

REPORT OF PRELIMINARY GEOTECHNICAL EXPLORATION



**Report of Preliminary
Geotechnical Exploration**

Hancock County Flood Risk Reduction
Program – Additional Hydraulic
Improvements

September 23, 2020

Prepared for:

Maumee Watershed Conservancy
District
Defiance, Ohio

Prepared by:

Stantec Consulting Services Inc.
Toledo, Ohio



Stantec Consulting Services Inc.
4540 Heatherdowns Boulevard Suite A, Toledo OH 43614-3100

September 23, 2020
File: 174316204

Attention: Steve Wilson, PE, PS
Maumee Watershed Conservancy District
1464 Pinehurst Drive
Defiance, Ohio 43512

**Reference: Report of Preliminary Geotechnical Exploration
Hancock County Flood Risk Reduction Program
Additional Hydraulic Improvements
Findlay, Hancock County, Ohio**

Dear Mr. Wilson,

Stantec Consulting Services Inc. (Stantec) has completed a preliminary geotechnical report for the proposed additional hydraulic improvements of the Blanchard River near downtown Findlay, Ohio in Hancock County. The enclosed report contains a brief description of the site, geologic conditions, the scope of work, and geotechnical recommendations for the project.

We appreciate the opportunity to assist you with this project. If you have any questions or need additional information, please contact our office.

Regards,

Stantec Consulting Services Inc.

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Attachment: Preliminary Report of Geotechnical Exploration
c. Derek Dalton, David Hayson - Stantec
/djg

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REPORT OF PRELIMINARY GEOTECHNICAL EXPLORATION

Introduction

Executive Summary

As part of the Hancock County Flood Risk Reduction Program, the Maumee Watershed Conservancy District (MWCD) is planning to widen an additional area of the floodplain bench of the Blanchard River in Hancock County, Ohio, near downtown Findlay, Ohio. The proposed floodplain bench widening covers an approximate area of 19 acres along the north bank of the river and extends from the Norfolk Southern Railroad bridge on the west side of the site to near Dr. Martin Luther King Jr. Way on the east side of the site. Stantec Consulting Services Inc. (Stantec) was contracted by MWCD to perform engineering and design services for the program, including the geotechnical exploration for the additional hydraulic improvements.

Four borings were advanced by Stantec to provide geotechnical data along the alignment of the proposed floodplain bench widening. Below a thin layer of topsoil, soils identified as lean clay and sandy lean clay (CL), silty clayey sand (SC-SM), clayey sand (SC), silty sand (SM), silt (ML) and silty clay with sand (CL-ML) were observed to depths ranging from 15.2 feet to 19.9, where auger refusal was encountered. Groundwater was encountered in B-3 at a depth of 17.2 feet while the remaining borings were dry upon completion.

Slope stability analyses were not performed as part of this preliminary geotechnical exploration. Based on the soils encountered and the results of stability analyses performed on the adjacent project, 3:1 (H:V) cut slopes are recommended. Prior to final design, it is recommended that slope stability analyses be performed for any slopes exceeding 10 feet in height to confirm adequate factors of safety against slope failure. Additional borings and laboratory testing will be required to support slope stability analyses.

Based on the conceptual drawings provided for the current preferred alignment, it appears that no embankments will be constructed as part of this project. If the final design includes constructing embankments for the bike path or other structures, it is recommended that settlement analyses be performed to confirm that estimated settlement values are within recommended tolerances. Additional borings and laboratory testing will be required to support settlement analyses.

The conceptual drawings provided for the current preferred alignment indicate that culverts are being considered under Cory Street and Main Street. Based on the depths to bedrock found during this exploration, culverts may be either be soil bearing or rock bearing depending on the size and invert elevation determined in detailed design. Prior to final design, it is recommended that additional borings be drilled near the exact locations of culverts in accordance with Section 303.7.2 of "*Ohio Department of Transportation (ODOT) Specifications for Geotechnical Explorations*". For culverts with a planned diameter or span of 10 feet or greater, additional borings should include 5 feet of rock core to confirm the elevation and quality of the bedrock where culverts will be founded. Culverts shall be designed in accordance with all applicable ODOT standards and specifications.



REPORT OF PRELIMINARY GEOTECHNICAL EXPLORATION

Introduction

1.0 INTRODUCTION

As part of the Hancock County Flood Risk Reduction Program, the Maumee Watershed Conservancy District (MWCD) is planning to widen an additional area of the floodplain bench of the Blanchard River in Hancock County, Ohio, near downtown Findlay, Ohio. The proposed floodplain bench widening covers an approximate area of 19 acres along the north bank of the river and extends from the Norfolk Southern Railroad bridge on the west side of the site to near Dr. Martin Luther King Jr. Way on the east side of the site.

Stantec Consulting Services Inc. (Stantec) was contracted by MWCD to perform engineering and design services for the program, including the geotechnical exploration for the additional hydraulic improvements. Figure 1 shows the proposed bench widening extents with the borings completed by Stantec as part of this exploration.

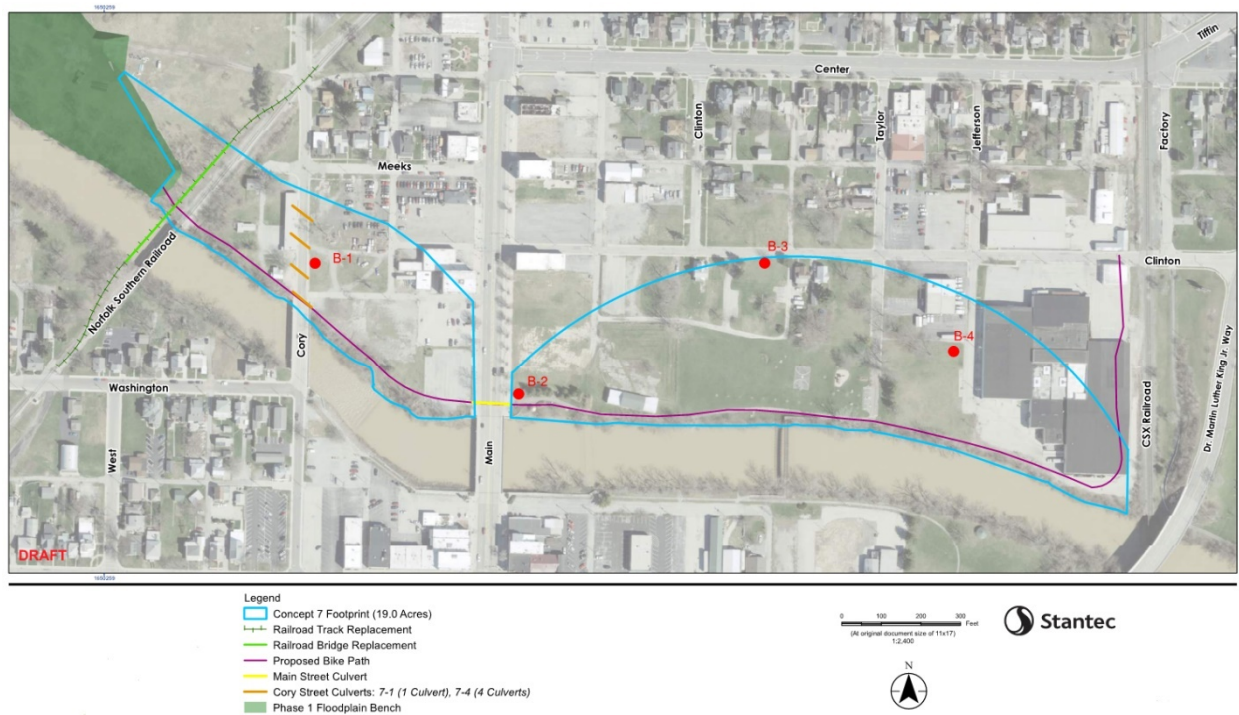


Figure 1. Boring Layout



REPORT OF PRELIMINARY GEOTECHNICAL EXPLORATION

Geology and Observations

2.0 GEOLOGY AND OBSERVATIONS

2.1 GENERAL

The *Physiographic Regions of Ohio* map (Ohio Department of Natural Resources (ODNR), 1998) indicates that the proposed floodplain widening project is in the Findlay Embayment region. The Findlay Embayment is a broadly rolling lacustrine plain and is an embayment of ancestral Lake Erie where relatively coarse lacustrine sediments collected. This region has very low relief (10 feet) with elevations of 775 to 800 feet.

2.2 SOIL GEOLOGY

According to the *Quaternary Geology of Ohio* map (ODNR, 1999), the project site is predominantly underlain by clayey till deposited during the Late Wisconsinan Age. The clayey till originated as a very flat lake-planted moraine and was planted by waves in glacial lakes. There are small patches of sand, silt, or clay on the surface in many areas.

The soil survey (*Web Soil Survey of Hancock County, Ohio*, United States Department of Agriculture (USDA), 2017) indicates that the site is underlain predominantly by Flatrock silt loam (0 to 2 percent slopes) and Lamberjack-Urban land complex (0 to 2 percent slopes). These soils consist of silt loam, loam, and stratified coarse sandy loam with moderately high to high capacities to transmit water.

The *Drift Thickness Map of Ohio* (ODNR, 2004) suggests a range of soil cover near the project site between 0 and 50 feet.

2.3 BEDROCK GEOLOGY

Bedrock mapping (*Bedrock Geology of the Findlay, Ohio Quadrangle*, ODNR, 1994) and Descriptions of Geologic Map Units (ODNR, 2000) indicates that overburden soils along the channel alignment are underlain by sedimentary bedrock from the Lockport Dolomite Formation of the Silurian System. The Lockport Dolomite is described as white to medium gray dolomite with medium to massive bedding ranging from 30 to 300 feet thick.

According to the Abandoned Underground Mine Locator (ODNR, 2015), mapped underground mines have not been identified in the project vicinity.

The *Ohio Karst Areas* map (ODNR, 2007) does not indicate known karst areas in the vicinity of the project. Probable karst areas are located approximately 10 to 15 miles east of the project area.



REPORT OF PRELIMINARY GEOTECHNICAL EXPLORATION

Geology and Observations

2.4 SEISMIC

A review of the seismic data available in the project vicinity included the OhioSeis database developed by the ODNR, Division of Geological Survey. The review was performed using the internet mapping service (rev. 2012) at the following website: <https://gis.ohiodnr.gov/website/dgs/earthquakes/>.

Overall, Ohio has a relatively limited amount of seismic activity. However, within a 20-mile radius of the proposed floodplain widening, there have been six earthquake epicenters with magnitudes ranging between 2.0 and 3.0. The available data reviewed included events that occurred from 1804 to present day.

2.5 HYDROLOGY

The project is located in the Blanchard River Watershed. The Blanchard River flows east to west through the City of Findlay. The proposed floodplain bench widening begins where the Norfolk Southern Railroad crosses the Blanchard River and ends just west of where Dr. Martin Luther King Jr. Way crosses the river.

2.6 HYDROGEOLOGY

Groundwater migrates by both primary and secondary porosity at the site. The soils in the area range from silts and clays to zones with sands and gravels. Surface water seeps into the soil overburden, particularly within the coarser zones. Perched water will often concentrate in the coarser soils and along the soil-bedrock interface. The groundwater will then primarily migrate downward through secondary porosity features such as the existing fractures, joints, and bedding planes, and to a lesser extent by primary porosity through the bedrock matrix. Groundwater follows the path of greater transmissivity downward and laterally until it intercepts the ground surface at seeps or springs, or intercepts the primary water table at varying depths within the bedrock. Regionally, groundwater generally flows in the direction of the surface drainage and intercepts channels and streams at lower elevations in the surrounding watersheds.



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Exploration

3.0 EXPLORATION

Four borings were advanced by Stantec to obtain preliminary geotechnical data for use in the design and construction of the proposed floodplain bench widening. A summary of the borings advanced for this project is shown in Table 1. Boring logs are provided in Appendix A.

Table 1. Boring Summary

Boring No.	Northing	Easting	Ground Surface Elevation (ft)	Depth to Auger Refusal (ft)	Elevation of Auger Refusal (ft)
B-1	N/A ¹	N/A ¹	N/A ¹	N/A ²	N/A ²
B-1A	N/A ¹	N/A ¹	N/A ¹	N/A ²	N/A ²
B-1B	503,454.34	1,650,788.49	772.2	19.9	752.3
B-2	503,107.62	1,651,293.87	774.3	15.2	759.1
B-3	503,413.93	1,651,901.18	773.2	19.0	754.2
B-4	503,187.67	1,652,414.56	772.3	19.3	753.0

1. Locations were not surveyed. B-1 drilled approximately 50 feet south of B-1B; B-1A drilled approximately 65 feet south of B-1B.
2. B-1 terminated at 6.5 feet and B-1A terminated at 3.0 feet due to apparent soil contamination and strong odor of hydrocarbons. No refusal.

The borings were completed with a CME 45 truck-mounted drill rig using 3¼-inch inside diameter (ID) hollow stem augers to advance through soil. Standard penetration test (SPT) sampling was performed at select intervals until auger refusal was encountered in the borings. The energy ratio (ER) of the drill rigs' automatic hammer and drill rod systems was measured on a previous project. The average ER value for the equipment used on this project is 88.4 percent. The boring locations were provided by Bockrath & Associates Engineering and Surveying, LLC.

Borings B-1 and B-1A were terminated early due to apparent soil contamination, as indicated in Table 1. SPT samples recovered in these borings indicate perched water at a depth of approximately three feet that contains a black oily substance and a strong odor of hydrocarbons. The drillers moved 50 feet to the north of B-1 and did not encounter any contaminated soils.

The SPT sampling was performed in accordance with ASTM D1586, without the use of liners. The SPT samples were driven with an automatic hammer and consisted of repeatedly dropping a 140-pound hammer from a height of 30 inches to drive a split-spoon sampler a distance of 18-inches. The number of hammer blows needed to advance the sampler was recorded over three 6-inch increments. The blow count from the first 6-inch increment was discarded due to ground disturbance at the bottom of the borehole. The sum of the blow counts from the second and third 6-inch increments is called the field N-value (N_{field}). The field N-value is corrected to an equivalent rod energy ratio of 60 percent (N_{60}) according to the equation below.



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Exploration

$$N_{60} = N_{field} \left(\frac{ER}{60} \right)$$

The depths/elevations of the SPTs with the corresponding field blow counts are shown on the boring logs in Appendix A.

The materials encountered were logged by a geotechnical engineer, with particular attention given to soil type, consistency, and moisture content. Hand pressure readings were performed on selected samples using a pocket penetrometer. The borings were checked for the presence of groundwater during and after drilling with the depth of water recorded on the boring logs. Borings were terminated upon encountering refusal and backfilled with auger cuttings.

The soil samples obtained from the borings were transported to Stantec's geotechnical laboratory. All samples were tested for natural moisture content. Engineering classification testing was performed on selected disturbed SPT samples reflecting the main soil horizons. The engineering classification tests included sieve and hydrometer analysis (ASTM D 422) and Atterberg limits (ASTM D 4318). Details and results of laboratory testing are further discussed in Section 4.1. The laboratory test reports are provided in Appendix B.



REPORT OF PRELIMINARY GEOTECHNICAL EXPLORATION

Findings

4.0 FINDINGS

4.1 LABORATORY TESTING

4.1.1 Overview

Geotechnical laboratory tests were assigned to select soil samples. Soil samples were tested for soil classification and moisture content. Laboratory testing performed on this project is summarized in Table 2. Results of laboratory testing are provided in Appendix B.

Table 2. Summary of Laboratory Testing

Laboratory Test	Method	Number of Tests
Natural Moisture Content	ASTM D 2216	40
Sieve and Hydrometer Analysis	ASTM D 422	8
Atterberg Limits	ASTM D 4318	8
Soil Classifications	ASTM D 2487	8

4.1.2 Natural Moisture Content

Selected SPT samples were subjected to natural moisture content testing in accordance with ASTM D 2216. Moisture contents ranged from 4 percent to 31 percent with an average of 15 percent. The test results are provided in Appendix B.

4.1.3 Soil Classification

Selected SPT samples were subjected to soil classification testing in accordance with ASTM D 2487 which included sieve and hydrometer analysis in accordance with ASTM D 422 and Atterberg limits in accordance with ASTM D 4318. Classification results are presented in Table 3.



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Findings

Table 3. Results of Soil Classification Testing

Boring No.	Sample Type	Depth (ft)	LL (%)	PL (%)	PI (%)	Classification
B-1B	SPT Composite	1.5 – 6.5	20	15	5	SC-SM
	SPT Composite	10.0 – 14.0	31	21	10	CL
B-2	SPT Composite	7.5 – 14.0	28	18	10	SC
B-3	SPT Composite	5.0 – 9.0	29	17	12	CL
	SPT Composite	10.0 – 13.4	NP	NP	NP	ML
	SPT Composite	13.4 – 16.5	14	13	1	SM
B-4	SPT Composite	1.5 – 6.0	31	17	14	CL
	SPT Composite	12.5 – 19.0	20	16	4	CL-ML

4.2 SUBSURFACE CONDITIONS

Surface materials encountered consisted of 0.1 to 0.5 feet of topsoil. Below the topsoil, fill material (Soil 1) was encountered and described as brown silty sand, clayey sand, or silty clayey sand. It was further described as damp to moist, medium dense to dense in consistency, and containing a trace of brick fragments, wood, and other debris. The fill material extended to depths ranging from 1.5 feet in B-4 to 15 feet in B-2. The soil classified as SC-SM and SC according to the USCS and A-4 according to the AASHTO method. SPT N-values ranged from 2 to 40 blows per foot, with an average of 13 blows per foot. Natural moisture contents ranged from 4 to 23 percent, with an average of 10 percent. Liquid limits of 20 and 28 and plasticity indices of 5 and 10 were recorded in this material.

Soil 2 was observed below Soil 1 in all borings except B-2. Soil 2 was described as lean clay or sandy lean clay and extended to depths varying from 10.0 feet in B-3 to 15.8 feet in B-1B. Soil 2 classified as CL according to USCS and A-4 or A-6 according to the AASHTO method. It was further described as brown, damp to moist, soft to very stiff in consistency, and containing a trace of organics in some areas. Natural moisture contents ranged from 13 to 24 percent, with an average of 18 percent. SPT N-values ranged from 1 to 25 blows per foot, with an average of 10 blows per foot. Liquid limits of 31, 29, and 31 and plasticity indices of 10, 12, and 14 were recorded in this material, respectively. Pocket penetrometer hand pressures of 2.5 to 3.5 tons per square foot were recorded in this material.

Soil 3 was described as gray, moist, stiff to very stiff silt or silty clay with sand and was encountered below Soil 2 in borings B-3 and B-4. Soil 3 extends to bedrock in B-4. It is classified as ML or CL-ML according to USCS and A-4 according to the AASHTO method. Natural moisture contents ranged from 9 to 31 percent, with an average of 18 percent. SPT N-values ranged from 9 to 70 blows per foot, with an average of 37 blows per foot. The ML classified material was non-plastic, and the CL-ML yielded a liquid



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limit of 20 and plasticity index of 4. Pocket penetrometer hand pressures of 1.75 tons per square foot were recorded in this material.

Soil 4 was described as gray, moist, medium dense to dense, fine to coarse grained clayey sand or silty sand and extends to bedrock in borings B-1B and B-3. Soil 4 classified as SM according to USCS and A-4 according to the AASHTO method. Natural moisture contents ranged from 9 to 14 percent, with an average of 10 percent. SPT N-values ranged from 10 to 29 blows per foot, with an average of 17 blows per foot. A liquid limit of 14 and a plasticity index of 1 was recorded in this material.

The borings were terminated upon encountering auger refusal at depths ranging from 15.2 feet in B-2 to 19.9 feet in B-1B. The auger refusal was likely caused by bedrock, however, confirmatory penetration into bedrock by rock coring was not performed.

Groundwater was encountered in B-3 at a depth of 17.2 feet. The remainder of the borings were dry at completion.



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Conclusions and Recommendations

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

The recommendations that follow are based on the information discussed in this report and the interpretation of the subsurface conditions encountered at the site during fieldwork. If future design changes are made, the geotechnical engineers should be notified so that such changes can be reviewed, and the recommendations amended as necessary.

These conclusions and recommendations are based on data and subsurface conditions from the borings advanced during this exploration using the degree of care and skill ordinarily exercised under similar circumstances by competent members of the engineering profession. No warranties can be made regarding the continuity of conditions.

5.2 SLOPE STABILITY

Slope stability analyses were not performed as part of this preliminary geotechnical exploration. Based on the soils encountered and the results of stability analyses performed on the adjacent project, 3:1 (H:V) cut slopes are recommended. Prior to final design, it is recommended that slope stability analyses be performed for any slopes exceeding 10 feet in height to confirm adequate factors of safety against slope failure. Additional borings and laboratory testing will be required to support slope stability analyses.

5.3 SETTLEMENT

Based on the conceptual drawings provided for the current preferred alignment, it appears that no embankments will be constructed as part of this project. If the final design includes constructing embankments for the bike path or other structure, it is recommended that settlement analyses be performed to confirm that estimated settlement values are within recommended tolerances. Additional borings and laboratory testing will be required to support settlement analyses.

5.4 CULVERTS

The conceptual drawings provided for the current preferred alignment indicate that culverts are being considered under Cory Street and Main Street. Based on the depths to bedrock found during this exploration, culverts may be either be soil bearing or rock bearing depending on the size and invert elevation determined in detailed design. Prior to final design, it is recommended that additional borings be drilled near the exact locations of culverts in accordance with Section 303.7.2 of "*Ohio Department of Transportation (ODOT) Specifications for Geotechnical Explorations*". For culverts with a planned diameter or span of 10 feet or greater, additional borings should include 5 feet of rock core to confirm the elevation and quality of the bedrock where culverts will be founded. Culverts shall be designed in accordance with all applicable ODOT standards and specifications.



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Conclusions and Recommendations

5.5 EARTHWORK RECOMMENDATIONS

5.5.1. Soils with a strong petroleum odor were discovered in borings B-1 and B-1A located in parcel number 570000200180, east of Cory Street. It is recommended that an environmental investigation be performed to confirm the presence and extent of contamination. During construction, contaminated soil should be disposed of off-site in accordance with state and federal regulations.

5.5.2. Clearing of vegetation and topsoil should be performed below the footprint of embankments, if any. The exposed subgrade should be proof-rolled to observe the presence of any soft or unstable areas that may require stabilization. The areas should be proof-rolled using a loaded tandem axle dump truck or similarly heavy equipment in the presence of a geotechnical engineer or trained representative. Surficial soft soils delineated by proof-rolling should be undercut or stabilized in place as per recommendation of the geotechnical engineer.

5.5.3. On-site or borrow material to be used as fill should be approved for such use by the geotechnical engineer. Prior to its use, the contractor should identify the source and provide samples for soil classification and moisture-density testing. Fill material should meet the following requirements:

- Unless otherwise permitted by the geotechnical engineer, borrow material should not consist of soils represented by the following classifications, as determined in accordance with ASTM D 2487: MH, CH, OL, OH, PT.
- The fill material should be free from rubbish, organic matter, frozen soil, muck or other perishable, compressible debris, which prevent compaction to a dense, uniform state. Rock and other hard, durable fragments should be limited to particles displaying maximum dimension of six inches, should not exceed ten percent of the total volume, and should be uniformly distributed throughout the material.
- The maximum dry density of the borrow material should meet or exceed 98 pounds per cubic foot in accordance with ASTM D 698, Standard Specification for Test Methods for Moisture-Density Relations for Soils and Soil-Aggregate Mixtures.

5.5.4. Embankment material should be placed in a maximum of eight-inch (compacted) lifts. Engineered fill shall be compacted to at least 95 percent of standard Proctor density. Some adjustment of moisture content may be required to achieve the desired density. Typically, the water content of low plasticity cohesive soils within -2 to +2 percent of optimum provides the desired density. Field density tests should be performed to verify compaction.

5.5.5. Soil exposed on cut slopes for the floodplain widening will be susceptible to erosion. Seed and mulch should be applied as soon as possible after completion of the cut slopes in order to establish vegetation that will provide erosion protection.



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Conclusions and Recommendations

5.5.6. All construction operations involving earthwork should be performed in the presence of a qualified technician who is experienced in monitoring and testing earthwork construction. The technician should operate under the direct supervision of a Professional Engineer experienced in geotechnical engineering. We strongly recommend to your office that our staff be retained for earthwork and foundation excavation observation in order to maintain a continuity of the assessment of soil materials from this study through construction.



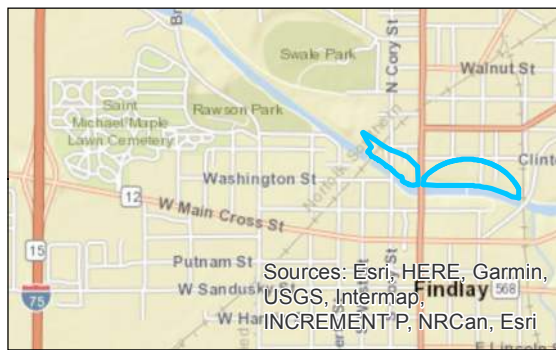
APPENDIX A
BORING LAYOUT AND LOGS

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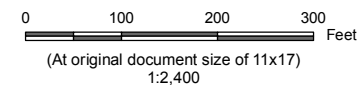
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Legend

- Concept 7 Footprint (19.0 Acres)
- Railroad Track Replacement
- Railroad Bridge Replacement
- Proposed Bike Path
- Main Street Culvert
- Cory Street Culverts: 7-1 (1 Culvert), 7-4 (4 Culverts)
- Phase 1 Floodplain Bench



Project Location: Findlay, Ohio
 Client/Project: Maumee Watershed Conservancy District Additional Hydraulic Improvements
 Prepared by LEK on 2019-08-23
 TR by ACS on 2019-08-23
 IR Review by DTH on 2019-08-23
 174316204

Figure No. 7

Title

**Additional Benching Layouts
 Concept 7**

Notes
 1. Coordinate System: NAD 1983 2011 StatePlane Ohio North FIPS 3401 Ft US
 2. Background: 2017 Aerial Photography, Hancock County Auditor GIS Data Downloads, 2019

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Stantec Boring No. **B-1**

Client <u>MWCD</u>	Boring Location <u>503,454.3 N; 1,650,788.5 E</u>
Project Number <u>174316204.411</u>	Surface Elevation <u>772.2 ft</u> Elevation Datum <u>NAVD88</u>
Project Name <u>HCFRR Additional Benching</u>	Date Started <u>7/22/20</u> Completed <u>7/22/20</u>
Project Location <u>Hancock County, Ohio</u>	Depth to Water <u>N/A</u> Date/Time <u>N/A</u>
Inspector <u>Stantec - L. Talbot</u>	Depth to Water <u>N/A</u> Date/Time <u>N/A</u>
Drilling Contractor <u>Stantec - G. Wilson</u>	Drill Rig Type and ID <u>CME 45C#3 (#812)</u>
Overburden Drilling and Sampling Tools (Type and Size) <u>3.25" ID HSA, 2" SPT</u>	
Rock Drilling and Sampling Tools (Type and Size) <u>N/A</u>	
Sampler Hammer Type <u>Automatic</u> Weight <u>140 lb</u> Drop <u>30 in</u> Efficiency <u>88.4 % (Avg.)</u>	
Borehole Azimuth <u>N/A (Vertical)</u>	Borehole Inclination (from Vertical) <u>Vertical</u>

DEPTH (ft)	ELEVATION (ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES				MONITOR WELL / PIEZOMETER	UNDRAINED SHEAR STRENGTH - tsf ▲														
				TYPE	NUMBER	RECOVERY	BLOWS / PRESS. (psi) / RQD (%)		1	2	3	4	5	6	7	8	9	10					
0	772.2						ft		WATER CONTENT & ATTERBERG LIMITS $\left[\begin{array}{c} W_P \\ W \\ W_L \end{array} \right]$ Pocket Penetrometer/Torvane (tsf) ★ STANDARD PENETRATION TEST, BLOWS/FOOT ●														
	772.1	Topsoil																					
1		Silty Sand with Gravel (FILL), little brick fragments & debris, brown with gray & red, medium dense, dry to damp, fine to coarse grained <i>grades to trace brick fragments & debris at 1.5'</i>		SPT	1	1.1	3-8-10																
2					SPT	2	1.2	4-3-8															
3	769.2	Sandy Lean Clay with Gravel (FILL), and brick fragments, some silt, gray with red, medium stiff, wet, trace hydrocarbons <i>grades to trace brick fragments, organics & debris, becomes brown with gray & red, soft, moist to wet at 5.0'</i>		SPT	3	0.2	2-3-4																
4																							
5																							
6	765.7			SPT	4	0.9	1-1-1																
7		<i>Boring terminated due to strong petroleum odor in sample S-3. Backfilled with soil cuttings, gravel at top.</i>																					
8																							
9																							
10																							

Stantec Boring No. **B-1A**

Client <u>MWCD</u>	Boring Location <u>503,454.3 N; 1,650,788.5 E</u>
Project Number <u>174316204.411</u>	Surface Elevation <u>772.2 ft</u> Elevation Datum <u>NAVD88</u>
Project Name <u>HCFRR Additional Benching</u>	Date Started <u>7/22/20</u> Completed <u>7/22/20</u>
Project Location <u>Hancock County, Ohio</u>	Depth to Water <u>N/A</u> Date/Time <u>N/A</u>
Inspector <u>Stantec - L. Talbot</u>	Depth to Water <u>N/A</u> Date/Time <u>N/A</u>
Drilling Contractor <u>Stantec - G. Wilson</u>	Drill Rig Type and ID <u>CME 45C#3 (#812)</u>
Overburden Drilling and Sampling Tools (Type and Size) <u>3.25" ID HSA, 2" SPT</u>	
Rock Drilling and Sampling Tools (Type and Size) <u>N/A</u>	
Sampler Hammer Type <u>Automatic</u> Weight <u>140 lb</u> Drop <u>30 in</u> Efficiency <u>88.4 % (Avg.)</u>	
Borehole Azimuth <u>N/A (Vertical)</u>	Borehole Inclination (from Vertical) <u>Vertical</u>

DEPTH (ft)	ELEVATION (ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES				MONITOR WELL / PIEZOMETER	UNDRAINED SHEAR STRENGTH - tsf ▲														
				TYPE	NUMBER	RECOVERY	BLOWS / PRESS. (psi) / RQD (%)		1	2	3	4	5	6	7	8	9	10					
0	772.2						ft		WATER CONTENT & ATTERBERG LIMITS $\left \begin{matrix} W_P \\ W \\ W_L \end{matrix} \right $ Pocket Penetrometer/Torvane (tsf) ★ STANDARD PENETRATION TEST, BLOWS/FOOT ●														
0	772.1	Topsoil																					
1		Silty Sand with Gravel (FILL), trace debris, organics & brick fragments, brown with gray, medium dense, damp to wet, fine to coarse grained, trace hydrocarbons <i>becomes gray with brown & orange, loose, dry to damp at 1.5'</i>		SPT	1	1.2	2-6-8																
2			SPT	2	0.9	2-4-3																	
3	769.2																						
Boring terminated due to strong petroleum odor in sample S-1. Backfilled with soil cuttings, gravel at top.																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							

Stantec Boring No. **B-1B**

 Client MWCD
 Project Number 174316204.411
 Project Name HCFRR Additional Benching
 Project Location Hancock County, Ohio
 Inspector Stantec - L. Talbot
 Drilling Contractor Stantec - G. Wilson

 Boring Location 503,454.3 N; 1,650,788.5 E
 Surface Elevation 772.2 ft Elevation Datum NAVD88
 Date Started 7/22/20 Completed 7/22/20
 Depth to Water N/A Date/Time N/A
 Depth to Water N/A Date/Time N/A
 Drill Rig Type and ID CME 45C#3 (#812)

 Overburden Drilling and Sampling Tools (Type and Size) 3.25" ID HSA, 2" SPT

 Rock Drilling and Sampling Tools (Type and Size) N/A

 Sampler Hammer Type Automatic Weight 140 lb Drop 30 in Efficiency 88.4 % (Avg.)

 Borehole Azimuth N/A (Vertical) Borehole Inclination (from Vertical) Vertical

DEPTH (ft)	ELEVATION (ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES				MONITOR WELL / PIEZOMETER	UNDRAINED SHEAR STRENGTH - tsf ▲									
				TYPE	NUMBER	RECOVERY	BLOWS / PRESS. (psi) / RQD (%)		1	2	3	4	5	6	7	8	9	10
0	772.2						ft		WATER CONTENT & ATTERBERG LIMITS $\left[\begin{array}{c} W_P \\ W \\ W_L \end{array} \right]$ Pocket Penetrometer/Torvane (tsf) ★ STANDARD PENETRATION TEST, BLOWS/FOOT ●									
0	772.1	TOPSOIL							10	20	30	40	50	60	70	80	90	
0.5		Silty Clayey Sand (SC-SM), trace debris, asphalt & brick fragments, brown & gray with black, medium dense to dense, damp, fine to coarse grained (FILL) <i>becomes brownish gray with black & red at 1.5'</i>		SPT	1	1.1	10-27-13											
1.5				SPT	2	0.9	7-9-9											
3.5				SPT	3	0.3	6-4-5											
5.5																		
6.5				SPT	4	1.2	2-3-3											
7.5																		
8.5	764.7	Lean Clay (CL), some silt, trace sand, trace organics, brown, stiff, damp, trace oxidized soil		SPT	5	1.1	2-5-5											
9.5																		
10	762.2																	

Stantec Boring No. **B-1B**

 Client MWCD

 Boring Location 503,454.3 N; 1,650,788.5 E

 Project Number 174316204.411

 Surface Elevation 772.2 ft Elevation Datum NAVD88

DEPTH(ft)	ELEVATION(ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES				MONITOR WELL / PIEZOMETER	UNDRAINED SHEAR STRENGTH - tsf ▲					
				TYPE	NUMBER	RECOVERY	BLOWS / PRESS.(psi) / RQD (%)		1	2	3	4		
						ft								
10		Sandy Lean Clay (CL), some silt, brown, very soft, moist to wet, fine to medium grained sand <i>sand becomes fine to coarse grained at 12.5'</i>	[Diagonal Hatching]	SPT	6	1.1	1-1-1							
11														
12														
13				SPT	7	1.1	1-0-1							
14														
15														
16	756.4	Clayey Sand (SC), some silt, trace gravel, gray & brown, loose, moist to wet, fine to coarse grained	[Diagonal Hatching]	SPT8ab		1.5	WH-3-7							
17														
18	754.3	Severely Weathered Dolomite, gray, moderately strong to strong	[Brick Pattern]	SPT9ab		1.4	9-41-29							
19														
20	752.3	Boring terminated at auger refusal. Backfilled with soil cuttings, gravel at top.												
21														
22														
23														

Stantec Boring No. **B-2**

Client MWCD
 Project Number 174316204.411
 Project Name HCFRR Additional Benching
 Project Location Hancock County, Ohio
 Inspector Stantec - L. Talbot
 Drilling Contractor Stantec - G. Wilson

Boring Location 503,107.6 N; 1,651,293.9 E
 Surface Elevation 774.3 ft Elevation Datum NAVD88
 Date Started 7/21/20 Completed 7/21/20
 Depth to Water N/A Date/Time N/A
 Depth to Water N/A Date/Time N/A
 Drill Rig Type and ID CME 45C#3 (#812)

Overburden Drilling and Sampling Tools (Type and Size) 3.25" ID HSA, 2" SPT

Rock Drilling and Sampling Tools (Type and Size) N/A

Sampler Hammer Type Automatic Weight 140 lb Drop 30 in Efficiency 88.4 % (Avg.)

Borehole Azimuth N/A (Vertical) Borehole Inclination (from Vertical) Vertical

DEPTH (ft)	ELEVATION (ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES				MONITOR WELL / PIEZOMETER	UNDRAINED SHEAR STRENGTH - tsf ▲															
				TYPE	NUMBER	RECOVERY	BLOWS / PRESS. (psi) / RQD (%)		1				2				3				4			
									WATER CONTENT & ATTERBERG LIMITS $\frac{W_P}{W} \frac{W_L}{W}$															
0	774.3	Silty Sand (FILL), little gravel, trace brick fragments & organics, brown to red, very loose to medium dense, dry, fine to coarse grained <i>brick fragment (1.5") at 5.0'</i>	[Cross-hatched pattern]				ft		Pocket Penetrometer/Torvane (tsf) ★ STANDARD PENETRATION TEST, BLOWS/FOOT ●															
1				SPT	1	0.9	4-5-9																	
2				SPT	2	0.1	13-12-9																	
3																								
4				SPT	3	0.6	19-2-0																	
5																								
6				SPT	4	0.1	4-1-1																	
7																								
8	766.8	Clayey Sand with Gravel (SC), some silt, trace wood and debris, brown, medium dense, damp to moist	[Diagonal hatched pattern]	SPT	5	1.1	3-11-6																	
9																								
10																								

Stantec Boring No. **B-2**

 Client MWCD

 Boring Location 503,107.6 N; 1,651,293.9 E

 Project Number 174316204.411

 Surface Elevation 774.3 ft Elevation Datum NAVD88

DEPTH (ft)	ELEVATION (ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES				MONITOR WELL / PIEZOMETER	UNDRAINED SHEAR STRENGTH - tsf ▲				
				TYPE	NUMBER	RECOVERY	BLOWS / PRESS. (psi) / RQD (%)		1	2	3	4	
						ft							
10		Clayey Sand with Gravel (SC), some silt, trace wood and debris, brown, medium dense, damp to moist - (Continued) <i>grades to trace wood & brick fragments</i>		SPT	6	0.6	5-5-2						
11													
12													
13				SPT	7	0.4	2-3-2						
14													
15	759.3 759.1	Dolomite, gray, moderately strong to strong		SPT	8	0.2	50/2						
16		<i>Boring terminated at split spoon refusal. Backfilled with soil cuttings.</i>											
17													
18													
19													
20													
21													
22													
23													

Stantec Boring No. **B-3**

Client <u>MWCD</u>	Boring Location <u>503,413.9 N; 1,651,901.2 E</u>
Project Number <u>174316204.411</u>	Surface Elevation <u>773.2 ft</u> Elevation Datum <u>NAVD88</u>
Project Name <u>HCFRR Additional Benching</u>	Date Started <u>7/22/20</u> Completed <u>7/22/20</u>
Project Location <u>Hancock County, Ohio</u>	Depth to Water <u>17.2 ft</u> Date/Time <u>7/22/20</u>
Inspector <u>Stantec - L. Talbot</u>	Depth to Water <u>N/A</u> Date/Time <u>N/A</u>
Drilling Contractor <u>Stantec - G. Wilson</u>	Drill Rig Type and ID <u>CME 45C#3 (#812)</u>
Overburden Drilling and Sampling Tools (Type and Size) <u>3.25" ID HSA, 2" SPT</u>	
Rock Drilling and Sampling Tools (Type and Size) <u>N/A</u>	
Sampler Hammer Type <u>Automatic</u> Weight <u>140 lb</u> Drop <u>30 in</u> Efficiency <u>88.4 % (Avg.)</u>	
Borehole Azimuth <u>N/A (Vertical)</u>	Borehole Inclination (from Vertical) <u>Vertical</u>

DEPTH (ft)	ELEVATION (ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES				MONITOR WELL / PIEZOMETER	UNDRAINED SHEAR STRENGTH - tsf ▲									
				TYPE	NUMBER	RECOVERY	BLOWS / PRESS. (psi) / RQD (%)		1	2	3	4	5	6	7	8	9	10
0	773.2						ft		WATER CONTENT & ATTERBERG LIMITS $\left[\begin{array}{c} W_P \\ W \\ W_L \end{array} \right]$ Pocket Penetrometer/Torvane (tsf) ★ STANDARD PENETRATION TEST, BLOWS/FOOT ●									
0	773.1	Topsoil							10	20	30	40	50	60	70	80	90	
1		Silty Sand (FILL), trace gravel, trace organics & debris, brown, medium dense, dry, fine to coarse grained		SPT	1	1.1	4-7-8											
2		<i>grades to little clay, no organics at 1.5'</i>		SPT	2	0.8	3-7-8											
3	770.2	Clayey Sand (FILL), trace debris, brown with white, medium dense, dry to damp, fine to medium grained		SPT	3	1.2	3-7-8											
4	768.7																	
5		Sandy Lean Clay (CL), some silt, trace gravel, brown with white & orange, stiff to very stiff, dry to damp, trace oxidized soil		SPT	4	1.4	4-8-10											
6																		
7																		
8	765.2	<i>becomes damp to moist at 7.5'</i>		SPT5ab	1.5	4-5-6												
9	763.7	Lean Clay (CL), some silt, trace sand, brownish gray, stiff, damp to moist																
10																		

Stantec Boring No. **B-3**

 Client MWCD

 Boring Location 503,413.9 N; 1,651,901.2 E

 Project Number 174316204.411

 Surface Elevation 773.2 ft Elevation Datum NAVD88

DEPTH (ft)	ELEVATION (ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES				MONITOR WELL / PIEZOMETER	UNDRAINED SHEAR STRENGTH - tsf ▲					
				TYPE	NUMBER	RECOVERY	BLOWS / PRESS. (psi) / RQD (%)		1	2	3	4		
10		Silt (ML), little clay, gray, stiff, moist - (Continued)				ft								
11				SPT 6	6	1.5	3-4-5							
12														
13	759.8			SPT7ab		1.5	3-4-8							
14		Silty Sand (SM), trace gravel, gray with white, dense, moist, fine to coarse grained												
15		<i>grades to no gravel at 15.0'</i>												
16				SPT 8		1.0	5-14-15							
17	756.0													
18		Clayey Gravel (SEVERELY WEATHERED DOLOMITE), little silt, little sand, brownish gray & white, dense, moist to wet, fine to coarse grained		SPT 9		0.9	3-8-50/.5							
19	754.2													
Boring terminated at auger refusal. Backfilled with soil cuttings, gravel at top.														
20														
21														
22														
23														

Stantec Boring No. **B-4**

 Client MWCD

 Boring Location 503,187.7 N; 1,652,414.6 E

 Project Number 174316204.411

 Surface Elevation 772.3 ft Elevation Datum NAVD88

 Project Name HCFRR Additional Benching

 Date Started 7/21/20 Completed 7/21/20

 Project Location Hancock County, Ohio

 Depth to Water N/A Date/Time N/A

 Inspector Stantec - L. Talbot

 Depth to Water N/A Date/Time N/A

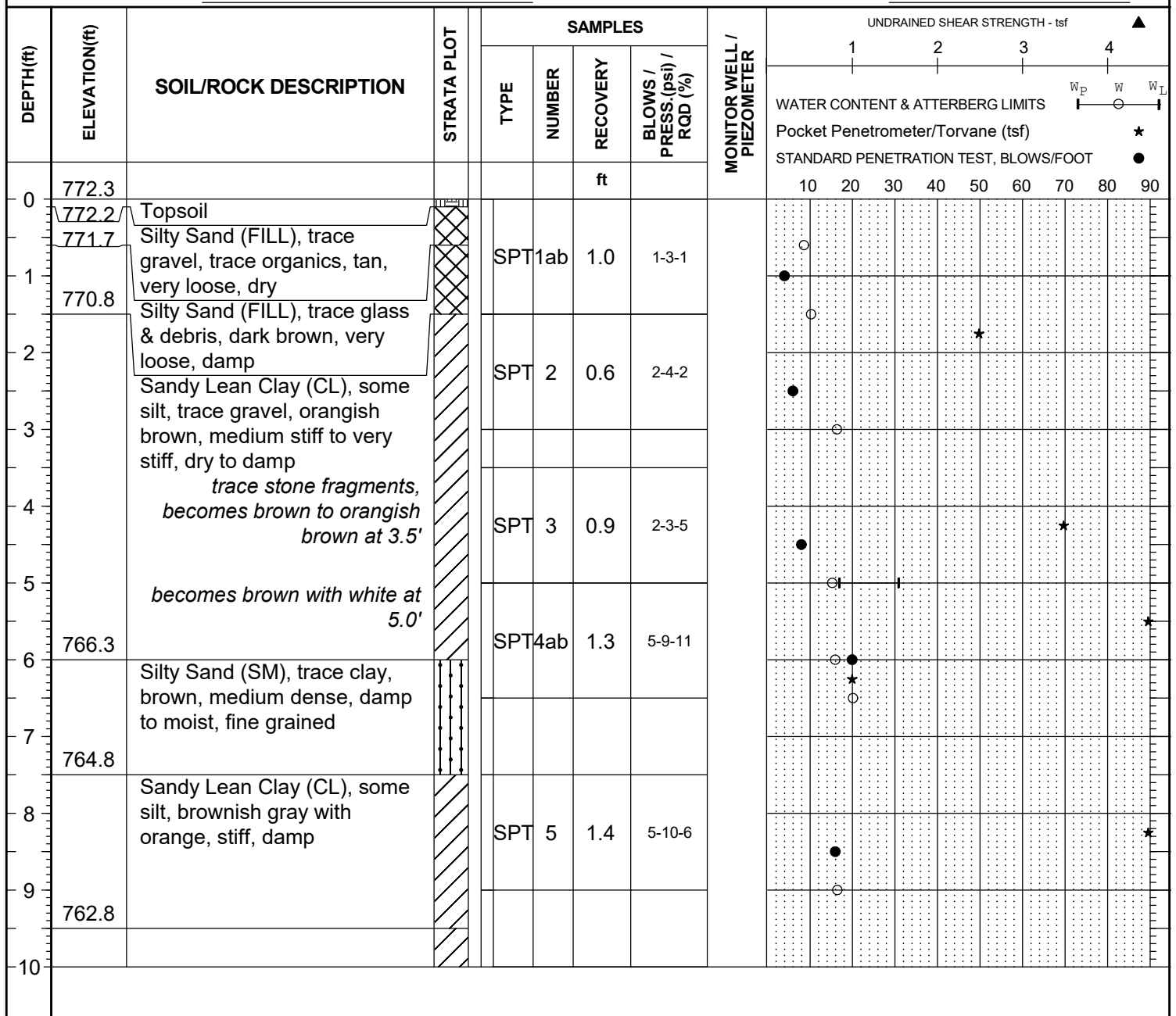
 Drilling Contractor Stantec - G. Wilson

 Drill Rig Type and ID CME 45C#3 (#812)

 Overburden Drilling and Sampling Tools (Type and Size) 3.25" ID HSA, 2" SPT

 Rock Drilling and Sampling Tools (Type and Size) N/A

 Sampler Hammer Type Automatic Weight 140 lb Drop 30 in Efficiency 88.4 % (Avg.)

 Borehole Azimuth N/A (Vertical) Borehole Inclination (from Vertical) Vertical






Stantec Boring No. **B-4**

 Client MWCD

 Boring Location 503,187.7 N; 1,652,414.6 E

 Project Number 174316204.411

 Surface Elevation 772.3 ft Elevation Datum NAVD88

DEPTH (ft)	ELEVATION (ft)	SOIL/ROCK DESCRIPTION	STRATA PLOT	SAMPLES				MONITOR WELL / PIEZOMETER	UNDRAINED SHEAR STRENGTH - tsf ▲					
				TYPE	NUMBER	RECOVERY	BLOWS / PRESS. (psi) / RQD (%)		1	2	3	4		
10		Lean Clay (CL), some silt, little sand, trace gravel, gray, very stiff, damp - (Continued)												
11				SPT 6	6	1.4	5-15-10							
12	760.3	Silty Clay with Sand (CL-ML), little gravel, gray, stiff to very stiff, damp to moist, fine grained sand												
13				SPT 7	7	1.0	3-5-6							
14														
15														
16	756.0	Dolomite, gray, moderately strong to strong		SPT8ab	8ab	0.4	19-41-29							
17	755.8													
18		Silty Clay with Sand (CL-ML), little gravel, gray, very stiff, moist, fine grained sand												
19	753.0			SPT 9	9	0.8	3-29-30							
20		<i>Boring terminated at auger refusal. Backfilled with soil cuttings, gravel at top.</i>												
21														
22														
23														

APPENDIX B
LABORATORY TEST RESULTS



Summary of Soil Tests

Project Name HCFRR Additional Benching Project Number 174316204
 Source B-1B, 1.5'-3.0', 3.0'-4.5', 5.0'-6.5' Lab ID 179
 Sample Type SPT Composite Date Received 8-4-20
 Date Reported 8-18-20

Test Results

Natural Moisture Content

Test Not Performed
 Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
 Gradation Method: ASTM D 422
 Hydrometer Method: ASTM D 422

Particle Size		% Passing
Sieve Size	(mm)	
	N/A	
	N/A	
	N/A	
1 1/2"	37.5	100.0
3/4"	19	95.1
3/8"	9.5	91.6
No. 4	4.75	88.7
No. 10	2	81.7
No. 40	0.425	80.5
No. 200	0.075	45.5
	0.02	23.7
	0.005	15.4
	0.002	11.2
estimated	0.001	8.9

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	11.3	18.3
Coarse Sand	7.0	1.2
Medium Sand	1.2	---
Fine Sand	35.0	35.0
Silt	30.1	34.3
Clay	15.4	11.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
 Prepared: Dry

Liquid Limit: 20
 Plastic Limit: 15
 Plasticity Index: 5
 Activity Index: 0.4

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft³): N/A
 Maximum Dry Density (kg/m³): N/A
 Optimum Moisture Content (%): N/A
 Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
 Compacted Dry Density (lb/ft³): N/A
 Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
 Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SC-SM
 Group Name: Silty, clayey sand

AASHTO Classification: A-4 (0)

Comments: _____

Reviewed By

RJ



Particle-Size Analysis of Soils
ASTM D 422

Project Name HCFRR Additional Benching
Source B-1B, 1.5'-3.0', 3.0'-4.5', 5.0'-6.5'

Project Number 174316204
Lab ID 179

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method ASTM D 422
Prepared using ASTM D 421

Particle Shape Angular
Particle Hardness: Hard and Durable

Tested By DW
Test Date 08-10-2020
Date Received 08-04-2020

Sieve Size	% Passing
1 1/2"	100.0
3/4"	95.1
3/8"	91.6
No. 4	88.7
No. 10	81.7

Maximum Particle size: 1 1/2" Sieve

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

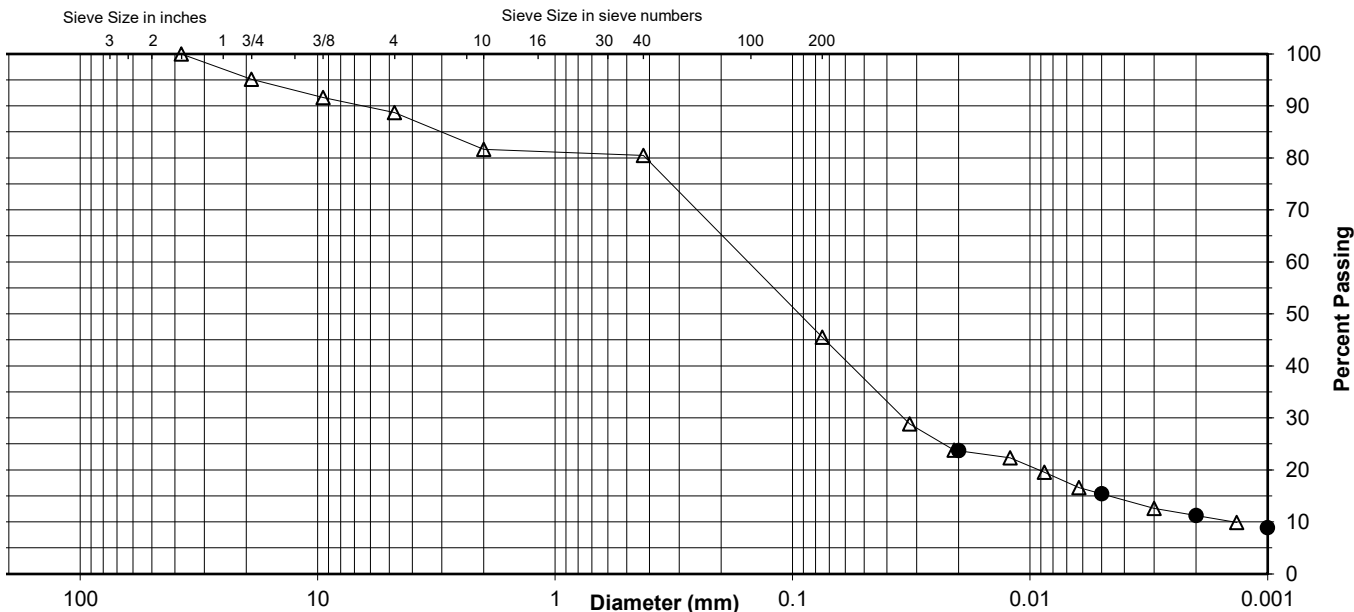
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	80.5
No. 200	45.5
0.02 mm	23.7
0.005 mm	15.4
0.002 mm	11.2
0.001 mm	8.9

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	4.9	6.4	7.0	1.2	35.0	30.1	15.4
AASHTO	Gravel		Coarse Sand		Fine Sand	Silt	Clay
	18.3		1.2		35.0	34.3	11.2



Comments _____

Reviewed By RJ

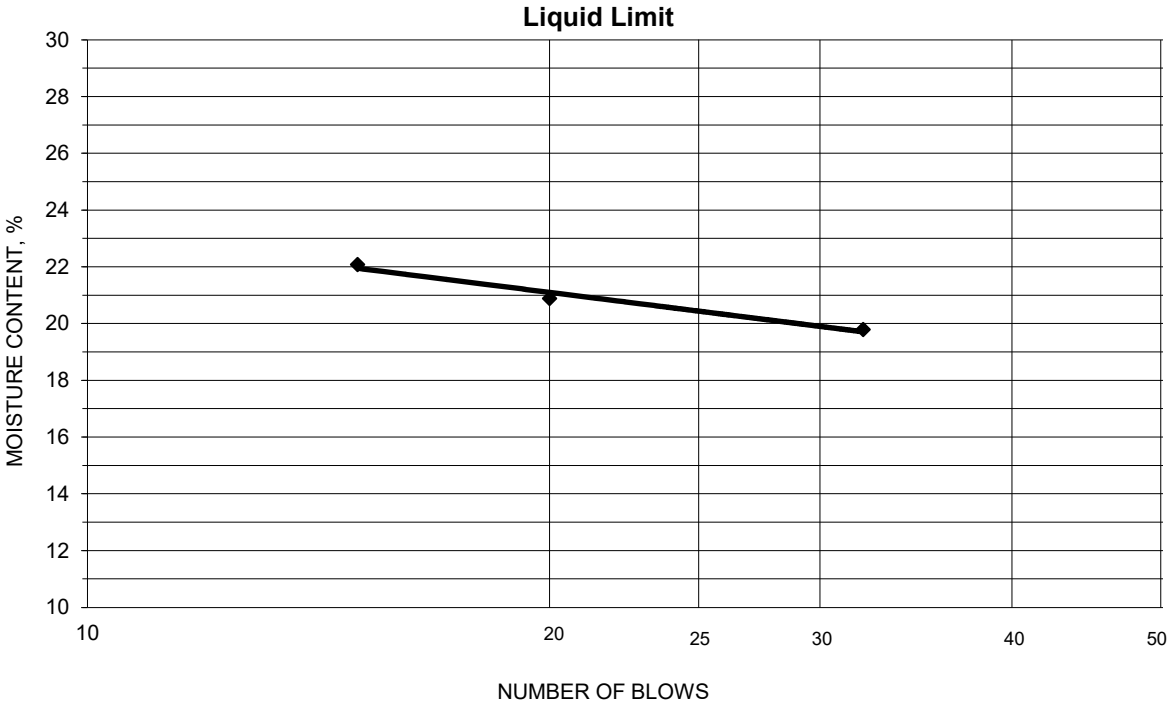


ATTERBERG LIMITS

Project HCFRR Additional Benching
 Source B-1B, 1.5'-3.0', 3.0'-4.5', 5.0'-6.5'
 Tested By KWS Test Method ASTM D 4318 Method A
 Test Date 08-12-2020 Prepared Dry

Project No. 174316204
 Lab ID 179
 % + No. 40 20
 Date Received 08-04-2020

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.87	18.26	10.97	15	22.1	20
17.48	16.34	10.88	20	20.9	
19.21	17.87	11.10	32	19.8	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
17.29	16.48	11.19	15.3	15	5
18.14	17.26	11.47	15.2		

Remarks: _____

Reviewed By RJ



Summary of Soil Tests

Project Name HCFRR Additional Benching Project Number 174316204
 Source B-1B, 10.0'-11.5', 12.5'-14.0' Lab ID 184
 Sample Type SPT Composite Date Received 8-4-20
 Date Reported 8-18-20

Test Results

Natural Moisture Content

Test Not Performed
 Moisture Content (%): N/A

Atterberg Limits

Test Method: ASTM D 4318 Method A
 Prepared: Dry
 Liquid Limit: 31
 Plastic Limit: 21
 Plasticity Index: 10
 Activity Index: 0.6

Particle Size Analysis

Preparation Method: ASTM D 421
 Gradation Method: ASTM D 422
 Hydrometer Method: ASTM D 422

Particle Size		% Passing
Sieve Size	(mm)	
	N/A	
	N/A	
	N/A	
1 1/2"	37.5	100.0
3/4"	19	98.2
3/8"	9.5	97.9
No. 4	4.75	97.9
No. 10	2	97.5
No. 40	0.425	78.1
No. 200	0.075	56.3
	0.02	36.5
	0.005	23.0
	0.002	15.8
estimated	0.001	11.1

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	2.1	2.5
Coarse Sand	0.4	19.4
Medium Sand	19.4	---
Fine Sand	21.8	21.8
Silt	33.3	40.5
Clay	23.0	15.8

Moisture-Density Relationship

Test Not Performed
 Maximum Dry Density (lb/ft³): N/A
 Maximum Dry Density (kg/m³): N/A
 Optimum Moisture Content (%): N/A
 Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
 Bearing Ratio (%): N/A
 Compacted Dry Density (lb/ft³): N/A
 Compacted Moisture Content (%): N/A

Specific Gravity

Estimated
 Particle Size: No. 10
 Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL
 Group Name: Sandy lean clay
 AASHTO Classification: A-4 (3)

Comments: _____

Reviewed By RJ



Particle-Size Analysis of Soils
ASTM D 422

Project Name HCFRR Additional Benching
Source B-1B, 10.0'-11.5', 12.5'-14.0'

Project Number 174316204
Lab ID 184

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method ASTM D 422
Prepared using ASTM D 421

Particle Shape Angular
Particle Hardness: Hard and Durable

Tested By DW
Test Date 08-10-2020
Date Received 08-04-2020

Sieve Size	% Passing
1 1/2"	100.0
3/4"	98.2
3/8"	97.9
No. 4	97.9
No. 10	97.5

Maximum Particle size: 1 1/2" Sieve

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

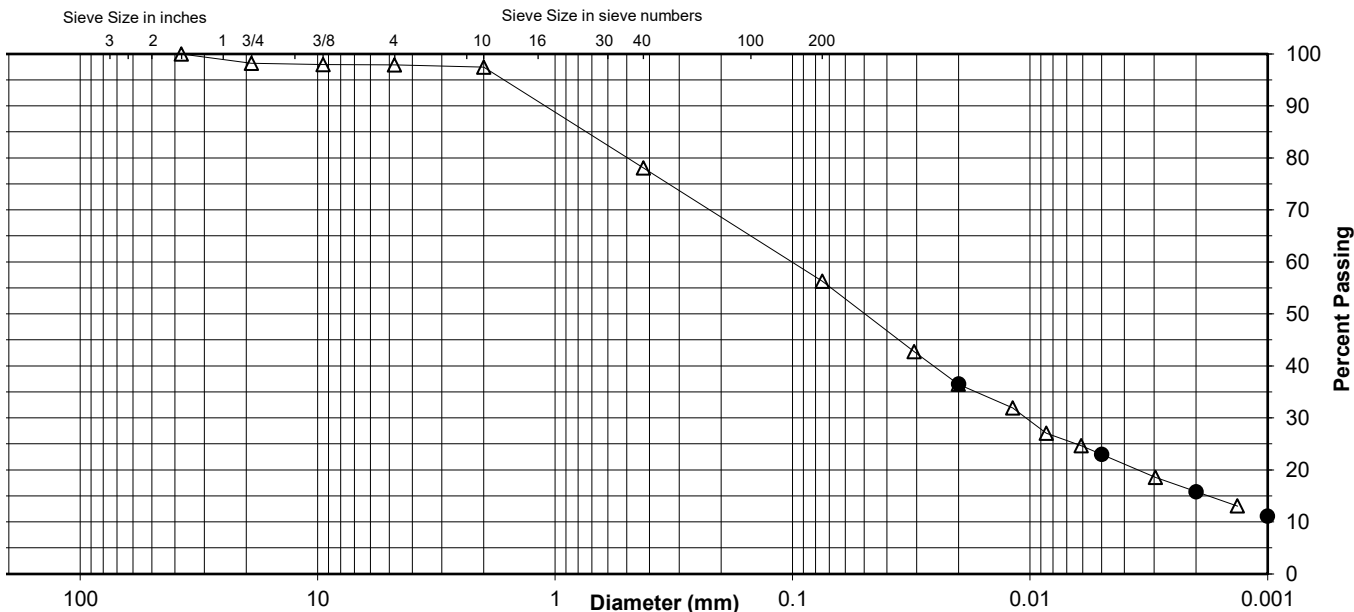
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	78.1
No. 200	56.3
0.02 mm	36.5
0.005 mm	23.0
0.002 mm	15.8
0.001 mm	11.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	1.8	0.3	0.4	19.4	21.8	33.3	23.0
AASHTO	Gravel		Coarse Sand		Fine Sand	Silt	Clay
	2.5		19.4		21.8	40.5	15.8



Comments _____

Reviewed By RJ

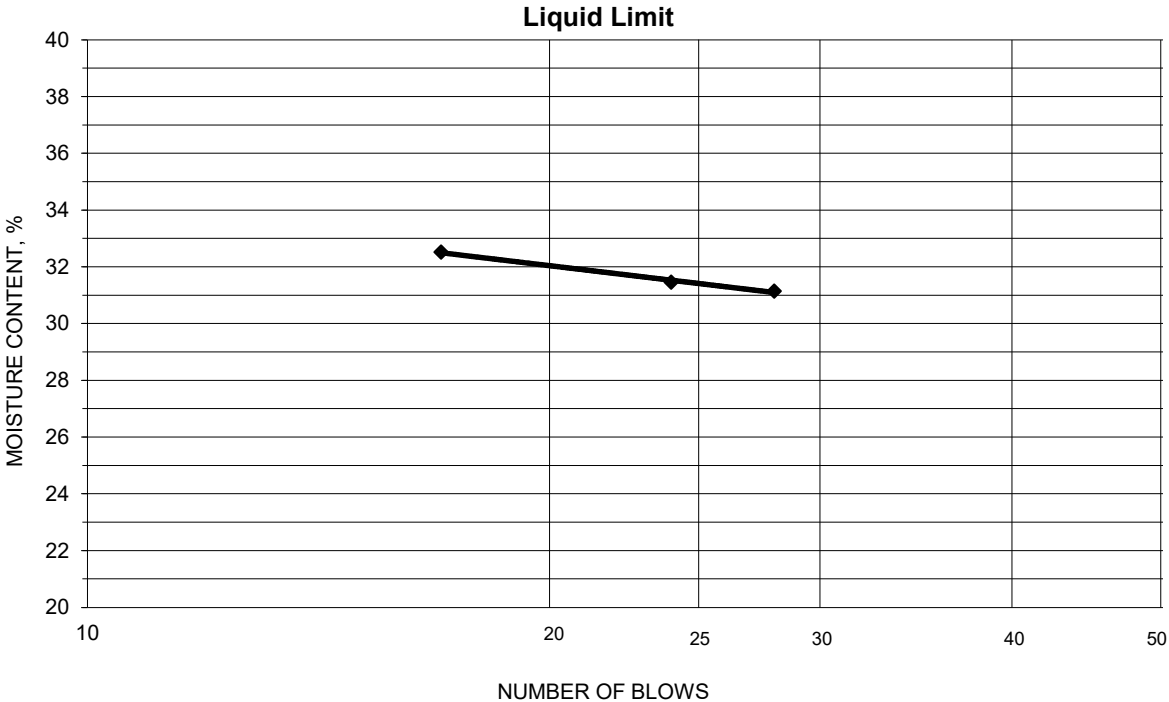


ATTERBERG LIMITS

Project HCFRR Additional Benching
 Source B-1B, 10.0'-11.5', 12.5'-14.0'
 Tested By KWS Test Method ASTM D 4318 Method A
 Test Date 08-12-2020 Prepared Dry

Project No. 174316204
 Lab ID 184
 % + No. 40 22
 Date Received 08-04-2020

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
17.87	16.14	10.82	17	32.5	31
17.88	16.26	11.11	24	31.5	
18.32	16.66	11.33	28	31.1	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
17.05	15.98	10.93	21.2	21	10
17.93	16.87	11.61	20.2		

Remarks: _____

Reviewed By RJ



Summary of Soil Tests

Project Name HCFRR Additional Benching Project Number 174316204
 Source B-2, 7.5'-9.0', 10.0'-11.5', 12.5'-14.0' Lab ID 193
 Sample Type SPT Composite Date Received 8-4-20
 Date Reported 8-17-20

Test Results

Natural Moisture Content

Test Not Performed
 Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
 Gradation Method: ASTM D 422
 Hydrometer Method: ASTM D 422

Particle Size		% Passing
Sieve Size	(mm)	
	N/A	
	N/A	
	N/A	
1 1/2"	37.5	100.0
3/4"	19	91.0
3/8"	9.5	84.3
No. 4	4.75	80.4
No. 10	2	73.8
No. 40	0.425	65.3
No. 200	0.075	37.0
	0.02	24.5
	0.005	16.4
	0.002	11.7
estimated	0.001	9.2

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	19.6	26.2
Coarse Sand	6.6	8.5
Medium Sand	8.5	---
Fine Sand	28.3	28.3
Silt	20.6	25.3
Clay	16.4	11.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
 Prepared: Dry

Liquid Limit: 28
 Plastic Limit: 18
 Plasticity Index: 10
 Activity Index: 0.9

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft³): N/A
 Maximum Dry Density (kg/m³): N/A
 Optimum Moisture Content (%): N/A
 Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
 Compacted Dry Density (lb/ft³): N/A
 Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
 Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SC
 Group Name: Clayey sand with gravel

AASHTO Classification: A-4 (0)

Comments:

Reviewed By

RJ



Particle-Size Analysis of Soils
ASTM D 422

Project Name HCFRR Additional Benching
Source B-2, 7.5'-9.0', 10.0'-11.5', 12.5'-14.0'

Project Number 174316204
Lab ID 193

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method ASTM D 422
Prepared using ASTM D 421

Particle Shape Angular
Particle Hardness: Hard and Durable

Tested By DW
Test Date 08-10-2020
Date Received 08-04-2020

Sieve Size	% Passing
1 1/2"	100.0
3/4"	91.0
3/8"	84.3
No. 4	80.4
No. 10	73.8

Maximum Particle size: 1 1/2" Sieve

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

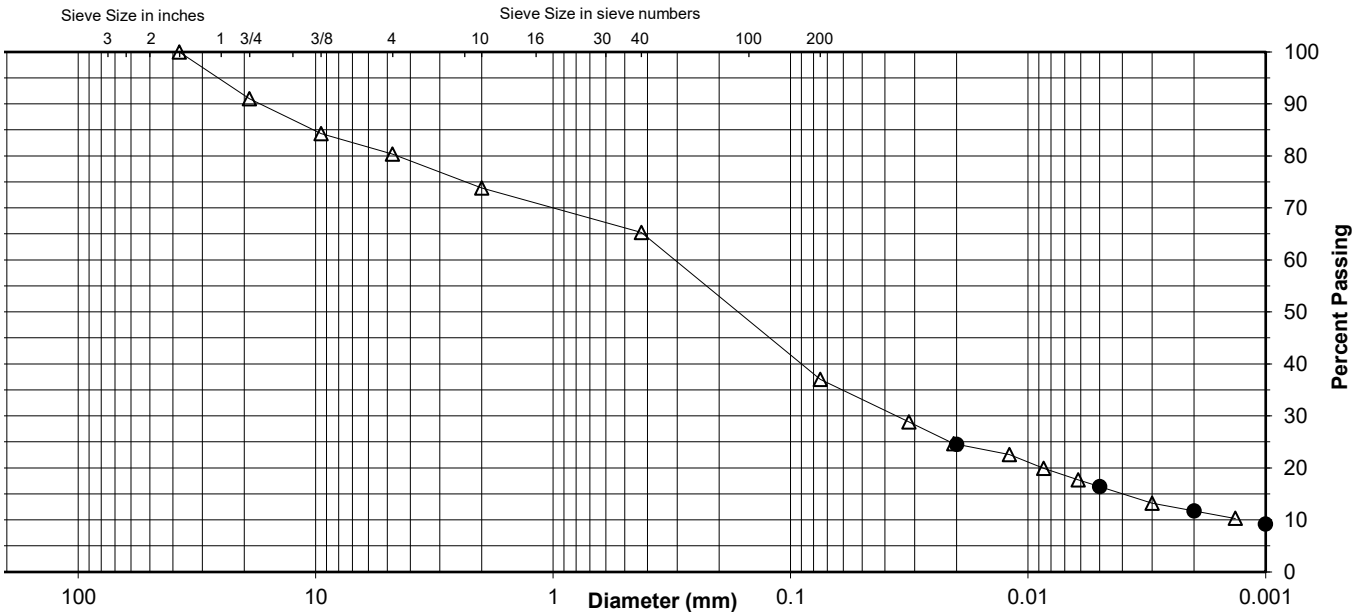
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	65.3
No. 200	37.0
0.02 mm	24.5
0.005 mm	16.4
0.002 mm	11.7
0.001 mm	9.2

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	9.0	10.6	6.6	8.5	28.3	20.6	16.4
AASHTO	Gravel		Coarse Sand		Fine Sand	Silt	Clay
	26.2		8.5		28.3	25.3	11.7



Comments _____

Reviewed By RJ

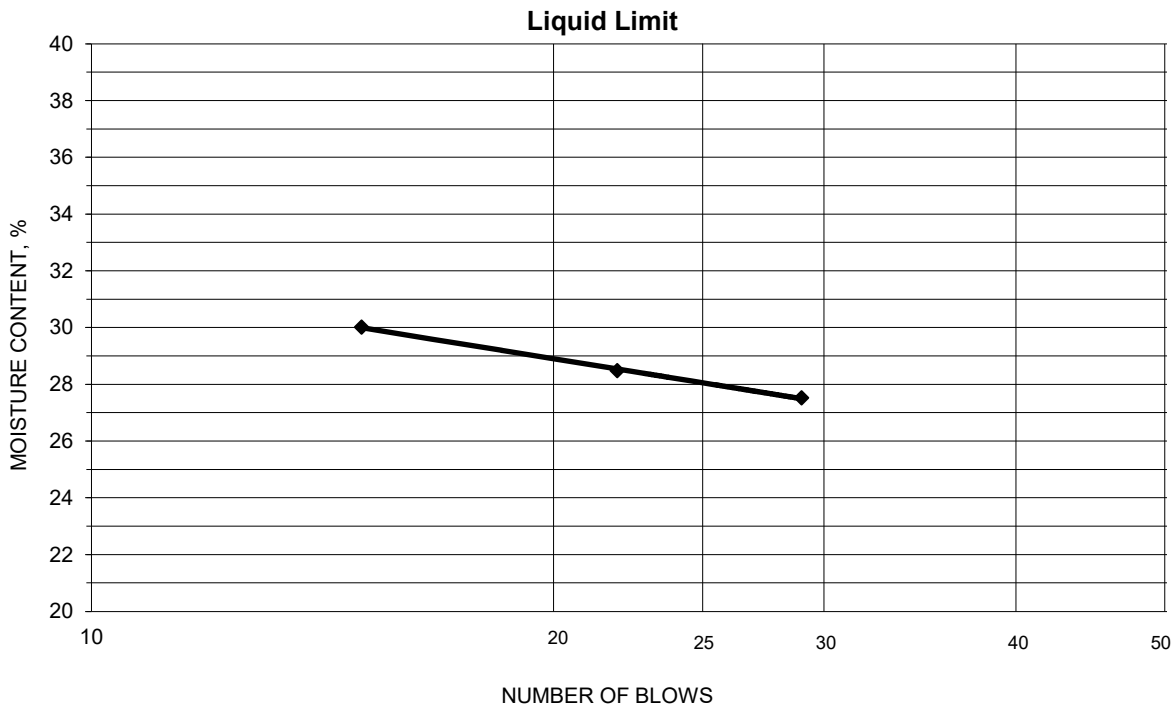


ATTERBERG LIMITS

Project HCFRR Additional Benching
 Source B-2, 7.5'-9.0', 10.0'-11.5', 12.5'-14.0'
 Tested By KWS Test Method ASTM D 4318 Method A
 Test Date 08-14-2020 Prepared Dry

Project No. 174316204
 Lab ID 193
 % + No. 40 35
 Date Received 08-04-2020

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
18.02	16.44	10.70	29	27.5	28
19.05	17.21	10.75	22	28.5	
19.03	17.16	10.93	15	30.0	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
17.41	16.46	11.06	17.6	18	10
16.81	15.88	10.78	18.2		

Remarks: _____

Reviewed By RJ



Summary of Soil Tests

Project Name HCFRR Additional Benching Project Number 174316204
 Source B-3, 5.0'-6.5', 8.0'-9.0' Lab ID 200
 Sample Type SPT Composite Date Received 8-4-20
 Date Reported 8-18-20

Test Results

Natural Moisture Content

Test Not Performed
 Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
 Gradation Method: ASTM D 422
 Hydrometer Method: ASTM D 422

Particle Size		% Passing
Sieve Size	(mm)	
	N/A	
	N/A	
	N/A	
	N/A	
3/4"	19	100.0
3/8"	9.5	99.6
No. 4	4.75	99.2
No. 10	2	98.1
No. 40	0.425	95.5
No. 200	0.075	89.6
	0.02	73.8
	0.005	46.3
	0.002	30.2
estimated	0.001	21.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.8	1.9
Coarse Sand	1.1	2.6
Medium Sand	2.6	---
Fine Sand	5.9	5.9
Silt	43.3	59.4
Clay	46.3	30.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
 Prepared: Dry

Liquid Limit: 29
 Plastic Limit: 17
 Plasticity Index: 12
 Activity Index: 0.4

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft³): N/A
 Maximum Dry Density (kg/m³): N/A
 Optimum Moisture Content (%): N/A
 Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
 Compacted Dry Density (lb/ft³): N/A
 Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
 Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL
 Group Name: Lean clay

AASHTO Classification: A-6 (9)

Comments: _____

Reviewed By RJ



Particle-Size Analysis of Soils
ASTM D 422

Project Name HCFRR Additional Benching
Source B-3, 5.0'-6.5', 8.0'-9.0'

Project Number 174316204
Lab ID 200

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method ASTM D 422
Prepared using ASTM D 421

Particle Shape Angular
Particle Hardness: Hard and Durable

Tested By MW
Test Date 08-10-2020
Date Received 08-04-2020

Sieve Size	% Passing
3/4"	100.0
3/8"	99.6
No. 4	99.2
No. 10	98.1

Maximum Particle size: 3/4" Sieve

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

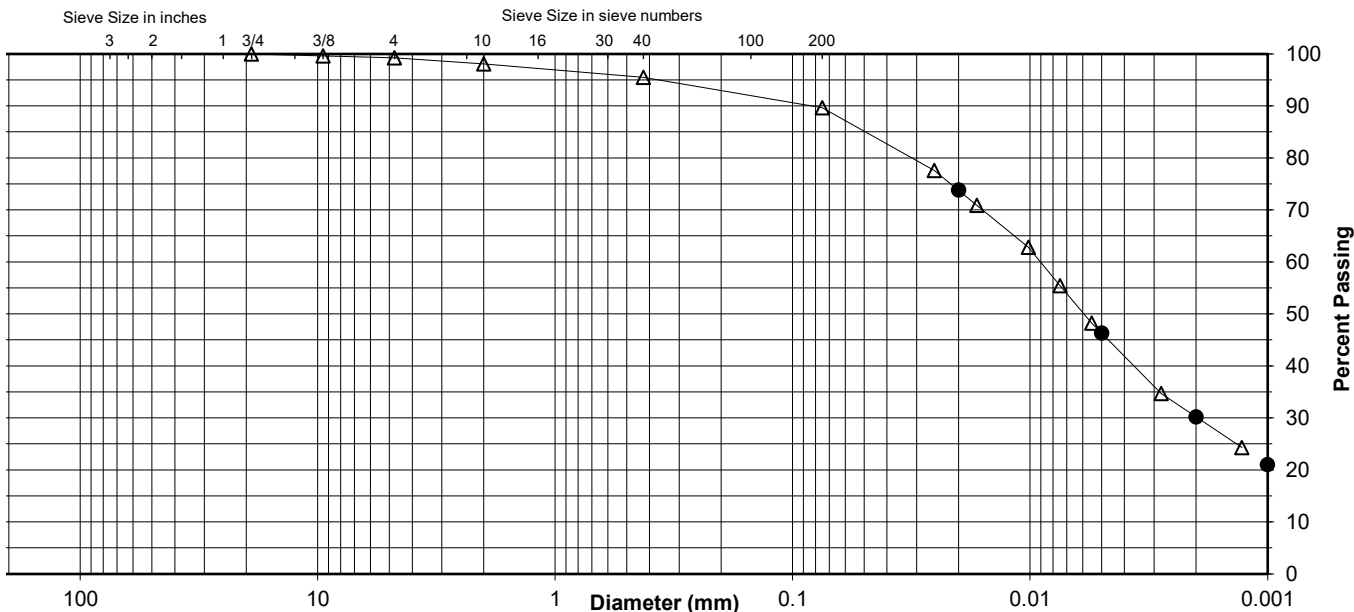
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	95.5
No. 200	89.6
0.02 mm	73.8
0.005 mm	46.3
0.002 mm	30.2
0.001 mm	21.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.8	1.1	2.6	5.9	43.3	46.3
AASHTO	Gravel		Coarse Sand		Fine Sand	Silt	Clay
	1.9		2.6		5.9	59.4	30.2



Comments _____

Reviewed By RJ

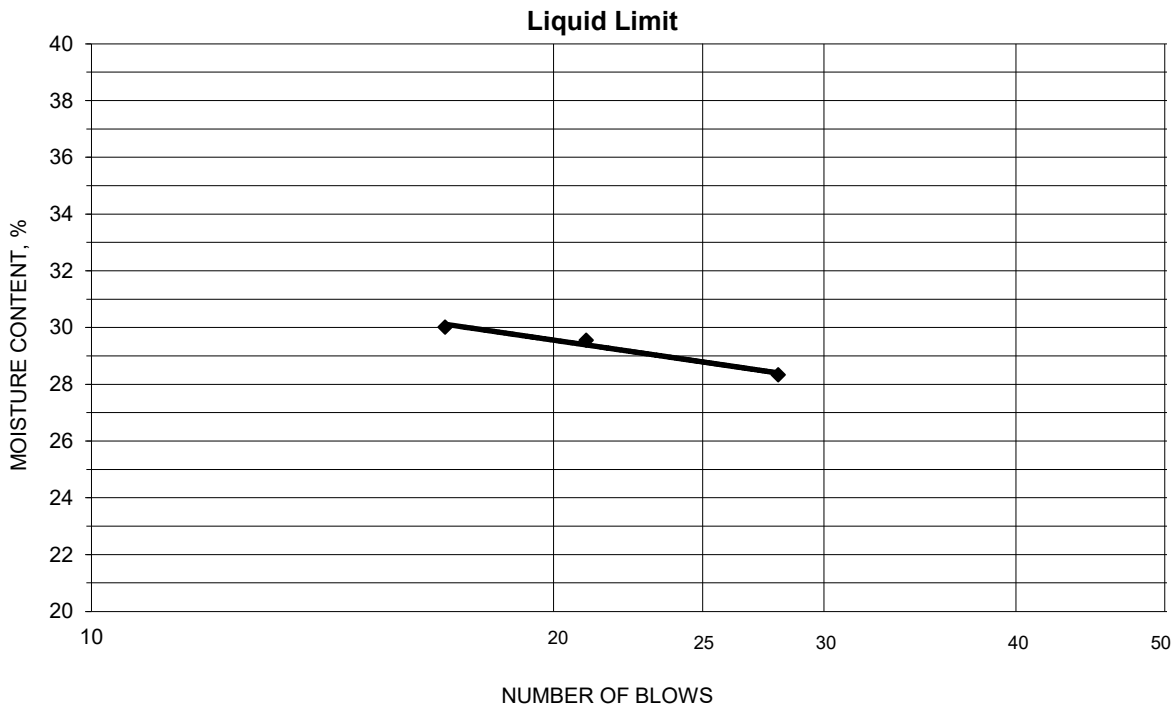


ATTERBERG LIMITS

Project HCFRR Additional Benching
 Source B-3, 5.0'-6.5', 8.0'-9.0'
 Tested By KWS Test Method ASTM D 4318 Method A
 Test Date 08-12-2020 Prepared Dry

Project No. 174316204
 Lab ID 200
 % + No. 40 5
 Date Received 08-04-2020

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
17.21	15.76	10.93	17	30.0	29
17.51	16.05	11.11	21	29.6	
17.44	15.93	10.60	28	28.3	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
16.95	16.01	10.55	17.2	17	12
17.40	16.45	11.01	17.5		

Remarks: _____

Reviewed By RJ



Summary of Soil Tests

Project Name HCFRR Additional Benching Project Number 174316204
 Source B-3, 10.0'-11.5', 12.5'-13.4' Lab ID 203
 Sample Type SPT Composite Date Received 8-4-20
 Date Reported 8-18-20

Test Results

Natural Moisture Content

Test Not Performed
 Moisture Content (%): N/A

Atterberg Limits

Test Method: ASTM D 4318 Method A
 Prepared: Dry
 Liquid Limit: NP
 Plastic Limit: NP
 Plasticity Index: NP
 Activity Index: N/A

Particle Size Analysis

Preparation Method: ASTM D 421
 Gradation Method: ASTM D 422
 Hydrometer Method: ASTM D 422

Particle Size		% Passing
Sieve Size	(mm)	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.8
No. 200	0.075	98.1
	0.02	61.8
	0.005	22.4
	0.002	12.8
estimated	0.001	8.6

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.1
Medium Sand	0.1	---
Fine Sand	1.7	1.7
Silt	75.7	85.3
Clay	22.4	12.8

Moisture-Density Relationship

Test Not Performed
 Maximum Dry Density (lb/ft³): N/A
 Maximum Dry Density (kg/m³): N/A
 Optimum Moisture Content (%): N/A
 Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
 Bearing Ratio (%): N/A
 Compacted Dry Density (lb/ft³): N/A
 Compacted Moisture Content (%): N/A

Specific Gravity

Estimated
 Particle Size: No. 10
 Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: ML
 Group Name: Silt
 AASHTO Classification: A-4 (0)

Comments: _____

Reviewed By RJ

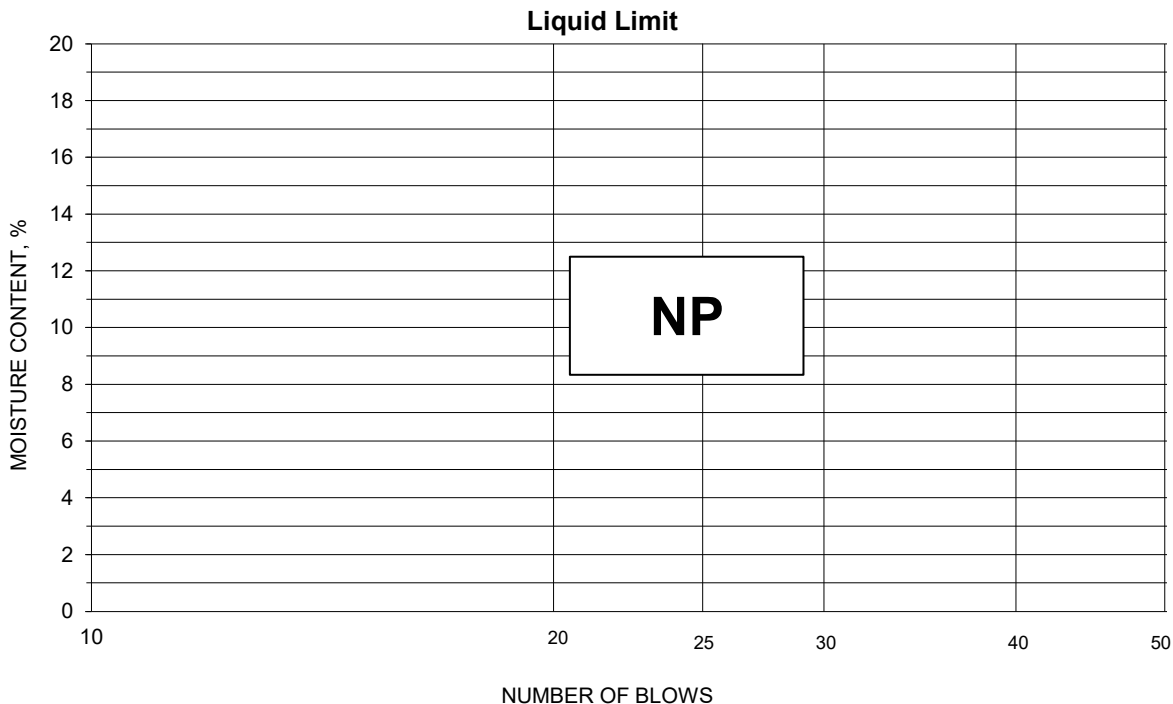


ATTERBERG LIMITS

Project HCFRR Additional Benching
 Source B-3, 10.0'-11.5', 12.5'-13.4'
 Tested By KWS Test Method ASTM D 4318 Method A
 Test Date 08-14-2020 Prepared Dry

Project No. 174316204
 Lab ID 203
 % + No. 40 0
 Date Received 08-04-2020

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RJ



Summary of Soil Tests

Project Name HCFRR Additional Benching Project Number 174316204
 Source B-3, 13.4'-14.0', 15.0'-16.5' Lab ID 206
 Sample Type SPT Composite Date Received 8-4-20
 Date Reported 8-18-20

Test Results

Natural Moisture Content
 Test Not Performed
 Moisture Content (%): N/A

Atterberg Limits
 Test Method: ASTM D 4318 Method A
 Prepared: Dry
 Liquid Limit: 14
 Plastic Limit: 13
 Plasticity Index: 1
 Activity Index: 0.1

Particle Size Analysis
 Preparation Method: ASTM D 421
 Gradation Method: ASTM D 422
 Hydrometer Method: ASTM D 422

Moisture-Density Relationship
 Test Not Performed
 Maximum Dry Density (lb/ft³): N/A
 Maximum Dry Density (kg/m³): N/A
 Optimum Moisture Content (%): N/A
 Over Size Correction %: N/A

Particle Size		%
Sieve Size	(mm)	
	N/A	Passing
	N/A	
	N/A	
	N/A	
1 1/2"	37.5	100.0
3/4"	19	96.8
3/8"	9.5	94.0
No. 4	4.75	90.9
No. 10	2	86.4
No. 40	0.425	74.5
No. 200	0.075	46.0
	0.02	28.6
	0.005	16.6
	0.002	9.7
estimated	0.001	6.2

California Bearing Ratio
 Test Not Performed
 Bearing Ratio (%): N/A
 Compacted Dry Density (lb/ft³): N/A
 Compacted Moisture Content (%): N/A

Plus 3 in. material, not included: 0 (%)

Specific Gravity
 Estimated
 Particle Size: No. 10
 Specific Gravity at 20° Celsius: 2.70

Range	ASTM (%)	AASHTO (%)
Gravel	9.1	13.6
Coarse Sand	4.5	11.9
Medium Sand	11.9	---
Fine Sand	28.5	28.5
Silt	29.4	36.3
Clay	16.6	9.7

Classification
 Unified Group Symbol: SM
 Group Name: Silty sand
 AASHTO Classification: A-4 (0)

Comments: _____

Reviewed By RJ



Particle-Size Analysis of Soils
ASTM D 422

Project Name HCFRR Additional Benching
Source B-3, 13.4'-14.0', 15.0'-16.5'

Project Number 174316204
Lab ID 206

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method ASTM D 422
Prepared using ASTM D 421

Particle Shape Rounded and Angular
Particle Hardness: Hard and Durable

Tested By MW
Test Date 08-10-2020
Date Received 08-04-2020

Sieve Size	% Passing
1 1/2"	100.0
3/4"	96.8
3/8"	94.0
No. 4	90.9
No. 10	86.4

Maximum Particle size: 1 1/2" Sieve

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

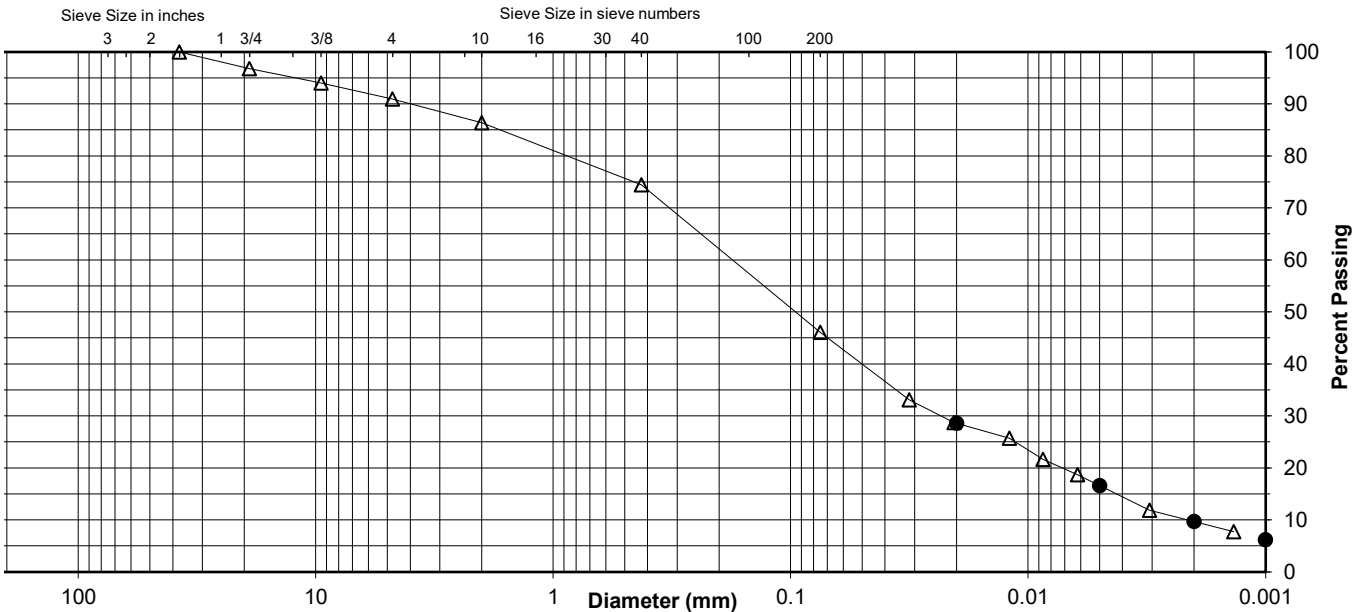
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	74.5
No. 200	46.0
0.02 mm	28.6
0.005 mm	16.6
0.002 mm	9.7
0.001 mm	6.2

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	3.2	5.9	4.5	11.9	28.5	29.4	16.6
AASHTO	Gravel		Coarse Sand		Fine Sand	Silt	Clay
	13.6		11.9		28.5	36.3	9.7



Comments _____

Reviewed By RJ

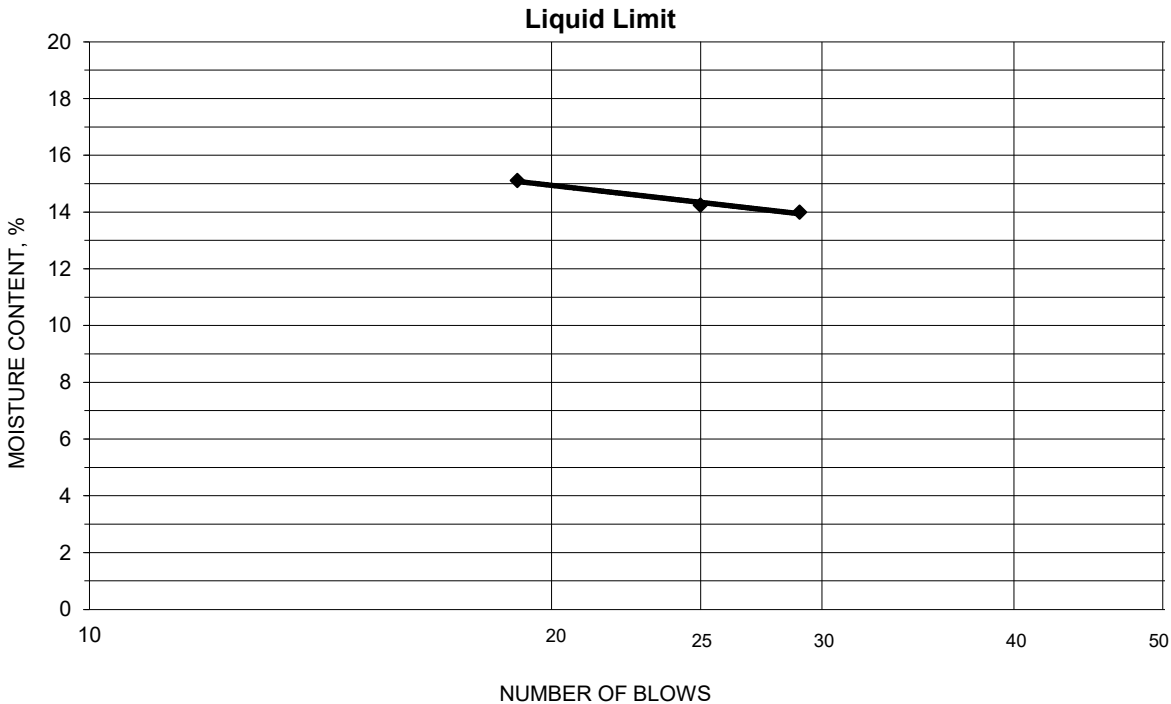


ATTERBERG LIMITS

Project HCFRR Additional Benching
 Source B-3, 13.4'-14.0', 15.0'-16.5'
 Tested By KWS Test Method ASTM D 4318 Method A
 Test Date 08-14-2020 Prepared Dry

Project No. 174316204
 Lab ID 206
 % + No. 40 26
 Date Received 08-04-2020

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.88	18.82	11.25	29	14.0	14
19.74	18.65	11.00	25	14.2	
18.22	17.28	11.06	19	15.1	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
18.28	17.43	11.05	13.3	13	1
18.60	17.69	11.02	13.6		

Remarks: _____

Reviewed By RJ



Summary of Soil Tests

Project Name HCFRR Additional Benching Project Number 174316204
 Source B-4, 1.5'-3.0', 3.5'-5.0', 5.0'-6.0' Lab ID 211
 Sample Type SPT Composite Date Received 8-4-20
 Date Reported 8-18-20

Test Results

Natural Moisture Content

Test Not Performed
 Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
 Gradation Method: ASTM D 422
 Hydrometer Method: ASTM D 422

Particle Size		% Passing
Sieve Size	(mm)	
	N/A	
	N/A	
	N/A	
1 1/2"	37.5	100.0
3/4"	19	98.7
3/8"	9.5	95.7
No. 4	4.75	93.1
No. 10	2	89.0
No. 40	0.425	78.6
No. 200	0.075	57.5
	0.02	44.2
	0.005	30.7
	0.002	22.8
estimated	0.001	17.9

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	6.9	11.0
Coarse Sand	4.1	10.4
Medium Sand	10.4	---
Fine Sand	21.1	21.1
Silt	26.8	34.7
Clay	30.7	22.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
 Prepared: Dry

Liquid Limit: 31
 Plastic Limit: 17
 Plasticity Index: 14
 Activity Index: 0.6

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft³): N/A
 Maximum Dry Density (kg/m³): N/A
 Optimum Moisture Content (%): N/A
 Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
 Compacted Dry Density (lb/ft³): N/A
 Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
 Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL
 Group Name: Sandy lean clay

AASHTO Classification: A-6 (5)

Comments: _____

Reviewed By RJ



Particle-Size Analysis of Soils
ASTM D 422

Project Name HCFRR Additional Benching
Source B-4, 1.5'-3.0', 3.5'-5.0', 5.0'-6.0'

Project Number 174316204
Lab ID 211

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method ASTM D 422
Prepared using ASTM D 421

Particle Shape Angular
Particle Hardness: Hard and Durable

Tested By MW
Test Date 08-10-2020
Date Received 08-04-2020

Sieve Size	% Passing
1 1/2"	100.0
3/4"	98.7
3/8"	95.7
No. 4	93.1
No. 10	89.0

Maximum Particle size: 1 1/2" Sieve

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

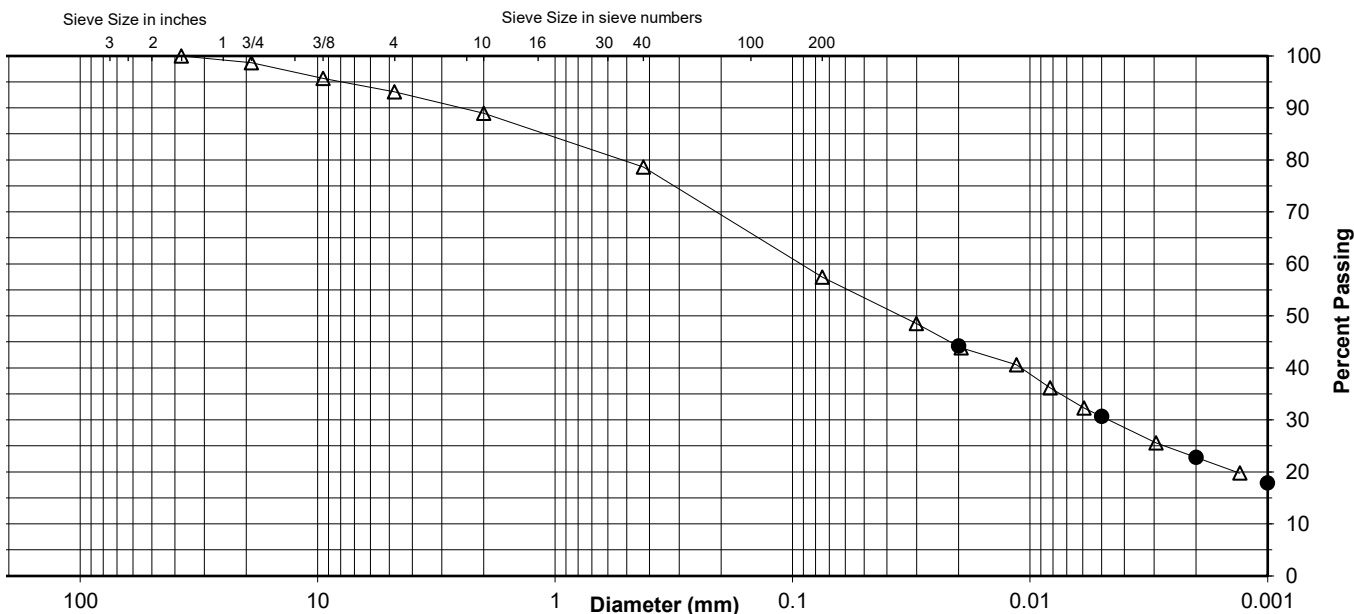
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	78.6
No. 200	57.5
0.02 mm	44.2
0.005 mm	30.7
0.002 mm	22.8
0.001 mm	17.9

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	1.3	5.6	4.1	10.4	21.1	26.8	30.7
AASHTO	Gravel		Coarse Sand		Fine Sand	Silt	Clay
	11.0		10.4		21.1	34.7	22.8



Comments _____

Reviewed By RJ

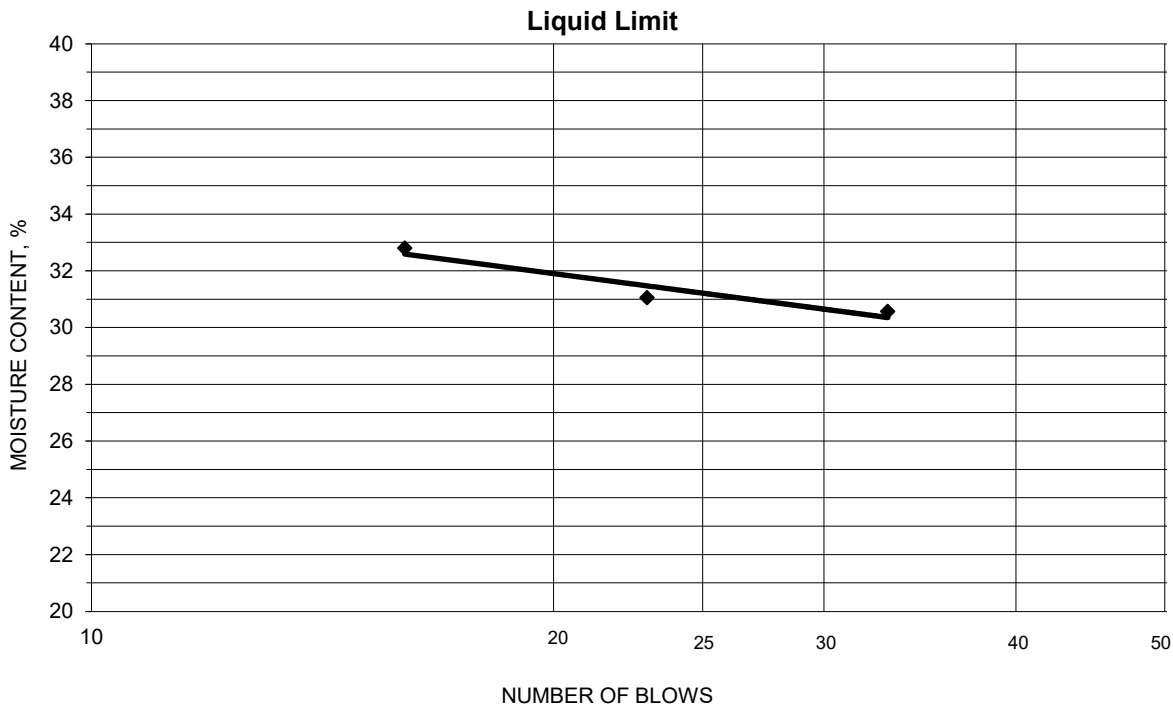


ATTERBERG LIMITS

Project HCFRR Additional Benching
 Source B-4, 1.5'-3.0', 3.5'-5.0', 5.0'-6.0'
 Tested By KWS Test Method ASTM D 4318 Method A
 Test Date 08-14-2020 Prepared Dry

Project No. 174316204
 Lab ID 211
 % + No. 40 21
 Date Received 08-04-2020

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.37	17.31	11.03	16	32.8	31
19.89	17.76	10.90	23	31.0	
17.87	16.36	11.42	33	30.6	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
17.32	16.40	11.03	17.1	17	14
17.19	16.26	10.85	17.2		

Remarks: _____

Reviewed By RJ



Summary of Soil Tests

Project Name HCFRR Additional Benching Project Number 174316204
 Source B-4, 12.5'-14.0', 15.0'-16.5', 17.5'-19.0' Lab ID 218
 Sample Type SPT Composite Date Received 8-4-20
 Date Reported 8-18-20

Test Results

Natural Moisture Content

Test Not Performed
 Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
 Gradation Method: ASTM D 422
 Hydrometer Method: ASTM D 422

Particle Size		% Passing
Sieve Size	(mm)	
	N/A	
	N/A	
	N/A	
1 1/2"	37.5	100.0
3/4"	19	94.3
3/8"	9.5	89.6
No. 4	4.75	87.6
No. 10	2	82.0
No. 40	0.425	79.8
No. 200	0.075	73.4
	0.02	45.1
	0.005	22.5
	0.002	15.0
estimated	0.001	10.4

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	12.4	18.0
Coarse Sand	5.6	2.2
Medium Sand	2.2	---
Fine Sand	6.4	6.4
Silt	50.9	58.4
Clay	22.5	15.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
 Prepared: Dry

Liquid Limit: 20
 Plastic Limit: 16
 Plasticity Index: 4
 Activity Index: 0.3

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft³): N/A
 Maximum Dry Density (kg/m³): N/A
 Optimum Moisture Content (%): N/A
 Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
 Compacted Dry Density (lb/ft³): N/A
 Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10
 Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL-ML
 Group Name: Silty clay with sand

AASHTO Classification: A-4 (0)

Comments: _____

Reviewed By RJ



Particle-Size Analysis of Soils
ASTM D 422

Project Name HCFRR Additional Benching
Source B-4, 12.5'-14.0', 15.0'-16.5', 17.5'-19.0'

Project Number 174316204
Lab ID 218

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method ASTM D 422
Prepared using ASTM D 421

Particle Shape Angular
Particle Hardness: Hard and Durable

Tested By DW
Test Date 08-10-2020
Date Received 08-04-2020

Sieve Size	% Passing
1 1/2"	100.0
3/4"	94.3
3/8"	89.6
No. 4	87.6
No. 10	82.0

Maximum Particle size: 1 1/2" Sieve

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

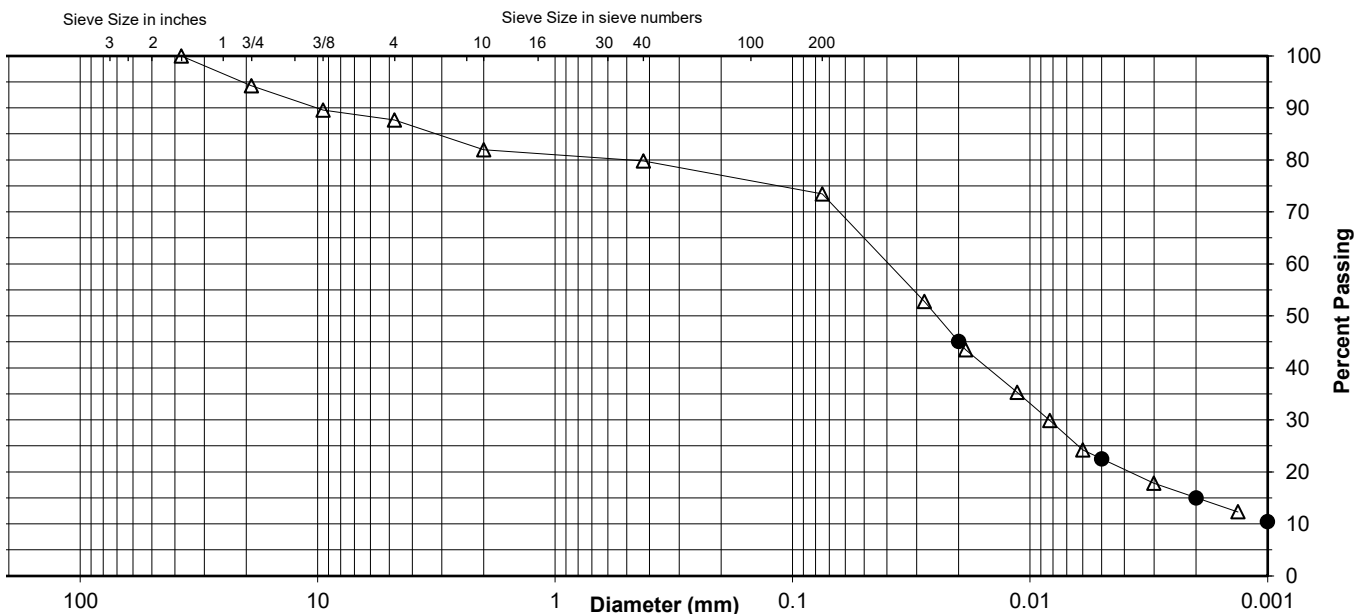
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	79.8
No. 200	73.4
0.02 mm	45.1
0.005 mm	22.5
0.002 mm	15.0
0.001 mm	10.4

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	5.7	6.7	5.6	2.2	6.4	50.9	22.5
AASHTO	Gravel		Coarse Sand		Fine Sand	Silt	Clay
	18.0		2.2		6.4	58.4	15.0



Comments _____

Reviewed By RJ

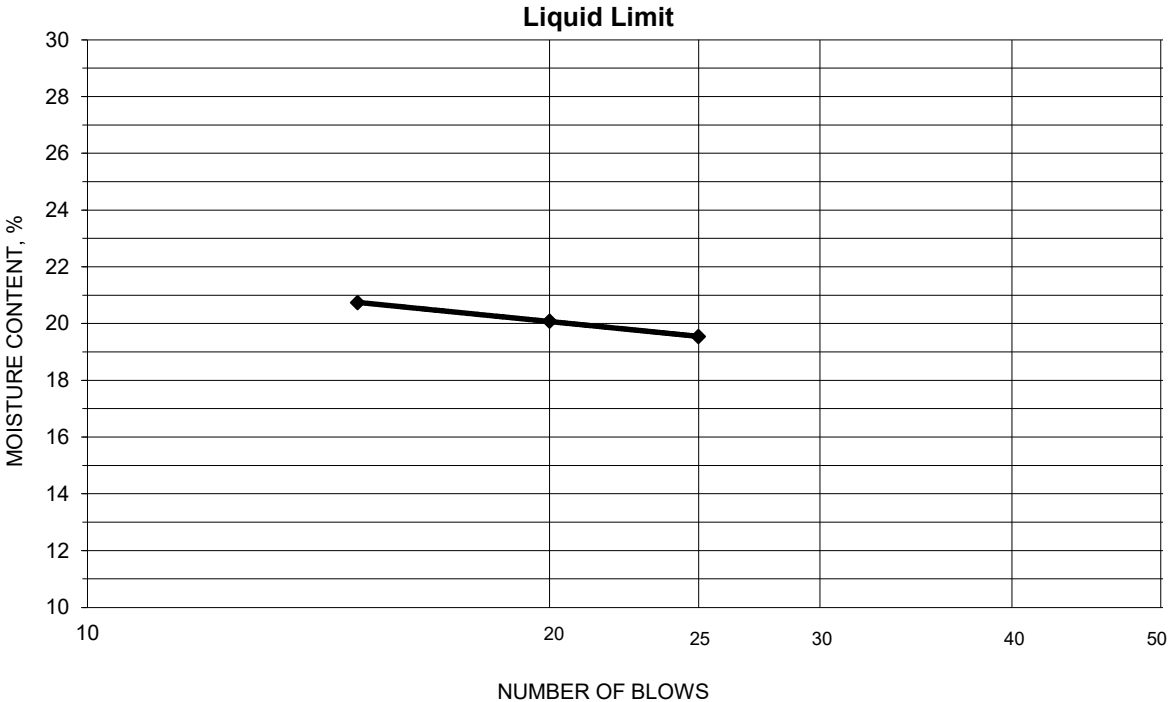


ATTERBERG LIMITS

Project HCFRR Additional Benching
 Source B-4, 12.5'-14.0', 15.0'-16.5', 17.5'-19.0'
 Tested By KWS Test Method ASTM D 4318 Method A
 Test Date 08-14-2020 Prepared Dry

Project No. 174316204
 Lab ID 218
 % + No. 40 20
 Date Received 08-04-2020

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
19.15	17.75	11.00	15	20.7	20
19.15	17.76	10.84	20	20.1	
19.30	17.94	10.98	25	19.5	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
17.71	16.76	11.02	16.6	16	4
18.23	17.30	11.46	15.9		

Remarks: _____

Reviewed By RJ



Moisture Content of Soil

ASTM D 2216

Project Name HCFR Additional BenchingProject Number 174316204Tested By MWTest Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
B-1B, 0.0'-1.5'	178	8/7/20	Dist	3/4"			No	31.84	181.65	176.15	3.8
B-1B, 1.5'-3.0'	180	8/7/20	Dist	3/4"			No	31.32	80.64	78.44	4.7
B-1B, 3.0'-4.5'	181	8/7/20	Hom	No. 10			Yes	30.10	54.56	50.76	18.4
B-1B, 5.0'-6.5'	182	8/7/20	Dist	No. 4			No	30.04	75.95	67.36	23.0
B-1B, 7.5'-9.0'	183	8/7/20	Hom	No. 4			No	32.22	125.72	109.34	21.2
B-1B, 10.0'-11.5'	185	8/7/20	Dist	3/4"			No	30.55	122.53	105.05	23.5
B-1B, 12.5'-14.0'	186	8/7/20	Dist	No. 4			No	29.98	69.77	63.73	17.9
B-1B, 15.0'-15.8'	187A	8/7/20	Dist	No. 4			Yes	31.96	175.54	150.09	21.5
B-1B, 15.8'-16.5'	187B	8/7/20	Dist	3/4"			No	30.24	154.34	144.51	8.6
B-1B, 17.5'-17.9'	188A	8/7/20	Dist	No. 4			Yes	30.39	166.79	150.00	14.0
B-1B, 17.9'-19.0'	188B	8/7/20	Dist	3/4"			No	31.13	172.76	163.96	6.6
B-2, 0.0'-1.5'	189	8/7/20	Dist	3/8"			No	31.96	148.61	141.21	6.8
B-2, 1.5'-3.0'	190	8/7/20	Dist	3/8"			No	31.05	94.67	92.46	3.6
B-2, 3.5'-5.0'	191	8/7/20	Dist	3/4"			No	29.83	139.07	132.25	6.7
B-2, 5.0'-6.5'	192	8/7/20	Dist	3/4"			No	30.25	67.92	63.38	13.7
B-2, 7.5'-9.0'	194	8/7/20	Dist	3/4"			No	31.64	75.17	70.30	12.6
B-2, 10.0'-11.5'	195	8/7/20	Dist	No. 4			No	31.48	67.24	62.00	17.2
B-2, 12.5'-14.0'	196	8/7/20	Dist	3/8"			No	30.10	77.14	70.57	16.2
B-3, 0.0'-1.5'	197	8/7/20	Dist	3/4"			No	29.58	140.63	134.84	5.5
B-3, 1.5'-3.0'	198	8/7/20	Dist	3/8"			No	30.16	149.95	138.21	10.9
B-3, 3.0'-4.5'	199	8/7/20	Dist	No. 4			Yes	29.97	165.88	148.77	14.4
B-3, 5.0'-6.5'	201	8/7/20	Hom	No. 4			No	32.05	89.17	81.41	15.7
B-3, 8.0'-9.0'	202	8/7/20	Dist	No. 4			No	31.45	94.27	83.28	21.2
B-3, 10.0'-11.5'	204	8/7/20	Hom	No. 10			Yes	30.20	85.32	75.28	22.3
B-3, 12.5'-13.4'	205	8/7/20	Hom	No. 10			Yes	30.10	68.22	61.68	20.7
B-3, 13.4'-14.0'	207	8/7/20	Dist	3/4"			No	29.84	93.28	86.57	11.8
B-3, 15.0'-16.5'	208	8/7/20	Dist	3/4"			No	29.91	75.92	72.28	8.6
B-3, 17.5'-19.0'	209	8/7/20	Dist	3/4"			No	31.53	158.41	148.14	8.8



Moisture Content of Soil
ASTM D 2216

Project Name HCFRR Additional Benching

Project Number 174316204

Tested By MW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
B-4, 0.0'-0.6'	210A	8/7/20	Dist	3/8"			No	29.97	122.49	115.16	8.6
B-4, 0.6'-1.5'	210B	8/7/20	Dist	No. 4			No	29.93	59.48	56.72	10.3
B-4, 1.5'-3.0'	212	8/7/20	Dist	3/4"			No	31.48	66.49	61.55	16.4
B-4, 3.5'-5.0'	213	8/7/20	Dist	3/8"			No	32.08	63.11	59.00	15.3
B-4, 5.0'-6.0'	214	8/7/20	Dist	3/8"			No	30.51	94.73	85.88	16.0
B-4, 6.0'-6.5'	215	8/7/20	Dist	No. 4			No	30.85	130.95	114.16	20.2
B-4, 7.5'-9.0'	216	8/7/20	Dist	No. 10			Yes	31.79	139.20	123.98	16.5
B-4, 10.0'-11.5'	217	8/7/20	Dist	3/4"			No	30.97	204.55	184.04	13.4
B-4, 12.5'-14.0'	219	8/7/20	Hom	No. 10			Yes	31.52	96.24	81.03	30.7
B-4, 15.0'-16.3'	220A	8/7/20	Dist	No. 10			Yes	30.58	71.34	65.00	18.4
B-4, 16.3'-16.5'	220B	8/7/20	Dist	3/4"			No	30.00	45.41	44.19	8.6
B-4, 17.5'-19.0'	221	8/7/20	Dist	3/4"			No	30.99	135.17	126.89	8.6

Comments _____

Reviewed By RJ