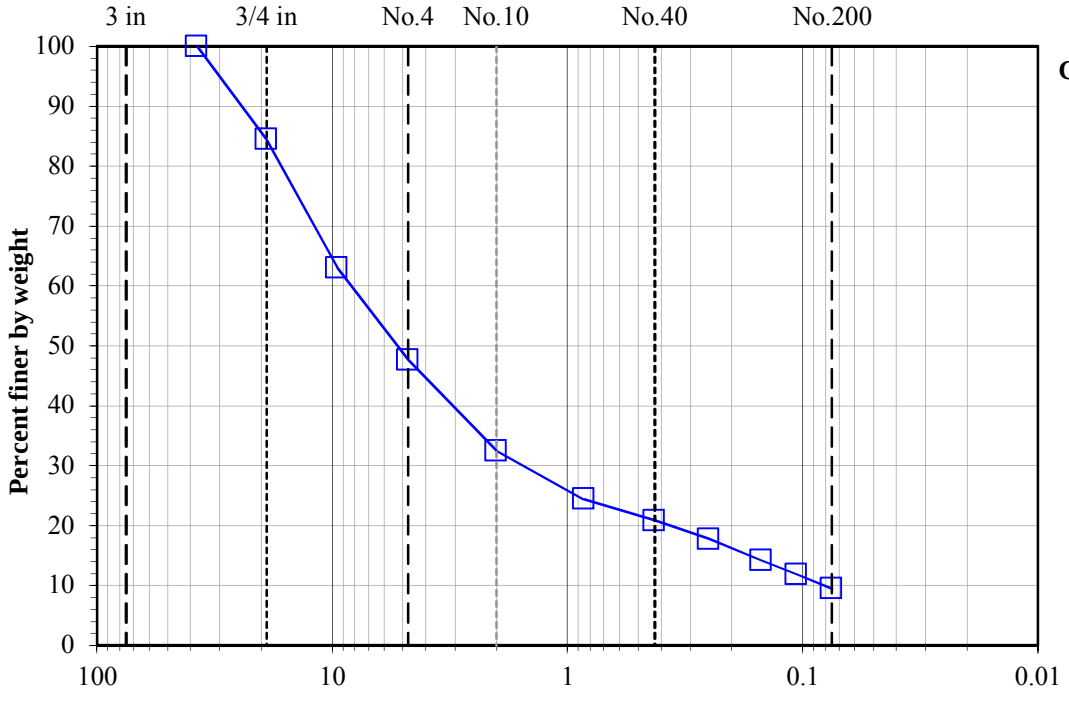
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

Boring No.: BH-17
Sample:
Depth: 20.0'
Description: Brown gravel with silt and sand

	Moist	Dry
Split:	Yes	
Split sieve:	3/8"	
Total sample wt. (g):	2425.6	2292.52
+3/8" Coarse fraction (g):	881.62	847.55
-3/8" Split fraction (g):	393.45	368.22
Split fraction:	0.630	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1312.56	545.18
Dry soil + tare (g):	1276.95	519.95
Tare (g):	391.16	151.73
Water content (%):	4.0	6.9

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
3/4"	355.94	19	84.5	
3/8"	847.55	9.5	63.0	←Split
No.4	89.87	4.75	47.6	
No.10	178.59	2	32.5	
No.20	225.89	0.85	24.4	
No.40	246.80	0.425	20.8	
No.60	264.92	0.25	17.7	
No.100	285.26	0.15	14.2	
No.140	299.10	0.106	11.8	
No.200	312.98	0.075	9.5	



Gravel (%): 52.4
Sand (%): 38.2
Fines (%): 9.5

Entered by:_____
Reviewed:_____

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

(ASTM D6913)

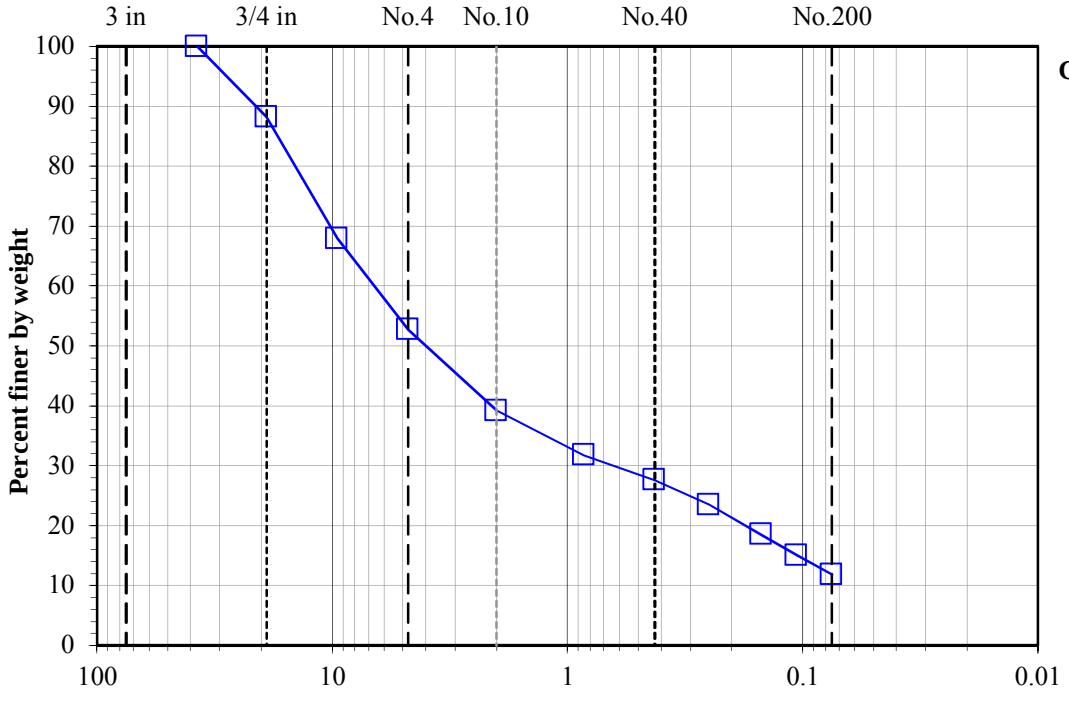
Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/20/2016
By: NB

Boring No.: BH-18
Sample:
Depth: 10.0'
Description: Brown gravel with silt and sand

Split:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	2378.96	2259.89
+3/8" Coarse fraction (g):	750.08	725.14
-3/8" Split fraction (g):	599.63	564.98
Split fraction:	0.679	

Water content data	C.F.(+3/8")	S.F.(-3/8")
Moist soil + tare (g):	1115.24	726.94
Dry soil + tare (g):	1088.47	692.29
Tare (g):	310.21	127.31
Water content (%):	3.4	6.1

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer	
8"	-	200	-	
6"	-	150	-	
4"	-	100	-	
3"	-	75	-	
1.5"	-	37.5	100.0	
3/4"	265.88	19	88.2	
3/8"	725.14	9.5	67.9	←Split
No.4	126.39	4.75	52.7	
No.10	239.17	2	39.2	
No.20	300.85	0.85	31.7	
No.40	335.66	0.425	27.6	
No.60	369.45	0.25	23.5	
No.100	411.19	0.15	18.5	
No.140	440.02	0.106	15.0	
No.200	466.36	0.075	11.9	



Gravel (%): 47.3
Sand (%): 40.9
Fines (%): 11.9

Entered by:_____
Reviewed:_____

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/24/2016
By: NB/JDF

Boring No.: BH-3
Sample: A
Depth: 10.0'
Sample Description: Light brown clay
Sample type: Undisturbed-trimmed from ring

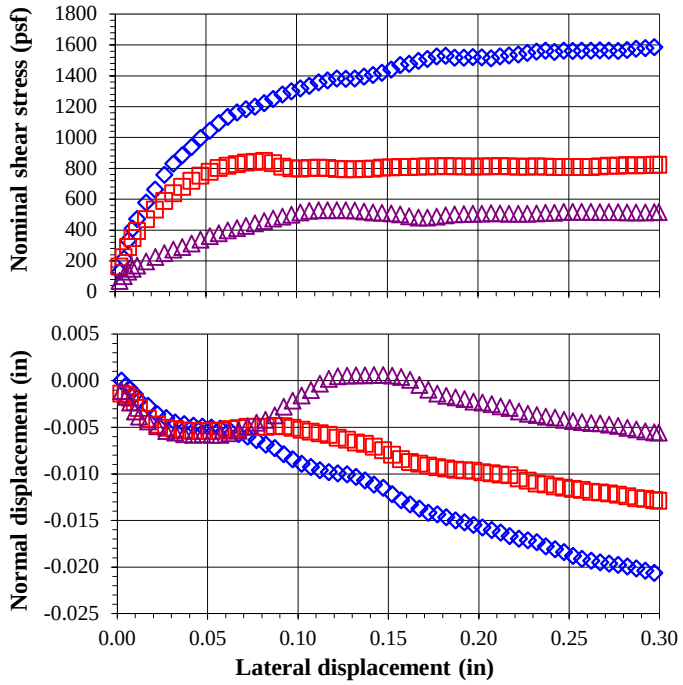
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0043
Specific gravity, Gs: 2.70 Assumed

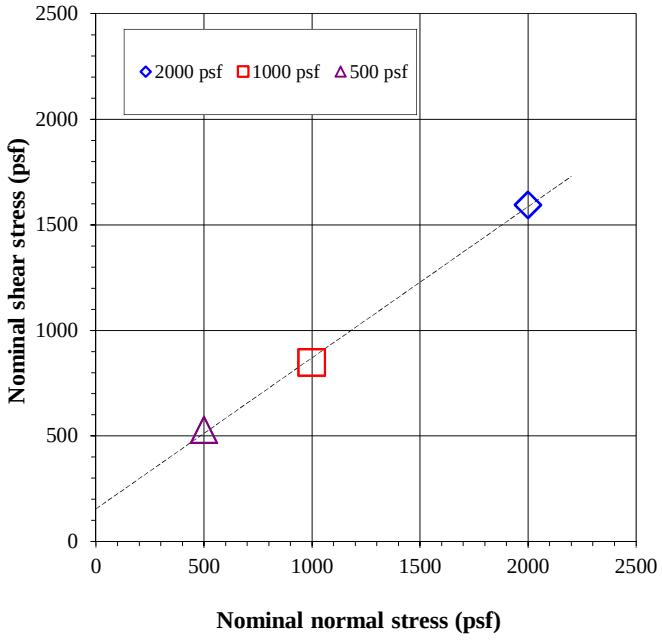
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	2000		1000		500	
Peak shear stress (psf)	1594		847		528	
Lateral displacement at peak (in)	0.302		0.082		0.122	
Load Duration (min)	207		208		234	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9522	1.0000	0.9707	1.0000	0.9820
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	181.85	183.08	176.50	180.32	177.85	183.41
Wt. rings (g)	47.31	47.31	44.26	44.26	47.32	47.32
Wet soil + tare (g)	259.81		259.81		259.81	
Dry soil + tare (g)	228.09		228.09		228.09	
Tare (g)	128.57		128.57		128.57	
Water content (%)	31.9	33.1	31.9	35.7	31.9	37.5
Dry unit weight (pcf)	84.8	89.0	83.3	85.8	82.3	83.7
Void ratio, e, for assumed Gs	0.99	0.89	1.02	0.96	1.05	1.01
Saturation (%)*	87.1	100.0	84.1	100.0	82.0	100.0

ϕ' (deg)	36
c' (psf)	155

Average of 3 samples	Initial	Pre-shear
Water content (%)	31.9	35.4
Dry unit weight (pcf)	83.5	86.2

*Pre-shear saturation set to 100% for phase calculations





Entered by:_____
Reviewed:_____

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: JVWCD-U111 & 11800 South **Boring No.:** BH-3

No: 00301-025 **Sample:** A

Location: U111 and 11800 South **Depth:** 10.0'

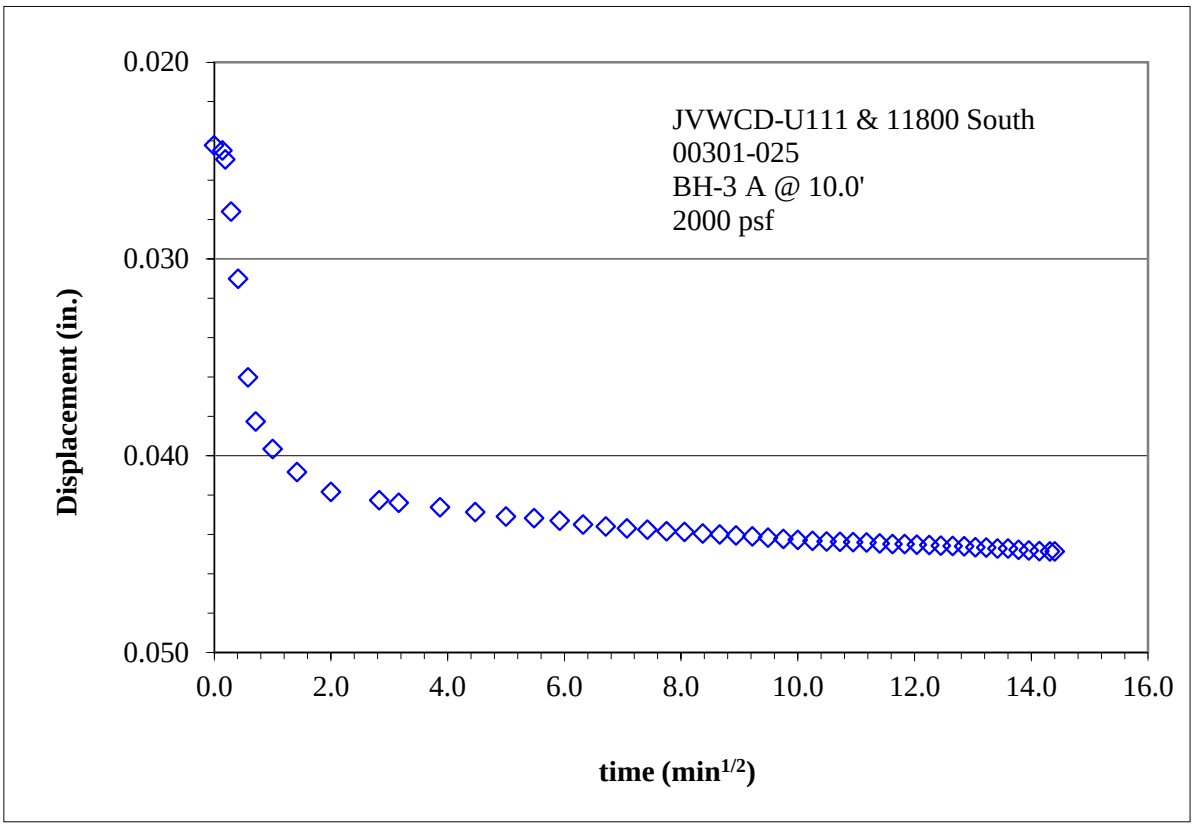
Nominal normal stress = 2000 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 500 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.002	129	0.000	0.002	163	-0.001	0.002	70	-0.001
0.005	214	-0.001	0.005	223	-0.002	0.005	100	-0.002
0.007	333	-0.001	0.007	289	-0.002	0.007	128	-0.002
0.010	410	-0.001	0.010	348	-0.002	0.010	149	-0.003
0.012	472	-0.002	0.012	392	-0.003	0.012	169	-0.004
0.017	578	-0.003	0.017	469	-0.004	0.017	196	-0.004
0.022	663	-0.004	0.022	531	-0.005	0.022	225	-0.005
0.027	758	-0.004	0.027	589	-0.005	0.027	249	-0.005
0.032	831	-0.005	0.032	638	-0.005	0.032	273	-0.006
0.037	885	-0.005	0.037	679	-0.005	0.037	289	-0.006
0.042	939	-0.005	0.042	719	-0.005	0.042	312	-0.006
0.047	996	-0.005	0.047	751	-0.005	0.047	337	-0.006
0.052	1045	-0.005	0.052	777	-0.005	0.052	360	-0.006
0.057	1094	-0.005	0.057	802	-0.005	0.057	379	-0.006
0.062	1133	-0.005	0.062	817	-0.005	0.062	398	-0.006
0.067	1163	-0.006	0.067	827	-0.005	0.067	411	-0.005
0.072	1184	-0.006	0.072	836	-0.005	0.072	425	-0.005
0.077	1200	-0.006	0.077	840	-0.005	0.077	442	-0.005
0.082	1223	-0.007	0.082	847	-0.005	0.082	457	-0.004
0.087	1251	-0.007	0.087	834	-0.005	0.087	474	-0.004
0.092	1280	-0.008	0.092	810	-0.005	0.092	486	-0.003
0.097	1300	-0.008	0.097	799	-0.005	0.097	499	-0.002
0.102	1318	-0.009	0.102	798	-0.005	0.102	514	-0.002
0.107	1336	-0.009	0.107	801	-0.005	0.107	523	-0.001
0.112	1357	-0.010	0.112	804	-0.006	0.112	528	0.000
0.117	1370	-0.010	0.117	802	-0.006	0.117	527	0.000
0.122	1383	-0.010	0.122	796	-0.006	0.122	528	0.000
0.127	1380	-0.010	0.127	794	-0.006	0.127	528	0.001
0.132	1383	-0.010	0.132	794	-0.007	0.132	526	0.001
0.137	1396	-0.011	0.137	795	-0.007	0.137	519	0.001
0.142	1406	-0.011	0.142	798	-0.007	0.142	513	0.001
0.147	1421	-0.012	0.147	803	-0.007	0.147	511	0.001
0.152	1440	-0.012	0.152	805	-0.008	0.152	507	0.001
0.157	1470	-0.013	0.157	807	-0.008	0.157	500	0.000
0.162	1478	-0.013	0.162	809	-0.009	0.162	488	0.000
0.167	1496	-0.014	0.167	810	-0.009	0.167	480	0.000
0.172	1509	-0.014	0.172	811	-0.009	0.172	481	-0.001
0.177	1525	-0.014	0.177	813	-0.009	0.177	486	-0.001
0.182	1530	-0.015	0.182	815	-0.009	0.182	494	-0.002
0.187	1517	-0.015	0.187	813	-0.010	0.187	500	-0.002
0.192	1517	-0.015	0.192	811	-0.010	0.192	502	-0.002
0.197	1522	-0.015	0.197	810	-0.010	0.197	504	-0.002
0.202	1519	-0.016	0.202	811	-0.010	0.202	506	-0.002
0.207	1514	-0.016	0.207	812	-0.010	0.207	508	-0.003
0.212	1525	-0.016	0.212	814	-0.010	0.212	507	-0.003
0.217	1532	-0.017	0.217	813	-0.010	0.217	506	-0.003
0.222	1538	-0.017	0.222	810	-0.011	0.222	506	-0.003
0.227	1548	-0.017	0.227	810	-0.011	0.227	505	-0.004
0.232	1558	-0.017	0.232	811	-0.011	0.232	507	-0.004
0.237	1563	-0.018	0.237	810	-0.011	0.237	511	-0.004
0.242	1556	-0.018	0.242	808	-0.011	0.242	512	-0.004
0.247	1563	-0.018	0.247	809	-0.012	0.247	517	-0.004
0.252	1561	-0.019	0.252	809	-0.012	0.252	518	-0.004
0.257	1563	-0.019	0.257	807	-0.012	0.257	518	-0.004
0.262	1563	-0.019	0.262	809	-0.012	0.262	517	-0.005
0.267	1566	-0.020	0.267	812	-0.012	0.267	516	-0.005
0.272	1563	-0.020	0.272	815	-0.012	0.272	516	-0.005
0.277	1561	-0.020	0.277	817	-0.012	0.277	515	-0.005
0.282	1568	-0.020	0.282	820	-0.012	0.282	514	-0.005
0.287	1576	-0.020	0.287	818	-0.013	0.287	513	-0.005
0.292	1579	-0.020	0.292	820	-0.013	0.292	513	-0.005
0.297	1587	-0.021	0.297	823	-0.013	0.297	515	-0.006
0.302	1594	-0.021	0.299	823	-0.013	0.300	516	-0.006

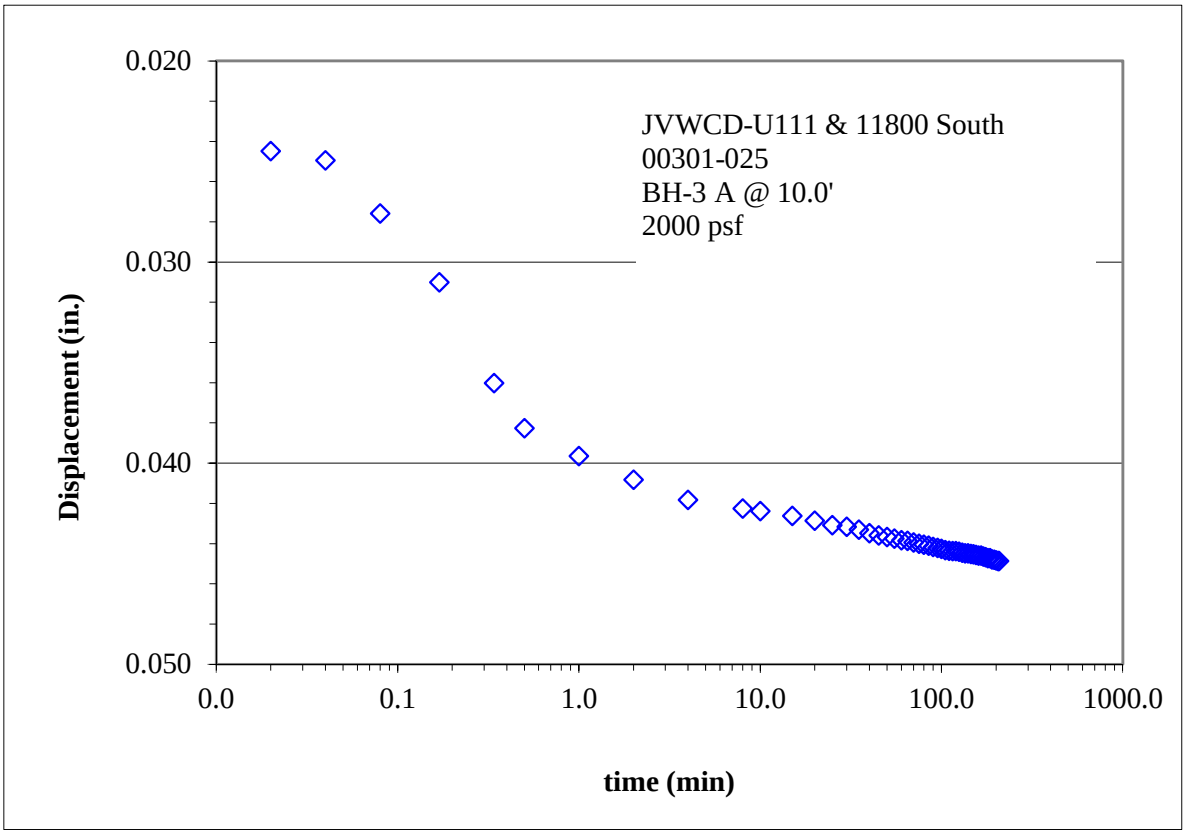
Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South

Boring No.: BH-3
Sample: A
Depth: 10.0'





Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South
Date: 10/24/2016
By: NB

Boring No.: BH-9
Sample:
Depth: 10.0'
Sample Description: Brown stiff clay
Sample type: Undisturbed-trimmed from ring

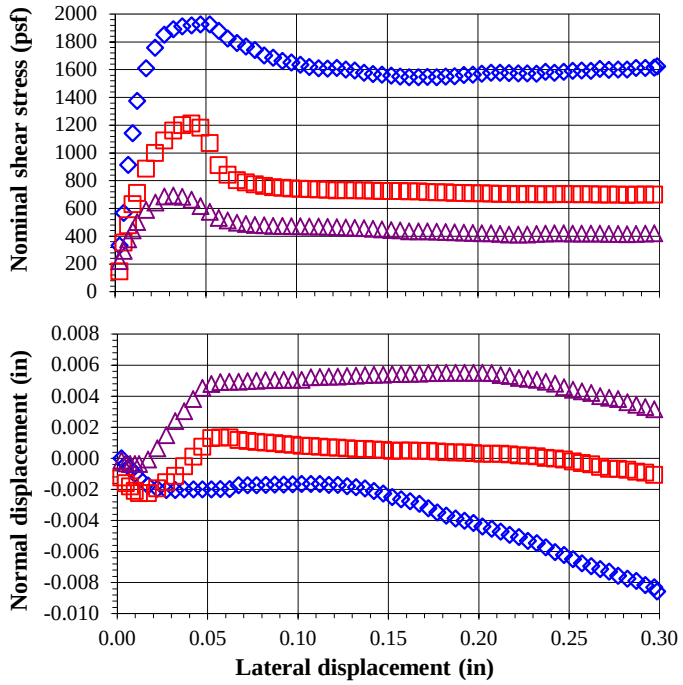
Test type: Inundated
Lateral displacement (in.): 0.3
Shear rate (in./min): 0.0012
Specific gravity, Gs: 2.70 Assumed

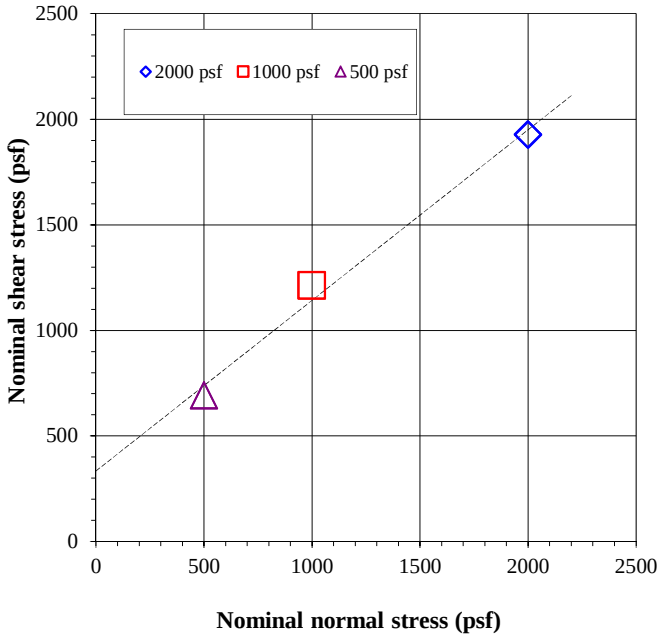
	Sample 1		Sample 2		Sample 3	
Nominal normal stress (psf)	2000		1000		500	
Peak shear stress (psf)	1927		1212		692	
Lateral displacement at peak (in)	0.047		0.042		0.032	
Load Duration (min)	134		136		227	
	Initial	Pre-shear	Initial	Pre-shear	Initial	Pre-shear
Sample height (in)	1.0000	0.9896	1.0000	0.9875	1.0000	0.9966
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	196.26	196.79	195.83	198.27	189.68	194.15
Wt. rings (g)	41.95	41.95	45.84	45.84	42.50	42.50
Wet soil + tare (g)	497.10		497.10		497.10	
Dry soil + tare (g)	433.56		433.56		433.56	
Tare (g)	126.48		126.48		126.48	
Water content (%)	20.7	21.1	20.7	22.7	20.7	24.4
Dry unit weight (pcf)	106.2	107.3	103.3	104.5	101.3	101.6
Void ratio, e, for assumed Gs	0.59	0.57	0.63	0.61	0.66	0.66
Saturation (%)*	95.3	100.0	88.4	100.0	84.2	100.0

ϕ' (deg)	39
c' (psf)	334

Average of 3 samples	Initial	Pre-shear
Water content (%)	20.7	22.7
Dry unit weight (pcf)	103.6	104.5

*Pre-shear saturation set to 100% for phase calculations





Comments:
Test specimens swelled upon inundation.

Entered by:_____
Reviewed:_____

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: JVWCD-U111 & 11800 South **Boring No.:** BH-9

No: 00301-025 **Sample:**

Location: U111 and 11800 South **Depth:** 10.0'

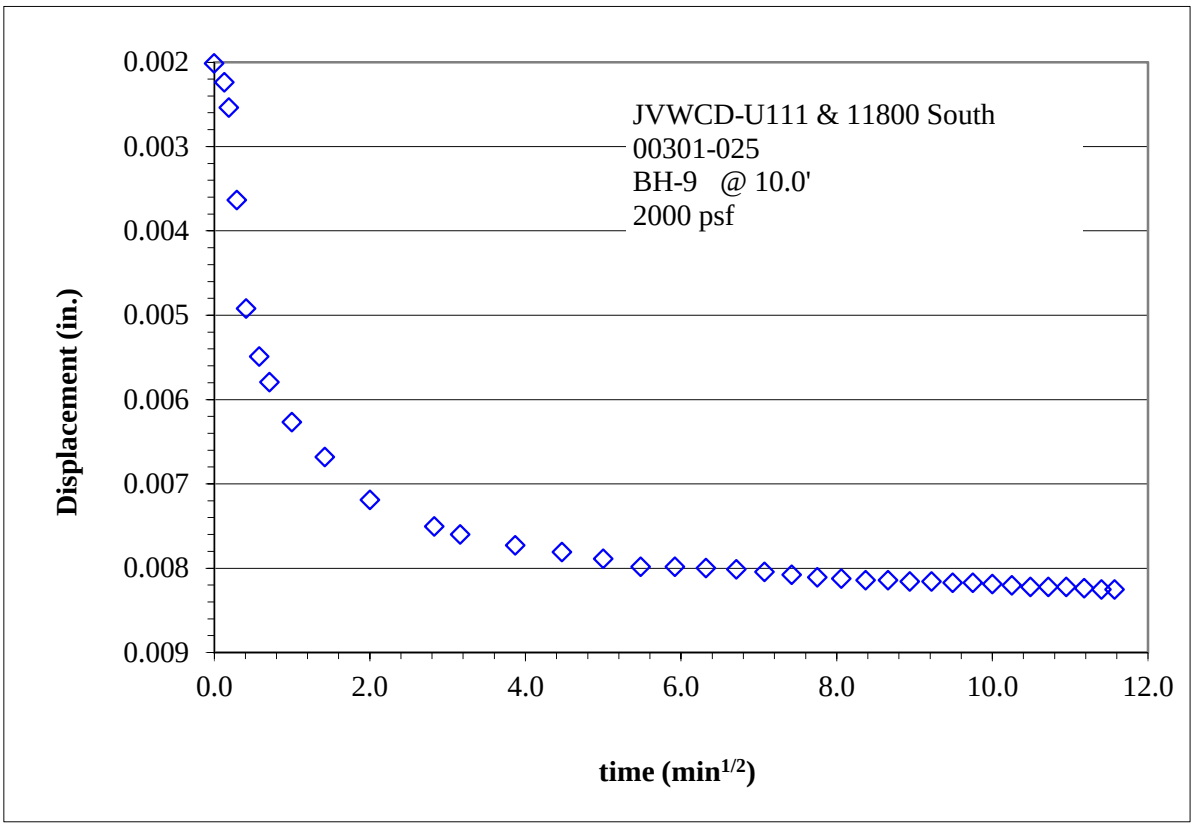
Nominal normal stress = 2000 psf			Nominal normal stress = 1000 psf			Nominal normal stress = 500 psf		
Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)	Lateral Displacement (in.)	Nominal Shear Stress (psf)	Normal Displacement (in.)
0.002	333	0.000	0.002	145	-0.001	0.002	219	0.000
0.005	568	0.000	0.005	354	-0.002	0.005	294	0.000
0.007	913	-0.001	0.007	479	-0.002	0.007	377	0.000
0.010	1143	-0.001	0.010	631	-0.002	0.010	442	0.000
0.012	1375	-0.001	0.012	711	-0.002	0.012	502	0.000
0.017	1610	-0.002	0.017	887	-0.002	0.017	589	0.000
0.022	1757	-0.002	0.022	1000	-0.002	0.022	642	0.001
0.027	1852	-0.002	0.027	1090	-0.002	0.027	685	0.001
0.032	1891	-0.002	0.032	1160	-0.001	0.032	692	0.002
0.037	1912	-0.002	0.037	1199	-0.001	0.037	683	0.003
0.042	1919	-0.002	0.042	1212	0.000	0.042	663	0.004
0.047	1927	-0.002	0.047	1181	0.001	0.047	617	0.005
0.052	1925	-0.002	0.052	1070	0.001	0.052	575	0.005
0.057	1881	-0.002	0.057	912	0.001	0.057	530	0.005
0.062	1824	-0.002	0.062	841	0.001	0.062	512	0.005
0.067	1793	-0.002	0.067	804	0.001	0.067	497	0.005
0.072	1767	-0.002	0.072	787	0.001	0.072	487	0.005
0.077	1741	-0.002	0.077	772	0.001	0.077	481	0.005
0.082	1703	-0.002	0.082	761	0.001	0.082	478	0.005
0.087	1687	-0.002	0.087	752	0.001	0.087	474	0.005
0.092	1664	-0.002	0.092	748	0.001	0.092	473	0.005
0.097	1651	-0.002	0.097	743	0.001	0.097	471	0.005
0.102	1636	-0.002	0.102	741	0.001	0.102	471	0.005
0.107	1620	-0.002	0.107	740	0.001	0.107	470	0.005
0.112	1610	-0.002	0.112	736	0.001	0.112	469	0.005
0.117	1607	-0.002	0.117	733	0.001	0.117	466	0.005
0.122	1612	-0.002	0.122	730	0.001	0.122	464	0.005
0.127	1602	-0.002	0.127	731	0.001	0.127	462	0.005
0.132	1594	-0.002	0.132	730	0.001	0.132	459	0.005
0.137	1579	-0.002	0.137	730	0.001	0.137	456	0.005
0.142	1568	-0.002	0.142	726	0.001	0.142	452	0.005
0.147	1563	-0.002	0.147	725	0.001	0.147	448	0.005
0.152	1558	-0.002	0.152	724	0.000	0.152	444	0.005
0.157	1550	-0.003	0.157	724	0.001	0.157	440	0.005
0.162	1545	-0.003	0.162	723	0.001	0.162	435	0.005
0.167	1545	-0.003	0.167	722	0.000	0.167	435	0.005
0.172	1548	-0.003	0.172	719	0.000	0.172	434	0.005
0.177	1545	-0.003	0.177	716	0.000	0.177	432	0.005
0.182	1550	-0.004	0.182	715	0.000	0.182	429	0.006
0.187	1553	-0.004	0.187	711	0.000	0.187	427	0.006
0.192	1561	-0.004	0.192	710	0.000	0.192	425	0.006
0.197	1563	-0.004	0.197	710	0.000	0.197	424	0.006
0.202	1571	-0.004	0.202	710	0.000	0.202	420	0.006
0.207	1579	-0.005	0.207	707	0.000	0.207	419	0.005
0.212	1579	-0.005	0.212	705	0.000	0.212	416	0.005
0.217	1576	-0.005	0.217	704	0.000	0.217	412	0.005
0.222	1574	-0.005	0.222	702	0.000	0.222	410	0.005
0.227	1574	-0.005	0.227	704	0.000	0.227	410	0.005
0.232	1571	-0.005	0.232	702	0.000	0.232	415	0.005
0.237	1584	-0.006	0.237	703	0.000	0.237	418	0.005
0.242	1579	-0.006	0.242	701	0.000	0.242	419	0.005
0.247	1584	-0.006	0.247	704	0.000	0.247	420	0.005
0.252	1592	-0.007	0.252	703	0.000	0.252	419	0.004
0.257	1594	-0.007	0.257	702	0.000	0.257	418	0.004
0.262	1592	-0.007	0.262	702	0.000	0.262	418	0.004
0.267	1605	-0.007	0.267	700	-0.001	0.267	418	0.004
0.272	1599	-0.007	0.272	700	-0.001	0.272	416	0.004
0.277	1602	-0.008	0.277	700	-0.001	0.277	415	0.004
0.282	1602	-0.008	0.282	698	-0.001	0.282	414	0.004
0.287	1612	-0.008	0.287	699	-0.001	0.287	416	0.003
0.292	1612	-0.008	0.292	699	-0.001	0.292	418	0.003
0.297	1615	-0.008	0.297	700	-0.001	0.297	419	0.003
0.299	1623	-0.009	0.301	700	-0.001	0.301	421	0.003

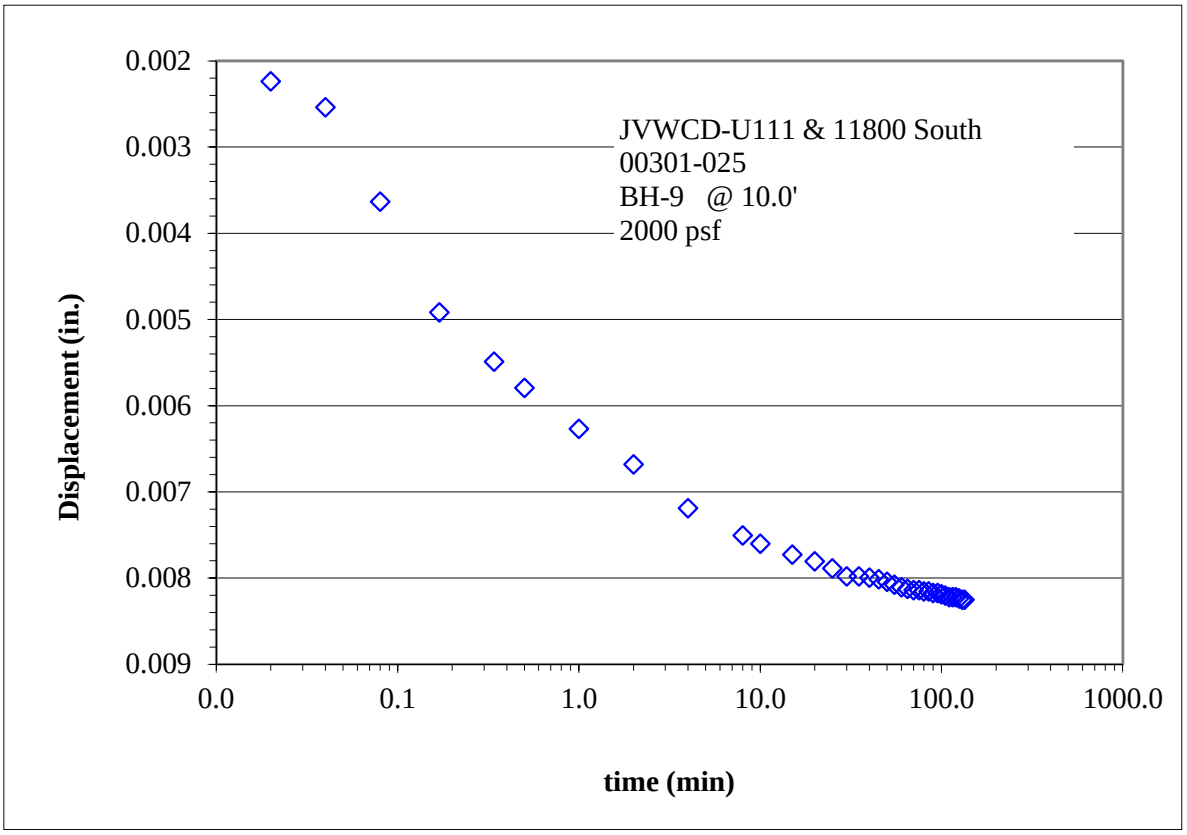
Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

Project: JVWCD-U111 & 11800 South
No: 00301-025
Location: U111 and 11800 South

Boring No.: BH-9
Sample:
Depth: 10.0'





INORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** Nick Best
Project: JVWCD-U111 & 11800 South / 00301-025
Lab Sample ID: 1610302-001
Client Sample ID: BH-6 @ 5.0'
Collection Date: 10/17/2016
Received Date: 10/17/2016 1401h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	10/17/2016 1725h	10/18/2016 1140h	SW6020B	2.94	**15.1**	
Lead	mg/kg-dry	10/17/2016 1725h	10/18/2016 1140h	SW6020B	7.64	**83.8**	[3]

[3] - Matrix spike recoveries and/or high RPDs indicate suspected sample non-homogeneity. The method is in control as indicated by the LCS.

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web: www.awal-labs.com

Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** Nick Best
Project: JVWCD-U111 & 11800 South / 00301-025
Lab Sample ID: 1610302-002
Client Sample ID: BH-7 @ 5.0' B
Collection Date: 10/17/2016
Received Date: 10/17/2016 1401h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	10/17/2016 1725h	10/18/2016 1155h	SW6020B	2.77	**15.8**	
Lead	mg/kg-dry	10/17/2016 1725h	10/18/2016 1155h	SW6020B	7.21	**64.2**	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** Nick Best
Project: JVWCD-U111 & 11800 South / 00301-025
Lab Sample ID: 1610302-004
Client Sample ID: BH-12 @ 15.0'
Collection Date: 10/17/2016
Received Date: 10/17/2016 1401h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	10/17/2016 1725h	10/18/2016 1208h	SW6020B	2.48	**19.7**	
Lead	mg/kg-dry	10/17/2016 1725h	10/18/2016 1208h	SW6020B	6.44	**157**	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** Nick Best
Project: JVWCD-U111 & 11800 South / 00301-025
Lab Sample ID: 1610302-006
Client Sample ID: BH-14 @ 15.0'
Collection Date: 10/17/2016
Received Date: 10/17/2016 1401h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	10/17/2016 1725h	10/18/2016 1211h	SW6020B	2.67	**40.7**	
Lead	mg/kg-dry	10/17/2016 1725h	10/18/2016 1211h	SW6020B	6.94	**279**	

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer

INORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** Bonnie Rice
Project: JVWCD / 00301-025
Lab Sample ID: 1611125-001
Client Sample ID: BH-15 @ 5.0'
Collection Date: 11/4/2016
Received Date: 11/4/2016 1500h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	11/7/2016 1550h	11/8/2016 716h	SW6020B	2.55	**28.8**	3
Lead	mg/kg-dry	11/7/2016 1550h	11/8/2016 716h	SW6020B	6.62	**160**	2

[2] - Analyte concentration is too high for accurate matrix spike recovery and/or RPD.
[3] - Matrix spike recoveries and/or high RPDs indicate suspected sample non-homogeneity. The method is in control as indicated by the LCS.

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Kyle F. Gross
Laboratory Director

Jose Rocha
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INORGANIC ANALYTICAL REPORT

Client: IGES **Contact:** Bonnie Rice
Project: JVWCD / 00301-025
Lab Sample ID: 1611125-002
Client Sample ID: BH-16 @ 7.5'
Collection Date: 11/4/2016
Received Date: 11/4/2016 1500h

Analytical Results TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	11/7/2016 1550h	11/8/2016 731h	SW6020B	2.49	**17.0**	
Lead	mg/kg-dry	11/7/2016 1550h	11/8/2016 731h	SW6020B	6.47	**143**	

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Laboratory Director

Jose Rocha
QA Officer

Minimum Laboratory Soil Resistivity, pH of Soil for Use in Corrosion Testing, and Ions in Water by Chemically Suppressed Ion Chromatography *(AASHTO T 288, T 289, ASTM D4327, and C1580)*

Project: **JVWCD-U111 & 11800 South**
No: **00301-025**
Location: U111 and 11800 South
Date: 10/25/2016
By: DKS

Sample info.	Boring No.	BH-10				BH-14			
	Sample					A			
	Depth	5.0'				5.0'			
Water content data	Wet soil + tare (g)	96.19				111.80			
	Dry soil + tare (g)	89.90				103.91			
	Tare (g)	37.22				37.04			
	Water content (%)	11.9				11.8			
Chem. data	pH	8.41				8.00			
	Soluble chloride* (ppm)	2280				1180			
	Soluble sulfate** (ppm)	137				15.9			
Resistivity data	Pin method	2				2			
	Soil box	Miller Small				Miller Small			
		Approximate Soil condition (%)	Resistance Reading (Ω)	Soil Box Multiplier (cm)	Resistivity (Ω-cm)	Approximate Soil condition (%)	Resistance Reading (Ω)	Soil Box Multiplier (cm)	Resistivity (Ω-cm)
		As Is	1973	0.67	1322	As Is	2204	0.67	1477
		+3	1273	0.67	853	+3	831	0.67	557
		+6	432	0.67	290	+6	438	0.67	294
		+9	292	0.67	196	+9	366	0.67	245
		+12	344	0.67	230	+12	377	0.67	252
	Minimum resistivity (Ω-cm)	**196**				**245**			

* Performed by AWAL using EPA 300.0

** Performed by AWAL using ASTM C1580

Entered by:_____
Reviewed:_____

Minimum Laboratory Soil Resistivity, pH of Soil for Use in Corrosion Testing, and Ions in Water by Chemically Suppressed Ion Chromatography *(AASHTO T 288, T 289, ASTM D4327, and C1580)*

Project: **JVWCD-U111 & 11800 South**
No: **00301-025**
Location: U111 and 11800 South
Date: 10/25/2016
By: DKS

Sample info.	Boring No.	BH-17				BH-18			
	Sample								
	Depth	10.0'				5.0'			
Water content data	Wet soil + tare (g)	86.38				109.78			
	Dry soil + tare (g)	81.22				102.77			
	Tare (g)	37.33				37.65			
	Water content (%)	11.8				10.8			
Chem. data	pH	8.07				8.73			
	Soluble chloride* (ppm)	1600				427			
	Soluble sulfate** (ppm)	29.9				21.9			
Resistivity data	Pin method	2				2			
	Soil box	Miller Small				Miller Small			
		Approximate Soil condition (%)	Resistance Reading (Ω)	Soil Box Multiplier (cm)	Resistivity (Ω-cm)	Approximate Soil condition (%)	Resistance Reading (Ω)	Soil Box Multiplier (cm)	Resistivity (Ω-cm)
		As Is	1183	0.67	793	As Is	1383	0.67	927
		+3	647	0.67	434	+3	936	0.67	627
		+6	419	0.67	280	+6	682	0.67	457
		+9	392	0.67	263	+9	639	0.67	428
		+12	445	0.67	298	+12	592	0.67	397
						+15	581	0.67	389
						+18	570	0.67	382
						+21	550	0.67	369
						+24	521	0.67	349
						+27	585	0.67	392
	Minimum resistivity (Ω-cm)	**263**				**349**			

* Performed by AWAL using EPA 300.0

** Performed by AWAL using ASTM C1580

Entered by:_____
Reviewed:_____

APPENDIX C

SAGE EARTH SCIENCE
GEOPHYSICAL SURVEYS

September 29, 2016

RE: IGES WENNER 4-PIN EARTH RESISTIVITY TESTS

Based on the project objective and site conditions, Sage Earth Science conducted a series of direct current earth resistivity tests on the Northern Utah site. The objective of the survey is to determine the resistivity properties of the shallow subsurface (0-30 ft.).

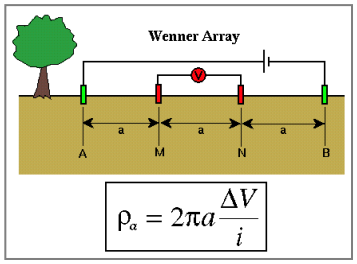


Figure 1. Wenner Array

In Situ Soil Resistivity Tests

Earth resistivity properties are obtained by introducing a DC or low frequency electrical current into the ground and measuring the potential drop between electrodes over a range of electrode spacings. Sage Earth Science conducted in-situ earth resistivity tests at each of sixteen locations, BH-1 thru BH-18 (excluding locations BH-15 and BH-17). Each test comprised single array parallel to the existing road and utility alignments. The following a-spacings were used(0.5, 1, 1.5, 2, 3, 5, 7, 10, 15, 20, and 30 feet) in accordance IEEE and ASTM standards for performing Wenner 4-pin resistivity measurements and Sage Earth Science Standard Operating Procedures.

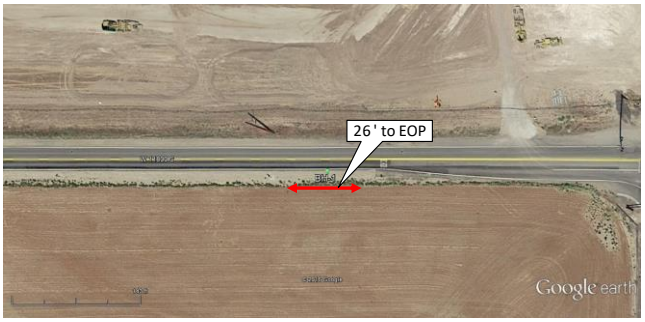
Array locations were selected in consultation with the customer and placed to avoid inference from utilities, fences, irrigation ditches and other features that may influence test results. Sage Earth Science Standard Operating Procedures calls for system calibration checks daily prior testing and maintaining pin depth less than 5% of the pin spacing. Measurements were made using an L and R MiniRes high precision resistivity meter. The work was performed on September 27, 2016.

Glen Carpenter / principal

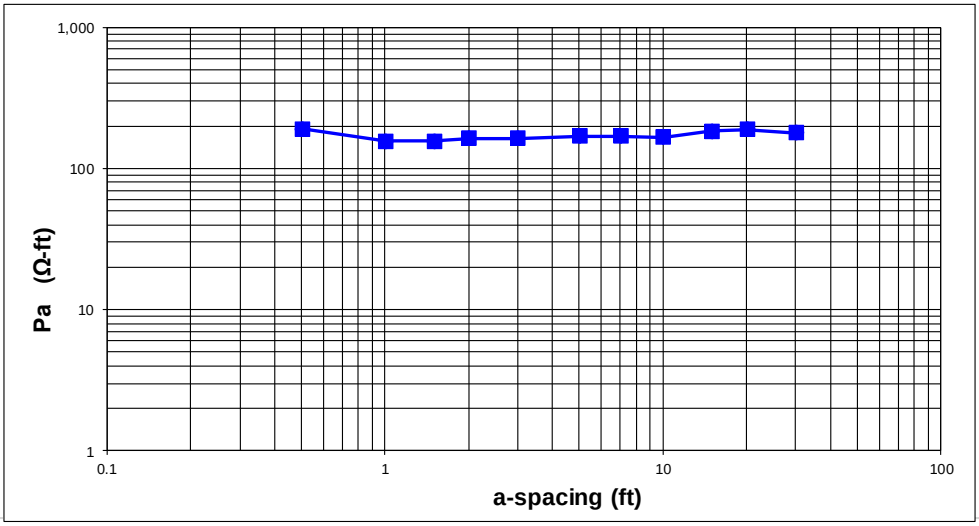
2184 Channing Way, Suite 110, Idaho Falls, ID 83404
telephone: (208)522-5049, Fax: (208)528-6200, email: sageearthscience@yahoo.com
http://www.sageearthscience.com

Project	**IGES**			Test Point	**BH-1**
Date	**9/27/2016**	Temp (^{o}f)	**68**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**1148**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	**1.61 inches**

		array orientation	E/W				depth (in)	
a-spc (ft)	mn/2	ab/2	Ω - R	ρa Ω-ft	a-spc (m)	ρa Ω-m	c	p
0.5	0.25	0.75	60.8	191.0			1	1
1	0.5	1.5	25.0	157.1			2	2
1.5	0.75	2.25	16.665	157.064			4	4
2	1	3	13.040	163.865			5	5
3	1.5	4.5	8.647	162.992			6	6
5	2.5	7.5	5.400	169.646			6	6
7	3.5	10.5	3.855	169.552			6	6
10	5	15	2.652	166.630			6	6
15	7.5	22.5	1.957	184.443			6	6
20	10	30	1.499	188.370			6	6
30	15	45	0.947	178.505			6	6

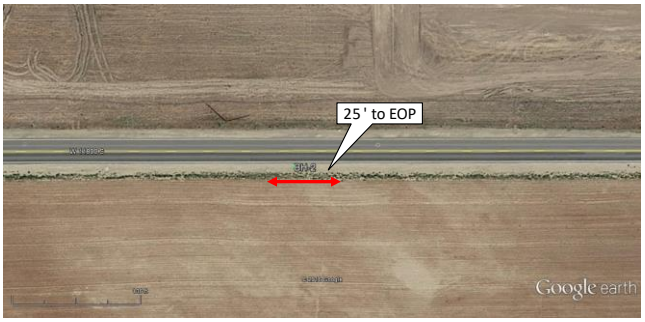


Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
harvested grain field,

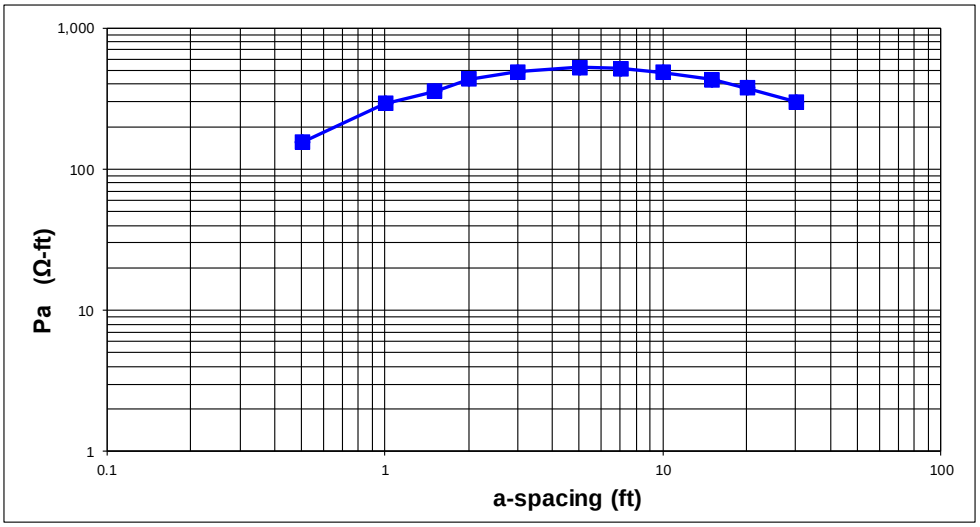


Project	**IGES**			Test Point	**BH-2**
Date	**9/27/2016**	Temp (°f)	**68**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**1125**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	

		array orientation	E/W				depth (in)	
a-spc (ft)	**mn/2**	**ab/2**	**Ω - R**	**ρa Ω-ft**	**a-spc (m)**	**ρa Ω-m**	**c**	**p**
0.5	**0.25**	**0.75**	**49.3**	**154.9**			1	1
1	**0.5**	**1.5**	**46.6**	**292.8**			2	2
1.5	**0.75**	**2.25**	**37.8**	**356.3**			4	4
2	**1**	**3**	**34.5**	**433.5**			5	5
3	**1.5**	**4.5**	**25.9**	**488.2**			6	6
5	**2.5**	**7.5**	**16.760**	**526.530**			6	6
7	**3.5**	**10.5**	**11.765**	**517.451**			6	6
10	**5**	**15**	**7.749**	**486.884**			6	6
15	**7.5**	**22.5**	**4.583**	**431.937**			6	6
20	**10**	**30**	**2.987**	**375.357**			6	6
30	**15**	**45**	**1.599**	**301.404**			6	6



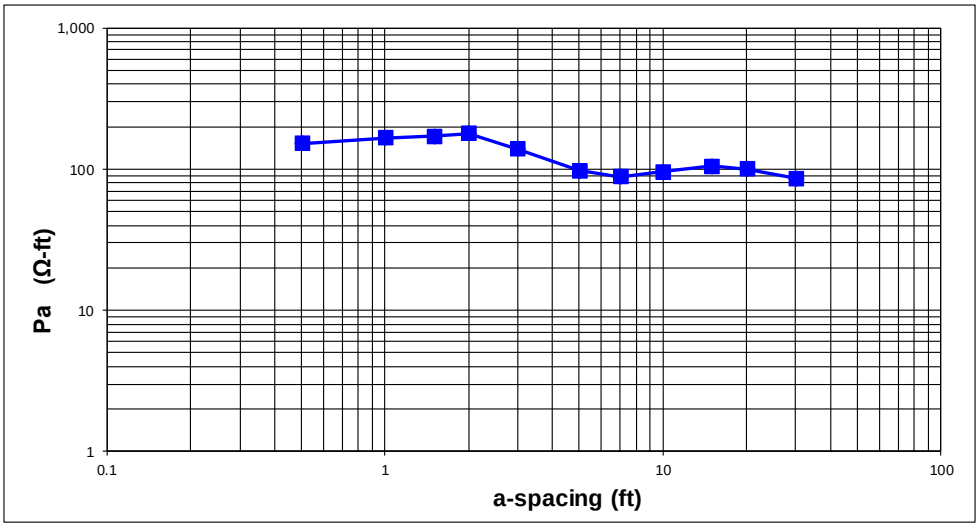
Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
harvested grain field,



Project	**IGES**			Test Point	**BH-3**
Date	**9/27/2016**	Temp (°f)	**58**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**1100**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	

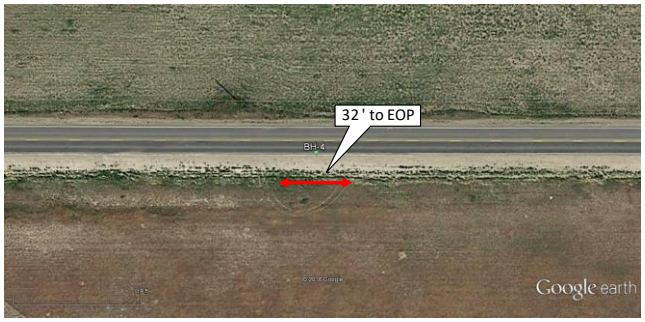
		array orientation	E/W				depth (in)	
a-spc (ft)	**mn/2**	**ab/2**	**Ω - R**	**ρa Ω-ft**	**a-spc (m)**	**ρa Ω-m**	**c**	**p**
0.5	**0.25**	**0.75**	**48.6**	**153**			1	1
1	**0.5**	**1.5**	**26.5**	**167**			2	2
1.5	**0.75**	**2.25**	**18.240**	**171.908**			4	4
2	**1**	**3**	**14.305**	**179.762**			5	5
3	**1.5**	**4.5**	**7.357**	**138.676**			6	6
5	**2.5**	**7.5**	**3.108**	**97.641**			6	6
7	**3.5**	**10.5**	**2.015**	**88.624**			6	6
10	**5**	**15**	**1.529**	**96.070**			6	6
15	**7.5**	**22.5**	**1.116**	**105.180**			6	6
20	**10**	**30**	**0.797**	**100.154**			6	6
30	**15**	**45**	**0.458**	**86.331**			6	6

Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
brush and grass, fine grained sediment. Good electrode plants

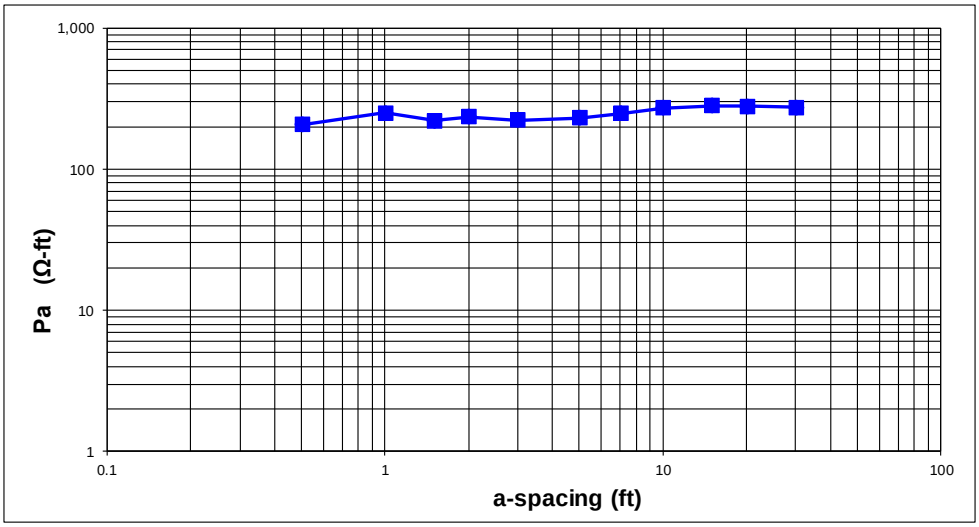


Project	**IGES**			Test Point	**BH-4**
Date	**9/27/2016**	Temp (°f)	**58**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**1035**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	

		array orientation	E/W				depth (in)	
a-spc (ft)	**mn/2**	**ab/2**	**Ω - R**	**ρa Ω-ft**	**a-spc (m)**	**ρa Ω-m**	**c**	**p**
0.5	**0.25**	**0.75**	**66.0**	**207.3**			1	1
1	**0.5**	**1.5**	**39.9**	**250.7**			2	2
1.5	**0.75**	**2.25**	**23.4**	**220.5**			4	4
2	**1**	**3**	**18.688**	**234.840**			5	5
3	**1.5**	**4.5**	**11.767**	**221.803**			6	6
5	**2.5**	**7.5**	**7.376**	**231.724**			6	6
7	**3.5**	**10.5**	**5.668**	**249.291**			6	6
10	**5**	**15**	**4.338**	**272.564**			6	6
15	**7.5**	**22.5**	**2.989**	**281.706**			6	6
20	**10**	**30**	**2.225**	**279.602**			6	6
30	**15**	**45**	**1.453**	**273.884**			6	6

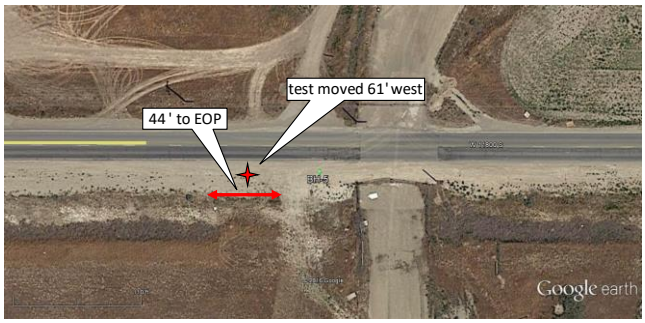


Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
brush and grass, fine grained sediment. Good electrode plants

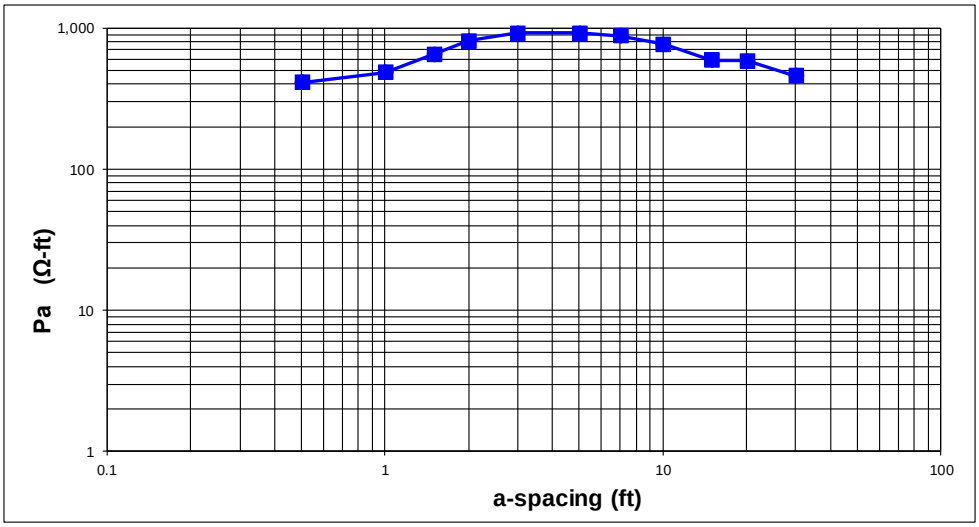


Project	**IGES**			Test Point	**BH-5**
Date	**9/27/2016**	Temp (°f)	**58**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**1010**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	

		array orientation	E/W				depth (in)	
a-spc (ft)	**mn/2**	**ab/2**	**Ω - R**	***ρa Ω-ft***	**a-spc (m)**	***ρa Ω-m***	**c**	**p**
0.5	**0.25**	**0.75**	**130.6**	**410.3**			1	1
1	**0.5**	**1.5**	**76.9**	**483.2**			2	2
1.5	**0.75**	**2.25**	**69.5**	**655.0**			4	4
2	**1**	**3**	**64.4**	**809.3**			5	5
3	**1.5**	**4.5**	**48.7**	**918.0**			6	6
5	**2.5**	**7.5**	**29.4**	**923.6**			6	6
7	**3.5**	**10.5**	**20.0**	**879.6**			6	6
10	**5**	**15**	**12.210**	**767.176**			6	6
15	**7.5**	**22.5**	**6.273**	**591.216**			6	6
20	**10**	**30**	**4.667**	**586.472**			6	6
30	**15**	**45**	**2.441**	**460.117**			6	6



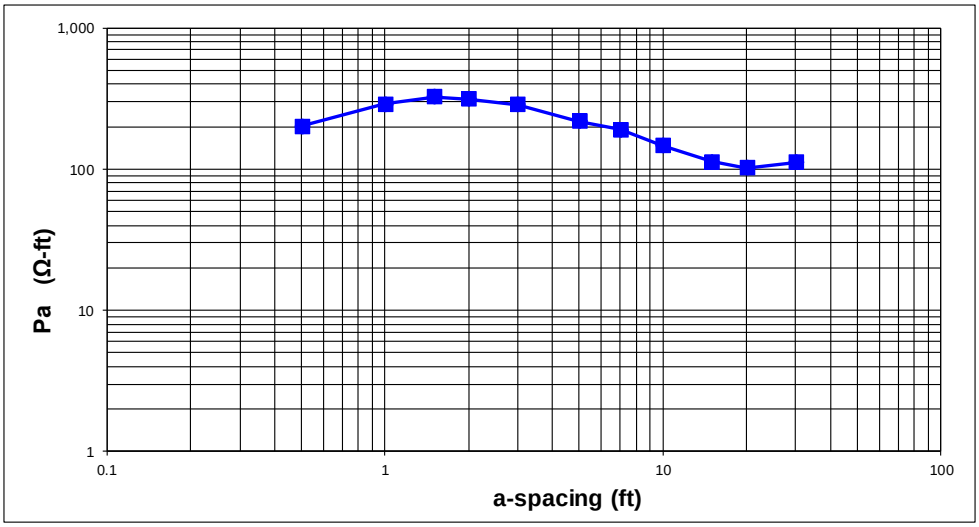
Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
brush and grass, fine grained sediment. Good electrode plants



Project	**IGES**			Test Point	**BH-6**
Date	**9/27/2016**	Temp (°f)	**53**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**950**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	**1.61 inches**

	array orientation		E/W				depth (in)	
a-spc (ft)	**mn/2**	**ab/2**	**Ω - R**	**ρa Ω-ft**	**a-spc (m)**	**ρa Ω-m**	**c**	**p**
0.5	**0.25**	**0.75**	**63.9**	**200.7**			1	1
1	**0.5**	**1.5**	**46.2**	**290.3**			2	2
1.5	**0.75**	**2.25**	**34.5**	**325.2**			4	4
2	**1**	**3**	**25.0**	**314.2**			5	5
3	**1.5**	**4.5**	**15.156**	**285.684**			6	6
5	**2.5**	**7.5**	**6.958**	**218.592**			6	6
7	**3.5**	**10.5**	**4.352**	**191.411**			6	6
10	**5**	**15**	**2.328**	**146.272**			6	6
15	**7.5**	**22.5**	**1.201**	**113.191**			6	6
20	**10**	**30**	**0.814**	**102.290**			6	6
30	**15**	**45**	**0.596**	**112.343**			6	6

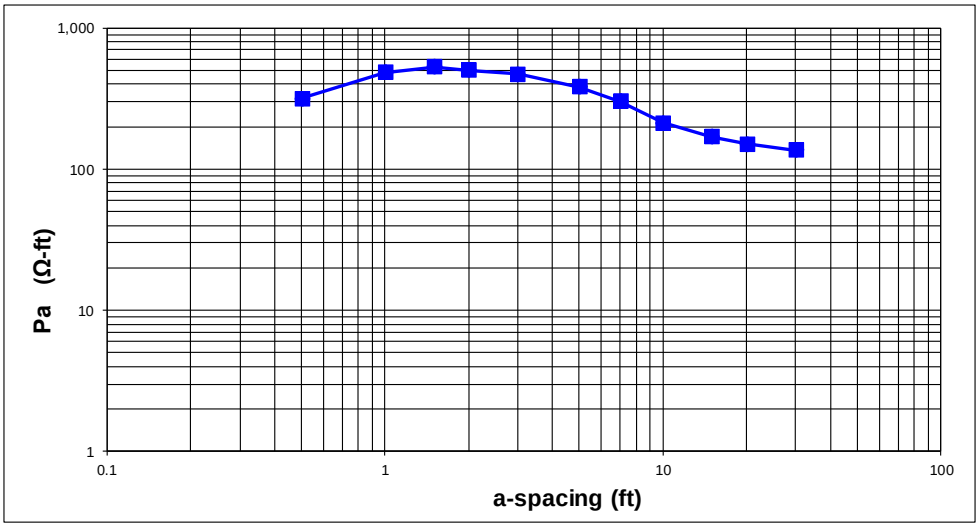
Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
brush and grass, fine grained sediment. Good electrode plants



Project	**IGES**	Test Point	**BH-7**
Date	**9/27/2016** Temp (°f)	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**910** Operator **GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner (ρa=2πRa)**	Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**	Model - S/N	**L&R Ultra MiniRes - 103**
		Precip previous 7 days	**1.61 inches**

	array orientation		E/W				depth (in)	
a-spc (ft)	mn/2	ab/2	Ω - R	ρa Ω-ft	a-spc (m)	ρa Ω-m	c	p
0.5	0.25	0.75	101.3	318.2			1	1
1	0.5	1.5	77.0	483.8			2	2
1.5	0.75	2.25	56.1	528.7			4	4
2	1	3	40.1	503.9			5	5
3	1.5	4.5	25.0	471.2			6	6
5	2.5	7.5	12.143	381.483			6	6
7	3.5	10.5	6.882	302.686			6	6
10	5	15	3.375	212.057			6	6
15	7.5	22.5	1.799	169.552			6	6
20	10	30	1.203	151.173			6	6
30	15	45	0.723	136.282			6	6

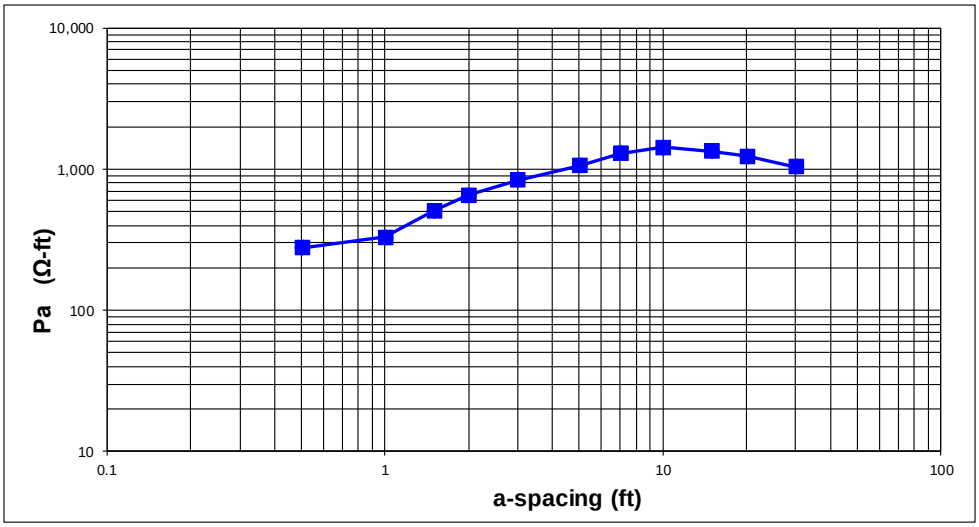
Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
brush and grass, fine grained sediment. Good electrode plants



Project	**IGES**			Test Point	**BH-8**
Date	**9/27/2016**	Temp (°f)	**70**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**1251**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	**1.61 inches**

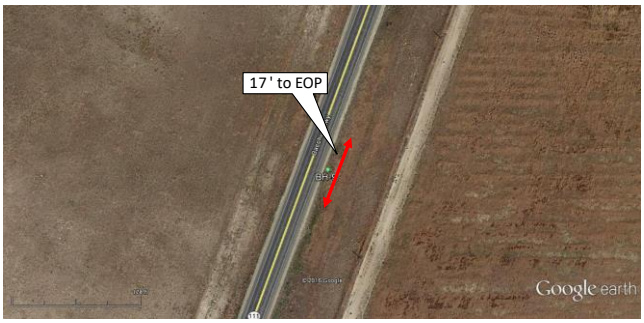
		array orientation	E/W				depth (in)	
a-spc (ft)	**mn/2**	**ab/2**	**Ω - R**	**ρa Ω-ft**	**a-spc (m)**	**ρa Ω-m**	**c**	**p**
0.5	**0.25**	**0.75**	**88.4**	**277.7**			1	1
1	**0.5**	**1.5**	**52.5**	**329.9**			2	2
1.5	**0.75**	**2.25**	**53.9**	**508.0**			4	4
2	**1**	**3**	**52.4**	**658.5**			5	5
3	**1.5**	**4.5**	**44.3**	**835.0**			6	6
5	**2.5**	**7.5**	**33.7**	**1058.7**			6	6
7	**3.5**	**10.5**	**29.3**	**1288.7**			6	6
10	**5**	**15**	**22.7**	**1426.3**			6	6
15	**7.5**	**22.5**	**14.292**	**1346.988**			6	6
20	**10**	**30**	**9.838**	**1236.278**			6	6
30	**15**	**45**	**5.529**	**1042.191**			6	6

Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
brush and grass, fine grained sediment. Good electrode plants

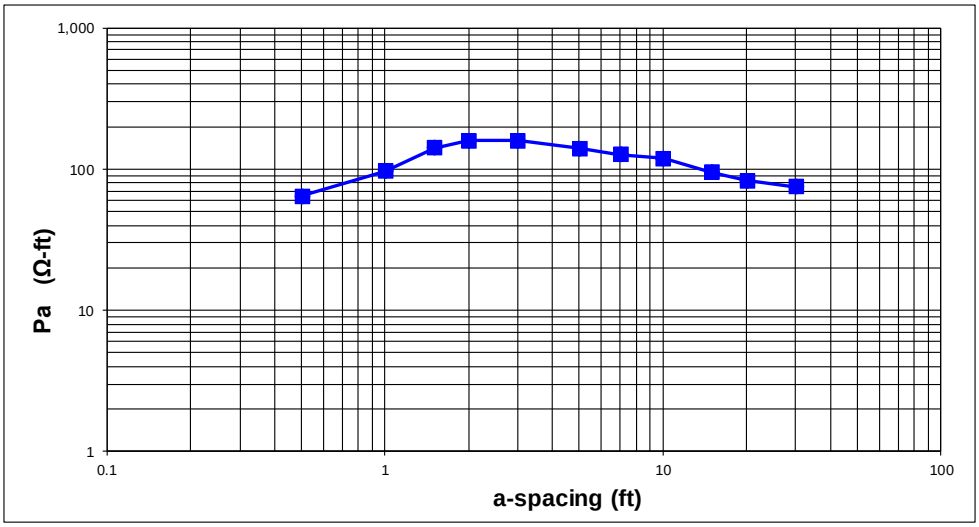


Project	**IGES**			Test Point	**BH-9**
Date	**9/27/2016**	Temp (°f)	**70**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**1320**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	**1.61 inches**

		array orientation	N/S				depth (in)	
a-spc (ft)	**mn/2**	**ab/2**	**Ω - R**	**ρa Ω-ft**	**a-spc (m)**	**ρa Ω-m**	**c**	**p**
0.5	**0.25**	**0.75**	**20.6**	**64.7**			1	1
1	**0.5**	**1.5**	**15.400**	**96.761**			2	2
1.5	**0.75**	**2.25**	**15.030**	**141.654**			4	4
2	**1**	**3**	**12.633**	**158.751**			5	5
3	**1.5**	**4.5**	**8.464**	**159.543**			6	6
5	**2.5**	**7.5**	**4.468**	**140.366**			6	6
7	**3.5**	**10.5**	**2.897**	**127.417**			6	6
10	**5**	**15**	**1.897**	**119.192**			6	6
15	**7.5**	**22.5**	**1.008**	**95.002**			6	6
20	**10**	**30**	**0.658**	**82.687**			6	6
30	**15**	**45**	**0.398**	**75.021**			6	6

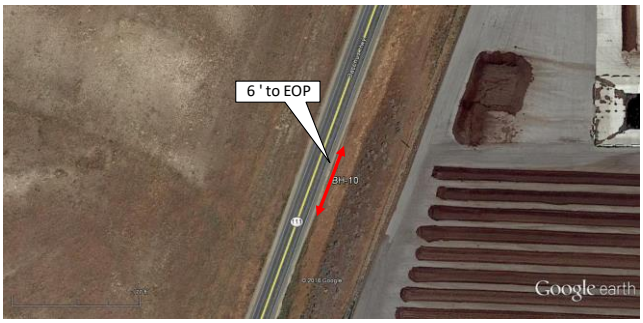


Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
brush and grass, fine grained sediment. Good electrode plants

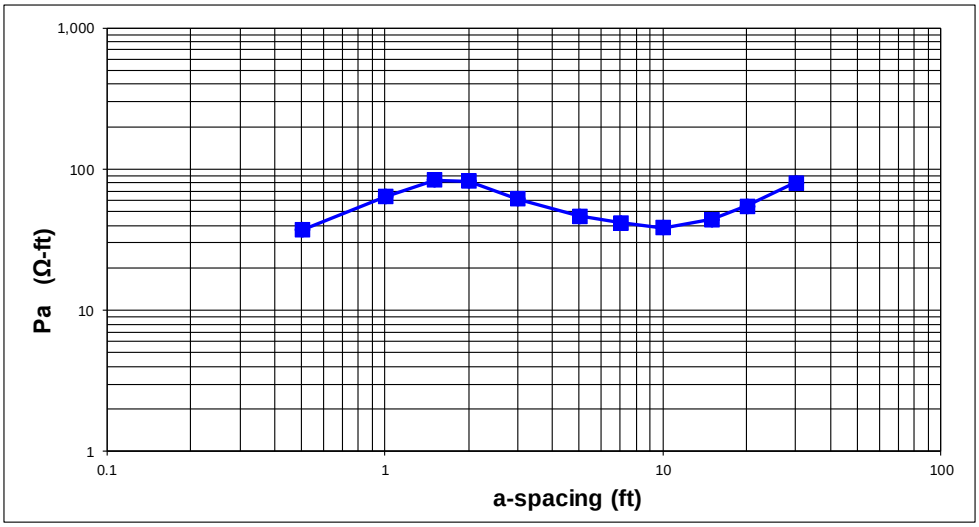


Project	**IGES**			Test Point	**BH-10**
Date	**9/27/2016**	Temp (°f)	**72**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**1343**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	**1.61 inches**

	array orientation		N/S				depth (in)	
a-spc (ft)	**mn/2**	**ab/2**	**Ω - R**	**ρa Ω-ft**	**a-spc (m)**	**ρa Ω-m**	**c**	**p**
0.5	**0.25**	**0.75**	**11.818**	**37.127**			1	1
1	**0.5**	**1.5**	**10.205**	**64.120**			2	2
1.5	**0.75**	**2.25**	**8.909**	**83.965**			4	4
2	**1**	**3**	**6.535**	**82.121**			5	5
3	**1.5**	**4.5**	**3.279**	**61.808**			6	6
5	**2.5**	**7.5**	**1.484**	**46.621**			6	6
7	**3.5**	**10.5**	**0.949**	**41.739**			6	6
10	**5**	**15**	**0.613**	**38.516**			6	6
15	**7.5**	**22.5**	**0.466**	**43.919**			6	6
20	**10**	**30**	**0.436**	**54.789**			6	6
30	**15**	**45**	**0.425**	**80.111**			6	6



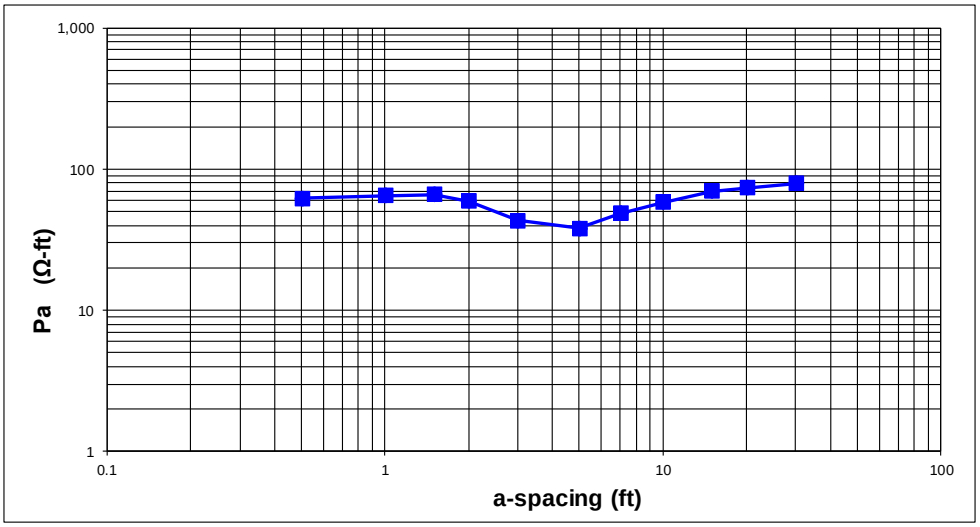
Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
brush and grass, fine grained sediment. Good electrode plants



Project	**IGES**			Test Point	**BH-11**
Date	**9/27/2016**	Temp (°f)	**72**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**1415**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	**1.61 inches**

		array orientation	N/S				depth (in)	
a-spc (ft)	**mn/2**	**ab/2**	**Ω - R**	**ρa Ω-ft**	**a-spc (m)**	**ρa Ω-m**	**c**	**p**
0.5	**0.25**	**0.75**	**19.767**	**62.100**			1	1
1	**0.5**	**1.5**	**10.389**	**65.276**			2	2
1.5	**0.75**	**2.25**	**7.001**	**65.983**			4	4
2	**1**	**3**	**4.726**	**59.389**			5	5
3	**1.5**	**4.5**	**2.294**	**43.241**			6	6
5	**2.5**	**7.5**	**1.214**	**38.139**			6	6
7	**3.5**	**10.5**	**1.105**	**48.600**			6	6
10	**5**	**15**	**0.926**	**58.182**			6	6
15	**7.5**	**22.5**	**0.740**	**69.743**			6	6
20	**10**	**30**	**0.587**	**73.765**			6	6
30	**15**	**45**	**0.422**	**79.545**			6	6

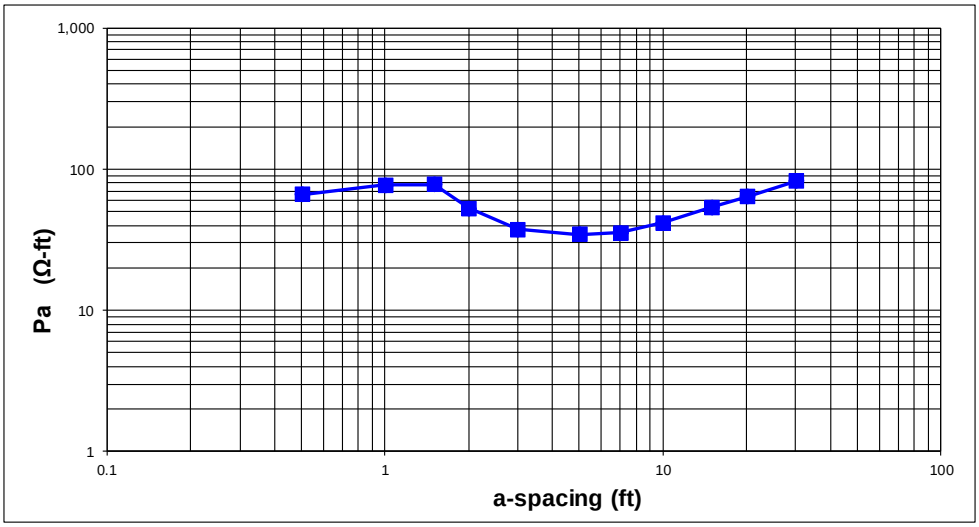
Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
brush and grass, fine grained sediment. Good electrode plants



Project	**IGES**		Test Point	**BH-12**	
Date	**9/27/2016**	Temp (°f)	Field Calib.	**18.993**	**Ω /19.000 Ω (±1%)**
Time	**1440**	Operator **GSC**	Field Calib.	**1901.0**	**Ω /1900.0 milli Ω (±1%)**
array	**Wenner (ρa=2πRa)**		Field Calib.	**190.000**	**Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**		Model - S/N	**L&R Ultra MiniRes - 103**	
			Precip previous 7 days	**1.61 inches**	

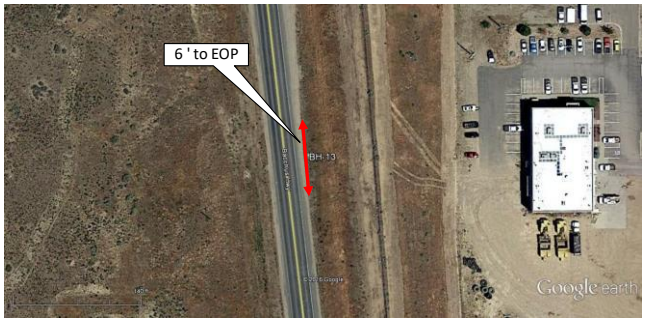
		array orientation	N/S				depth (in)	
a-spc (ft)	mn/2	ab/2	Ω - R	ρa Ω-ft	a-spc (m)	ρa Ω-m	c	p
0.5	0.25	0.75	21.1	66.3			1	1
1	0.5	1.5	12.273	77.113			2	2
1.5	0.75	2.25	8.292	78.150			4	4
2	1	3	4.187	52.615			5	5
3	1.5	4.5	1.988	37.473			6	6
5	2.5	7.5	1.096	34.432			6	6
7	3.5	10.5	0.808	35.538			6	6
10	5	15	0.664	41.720			6	6
15	7.5	22.5	0.568	53.533			6	6
20	10	30	0.510	64.088			6	6
30	15	45	0.438	82.561			6	6

Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
brush and grass, fine grained sediment. Good electrode plants

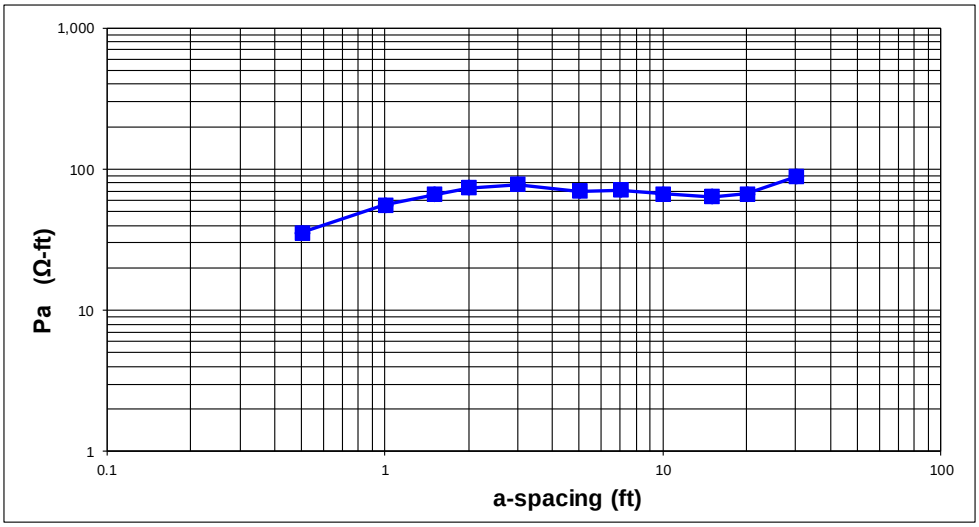


Project	**IGES**			Test Point	**BH-13**
Date	**9/27/2016**	Temp (°f)	**75**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**1506**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	**1.61 inches**

		array orientation	N/S				depth (in)	
a-spc (ft)	**mn/2**	**ab/2**	**Ω - R**	**ρa Ω-ft**	**a-spc (m)**	**ρa Ω-m**	**c**	**p**
0.5	**0.25**	**0.75**	**11.279**	**35.434**			1	1
1	**0.5**	**1.5**	**8.856**	**55.644**			2	2
1.5	**0.75**	**2.25**	**7.049**	**66.435**			4	4
2	**1**	**3**	**5.868**	**73.739**			5	5
3	**1.5**	**4.5**	**4.135**	**77.943**			6	6
5	**2.5**	**7.5**	**2.225**	**69.900**			6	6
7	**3.5**	**10.5**	**1.625**	**71.471**			6	6
10	**5**	**15**	**1.066**	**66.979**			6	6
15	**7.5**	**22.5**	**0.675**	**63.617**			6	6
20	**10**	**30**	**0.530**	**66.602**			6	6
30	**15**	**45**	**0.471**	**88.781**			6	6

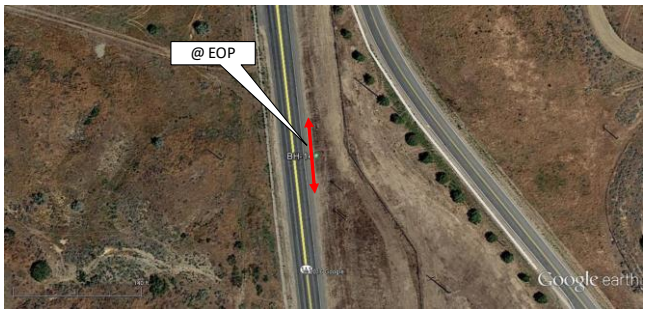


Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
brush and grass, fine grained sediment. Good electrode plants

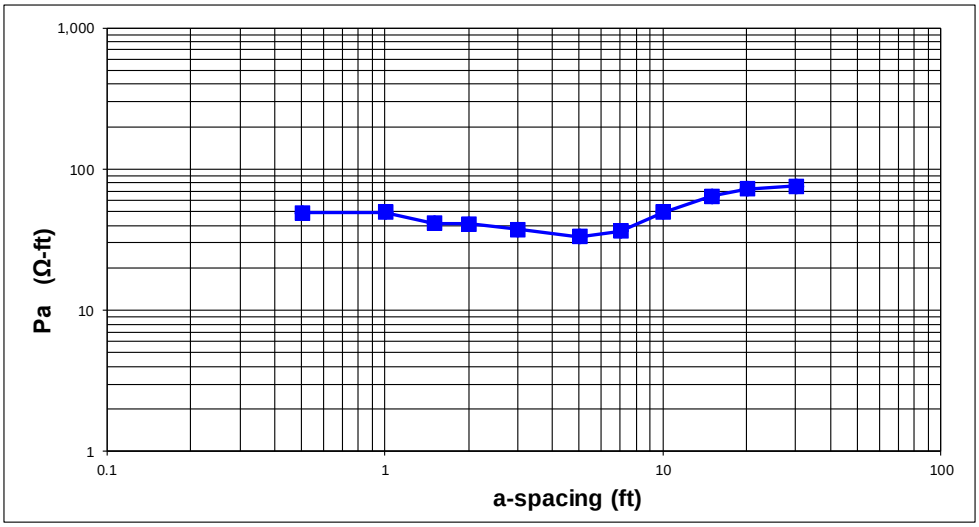


Project	**IGES**			Test Point	**BH-14**
Date	**9/27/2016**	Temp (°f)	**75**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**1527**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	**1.61 inches**

		array orientation	N/S				depth (in)	
a-spc (ft)	**mn/2**	**ab/2**	**Ω - R**	**ρa Ω-ft**	**a-spc (m)**	**ρa Ω-m**	**c**	**p**
0.5	**0.25**	**0.75**	**15.582**	**48.952**			1	1
1	**0.5**	**1.5**	**7.869**	**49.442**			2	2
1.5	**0.75**	**2.25**	**4.400**	**41.469**			4	4
2	**1**	**3**	**3.275**	**41.155**			5	5
3	**1.5**	**4.5**	**1.980**	**37.322**			6	6
5	**2.5**	**7.5**	**1.063**	**33.395**			6	6
7	**3.5**	**10.5**	**0.830**	**36.505**			6	6
10	**5**	**15**	**0.790**	**49.637**			6	6
15	**7.5**	**22.5**	**0.686**	**64.654**			6	6
20	**10**	**30**	**0.577**	**72.508**			6	6
30	**15**	**45**	**0.402**	**75.775**			6	6

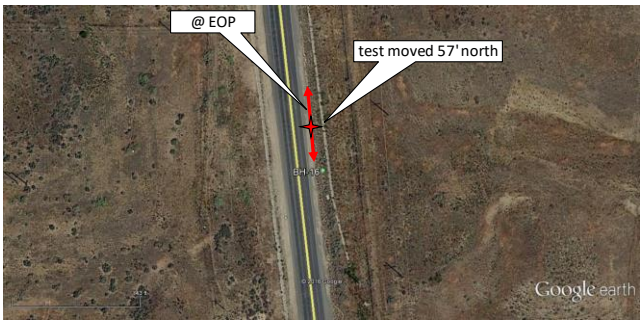


Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
brush and grass, fine grained sediment. Good electrode plants

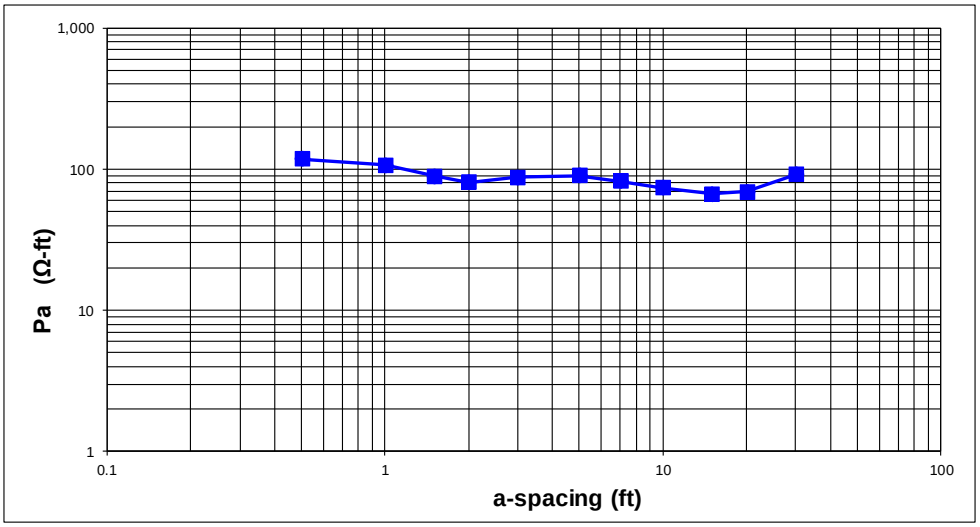


Project	**IGES**			Test Point	**BH-16**
Date	**9/27/2016**	Temp (°f)	**75**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**1548**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	**1.61 inches**

		array orientation	N/S				depth (in)	
a-spc (ft)	mn/2	ab/2	Ω - R	ρa Ω-ft	a-spc (m)	ρa Ω-m	c	p
0.5	0.25	0.75	37.7	118.4			1	1
1	0.5	1.5	17.044	107.091			2	2
1.5	0.75	2.25	9.444	89.008			4	4
2	1	3	6.446	81.003			5	5
3	1.5	4.5	4.651	87.669			6	6
5	2.5	7.5	2.871	90.195			6	6
7	3.5	10.5	1.875	82.467			6	6
10	5	15	1.171	73.576			6	6
15	7.5	22.5	0.706	66.539			6	6
20	10	30	0.553	69.492			6	6
30	15	45	0.485	91.420			6	6

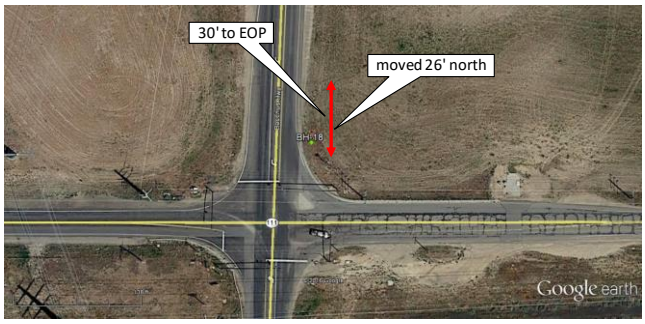


Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
brush and grass, fine grained sediment. Good electrode plants



Project	**IGES**			Test Point	**BH-18**
Date	**9/27/2016**	Temp (°f)	**76**	Field Calib.	**18.993** **Ω /19.000 Ω (±1%)**
Time	**1615**	Operator	**GSC**	Field Calib.	**1901.0** **Ω /1900.0 milli Ω (±1%)**
array	**Wenner**	**(ρa=2πRa)**		Field Calib.	**190.000** **Ω /190.00 milli Ω (±1%)**
weather	**clear, calm**			Model - S/N	**L&R Ultra MiniRes - 103**
				Precip previous 7 days	**1.61 inches**

		array orientation	N/S				depth (in)	
a-spc (ft)	mn/2	ab/2	Ω - R	ρa Ω-ft	a-spc (m)	ρa Ω-m	c	p
0.5	0.25	0.75	25.4	79.8			1	1
1	0.5	1.5	16.667	104.722			2	2
1.5	0.75	2.25	14.009	132.032			4	4
2	1	3	12.414	155.999			5	5
3	1.5	4.5	9.027	170.155			6	6
5	2.5	7.5	5.922	186.045			6	6
7	3.5	10.5	4.625	203.418			6	6
10	5	15	3.661	230.027			6	6
15	7.5	22.5	2.512	236.750			6	6
20	10	30	1.580	198.548			6	6
30	15	45	0.730	137.602			6	6



Comments (surface conditions, soil grain size, topography, foliage, electrode contact etc.)
fine grained sediment, light grass, good electrode plants