US Army Corps of Engineers ®
St. Paul District

Appendix G: Geotechnical & Sediment Quality Analysis

Mississippi River Upper Pool 4
Pierce County Islands Head of Lake Pepin Backwater Complex
Feasibility Report and Integrated Environmental Assessment

Section 1122

April 2020

Appendix G: Geotechnical & Sediment Quality Analysis

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1 Location and Physiography

The project area is located near the head of Lake Pepin in Upper Pool 4 of the Mississippi River. The proposed project area would be located around River Mile 787 in the backwater complexes adjacent to the main channel. It is contained within Navigation Pool 4, formed by Lock and Dam 4, located thirty miles downstream from the study area at river mile 752.8. The project area is located in Pierce County, Wisconsin in the Pierce County Islands Wildlife Management Area. The Pierce County Island Wildlife Area includes approximately 450 acres that was gifted from Pierce County and additional acres purchased to bring the total area to 956 acres. The land was gifted and purchased to be managed as a State Wildlife Area.

Lake Pepin extends about 22 miles in length from the delta of the Chippewa River to approximately River Mile 787 which is about 3 miles downstream of Red Wing, Minnesota and serves as a border between Wisconsin and Minnesota. The lake covers 26,000 acres and is an average of 1.7 miles wide. Upper Lake Pepin consists of channel border islands and backwater lakes grading into an expansive, shallow open water area with little physical structure. Water depths throughout much of Upper Lake Pepin are less than five feet.

The Pierce County Islands/Head of Pepin Backwater Complex is located in Upper Pool 4 of the UMR. The 6,500 acre Pierce County Islands/Head of Pepin Backwater Complex extends from RM 784 – 792 along the left descending bank (Wisconsin Side) of the main channel to the south and the Wisconsin mainland to the north. This large area includes backwater lakes, sloughs, flowing channels, and islands. The entire area is in Pierce County, Wisconsin. The closest community to the area is Bay City, Wisconsin, located adjacent to the backwater area.

Pre-impoundment, the Pierce County Islands/Head of Pepin Backwater Complex was a mixture of bottomland forest, permanent and seasonal lakes and forested wetlands, wet meadow and sloughs that conveyed flow seasonally. Impoundment did not greatly affect backwater and off channel areas within the Pierce County Islands/Head of Pepin Backwater Complex. This was due to buffering by Lake Pepin and distance from Lock and Dam 4, over 30 miles downstream. A portion of the Pierce County Islands/Head of Pepin Backwater Complex (Wildlife Refuge Subunit) is designated as a “no-entry waterfowl refuge” from September 1 to December 31. All waterfowl hunting is prohibited during this time, but the area can be opened earlier to other public uses as posted by the Department. For the last several years, the refuge has been posted to allow public access after Nov. 15 to allow trapping (in an attempt to reduce damage to the old dikes) and deer hunting. (WI DNR, 2010)

Water depths are variable throughout the area with deepest depths associated with the main channel of the Mississippi River and a larger secondary channel called the Wisconsin channel. Backwater depths are generally shallow and turbid due to long term effects of sedimentation. Most of the backwater areas that have adequate depth to provide over winter fish habitat also have flow that makes it unsuitable for over wintering centrarchids. (WI DNR, 2010)

1.1 Purpose

The US Army Corps of Engineers (USACE), St. Paul District (District) is proposing to restore, protect, and create aquatic and wetland habitats in connection with construction or maintenance dredging of an authorized projects under CAP Section 204 at the Mississippi River Upper Pool 4 Peirce County Islands Head of Lake Pepin Backwater Complex.

This analysis of the geotechical and sediment quality serves to supplement the Feasibility Study Report with integrated Environmental Assessment (EA).

1.2 Project Features

Proposed project features of the Tentatively Selected Plan (TSP) are indicated in Figure 1 and are summarized briefly below:

- Four peninsula features (#1, 3, 6, and 7), constructed of dredge sand and fines to a final grade of El. 671.0.
- Mudflat 2 – The interior of Peninsula #1 is filled with fines to 666.6
- WLM Dike 2 – 100 ft wide, constructed with sand and fines to final grade 672.0
- Dike 2 control structure - 36” CMP
- Access Dredging – Access dredging is needed from the staging area near Bay City to dredge areas 2 and 3 as well as to the control structure on Dike 2 and the Catherine Cut.
- Overwintering Habitat Dredging (Dredge Areas 2 and 3), dredged to El. 659.1
- Bankline restoration (north) - Fill placement to obtain consistent bank elevation
- Erosion Protection (north, west and CP cut) – 2-3 ft riprap
- Refuge dredging - shallow dredging (to 667.0) upstream of WLM Dike 2

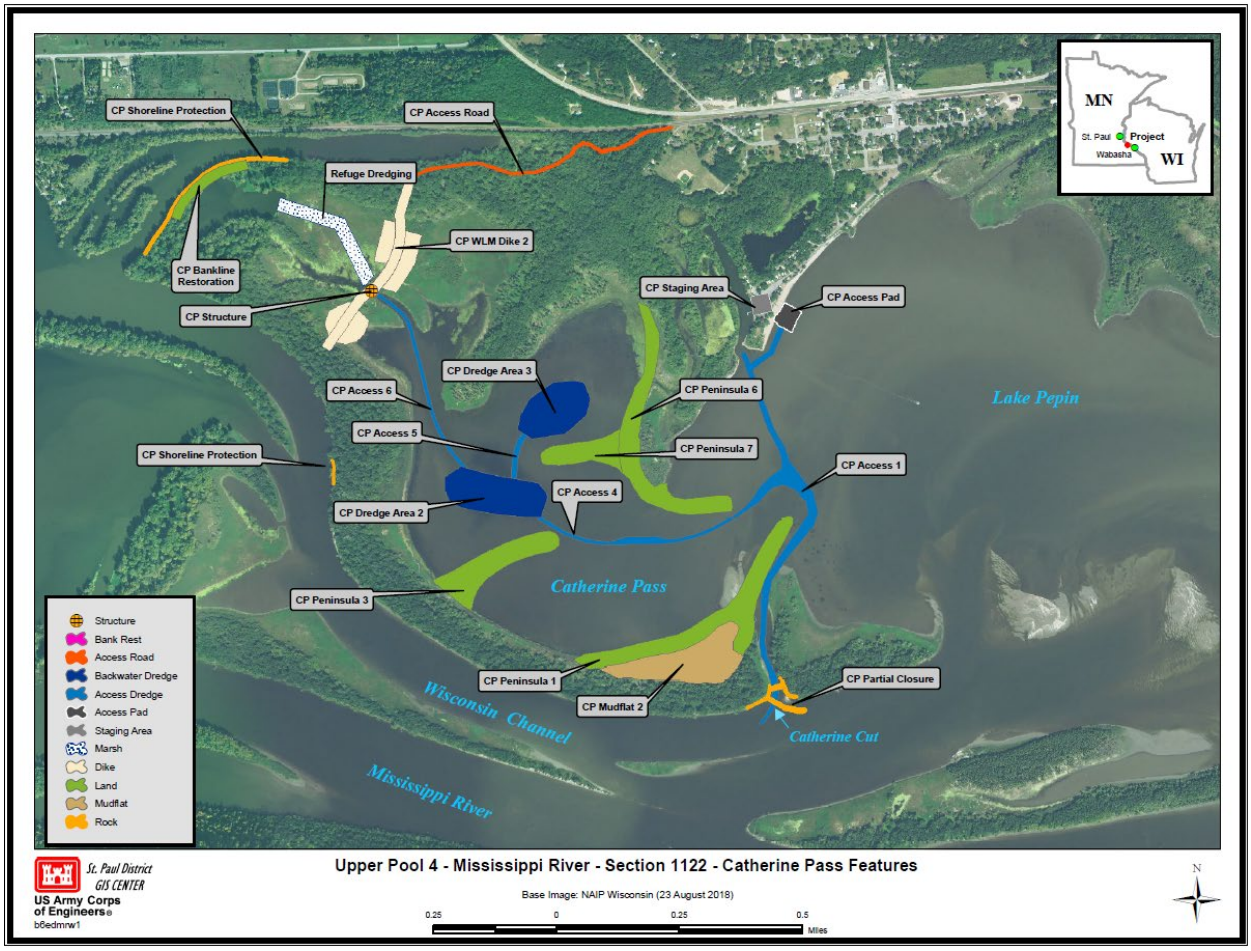


Figure 1: Features of the TSP

1.3 Datums

2 Geology

The most significant geologic event explaining the nature of the Mississippi River within Pool 4 occurred as the Pleistocene glaciation, approximately 10,000 years ago, came to a conclusion. During this time, tremendous volumes of glacial meltwater, primary from the Red River Valley's glacial Lake Agassiz, eroded the pre-glacial Minnesota and Mississippi River valleys. Glacial Lake Duluth also provided a significant amount of meltwater, carving out the St. Croix River that joins the Mississippi River upstream of the project area. As meltwaters diminished, the deeply eroded river valleys aggraded substantially to about the present levels. Prior to construction of the Lock and Dams and impoundment, the broad flood plain of the river contained depressions, sloughs, natural levees, islands, and shallow lakes.

The bluffs of the Upper Mississippi valley along Pool 3 and Upper Pool 4 consist of exposed Lower Paleozoic sedimentary rocks, dominantly carbonates (limestone and dolomite) and sandstones, overlain by unconsolidated materials of Quaternary (Upper Cenozoic) age loess of the earlier glacial advances. Pool 3 and Upper Pool 4 are at the northwest boundary of the Driftless Area that was not covered by the Wisconsin age advances of ice sheet. Prairie Island on the Minnesota bank is a fluvial terrace that has been cut from the valley wall by the Vermillion River to form an island.

In the reach from Red Wing, MN south to Alma, WI, the rock formations exposed in the bluffs are the Upper Cambrian sandstones from Jordan (Upper Cambrian). Overlying the Jordan Sandstone, with an unconformable contact, is the Lower Ordovician Prairie due Chien Formation.

The principal parent materials of soils in the Pool 3 and Upper Pool 4 drainage basin are loess, and alluvium glacial drift. The loess lay either over bedrock or over clay loam till which is the major historic parent material of Pool 3 and Upper Pool 4 and associated uplands. The slopes associated with these soil types make them very susceptible to erosion in upland areas, where cover of plants is sparse or where inadequate soil conservation practices are used. The sediment load carried into Pool 3 and Upper Pool 4 by the Mississippi River accumulates in backwater areas and in the navigation channel. This project area is part of the prograding delta that continue to form at the head of Lake Pepin.

Lake Pepin has many characteristics of an inland lake, including a fairly regular shoreline with few backwater bays and shoal water substrates comprised of sand, gravel, and rock. Much of the rock substrate is artificial bank protection where the railroad tracks border the lake. Deeper portions of the lake have predominantly silt substrates. Sedimentation has covered the pre-settlement lake bed in Lake Pepin except in the lower most area that retains significant areas of gravel substrates. Wind driven wave action in the lake maintains a breach zone of cobbled sized rock and coarse sand. Much of the beach zone is covered with shells of zebra mussels. (Environmental Pool Plans Mississippi River Pools 1-10, 2004)

3 Subsurface Exploration

3.1 2017 Exploration

In Fall of 2017, fourteen (14) borings were performed throughout the project area. Nine of the borings (17-1M through 17-9M) were conducted specifically to extract tube samples for environmental analysis. The remaining borings were conducted to evaluate foundation conditions for possible project features such as habitat dredging and the creation of islands or peninsulas.

Environmental borings were conducted to a depth of about 8 ft below the sediment surface, pushing four two-foot samples.

Standard borings were conducted to a maximum of 40 ft below the top of deck, or 29 to 36 feet beneath the sediment surface, depending on the water depth.

Geotechnical borings on the upstream end of the project area such as 17-10M, indicated thick sequences of very soft clay (0 < N < 3) to a depth of around 20 ft below the sediment surface.

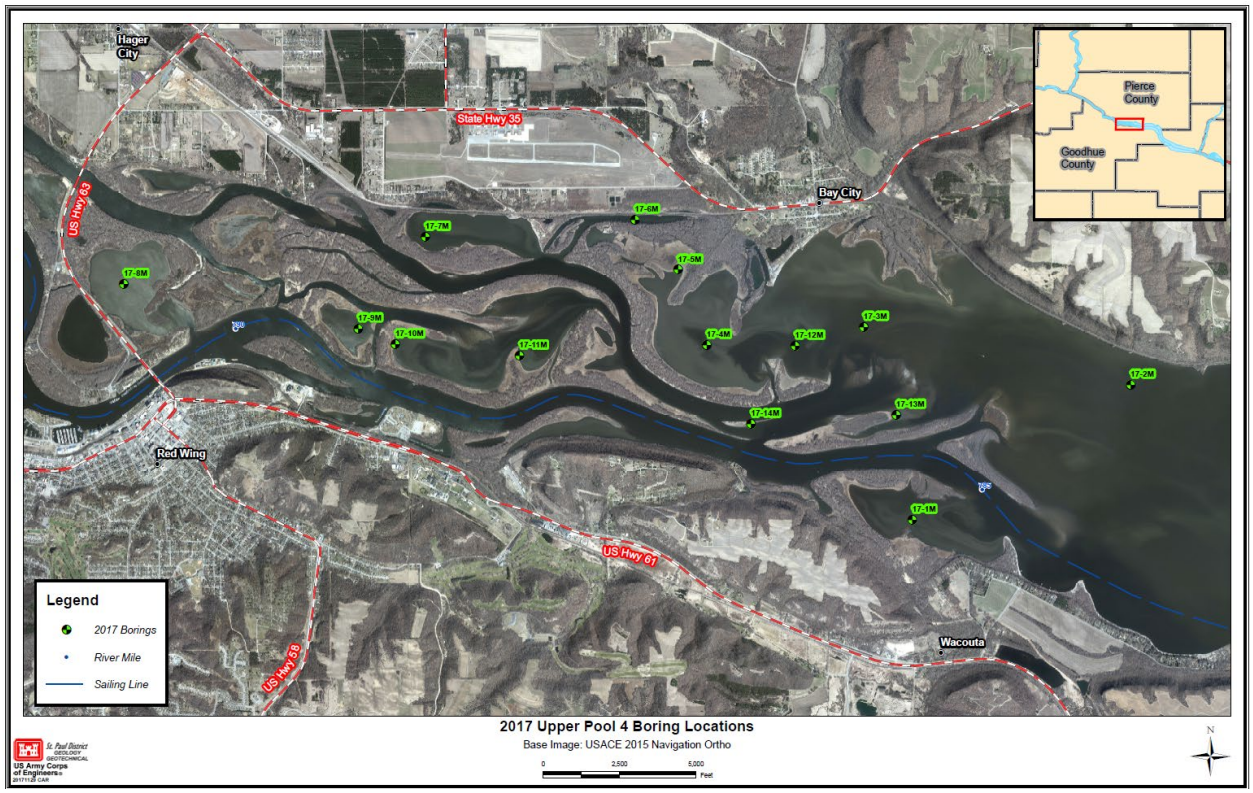


Figure 2: 2017 subsurface exploration

3.2 2019 Exploration

Following the 2017 soil exploration, the PDT narrowed the project area to the Wacouta Bay and Catherine's Pass areas. Due to a lack of geotechnical exploration and testing at the locations of the proposed project features, additional borings were performed. Ultimately, it was considered unlikely that the Wacouta Bay features would be included in the TSP, so the new borings focused specifically on Catherine's Pass.

In the vicinity of Catherine's pass, the only geotechnical boring from the previous phase of exploration was 17-12M. Other 2017 holes in this area were drilled for environmental sampling.

Borings 19-16M, 19-17M, 19-18M, 19-19M, 19-20M, and 19-21M focused on defining the stratigraphy and characterizing foundation materials at key locations below the proposed peninsula features. These holes ranged from 20 ft and 40 ft in depth. Based on these borings, three locations were selected in order to obtain undisturbed 5” tubes were collected from 19-16MU, 19-20MU, and 19-21MU for consolidation testing.

Draft soil boring logs for the Catherine’s Pass area are provided in Attachment G-1.

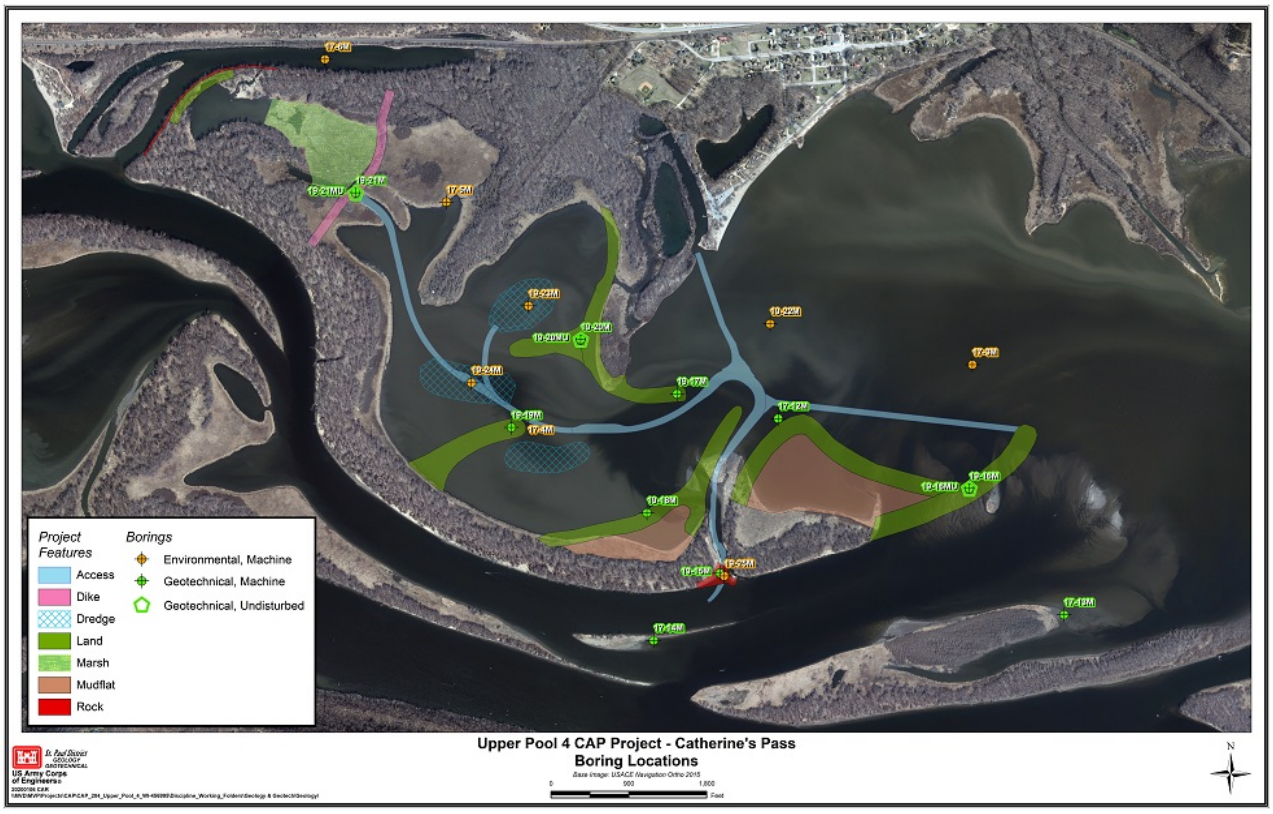


Figure 3 Subsurface Exploration in the Catherine's Pass area with potential features

3.3 Bathymetry

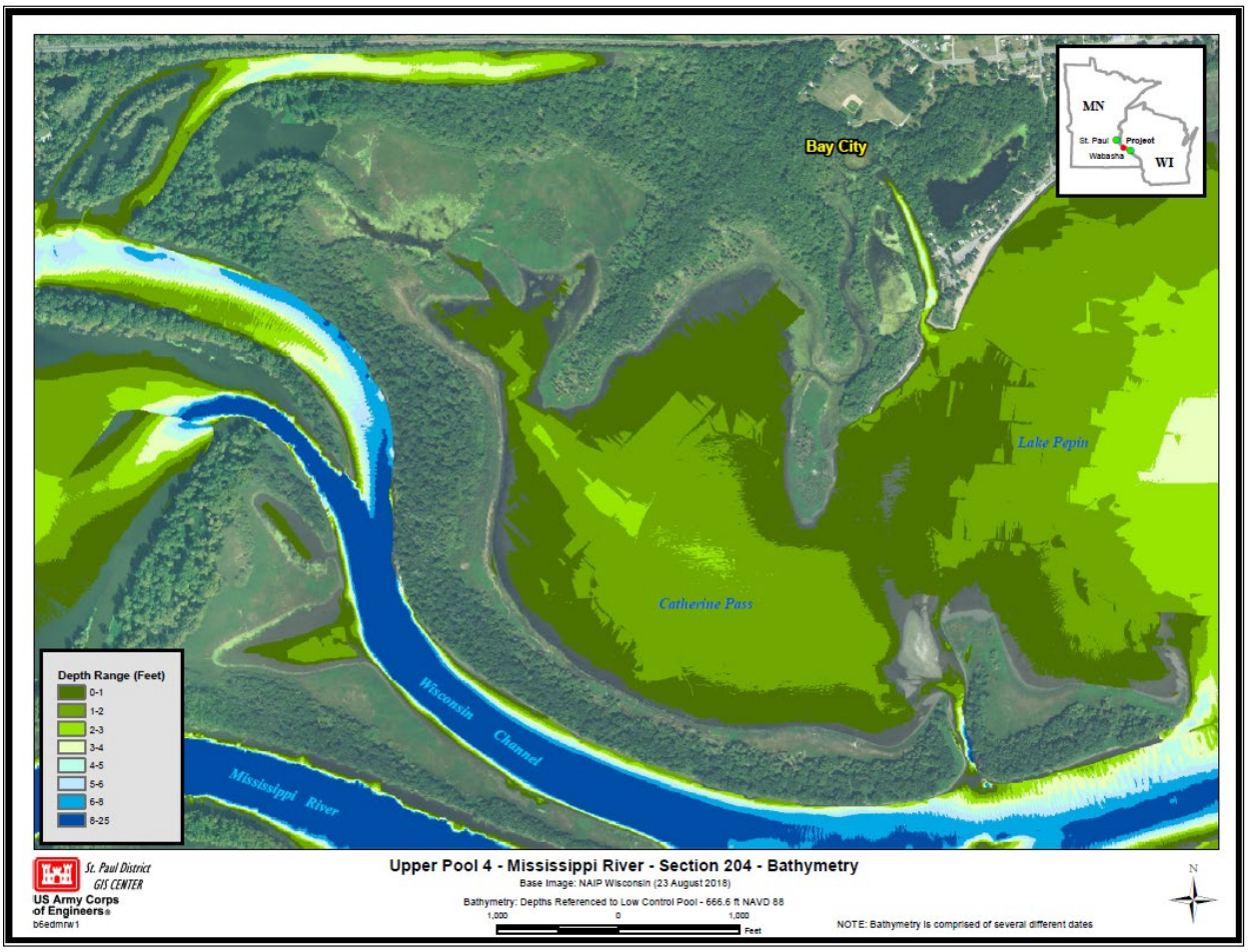


Figure 4 Bathymetry in the Study Area

4 Soils Testing

4.1 Testing Performed

The following testing was performed on soil samples from boring in the Catherine's Pass area:
Test Type (number of tests):

- Moisture Contents (34)
- Atterberg Limits (31)
- Grain size analysis
    - Nested sieves + hydrometer (5)
    - Nested sieves thru #200 (2)
- Consolidation (3)

Moisture contents in relation to Atterberg Limits are summarized in Figure 5, and a plasticity chart is provided in Figure 6. Test reports are provided in Attachment G-2.

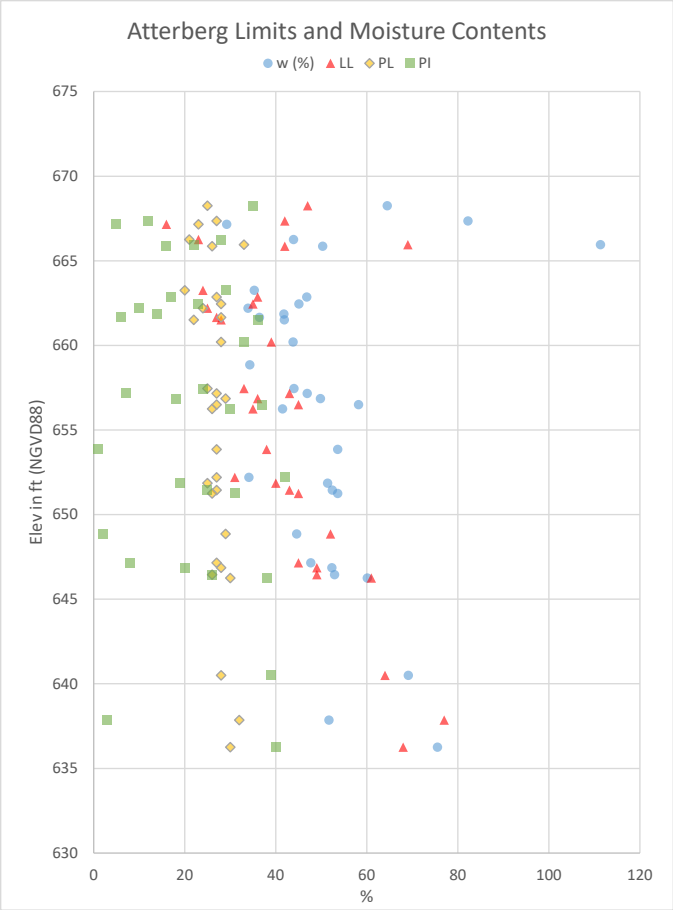


Figure 5 Elevation vs. Atterberg Limits and Moisture Contents

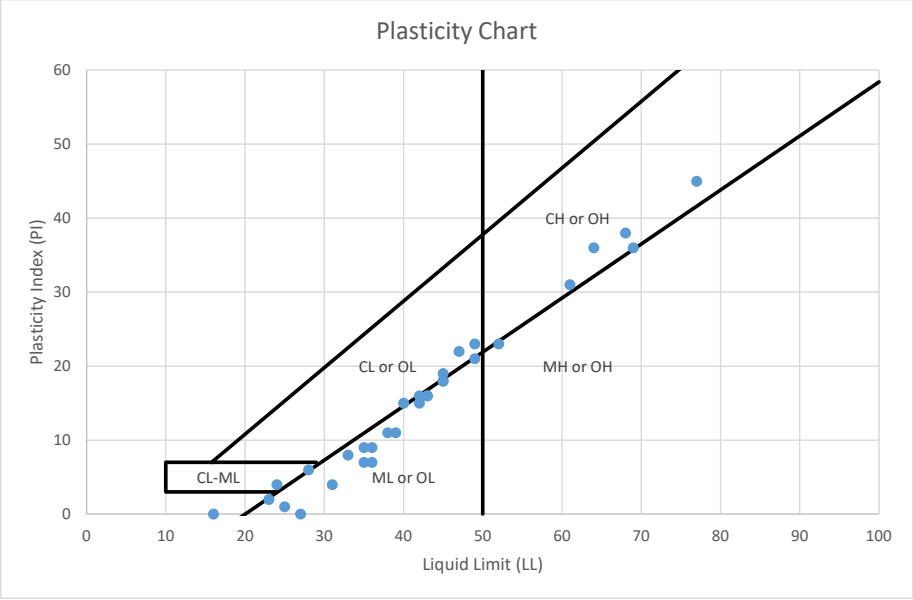


Figure 6 Plasticity chart for soils in Catherine's Pass area

Table 1 Consolidation test result summary

Boring	GSE (ft)	Sample El. (ft)	G_s	e_o	LL	P_c (tsf)	Estimated in-situ σ_v' at LCP* (tsf)	OCR	C_c lab test result	C_c Terzaghi and Peck (1967)	C_c Rendon-Herrero (1983)	C_c Nagaraj and Murty (1985)
19-16MU	670.0	662.2	2.86	1.14	25	0.7	0.31	2.3	0.15	0.14	0.25	0.17
19-20MU	667.2	660.2	2.7	1.19	39	0.5	0.2	2.5	0.28	0.26	0.28	0.25
19-21MU	668.8	652.2	2.7	0.94	31	0.7	0.48	1.5	0.16	0.19	0.21	0.20
*LCP refers to low control pool El. 666 ft												

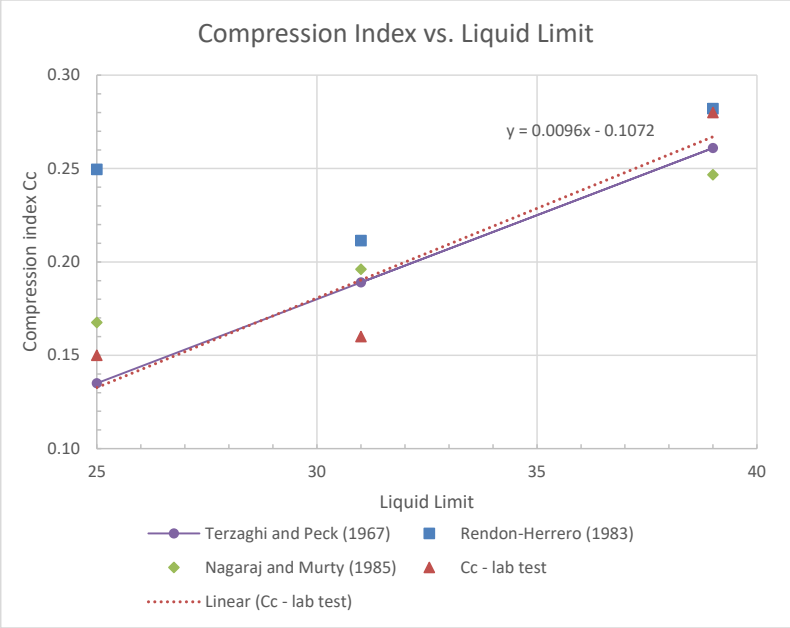


Figure 7 Compression index vs. liquid limit

4.2 Summary of findings

- High natural moisture contents: The vast majority of Atterberg Limit testing indicated a natural moisture content in excess of the liquid limit, an indication of the potential for liquid-like behavior. While the laboratory confirmed these values, there is some concern they may be inaccurate based on field experience with the samples.
- Tendency to classify as ML or OL: The majority of plastic soils classify as a silt (ML or OL), with most of the remainder classifying as CL-ML or as CL near the CL/ML boundary. Five samples classified as CH or OH. Grain size analysis indicates a very high percentage of silt-size particles. Sand particles tend to be fine.
- Liquid Limit trend: Liquid limit is high near the surface in the “ooze-like” material, then decreases beneath the ooze, and tends to increase gradually with depth.
- “Overconsolidation”: Consolidation testing indicates preconsolidation pressures exceeding the in-situ effective vertical stresses, even accounting for low water conditions. Overconsolidation ratios were calculated as between 1.4 and 2.5. Given the recent deposition of these sediments and the absence of a clear geologic cause for this overconsolidation, it is assumed for the purposes of the geotechnical evaluation that the soils are normally consolidated.

- Consolidation test interpretations: The procedure described in EM 1110-1-1904 Table 3-6a was followed in order to determine the preconsolidation pressure and compression index C_c.
- Relationship between liquid limit and compression index: The compression index resulting from consolidation testing was compared to several correlations. It was found that the Terzaghi and Peck (1967) relationship of $C_c = 0.009(LL-10)$ provides a reasonable approximation of the test results.

5 Geotechnical Evaluation and Design

Summary of Geotechnical Scope: The purpose of the geotechnical evaluation and design was to ensure the TSP was feasible and to provide input for the cost estimate. Foundations of the fill features (peninsulas and dike) were evaluated for consolidation settlement as well as lateral displacement during construction. Recommendations are provided in light of these evaluations.

5.1 Lateral Displacement

Experience on previous projects has shown that shear stresses resulting from the placement of fill atop very soft clayey strata can result in lateral displacement of the near-surface foundation material. Lateral displacement can occur in a semi-liquid fashion, in which the material is simply “squeezed” outwards from beneath the fill like toothpaste, or in a plastic fashion, in which distinct shear zones or planes develop within the soil mass and wedges of material are displaced outwards along those shear zones. Either mechanism is likely to result in uplift of foundation material directly outside the vicinity of loading. This uplifted material is often referred to colloquially as a “mud wave”, as it can protrude above the water surface giving the appearance of a wave. For the Upper Pool 4 project, mud waves are of interest since they can result in increased turbidity as well as suspension of contaminants that might have previously been sequestered beneath the lake bottom. A large mud wave may also be a concern as the lateral loss of foundation material would require additional fill in order to meet the required grade. Based on environmental sampling and testing it has been determined that the soils most likely to be exposed in a mud wave fall within acceptable limits with regards to contamination, however turbidity and fill quantities remain concerns that need to be considered.
See Section 6 for details of the sediment analysis.

A number of the borings in the Catherines Pass area call out a very soft “ooze-like” clay material at the surface, varying in thickness from 0 ft to 4 ft, though most typically around 2.0-2.5 ft (Table 2). This material has essentially no shear strength, and is likely to displace laterally during construction.

Table 2 "Ooze-like" or "very soft" near-surface material in the Catherine's Pass area

Boring	Thickness of near-surface “very soft” or “ooze-like” materials (ft)
17-4M	2.3
17-5M	0.0
19-12M	4.0
19-17M	2.0
19-18M	2.1
19-19M	2.4

19-20M	0.5
19-21M	2.9
19-23M	0.0
19-24M	2.5

Also worth noting is that many of the borings logged materials at greater depths with SPT blow counts of zero or 1. These are very soft materials that could potentially displace laterally under the right loading conditions.

There is no currently available method to accurately predict the depth and quantity of lateral displacement of soft materials. The approach taken in the geotechnical design is to provide a judgment-based estimate and to provide recommendations for minimizing that displacement during construction.

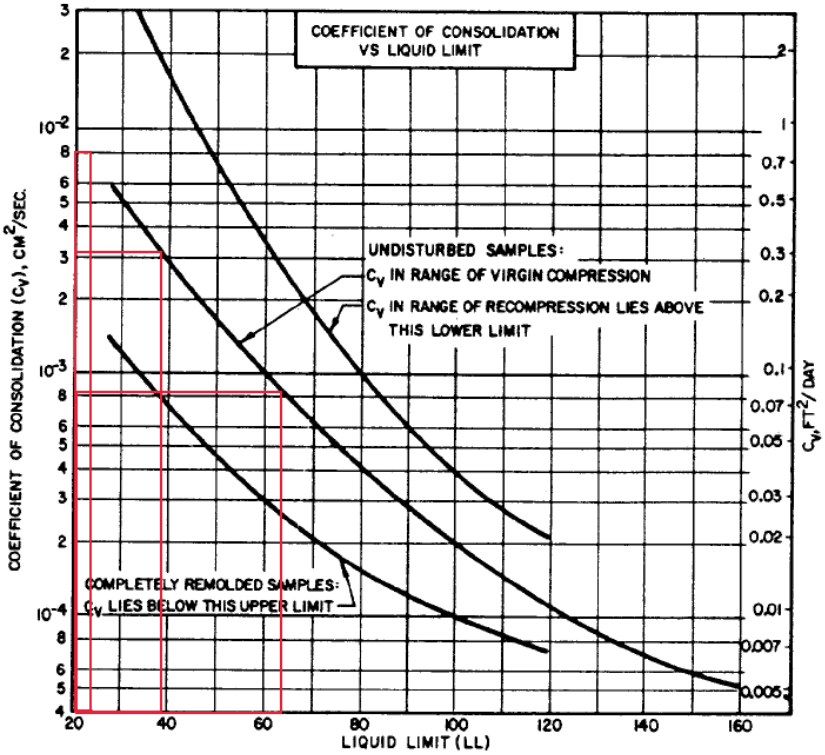
It is considered likely that a portion of these very soft soils will be displaced laterally, while a portion will remain in place and consolidate below the dredge sand fill. Based on the borings, it is suggested to plan for 1.5 ft of additional fill in order to compensate for foundation material lost as a result of lateral displacement. Consolidation of these soils has been incorporated in the consolidation evaluation described below.

5.2 Consolidation Settlement

This section discusses consolidation of the foundation in response to fill placement for the peninsula and dike features.

5.2.1 Methodology

- Settlement was evaluated based on the stratigraphy indicated by borings 19-18M, 19-19M, 19-20M, and 19-21M, each of which corresponds with a peninsula feature or dike in the tentatively selected plan (TSP).
- The stratigraphy for each boring was generalized based on soil type and liquid limits. An average liquid limit was calculated for layers of fines, and the compression index was estimated using the correlation $C_c = 0.009(LL-10)$ suggested by Terzaghi and Peck (1967). This correlation was found to be consistent with the three laboratory consolidation tests.
- Time Rate: Time rate of consolidation was estimated using Terzaghi's 1-D consolidation theory. Coefficient of consolidation c_v was averaged from test data for load increments 0.25 tsf and 0.50 tsf. The values obtained from the tests were generally consistent with liquid limit correlations provided in Figure 3-18 in EM 1110-1-1904, adapted from NAVFAC DM 7.1 (Figure 8) – around 1 ft^2/day. This value was assumed to represent lower plasticity clays and silts. A lower value was taken from the NAVFAC chart to represent higher plasticity CH soils in boring 19-21M (LL = 64). Although boring 19-20M indicates a gravelly sand layer at depth, most borings did not indicate a more pervious deeper layer that could serve as a drainage interface. Therefore, time rate calculations assumed one-way drainage for the full depth assumed in the total consolidation analysis.



Correlations between coefficient of consolidation and liquid limit (NAVFAC DM 7.1)

Figure 8 Estimated coefficient of consolidation for Catherines's Pass soils based on liquid limit correlations

5.2.2 Assumptions

- 1-Dimensional consolidation: As indicated in the current layout, the dike is 100 ft wide and peninsula features are at least 150 ft wide. Based on borings, the compressible strata are estimated to be 20-50 ft thick. Based on these dimensions, the assumption of 1-D consolidation is considered reasonable.
- Soils are assumed to be normally consolidated at low control pool (LCP). While testing indicated some overconsolidation, field experience with the soils, the high moisture contents, as well as what is known about the recent geologic history suggest the soils are most likely normally consolidated. Therefore, only the compression index C_c was used to calculate settlement.
- Sands (SP, SM, and SC) were assumed to be incompressible for the purposes of the consolidation calculation. Compression of these materials is assumed to be minimal in comparison to consolidation of the fine-grained soils.
- The calculations were performed for a water level of low control pool (El 666.0). Water levels below this would incur additional settlement.
- Due to limitations of the pontoon rig, borings were conducted to a maximum 40 ft depth, including the distance from the rig to the ground surface. Boring 19-20M indicated a medium dense gravelly sand about 20 ft below the ground surface that was assumed to represent a hard bottom. Boring 19-21 indicated a slightly stiffer clay near the bottom of

the boring, which was assumed to extend an additional 12 ft. Where borings indicated soft material at the bottom of the borings (19-18M and 19-19M), the compressible strata were assumed to be 45 ft thick, adding approximately 20-25 ft of compressible material below the end of the boring.

- Top of sand fill placement was assumed to be El. 671.0 for peninsula features and El. 672.0 for the dike.
- The analysis assumed lateral displacement of ½ to ¾ of the ooze-like surface material encountered in the boring. The presence of the ooze-like soil varied depending on the boring location and did not have a consistent thickness.

5.2.3 Results

Below is a table summarizing the results of the consolidation analysis for each boring, indicating the most relevant project feature(s). PDFs of the calculations are included in Attachment G-3.

Table 3 Total estimated consolidation settlement

Boring	Associated Project Feature	Total estimated settlement (ft)
19-12M	Peninsula 1	1.6
19-17M	Peninsula 6	0.6
19-18M	Peninsula 1	1.4
19-19M	Peninsula 3	1.7
19-20M	Peninsulas 6,7	0.8
19-21M	Dike 2	1.3

5.2.4 Interpretation

- Consolidation estimates range between 0.5 ft and 2 ft. There are two main factors that contribute to this variation:
    - (1) The assumed depth to hard bottom - more settlement results from a thicker compressible stratum
    - (2) The presence of ooze-like material at the surface leads to significant consolidation as a result of the high plasticity and compressibility of the ooze.
- Time-rate:
    - A preliminary time-rate evaluation assuming one-way drainage suggests that the majority of consolidation of the silt-dominated materials is likely to occur within 2 years of fill placement. At 19-21M and at any other locations where there is a thicker layer of high plasticity material, consolidation is likely to proceed slower, with the majority occurring within 5-10 years.
    - Uncertainty: Time rate of consolidation is difficult to predict accurately. It depends heavily on the thickness of the compressible layer and the drainage conditions, both of which are uncertain for Upper Pool 4 given the limited boring depths. Modeling two-way drainage in the stratigraphy results in a

majority of consolidation occurring within 6 months in silt-dominated materials and within 2-5 years for high plasticity clay layers.

5.3 Dredging Assessment (Materials)

Sands for the project are to be obtained from dredge cuts or Reed's Landing dredge material disposal site. Dredge sands typically classify as poorly-graded sand with fines content between 3-6%.

5.4 Topsoil Composition

Fines to be used as topsoil are expected to be obtained from hydraulic dredge detention ponds.

5.5 Erosion Protection

Riprap erosion protection is to be placed along the channel upstream of the dike. Rock thickness is expected to be 2-3 ft. Some settlement of the rock is expected to occur, and will be evaluated once the cross-section is defined. The evaluation will likely utilize boring 19-15M/MU for foundation conditions.

6 Sediment Quality

6.1 Dredge Material from Federal Navigation Project (Pool 4)

To determine the quality of the sand that is being proposed as construction fill for the TSP features in Catherine Pass, recent USACE surficial (top 10 cm) sediment surveys (2013-2014 and 2018-2019) collected from main channel dredge cuts in Pool 4 were evaluated for biological suitability.

Table 4 shows the average grain size composition for the Pool 4 navigational dredge cuts. Besides the sediment from the two harbors (Red Wing and Alma), which were mostly silt and not being considered as a source for this project, all the other locations were mostly sand with very little fines. Table 5 and Table 6 shows chemical results from the 2013-2014 and 2018-2019 surveys. The only main channel sample that was a concern was collected at Trenton (rm 794) in 2013. However, this location has not been dredged since 1975 and would not contribute any material for this project. All of other main channel dredge cuts had very low or non-detectable concentrations of organic compounds (PAHs, pesticides and PBCs) and the levels of metals found were not concerning. This lack of contamination was not surprising based on the sandy grain size and low organic carbon content of the material.

Table 4.Grain Size of Pool 4 Sediment from Navigational Dredge Cuts (top 10 cm)

Cut Name	Location (RM)	Year Last Tested	Avg. Coarse (< 4) % Gravel	Avg. Coarse (4-10) % Sand	Avg. Medium (10-40) % Sand	Avg. Fine (40-200) % Sand	Avg. Clay (>200) % fines
Trenton	794.6-794.1	2013	1.5	11.2	67.6	18.5	1.3
Red Wing Harbor	791.5	2013	0.0	0.0	4.1	8.8	84.1
Cannon River	793.6-792.8	2019	1.0	4.0	50.0	44.0	1.0
Red Wing Hwy. Br.	791.6-791.3	2018	0.1	0.2	72.8	25.9	1.0
Head of Lake Pepin	785.5-783.4	2019	0.0	0.0	3.0	95.0	2.0
Chippewa Delta	763.5-763.3	2013	3.2	6.8	64.0	24.1	1.9
Reads Landing	761.6-761.5	2014	1.75	2.25	70.75	24.4	0.8
Crats Island	758.8	2013	4.35	5.7	76.95	11.8	1.1
Teepeeota Point	757.6-757.5	2013	0.3	0.9	68.6	29.45	0.75
Grand Encampment	756.7-756.6	2014	1.6	4.15	79.6	13.2	1.45
Beef Slough	754.3-754.1	2014	1.25	3.75	79.95	14.25	0.75
Alma SBH	754.2	2014	0.1	0.65	10.4	43.95	41.85

Table 5. Chemical Analysis Results of 2013-2014 Sediment Samples from Pool 4 Navigational Dredge Cuts

2013-2014 Pool 4 Channel Dredge Cuts			Sample Location	Trenton	Trenton	Red Wing Harbor	Red Wing Harbor	Chippewa Delta	Chippewa Delta	Crats Island	Crats Island	TeePeeota Point	TeePeeota Point	Reads Landing	Reads Landing	Grand Encampment	Grand Encampment	Beef Slough	Beef Slough	Alma SBH	Alma SBH
			River Mile	794.4	794.3	791.5	791.5	763.5	763.3	758.8	758.8	757.6	757.5	761.6	761.5	756.7	756.6	754.3	754.1	754.2	754.2
			Pool	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
			Lab	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC	ADRL, INC
			database ID	P4-01-2013	P4-02-2013	P4-03-2013	P4-04-2013	P4-05-2013	P4-06-2013	P4-07-2013	P4-08-2013	P4-09-2013	P4-10-2013	P4-11-2014	P4-12-2014	P4-13-2014	P4-14-2014	P4-15-2014	P4-16-2014	P4-17-2014	P4-18-2014
			Lab ID	8966-17	8967-01	8966-16	8966-15	8966-10	8966-09	8966-14	8966-13	8966-12	8966-11	8007-01	8007-02	8007-03	8007-04	8007-05	8007-06	8007-07	8007-08
			Date Collected	9/10/2013	9/10/2013	9/10/2013	9/10/2013	9/9/2013	9/9/2013	9/9/2013	9/9/2013	9/9/2013	9/9/2013	10/22/2014	10/22/2014	10/22/2014	10/22/2014	10/22/2014	10/22/2014	10/22/2014	10/22/2014
	ug/kg		Acenaphthylene	9.81	ND	8.69	10.7	ND	ND	ND	ND	ND	ND	<0.831	<0.816	<0.813	<0.831	<0.817	<0.830	0.831	<0.871
	ug/kg		Acenaphthene	1.95 J	ND	3.17 J	7.21	ND	ND	ND	ND	ND	ND	<0.831	<0.816	<0.813	<0.831	<0.817	<0.830	0.831	<0.871
	ug/kg		Anthracene	37.8	ND	9.82	16.1	ND	ND	ND	ND	ND	ND	<0.831	<0.816	<0.813	<0.831	<0.817	<0.830	0.831	<0.871
	ug/kg		Fluoranthene	151	ND	67.4	169	1.53 J	ND	ND	ND	ND	ND	<0.831	1.23 J	<0.813	<0.831	<0.817	<0.830	0.831	3.29 J
	ug/kg		Pyrene	209	ND	64.9	153	1.33 J	ND	ND	ND	ND	ND	<0.831	1.12 J	<0.813	<0.831	<0.817	<0.830	0.831	2.95 J
	ug/kg		Benzo(a) anthracene	82	ND	31.8	74.6	ND	ND	ND	ND	ND	ND	<0.831	1.12 J	<0.813	<0.831	<0.817	<0.830	0.831	1.68 J
	ug/kg		Benzo(b)fluoranthene	79.2	ND	61.8	128	ND	ND	ND	ND	ND	ND	<0.831	1.02 J	<0.813	<0.831	<0.817	<0.830	0.831	3.48 J
	ug/kg		Benzo(k)fluoranthene	26.6	ND	16.2	46.3	ND	ND	ND	ND	ND	ND	<0.831	<0.816	<0.813	<0.831	<0.817	<0.830	0.831	1.09 J
	ug/kg		Benzo(a)pyrene	88.8	ND	34.5	77.9	ND	ND	ND	ND	ND	ND	<0.831	<0.816	<0.813	<0.831	<0.817	<0.830	0.831	1.91 J
	ug/kg		Benzo(g,h,i)perylene	56.8	ND	28.8	66.7	ND	ND	ND	ND	ND	ND	<0.831	<0.816	<0.813	<0.831	<0.817	<0.830	0.831	2.13 J
	ug/kg		Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<4.10	<4.07	<4.05	<4.07	<4.05	<4.12	<4.11	<4.34
	ug/kg		Chlordane trans isomer	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<4.10	<4.07	<4.05	<4.07	<4.05	<4.12	<4.11	<4.34
	ug/kg		Chlordane cis isomer	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<4.10	<4.07	<4.05	<4.07	<4.05	<4.12	<4.11	<4.34
	ug/kg		P, P'-DDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<4.10	<4.07	<4.05	<4.07	<4.05	<4.12	<4.11	<4.34
	ug/kg		O, P'-DDD	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<4.10	<4.07	<4.05	<4.07	<4.05	<4.12	<4.11	<4.34
	ug/kg		Dieldrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<4.10	<4.07	<4.05	<4.07	<4.05	<4.12	<4.11	<4.34
	ug/kg		O, P'-DDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<4.10	<4.07	<4.05	<4.07	<4.05	<4.12	<4.11	<4.34
	ug/kg		O, P'-DDT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<4.10	<4.07	<4.05	<4.07	<4.05	<4.12	<4.11	<4.34
	ug/kg		P, P'-DDD	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<4.10	<4.07	<4.05	<4.07	<4.05	<4.12	<4.11	<4.34
	ug/kg		P, P'-DDT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<4.10	<4.07	<4.05	<4.07	<4.05	<4.12	<4.11	<4.34
	ug/kg		PCB 1016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<8.21	<8.15	<8.12	<8.16	<8.11	<8.26	<8.24	<8.7
	ug/kg		PCB 1248	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<12.3	<12.2	<12.2	<12.2	<12.2	<12.4	<12.4	<13.0
	ug/kg		PCB 1254	ND	ND	ND	66.6 J	ND	ND	ND	ND	ND	ND	<12.3	<12.2	<12.2	<12.2	<12.2	<12.4	<12.4	<13.0
	ug/kg		PCB 1260	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<8.21	<8.15	<8.12	<8.16	<8.11	<8.26	<8.24	<8.7
	ug/kg		Total PCBs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<61.6	<61.1	<60.9	<61.2	<60.8	<61.9	<61.8	<65.2
Metals	mg/kg		Arsenic	1.9	2.1	4.4	5	0.91	1.2	1.1	1.2	1.1	0.9	1.2	0.71	1.2	1	1.5	1.3	0.96	1.5
	mg/kg		Cadmium	0.22	0.24	0.78	1.2	0.23	0.24	0.21	0.21	0.23	0.17	<0.24	<0.24	<0.24	<0.24	<0.24	<0.25	<0.24	<0.26
	mg/kg		Chromium	6.1	4.7	19.7	66.8	5.8	6.1	6.2	7.5	5.8	4.7	6.2	5.5	5.5	4.6	5.7	6.7	5.2	7.5
	mg/kg		Copper	1.8	1.4	12.3	17	3.3	4.9	4.2	4.4	3.8	2.7	5.1	3.71	5.3	3.3	4.3	4.1	3.6	4.6
	mg/kg		Lead	1.8	1.6	8.5	14	1.4	1.5	1.4	1.3	1.3	1.2	1.5	1.7	1.3	1.3	1.5	1.4	1.2	2.3
	mg/kg		Manganese	536	569	979	743	221	333	286	278	263	216	134	164	266	358	476	190	161	257
	mg/kg		Mercury	ND	ND	0.074	ND	ND	ND	ND	ND	ND	ND	<0.097	<0.097	<0.096	<0.098	<0.098	<0.098	<0.097	<0.10
	mg/kg		Nickel	5.2	4.6	14	15.9	4.3	5.6	5.4	5.4	5	3.8	5.8	4.9	5.8	4.5	5.9	7.1	4.6	5
	mg/kg		Zinc	14.4	13.3	65.5	80.2	15.8	19.3	15.7	17.9	16.7	12.7	19.5	14.1	17.2	14.1	17.9	19.6	13	20
	mg/kg		Ammonia Nitrogen	3.7	ND	62.1	133	12.8	ND	ND	ND	ND	ND	5.8	7.8	5.2	6	6.1	5.4	5.9	15.3
	mg/kg		Chromium (VI)	ND	ND	ND	4.9	ND	ND	ND	ND	ND	ND	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.3
Inorganics	mg/kg		Cyanide, Total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.29	<0.29	<0.29	<0.28	<0.30	<0.28	<0.29	<0.32
	%		Moisture	14.2	12.9	50.7	51.5	16	14.7	15.6	14.8	14.9	18	18.8	18.4	17.6	18.8	18.3	19	18.8	23.3
	mg/kg		Phenol	ND	ND	ND	ND	ND	0.36	ND	0.42	ND	ND	<3.1	<3.1	<3.0	<3.1	<3.1	<3.1	<3.1	<3.3
	mg/kg		Phosphorus	315	149	505	574	229	208	161	190	170	126	224	184	124	160	357	265	134	235
	%		Solids, Percent	85.8	87.1	49.3	48.5	84	85.3	84.4	85.2	85.1	82	81.2	81.6	82.4	81.2	81.7	81	81.2	76.7
	%		Solids, Total Volatile	ND	ND	2.7	2.5	ND	ND	ND	ND	ND	ND	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.3
	mg/kg		Total Kjeldahl Nitrogen	36	33.7	1560	1800	782	63.8	42.1	39.8	ND	29.4	18.3	<20.4	<24.3	<21.2	40.4	29.6	35.1	253
	mg/kg		Total Organic Carbon	270	210	19000	19000	970	540	290	200	300	250	1200	1100	1300	1200	1300	1400	1500	2800
PARTICLE SIZE % FINER	SAND	coarse	4	98.5	98.6	100	100	94.1	99.5	95.9	95.4	99.4	100	98.5	98	98	98.8	98.4	99.1	99.5	99.8
			10	85.1	89.7	100	99.9	90.2	89.8	91.1	88.8	98	99.6	96.2	95.8	93.3	95.2	93.4	96.6	97.1	98.6
		medium	20	59.5	66	100	97.9	83.3	65.5	68.8	49.8	86.2	94.3	79.1	80.3	66	73.6	62.1	74.7	71.3	92.1
			40	19	20.7	99.8	92	39.1	13	12.4	13.6	26.4	34	23.5	27	10.2	19.1	11.9	18.2	30.6	85.7
		fine	60	4.9	2.4	99.6	84.3	8.7	3.1	2.1	1.1	1.3	2.3	1.6	1.5	2.7	1.9	1.5	1.5	8.1	68.4
			140	1.6	1.1	97.2	77	2.5	1.5	1.7	0.7	0.5	1	0.9	0.8	2.3	0.6	1.2	0.4	1.6	12.8
	SILT	clay	200	1.6	1	93.8	74.4	2.2	1.5	1.6	0.6	0.5	1	0.9	0.7	2.3	0.6	1.2	0.3	1.6	9.3

J - Indicates an estimated value. This flag is used either when estimating a concentration or this flag indicates analyte(s) associated with a DOD-QSM specified non-compliance pertaining to matrix QC criteria.
X- Analyses were performed outside of holding times.
< or ND - Indicates compound was analyzed for but not detected. The sample quantitation limit has been corrected for weight, dilution and/or percent moisture.
Q- This flag indicates analyte(s) associated with a DOD-QSM specified non-compliance pertaining to calibration or control QC criteria.
B- This flag is used when the analyte is found in the blank as well as the sample. It indicates analyte(s) associated with a DOD-QSM specified non-compliance pertaining to matrix QC criteria.

Table 6. Chemical Analysis Results of 2018-2019 Sediment Samples from Pool 4 Navigational Dredge Cuts

2018-2019 Pool 4 Channel Dredge Cuts			Sample Location	Cannon River		Cannon River		Head of Lake Pepin		Head of Lake Pepin		Reads Landing		Alma Marina Access		LD 4 Lock Chamber		Above Red Wing Hwy		Above Red Wing Hwy		Above Red Wing Hwy		Red Wing SB Harbor		Red Wing SB Harbor		Red Wing Comm. Harbor	
			Sample ID	P4-27-2019		P4-28-2019		P4-25-2019		P4-26-2019		P4-29-2019		P4-30-2019		P4-31-2019		P4-23-2018		P4-20-2018		P4-19-2018		P4-22-2018		P4-21-2018		P4-24-2018	
			Pool	4		4		4		4		4		4		4		4		4		4		4		4		4	
			LAB Number	8530-04		8530-05		8530-02		8530-03		8530-11		8530-12		8530-06		8434-12		8434-09		8434-08		8434-11		8434-10		8434-13	
			Lab	ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc	
			Date collected	9/18/2019		9/18/2019		9/18/2019		9/18/2019		9/18/2019		9/18/2019		9/18/2019		9/14/2018		9/13/2018		9/13/2018		9/14/2018		9/13/2018		9/14/2018	
				Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag
PAH (Method 8270, SIM)	ug/kg		Naphthalene	4.45	<	4.27	<	4.26	<	4.42	<	4.2	<	4.31	<	4.45	<	4.17	<	4.08	<	4.13	<	2.32	J	14.6		1.92	J
	ug/kg		Acenaphthylene	4.45	<	4.27	<	4.26	<	4.42	<	4.2	<Q	4.31	<Q	4.45	<	4.17	<	4.08	<	4.13	<	7.52		64		6.28	
	ug/kg		Acenaphthene	4.45	<	4.27	<	4.26	<	4.42	<	4.2	<Q	4.31	<Q	4.45	<	4.17	<	4.08	<	4.13	<	2.43	J	20.4		1.85	J
	ug/kg		Fluorene	4.45	<	4.27	<	4.26	<	4.42	<	4.2	<Q	4.31	<Q	4.45	<	4.17	<	4.08	<	4.13	<	4.4	J	32.7		4.94	J
	ug/kg		Phenanthrene	1.07	JB	1.1	JB	4.26	<	1.04	JB	4.2	<	0.944	JB	1.23	JB	4.17	<	4.08	<	4.13	<	23.8		201		17.4	
	ug/kg		Anthracene	4.45	<	4.27	<	4.26	<	4.42	<	4.2	<	4.31	<	4.45	<	4.17	<	4.08	<	4.13	<	6.07	J	64.8		5.09	J
	ug/kg		Fluoranthene	4.45	<	4.27	<	4.26	<	1.38	J	4.2	<	4.31	<	1.04	J	4.17	<	4.08	<	4.13	<	68.7		620		48	
	ug/kg		Pyrene	4.45	<	4.27	<	4.26	<	1.34	J	4.2	<	4.31	<	4.45	<	4.17	<	4.08	<	4.13	<	66.5		614		48.3	
	ug/kg		Benzo[a]anthracene	4.45	<	4.27	<	4.26	<	0.983	J	4.2	<	4.31	<	4.45	<	4.17	<	4.08	<	4.13	<	34.5		327		25.5	
	ug/kg		Chrysene	4.45	<	4.27	<	4.26	<	4.42	<	4.2	<	4.31	<	4.45	<	4.17	<	4.08	<	4.13	<	46.1		390		29.7	
	ug/kg		Benzo[b]fluoranthene	4.45	<	4.27	<	4.26	<	1.39	J	4.2	<	4.31	<	4.45	<	4.17	<	4.08	<	4.13	<	70		483		46.1	
	ug/kg		Benzo[k]fluoranthene	4.45	<	4.27	<	4.26	<	4.42	<	4.2	<	4.31	<	4.45	<	4.17	<	4.08	<	4.13	<	22.1		179		15.6	
	ug/kg		Benzo[a]pyrene	4.45	<	4.27	<	4.26	<	1.01	J	4.2	<	4.31	<	4.45	<	4.17	<	4.08	<	4.13	<	42.4		344		30.1	
	ug/kg		Benzo[e]pyrene	4.45	<	4.27	<	4.26	<	4.42	<	4.2	<	4.31	<	4.45	<	4.17	<	4.08	<	4.13	<	35.1		258		23.2	
	ug/kg		Indeno[1,2,3-cd]pyrene	4.45	<	4.27	<	4.26	<	4.42	<	4.2	<	4.31	<	4.45	<	4.17	<	4.08	<	4.13	<	12.3		32.8		9.28	
	ug/kg		Dibenzo[a,h]anthracene	4.45	<	4.27	<	4.26	<	4.42	<	4.2	<	4.31	<	4.45	<	4.17	<	4.08	<	4.13	<	5.07	J	35.6		4.17	J
	ug/kg		Benzo[g,h,i]perylene	4.45	<	4.27	<	4.26	<	0.917	J	4.2	<	4.31	<	4.45	<	4.17	<	4.08	<	4.13	<	18.5		193		14	
	ug/kg		2-Methylnaphthalene	4.45	<	4.27	<	4.26	<	4.42	<	4.2	<	4.31	<Q	4.45	<	4.17	<	4.08	<	4.13	<	7.43	<	16.5		6.28	<
PESTICIDES (8081/8082)	ug/kg		Hexachlorobenzene	4.39	<	4.26	<	4.29	<	4.41	<	4.2	<	4.35	<	4.43	<	4.19	<	4.14	<	4.03	<	7.43	<	6.99	<	6.2	<
	ug/kg		O,P'-DDE	4.39	<	4.26	<	4.29	<	4.41	<	4.2	<	4.35	<	4.43	<	4.19	<	4.14	<	4.03	<	7.43	<	6.99	<	6.2	<
	ug/kg		Chlordane, trans-	4.39	<	4.26	<	4.29	<	4.41	<	4.2	<	4.35	<	4.43	<	4.19	<	4.14	<	4.03	<	7.43	<	6.99	<J	6.2	<
	ug/kg		Chlordane, cis-	4.39	<	4.26	<	4.29	<	4.41	<	4.2	<	4.35	<	4.43	<	4.19	<	4.14	<	4.03	<	7.43	<	6.99	<J	6.2	<
	ug/kg		P,P'-DDE	4.39	<	4.26	<	4.29	<	4.41	<	4.2	<	4.35	<	4.43	<	4.19	<	4.14	<	4.03	<	7.43	<	6.99	<J	6.2	<
	ug/kg		O,P'-DDD	4.39	<	4.26	<	4.29	<	4.41	<	4.2	<	4.35	<	4.43	<	4.19	<	4.14	<	4.03	<	7.43	<	6.99	<	6.2	<
	ug/kg		Dieldrin	4.39	<	4.26	<	4.29	<	4.41	<	4.2	<	4.35	<	4.43	<	4.19	<	4.14	<	4.03	<	7.43	<	6.99	<J	6.2	<
	ug/kg		O,P'-DDT	4.39	<	4.26	<	4.29	<	4.41	<	4.2	<	4.35	<	4.43	<	4.19	<	4.14	<	4.03	<	7.43	<Q	6.99	<Q	6.2	<Q
	ug/kg		P,P'-DDD	4.39	<	4.26	<	4.29	<	4.41	<	4.2	<	4.35	<	4.43	<	4.19	<	4.14	<	4.03	<	7.43	<	6.99	<	6.2	<
	ug/kg		P,P'-DDT	4.39	<	4.26	<	4.29	<	4.41	<	4.2	<	4.35	<	4.43	<	4.19	<	4.14	<	4.03	<	7.43	<Q	6.99	<Q	6.2	<Q
PCBS (8081/8082)	ug/kg		Aroclor 1016	88	<	85.3	<	85.9	<	88.3	<	84.2	<	87.1	<	88.8	<	83.9	<	82.9	<	80.8	<	149	<	140	<	124	<
	ug/kg		Aroclor 1221	88	<	85.3	<	85.9	<	88.3	<	84.2	<	87.1	<	88.8	<	83.9	<	82.9	<	80.8	<	149	<	140	<	124	<
	ug/kg		Aroclor 1232	88	<	85.3	<	85.9	<	88.3	<	84.2	<	87.1	<	88.8	<	83.9	<	82.9	<	80.8	<	149	<	140	<	124	<
	ug/kg		Aroclor 1242	88	<	85.3	<	85.9	<	88.3	<	84.2	<	87.1	<	88.8	<	83.9	<	82.9	<	80.8	<	149	<	140	<	124	<
	ug/kg		Aroclor 1248	88	<	85.3	<	85.9	<	88.3	<	84.2	<	87.1	<	88.8	<	83.9	<	82.9	<	80.8	<	149	<	140	<	124	<
	ug/kg		Aroclor 1254	88	<	85.3	<	85.9	<	88.3	<	84.2	<	87.1	<	88.8	<	83.9	<	82.9	<	80.8	<	149	<	140	<	124	<
	ug/kg		Aroclor 1260	88	<	85.3	<	85.9	<	88.3	<	84.2	<	87.1	<	88.8	<	83.9	<	82.9	<	80.8	<	149	<	140	<J	124	<
Inorganics	mg/kg		Arsenic	0.9755		0.8489		0.5918		0.8005		0.7008		1.0356		0.9455		1.298		0.51		0.75		3.94		3.555		3.08	
	mg/kg		Cadmium	0.0661		0.0476	J	0.0533		0.0749		0.0575		0.0563		0.0769		0.0274	J	0.0198	J	0.0197	J	0.334		0.465		0.274	
	mg/kg		Chromium	3.31		2.96		3.47		3.63		4.78		4.33		3.91		4.87		3.11		3.72		16.2		16.7		13.8	
	mg/kg		Chromium, +6	0.48	<	0.49	<	0.49	<	0.27	J	0.26	J	0.45	<	0.48	<	1.14	<	1.1	<	1.17	<	2.26	<	2.1	<	1.81	<
	mg/kg		Copper	0.873		1		0.723		0.87		3.41		2.92		2.11		1.24		0.848		0.892		11.7		37.4		8.83	
	mg/kg		Lead	1.2		1.13		1.32		1.69		1.25		1.26		1.48		1.54		1.23		1.36		8.27		17.7		6.39	
	mg/kg		Manganese	189		194		119		235		206		265		201		283		101		118		675		532		647	
	mg/kg		Mercury	0.0029		0.0025		0.0047		0.0045		0.0025	<	0.0026	<	0.0048		0.0035		0.0036		0.0049		0.0634		0.0985		0.0465	
	mg/kg		Nickel	3.69		3.57		2.92		3.34		5.9		5.31		4.38		4.76		2.75		3.15		15.8		14.7		13.6	
	mg/kg		Zinc	8.73		8.09		7.85		9.96		18.1		15.5		13.4		11.8		8.19		10.6		69.4		90.8		52.4	
	mg/kg		Cyanide, total	1.2	<	1.1	<	1.2	<	1.2	<	1.2	<	0.55	J	1.1	<	0.24	<	0.224	<	0.241	<	0.445	<	0.407	<	0.363	<
	mg/kg		Kjeldahl nitrogen	32.6		37.8		71.6		54.3		24.3	<	35.6		195		32.1		50.3		25.8		1160		1640		1130	
	mg/kg		Nitrogen, ammonia	0.714	JB	0.585	J	1.38		0.832		0.736	<	0.754	<	2.9		3.63	<	3.63	<	3.66	<	25.5		41.3		17.2	
	%		Moisture (Gravimetric)	24.7		21		21.6		23.7		20.8		22.4		25.4		20.5	X	19.8	X	19.6	X	55.8	X	52.8	X	47	X
	mg/kg		Phenol IC	2.5	<	2.2	<	2.2	<	2.2	<	2.7	J	2.2	<	2.4	<	2.9	<	2.9	<	2.9	<	35		13		24	
	mg/kg		Phosphorus, total	142		187		216		168		103		127		364		121		125		133		668		578		610	
	%		Solids, total	75.3		79		78.4		76.3		79.2		77.6		74.6		79.5	X	80.2	X	80.4	X	44.2	X	47.2	X	53	X
	%		Total Volatile Solids	0.1	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1	<	0.1	<	0.13	X	0.1	<X	0.21	X	5.94	X	5	x	4.8	X
	mg/kg		Total Organic Carbon	1200	<	1200	<	1200	<	1200	<	1200	<	1100	<	1200	<	1000	<	1000	<	1000	<	18000		19000		13000	
PARTICLE SIZE % FINER	SAND	coarse	4	99.2		100		99.9		100		97.8		99.3		99.9		99.9		100		100		100		100		100	
		medium	10	95.7		100		99.9		99.9		94.1		96.6		98.3		99.7		100		100		100		100		100	
			20	83.9		97.4		99.8		98.3		85.3		85.4		97		88.3		100		99.6		100		99.8		99.8	
		fine	40	45.8		64.8		97.1		88.6		41.6		41.1		86.4		26.9		70.8		51.4		98.4		97.9		98	
			60	11.9		14.4		69.4		60.8		7.9		7.4		61.1		4.8		14.1		15.8		98.2		96.9		97.1	
			100	3		2.9		13		3.5		1		2		12.4		1		1.7		2.4		97		93.9		89	
	SILT	clay	200	1.5		1.9		2.4		1.6		0.6		1.5		4.8		1		1.6		2.1		96.1		91.1		83.5	
Particle Size	%		Gravel	0.8		0		0.1		0		2.2		0.7		0.1		0.1		0		0		0		0		0	
	%		Sand	97.7		98.1		97.5		98.4		97.2		97.8		95.1		98.9		98.4		97.8		3.9		8.9		16.5	
	%		Silt	0.7		1		0		0.8		0.3		0.7		2.4		0.7		1.3		1.8		75.3		77.2		67.5	
	%		Clay	0.8		0.9		2.4		0.8		0.3		0.8		2.4		0.3		0.3		0.4		20.8		13.9		16	

J - Indicates an estimated value. This flag is used either when estimating a concentration or this flag indicates analyte(s) associated with a DOD-QSM specified non-compliance pertaining to matrix QC criteria.
X- Analyses were performed outside of holding times.
< - Indicates compound was analyzed for but not detected. The sample quantitation limit has been corrected for weight, dilution and/or percent moisture.
Q- This flag indicates analyte(s) associated with a DOD-QSM specified non-compliance pertaining to calibration or control QC criteria.
B- This flag is used when the analyte is found in the blank as well as the sample. It indicates analyte(s) associated with a DOD-QSM specified non-compliance pertaining to matrix QC criteria.

6.2 Catherine Pass Surveys

In 2017 and 2019, the US Army Corps of Engineers (USACE), St. Paul District completed sediment surveys for the Upper Pool 4 CAP Section 1122 project. The purpose of the sediment surveys were to characterize the physical and chemical properties of the existing sediment in the vicinity of Catherine Pass. The sample locations were selected inside the footprint of the tentatively selected plan (Figure 9). Below is a detailed description of the 2017 and 2019 surveys, including: sampling locations, depths, sampling methods, chemical and physical analyses, results and discussion.

6.3 2017 Survey

For the 2017 survey, district staff drilled three boreholes and collected multiple composite samples at roughly two foot intervals below the sediment surface per borehole. Two boreholes were located at the upstream section of Catherine Pass (boreholes 17-5M and 17-6M) and the other borehole was located near the middle of Catherine Pass inside the proposed access dredging footprint (boreholes 17-4M).

All of the sediment samples from the 2017 survey were immediately processed after collection and sent on ice to ARDL, Inc., Mt Vernon, IL for physical and chemical analyses to determine grain size and contamination.

6.3.1 Analysis

Metals, PCBs, pesticides, PAHs, cyanide, total organic carbon, percent moisture, percent solids, percent total volatile solids, selected inorganics and grain-size analyses were performed or directed by ARDL, Inc. for each of the composite samples plus split QA/QC samples.

6.4 2019 Survey

For the 2019 survey, district staff drilled four boreholes and collected two composite samples at roughly one to three foot intervals below the sediment surface per borehole. Two boreholes were located in the middle of Catherine Pass inside the proposed backwater dredge area (boreholes 19-23M and 19-24M). A third borehole was located inside the proposed access channel leading out to the main channel (borehole 19-25M) and a final borehole was located downstream of Catherine Pass outside the footprint of the proposed TSP features (borehole 19-22M).

6.4.1 Analysis

Similar to the 2017 survey, ARDL, Inc., performed or managed analyses on the 2019 sediment samples that included: metals, PCBs, pesticides, PAHs, cyanide, total organic carbon, percent moisture, percent solids, percent total volatile solids, selected inorganics and grain-size. The analyses were performed for each of the composite samples plus split QA/QC samples.

6.5 Sediment Survey Results

The results of the grain size analyses showed that the sediment samples were fairly high in silt content. In general, material high in fines (>50% passing the #200 sieve) were found throughout

Catherine Pass, except for borehole 19-25M, which was located at the small outlet channel. The lack of fine material seen at 19-25M is most likely due to relatively higher flow velocities through the narrow channel.

Table 7 shows the percentage of material that passed through the #200 sieve for each sample and their total organic carbon content (TOC). The role of sediment in chemical pollution is tied both to the particle size of sediment, and to the amount of particulate organic carbon associated with the sediment. Silt content is important, because finer material has more surface area for binding with contaminants, but as TOC increases, the affinity between the sediment and the contaminants also increases. As a result, greater TOC concentrations reduces the biological availability of many of the persistent, bioaccumulating and toxic organic contaminants, especially chlorinated compounds.

To ascertain the possible toxicity of the samples to the benthic environment, the chemical results were compared to the Minnesota Pollution Control Agency's (MPCA) sediment quality targets (SQTs) for the protection of sediment-dwelling organisms in Minnesota (Table 8 and Table 9) and the Wisconsin Department of Natural Resource's Consensus Based Sediment Quality Guidelines (Table 10).

The SQTs (Level I and Level II) are guidelines used to identify contaminant concentrations that cause harmful effects on sediment-dwelling organisms. Level I SQTs are the concentrations that will provide a high level of protection for benthic invertebrates. Level II SQTs are the concentrations that will provide a moderate level of protection for benthic invertebrates. During dredging operations, there will be some disruption that may dislodge contaminated sediment into the water column. Looking at test results from the boreholes in the backwater areas (boreholes 19-23M and 19-24M) and the access channels (boreholes 17-4M and 19-25M), SQT level I exceedances are seen for some PAHs and some metals, most notably mercury which was exceeded in three of four boreholes. These exceedances may indicate some temporary, low-level of concern for benthic invertebrates.

In Wisconsin, agencies rely on Consensus Based Sediment Quality Guidelines (CBSQGs) for in-place effects of contaminated sediment to benthic macroinvertebrate species. Compared to CBSQGs, the material tested from Catherine Pass sediment samples were primarily below threshold effect concentrations (TEC), which is the lowest level of concern for toxicity to benthic-dwelling organisms (WDNR, 2003). However, a few metals such as manganese and cadmium had some midpoint effect concentration (MEC) exceedances and there were a few instances of organic contaminants exceeding the midpoint effect concentration (MEC) or the probable effect concentration (PEC). Notably, these organic exceedances were only found in 17-6M, which is not in the footprint of the project or 19-25M, which will be covered with rock.

The main concern for completing the TSP in relation to managing possibly contaminated sediment during- and post-project is primarily at locations that will be dredged (access and backwater dredging). Other TSP features, such as land creation, will essentially conceal any contaminated existing sediment with clean fill with only limited disturbance during construction. Overall, the material found in Catherine Pass is mostly clean and any disturbance of the sediment due to the construction of the TSP should be temporary. But, stakeholders should coordinate to determine if this limited exposure is acceptable.

Table 7. Silt Percentage and Total Organic Carbon content in Catherine Pass Sediment Samples

Sample ID	Percent of material passed through the #200 sieve	Total Organic Carbon mg/kg
17-4M SN1	98.8	27000
19-22M SN1	96.4	20000
17-4M SN2	96.2	23000
17-4M SN3	95.3	9400
17-4M SN4	95.3	14000
17-5M SN2	94	19000
17-5M SN1	93.5	13000
17-5M SN4	89.6	17000
17-5M SN3	83.3	4600
19-23M SN2	80.5	17000
17-6M SN1	78	11000
19-22M SN2	74.1	23000
19-24M SN2	65.4	17000
19-23M SN1	60.6	19000
19-24M SN1	53.1	19000
17-6M SN2	22.2	2500
19-25M SN1	6.1	<1000
19-25M SN2	2.4	<1000

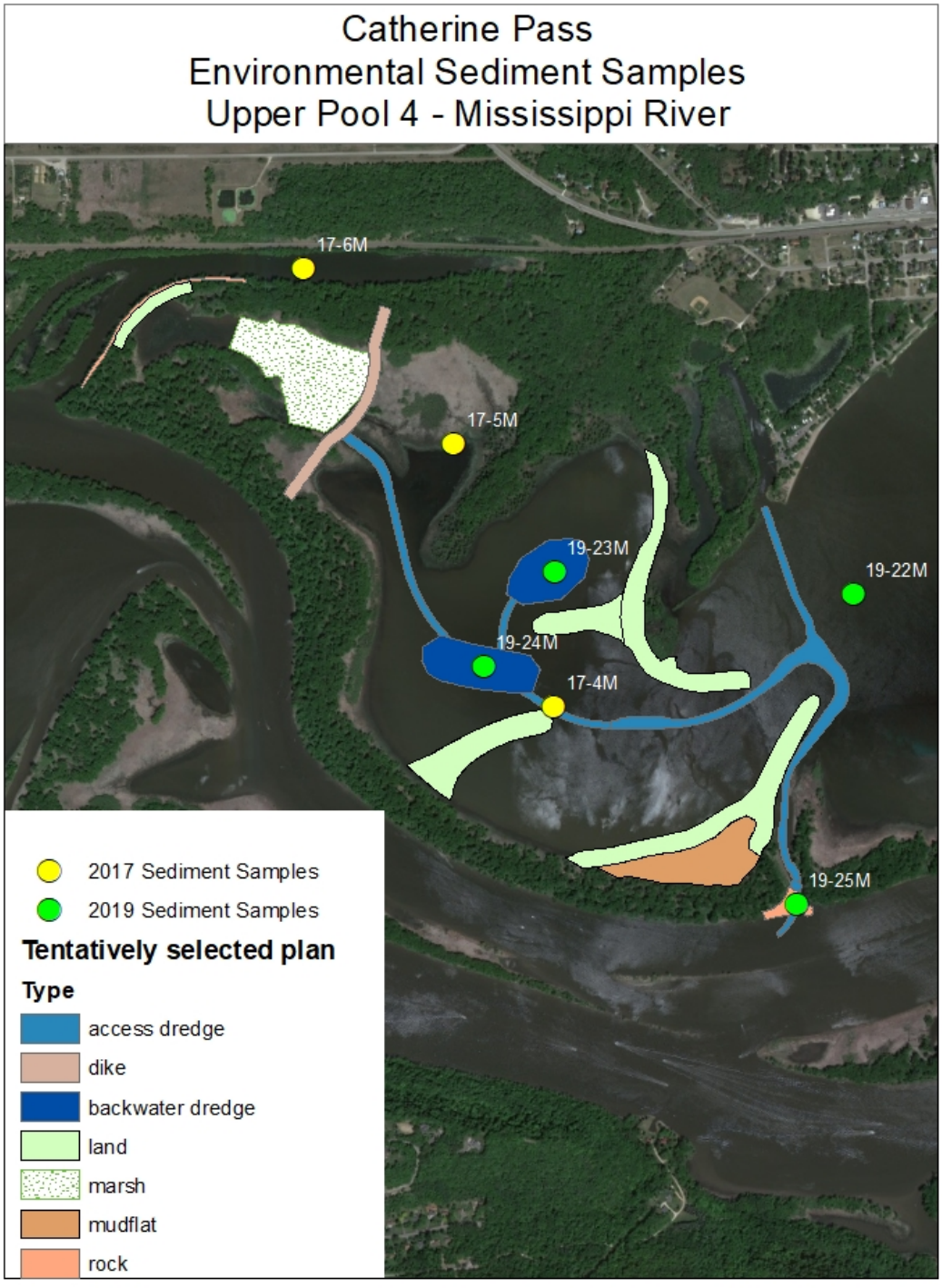


Figure 9. Environmental sediment samples collected in Catherine Pass – Upper Pool 4 – Upper Mississippi River

Table 8. Analytical Results of the Sediment Samples collected during the 2017 Survey within Catherine Pass. Yellow Highlight indicates Exceedance of MPCA's SQT Level I guidance.

2017 Upper Pool 4 CAP Section 204 Sediment Samples			Corps ID	17-4M, SN 1	17-4M, SN 2	17-4M, SN 3	17-4M, SN 4	17-5M, SN 1	17-5M, SN 2	17-5M, SN 3	17-5M, SN 4	17-6M, SN 1	17-6M, SN 2
			Date Collected	8/22/2017	8/22/2017	8/22/2017	8/22/2017	8/23/2017	8/23/2017	8/23/2017	8/23/2017	8/23/2017	8/23/2017
			ARDL Lab ID	008317-12	008317-13	008317-14	008317-15	008317-16	008317-17	008317-18	008317-19	008317-20	008318-17
			Depth (ft below sedimet surface)	0-2'	2-4'	4-6'	6-8'	0-2.1'	2.1-4.1'	4.1-6.1'	6.1 -8.1'	0-2.3'	2.3-4.3'
	Parameter	**Method**	**Units**										
	Solids, Percent	160.3	%	47.1	58.3	66.3	68	66.7	59.5	72.6	69.8	51.8	81
	Solids, Total Volatile	160.4	%	7.3	4.95	4.47	4.98	4.44	7.29	3.54	4.24	5.45	1.03
	Ammonia Nitrogen	350.1	MG/KG	203	156	131	229	104	59.3	36.6	81.2	39.7	22
	Kjeldahl Nitrogen	351.2	MG/KG	2900	1680	1480	1460	1340	3120	729	861	1830	281
	Phosphorus	365.2	MG/KG	956	690	568	639	477	676	456	494	438	204
	Moisture	D2974-87	%	52.9	41.7	33.7	32	33.3	40.5	27.4	30.2	48.2	19
	Total Organic Carbon	9060	MG/KG	27000	23000	9400	14000	13000	19000	4600	17000	11000	2500
	Cyanide, Total	9012B	MG/KG	<0.346	<0.278	<0.266	<0.263	<0.231	<0.252	<0.225	<0.236	<0.322	<0.198
	Phenol	9066	MG/KG	<2.15	<1.53	<1.45	<1.53	<1.53	<1.81	<1.49	<1.47	<1.79	<1.31
Metals	Arsenic	7062	MG/KG	8.44	2.68	4.32	4.22	2.06	5.56	3.57	4.33	3.92	1.54
	(a) Cadmium	6010C	MG/KG	1.5	0.642	0.61	0.632	0.605	1.1	0.498	0.596	1.19	J0.186
	(a) Chromium	6010C	MG/KG	32.6	16.5	14.6	16.2	15.9	22.9	15	16.1	26.9	8.46
	(a) Copper	6010C	MG/KG	32.9	12.5	12.6	14	13.7	21.2	11.8	12.4	24.6	5.56
	(a) Lead	6010C	MG/KG	33.1	7.18	6.2	7.43	7.77	15.3	6.59	7.69	31.5	7.6
	(a) Manganese	6010C	MG/KG	802	505	536	955	1190	900	835	1030	321	140
	(a) Nickel	6010C	MG/KG	26.5	14.2	14.1	16.5	16.8	22.4	15.1	16.4	20.1	7.37
	(a) Zinc	6010C	MG/KG	132	50.4	43.2	50.9	56	80.8	42.8	49.5	111	25.9
	Chromium (VI)	7196A	MG/KG	<1.86	<1.63	<1.46	<1.31	<1.47	<1.6	<1.32	<1.42	<1.86	<1.16
	(a) Mercury	7470A	MG/KG	0.292	<0.113	<0.112	<0.101	<0.11	<0.114	<0.0912	<0.102	0.161	0.147
PCBs	(a) Aroclor 1016	8081A	UG/KG	<10.4	<8.72	<7.44	<7.45	<7.37	<8.46	<6.77	<7.14	<9.65	<6.17
	(a) Aroclor 1248	8081A	UG/KG	<20.8	<17.4	<14.9	<14.9	<14.7	<16.9	<13.5	<14.3	<19.3	<12.3
	(a) Aroclor 1254	8081A	UG/KG	J48.1	<17.4	<14.9	<14.9	<14.7	J30.9	<13.5	<14.3	J38.6	<12.3
	(a) Aroclor 1260	8081A	UG/KG	<10.4	<8.72	<7.44	<7.45	<7.37	<8.46	<6.77	<7.14	<9.65	<6.17
	Total PCB's	8081A	UG/KG	<104	<87.2	<74.4	<74.5	<73.7	<84.6	<67.7	<71.4	<96.5	<61.7
Pesticides	(a) Chlordane cis isomer	8081A	UG/KG	<2.08	<1.74	<1.49	<1.49	<1.47	<1.69	<1.35	<1.43	<1.93	<1.23
	(a) Chlordane trans isomer	8081A	UG/KG	<2.08	<1.74	<1.49	<1.49	<1.47	<1.69	<1.35	<1.43	<1.93	<1.23
	(a) Dieldrin	8081A	UG/KG	<2.08	<1.74	<1.49	<1.49	<1.47	<1.69	<1.35	<1.43	<1.93	<1.23
	(a) P,P'-DDD	8081A	UG/KG	<2.08	<1.74	<1.49	<1.49	<1.47	<1.69	<1.35	<1.43	<1.93	<1.23
	O,P'-DDD	8081A	UG/KG	<2.08	<1.74	<1.49	<1.49	<1.47	<1.69	<1.35	<1.43	<1.93	<1.23
	(a) P,P'-DDE	8081A	UG/KG	<2.08	<1.74	<1.49	<1.49	<1.47	<1.69	<1.35	<1.43	<1.93	<1.23
	O,P'-DDE	8081A	UG/KG	<2.08	<1.74	<1.49	<1.49	<1.47	<1.69	<1.35	<1.43	<1.93	<1.23
	(a) P,P'-DDT	8081A	UG/KG	<2.08	<1.74	<1.49	<1.49	<1.47	<1.69	<1.35	<1.43	<1.93	<1.23
	O,P'-DDT	8081A	UG/KG	<2.08	<1.74	<1.49	<1.49	<1.47	<1.69	<1.35	<1.43	<1.93	<1.23
	Hexachlorobenzene	8081A	UG/KG	<2.08	<1.74	<1.49	<1.49	<1.47	<1.69	<1.35	<1.43	<1.93	<1.23
PAHs	(a) 2-Methylnaphthalene	8270C	UG/KG	10.5	<1.15	<0.988	<0.989	<0.995	<1.13	<0.923	<0.96	11.5	4.39
	(a) Acenaphthene	8270C	UG/KG	7.65	<1.15	<0.988	<0.989	<0.995	J2.77	<0.923	<0.96	<1.28	8.88
	(a) Acenaphthylene	8270C	UG/KG	54.2	J1.15	<0.988	<0.989	<0.995	16.1	<0.923	<0.96	100	51.8
	(a) Anthracene	8270C	UG/KG	36.5	J1.28	<0.988	<0.989	<0.995	10.5	<0.923	<0.96	65.8	38.4
	(a) Benzo(a)anthracene	8270C	UG/KG	197	8.29	<0.988	<0.989	<0.995	49.4	J1.16	<0.96	257	163
	(a) Benzo(a)pyrene	8270C	UG/KG	257	8.38	J1	<0.989	<0.995	62.1	J1.76	<0.96	277	178
	(a) Benzo(b)fluoranthene	8270C	UG/KG	301	10.4	J0.988	J1.31	<0.995	101	J2.71	J0.96	328	208
	(a) Benzo(g,h,i)perylene	8270C	UG/KG	101	J3.08	<0.988	<0.989	<0.995	19.7	<0.923	<0.96	153	64.1
	(a) Benzo(k)fluoranthene	8270C	UG/KG	102	J3.66	<0.988	<0.989	<0.995	28.4	<0.923	<0.96	104	69.8
	(a) Chrysene	8270C	UG/KG	223	7.92	<0.988	<0.989	<0.995	58.4	J1.4	<0.96	252	160
	(a) Dibenzo(a,h)anthracene	8270C	UG/KG	24.5	<1.15	<0.988	<0.989	<0.995	J4.77	<0.923	<0.96	29.3	15.7
	(a) Fluoranthene	8270C	UG/KG	229	14.1	<0.988	J1.09	<0.995	79.4	J1.69	<0.96	236	144
	(a) Fluorene	8270C	UG/KG	13.1	<1.15	<0.988	J1.11	<0.995	J4.18	<0.923	<0.96	25.4	8.56
	(a) Indeno(1,2,3-cd)pyrene	8270C	UG/KG	119	J3.71	<0.988	<0.989	<0.995	26.2	<0.923	<0.96	126	67.5
	(a) Naphthalene	8270C	UG/KG	9.69	<1.15	<0.988	<0.989	<0.995	J3.38	<0.923	<0.96	9.24	4.57
	(a) Phenanthrene	8270C	UG/KG	79.2	J4.22	J3.58	J1.71	<0.995	22.4	J1.16	<0.96	155	63.8
	(a) Pyrene	8270C	UG/KG	348	17.4	<0.988	J1.11	<0.995	99.1	J2.45	J1.17	437	233
	Benzo(e)pyrene	8270C	UG/KG	203	J5.37	<0.988	<0.989	<0.995	57	<0.923	<0.96	196	120

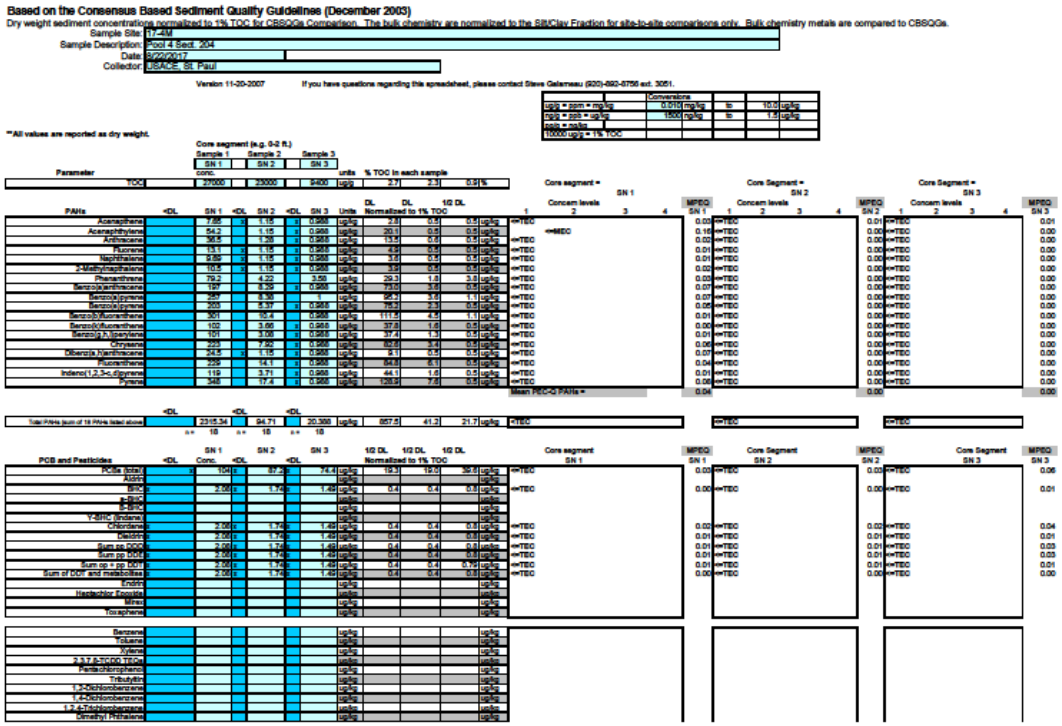
J - Indicates an estimated value. This flag is used either when estimating a concentration or this flag indicates analyte(s) associated with a DOD-QSM specified non-compliance pertaining to matrix QC criteria.
< - Indicates compound was analyzed for but not detected. The sample quantitation limit has been corrected for weight, dilution and/or percent moisture.
Q- This flag indicates analyte(s) associated with a DOD-QSM specified non-compliance pertaining to calibration or control QC criteria.
B- This flag is used when the analyte is found in the blank as well as the sample. It indicates analyte(s) associated with a DOD-QSM specified non-compliance pertaining to matrix QC criteria.
* SRV is for Total Chlordane
** Benzo(a)pyrene Equivalents
*** Total PCBs

Table 9. Analytical Results of the Sediment Samples collected during the 2019 Survey within Catherine Pass. Yellow Highlight indicates Exceedance of MPCA's SQT Level I guidance.

2019 Upper Pool 4 CAP Section 204 Sediment Samples			Sample Site				19-22M, SN 1		19-22M, SN 2		19-23M, SN 1		19-23M, SN 2		19-24M, SN 1		19-25M, SN 1		19-25M, SN 2		19-24M, SN 2	
			Pool				4		4		4		4		4		4		4		4	
			LAB Number				8484-01		8484-02		8484-03		8484-04		8484-05		8484-06		8484-07		8484-08	
			Lab				ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc		ARDL, Inc	
			Depth below sediment surface				0-1'		1-3'		0-3'		3-6.4'		0-2.5'		2.5-3.8'		0-2.4'		2.4-5.4'	
			Date collected				6/24/2019		6/24/2019		6/24/2019		6/24/2019		6/24/2019		6/25/2019		6/25/2019		6/24/2019	
				MPCA SQT I	MPCA SQT II	MPCA August 2016 Residential/Recreational Soil Reference Value (SRV)	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag
PAH (Method 8270, SIM)	ug/kg		Naphthalene	180	560	81000	3.93	J	10.1		3.8	J	1.62	J	6.29	J	0.852	J	4.24	<	2.31	J
	ug/kg		Acenaphthylene	5.9	130		18		96.4		21.1		7.8		42.2		2.5	J	4.24	<	10	
	ug/kg		Acenaphthene	6.7	89	1300000	5.11	J	11.8		3.42	J	1.52	J	5.87	J	0.936	J	4.24	<	2.79	J
	ug/kg		Fluorene	77	540	850000	11.7		28.9		7.65		5.34		14.3		2.7	J	1.24	J	5.83	
	ug/kg		Phenanthrene	200	1200		41.3	B	163	B	30.4	B	11.6	B	52.9	B	8.92	B	3.98	JB	20.5	B
	ug/kg		Anthracene	57	850	6500000	15.3		96.2		11.9		4.27	J	23.9		5.82		0.968	J	7.67	
	ug/kg		Fluoranthene	420	2200	510000	136		513		95.2		34.7		185		22.1		7.1		75.1	
	ug/kg		Pyrene	200	1500	44000	146		671		118		45.4		246		30.7		7.9		97.3	
	ug/kg		Benzo[a]anthracene	110	1100		105		455		76.1		29.7		161		18.6		4.89		57.5	
	ug/kg		Chrysene	170	1300		97.7		413		75.6		29.3		154		14.8		4.08	J	51.5	
	ug/kg		Benzo[b]fluoranthene				126		449		107		40		215		14.3		4.57		73.7	
	ug/kg		Benzo[k]fluoranthene				45.3		147		33.5		13.4		66.9		4.49		1.76	J	23.6	
	ug/kg		Benzo[a]pyrene	150	1500	1000**	114		466		94.4		37.3		195		16.4		4.29		69.9	
	ug/kg		Benzo[e]pyrene				69.2		260		61.6		24.7		121		9.04		2.57	J	42.6	
	ug/kg		Indeno[1,2,3-cd]pyrene				47.7		187		36.9		14.2		63.4		7.18		2.51	J	22.1	
	ug/kg		Dibenzo[a,h]anthracene	33	140		14.2		41.4		9.99		3.9	J	17.7		1.93	J	4.24	>	5.91	
	ug/kg		Benzo[g,h,i]perylene				56.3		159		43.7		16.3		71.3		9.88		3.02	J	24.8	
	ug/kg		2-Methylnaphthalene	20	200		4.18	J	10.1		4.93	J	1.56	J	6.03	J	0.804	J	4.24	<	2.22	J
PESTICIDES (8081/8082)	ug/kg		Hexachlorobenzene			230	5.77	<	6.3	<	7.57	<	5.17	<	6.56	<	4.04	<	4.23	<	4.96	<
	ug/kg		O,P'-DDE				5.77	<	6.3	<	7.57	<	5.17	<	6.56	<	4.04	<	4.23	<	4.96	<
	ug/kg		Chlordane, trans-			950*	5.77	<	6.3	<	7.57	<	5.17	<	6.56	<	4.04	<	4.23	<	4.96	<
	ug/kg		Chlordane, cis-			950*	5.77	<	6.3	<	7.57	<	5.17	<	6.56	<	4.04	<	4.23	<	4.96	<
	ug/kg		P,P'-DDE			22000	5.77	<	6.3	<	7.57	<	5.17	<	6.56	<	4.04	<	4.23	<	4.96	<
	ug/kg		O,P'-DDD				5.77	<	6.3	<	7.57	<	5.17	<	6.56	<	4.04	<	4.23	<	4.96	<
	ug/kg		Dieldrin	1.9	62	110	5.77	<	6.3	<	7.57	<	5.17	<	6.56	<	4.04	<	4.23	<	4.96	<
	ug/kg		O,P'-DDT				5.77	<,Q	6.3	<,Q	7.57	<,Q	5.17	<,Q	6.56	<,Q	4.04	<	4.23	<	4.96	<,Q
	ug/kg		P,P'-DDD			19000	5.77	<	6.3	<	7.57	<	5.17	<	6.56	<	4.04	<	4.23	<	4.96	<
	ug/kg		P,P'-DDT			7300	5.77	<,Q	6.3	<,Q	7.57	<,Q	5.17	<,Q	6.56	<,Q	4.04	<	4.23	<	4.96	<,Q
PCBS (8081/8082)	ug/kg		Aroclor 1016				116	<	126	<	152	<	104	<	131	<	80.9	<	84.7	<	99.3	<
	ug/kg		Aroclor 1221				116	<	126	<	152	<	104	<	131	<	80.9	<	84.7	<	99.3	<
	ug/kg		Aroclor 1232				116	<	126	<	152	<	104	<	131	<	80.9	<	84.7	<	99.3	<
	ug/kg		Aroclor 1242				116	<	126	<	152	<	104	<	131	<	80.9	<	84.7	<	99.3	<
	ug/kg		Aroclor 1248				116	<	126	<	152	<	104	<	131	<	80.9	<	84.7	<	99.3	<
	ug/kg		Aroclor 1254				116	<	126	<	152	<	104	<	131	<	80.9	<	84.7	<	99.3	<
	ug/kg		Aroclor 1260			810***	116	<	126	<	152	<	104	<	131	<	80.9	<	84.7	<	99.3	<
Inorganics	mg/kg		Arsenic	9.8	33	9	3.647		5.616		6.302		3.637		4.98		1.281		0.748		2.195	
	mg/kg		Cadmium	0.99	5	1.6	0.469		0.936		0.834		0.234		0.578		0.055		0.046	J	0.232	
	mg/kg		Chromium	43	110	23000	17.1		25.5		31.7		16.7		28.9		6.12		5.79		16.6	
	mg/kg		Chromium, +6			11	1.61	<	1.85	<	2.02	<	1.25	<	1.98	<	1.2	<J	1.16	<	1.37	<
	mg/kg		Copper	32	150	2200	10.2		17.1		19.3		8.41		16.8		0.892		0.963		7.42	
	mg/kg		Lead	36	130	300	8.04		21.3		18.5		5.84		18.1		1.6		1.39		6.36	
	mg/kg		Manganese			2100	668		709		807		730		733		182		124		503	
	mg/kg		Mercury	0.18	1.1	3.1	0.063		0.241		0.186		0.048		0.217		0.007		0.003		0.063	
	mg/kg		Nickel	23	49	170	15.1		19.5		30.2		17.8		28.3		4.83		4.73		15.7	
	mg/kg		Zinc	120	460	4600	64.1		104		123		52.1		114		12.9		10.6		52.6	
	mg/kg		Cyanide, total				0.327	<	0.596		0.693		0.281	<	0.33	<	0.239	<	0.232	<	0.27	<
	mg/kg		Kjeldahl nitrogen				1270		1820		2230		1100		2080		104		41.4		1020	
	mg/kg		Nitrogen, ammonia				83.7		182		121		135		110		10.4		6.89		132	
	%		Moisture (Gravimetric)				41.9		47		55.4		35		49.9		17.8		22.3		31.7	
	mg/kg		Phenol IC			3500	4.54	<	4.6	<	6.2	J	3.99	<	5.46	<	3.16	<	3.21	<	3.86	<
	mg/kg		Phosphorus, total				581		738		813		653		702		162	J	162		537	
	%		Solids, total				58.1		53		44.6		65		50.1		82.2		77.7		68.3	
	%		Total Volatile Solids				4.13		6.95		6.85		4		5.81		0.1	<	0.1	<	3.18	
	mg/kg		Total Organic Carbon				20000		23000		19000		17000		19000		1000	<	1000	<	17000	
PARTICLE SIZE % FINER	SAND	coarse	4				100		98.6		86.2		99.4		80.3		98.5		100		98.6	
			10				99		85		61.8		92.4		54		97.6		100		84.8	
		medium	20				98.9		84.5		61.8		92.4		53.9		95.1		97.4		84.6	
			40				98.7		83.5		61.7		92.2		53.9		80.8		84.2		84.3	
		fine	60				98.5		82.6		61.6		91.8		53.9		42.9		31.3		84.1	
			140				97.9		80.1		61.2		88.2		53.6		6.6		2.6		75.9	
	SILT	clay	200				96.4		74.1		60.6		80.5		53.1		6.1		2.4		65.4	
Particle Size	%		Gravel				0		1.4		13.8		0.6		19.7		1.5		0		1.4	
	%		Sand				3.6		24.5		25.6		18.8		27.3		92.4		97.6		33.2	
	%		Silt				81		61		45.2		64.2		39.5		4.9		1.2		54.1	
	%		Clay				15.4		13.1		15.4		16.4		13.5		1.2		1.2		11.3	

J - Indicates an estimated value. This flag is used either when estimating a concentration or this flag indicates analyte(s) associated with a DOD-QSM specified non-compliance pertaining to matrix QC criteria.
< - Indicates compound was analyzed for but not detected. The sample quantitation limit has been corrected for weight, dilution and/or percent moisture.
Q- This flag indicates analyte(s) associated with a DOD-QSM specified non-compliance pertaining to calibration or control QC criteria.
B- This flag is used when the analyte is found in the blank as well as the sample. It indicates analyte(s) associated with a DOD-QSM specified non-compliance pertaining to matrix QC criteria.
* SRV is for Total Chlordane
** Benzo(a)pyrene Equivalents
*** Total PCBs

Table 10. CBSQGs for Environmental Samples Collected in Catherine Pass. Double click to open as a .PDF.



7 Conclusions

- Mud Waves: Based on the presence of soft, ooze-like fine-grained materials in several of the borings, as well as the tendency for high natural moisture contents throughout the stratigraphy, there is a high potential for lateral displacements of foundation materials during construction (“mud waves”). Phasing material placement over time would reduce the potential for mud waves by allowing time for consolidation to occur. The final Engineering Considerations should quantify these recommendations in a way that does not impact constructability and economic feasibility of the project. Ultimately, significant mud waves will hamper construction and require additional fill, so it is in the interest of the contractor to find ways to minimize their formation. For planning purposes, it is recommended to assume 1.5 ft of additional fill material in order to account for lateral displacement of soft surface soils.

- Consolidation: Based on laboratory testing, it is estimated that anywhere between 0.5 ft and 2 ft of consolidation settlement will occur at locations of maximum fill placement (to El. 670-672). The amount of consolidation depends mainly on the thickness of

compressible soils and the presence of soft, high plasticity clay material near the surface. Due to the variability of the above factors, a single value of consolidation settlement of 1.5 ft is recommended for use during planning. While there is significant uncertainty and variability associated with time rate of consolidation predictions, it is likely most foundation consolidation will occur within two years of completing fill placement. Some overbuild of features will be added in the plans and specifications phase to account for this longer-term settlement.

- Slopes: The foundation, as indicated by the borings and testing, has very low shear strengths and is likely unable to support steep slopes. Slopes constructed steeper than 4H:1V are likely to flatten as a result of lateral displacement or and/or consolidation. The habitat dredging areas should be offset from peninsula features to the extent possible in order to minimize shear stresses resulting from the combined fill placement and excavation. Note: Current plans indicate 3H:1V slopes, with the understanding that there will likely be some flattening that occurs during and after construction. Ultimately submerged slopes will be governed by the angle of repose.

- Substrate and Contaminants: Sediment quality is generally good in Pool 4, and Results of the 2013-2019 survey showed that the sediments in Pool 4 were fairly clean. Based on this testing information, there shouldn’t be any special handling or treatment for upland or within floodplain placement of the dredged material generated from the navigational channel in Lower Pool 4. Dredged material from Catherine Pass access cuts, however, does have some CBSQG and SQT exceedances that may affect benthic invertebrates if the material is disturbed during project construction, or left exposed to the water column post–project. Because the material in question will only be temporarily disturbed, the concern is not considered serious, but should be coordinated with stakeholders.

8 References

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9 Attachments

Attachment G-1: Soil Boring Logs

Attachment G-2: Soil Test Reports

Attachment G-3: Settlement Analysis

DRAFT

Boring Designation 17-3M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM	HORIZONTAL NAD83 / VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT	3" Chopper Bit
2. HOLE NUMBER: 8	LOCATION COORDINATES: N 4,935,821.0 E 544,069.0	11. MANUFACTURER'S DESIGNATION OF DRILL	Jerk Line
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Kevin Nelson		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER	669.6
		15. DATE BORING	STARTED: / COMPLETED: 8/22/17
6. THICKNESS OF OVERBURDEN	---	16. ELEVATION TOP OF BORING	671.1
7. DEPTH DRILLED INTO ROCK	---	17. TOTAL CORE RECOVERY FOR BORING	N/A
8. TOTAL DEPTH OF BORING	15.0	18. SIGNATURE AND TITLE OF INSPECTOR	Geologist

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
670.9	0.2					**0' TO 0.2'** BARGE DECK									SPT=140 lbs @ 30" drop, safety hammer with cathead used
						0.2' TO 1.5' AIR									
669.6 ▼	1.5					**1.5' TO 6.8'** WATER									
664.3	6.8				CL	**6.8' TO 15'** (CL) LEAN CLAY, SOFT TO VERY SOFT, SATURATED, SOME SHELLS AND ORGANICS, 9.3' OCCASIONAL SILTY LAMINATIONS, 11.9' ZONES OF WOODY DEBRIS, TANNISH GRAY	18	1								
							80	2							
							60	3							
							60	4							
656.1	15.0														

0.0 2.5 5.0 7.5 10.0 12.5 15.0

Pulled casing and allowed hole to collapse

DRAFT

Boring Designation 17-4M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM	HORIZONTAL: NAD83 / VERTICAL: NAVD88
		10. SIZE AND TYPE OF BIT	3" Chopper Bit
2. HOLE NUMBER: 7	LOCATION COORDINATES: N 4,935,641.0 E 542,502.0	11. MANUFACTURER'S DESIGNATION OF DRILL	Jerk Line
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Kevin Nelson		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER	669.6
		15. DATE BORING	STARTED: / COMPLETED: 8/22/17
6. THICKNESS OF OVERBURDEN	---	16. ELEVATION TOP OF BORING	671.1
7. DEPTH DRILLED INTO ROCK	---	17. TOTAL CORE RECOVERY FOR BORING	N/A
8. TOTAL DEPTH OF BORING	14.0	18. SIGNATURE AND TITLE OF INSPECTOR	Geologist

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
670.9	0.2					**0' TO 0.2'** BARGE DECK									SPT=140 lbs @ 30" drop, safety hammer with cathead used
669.6 ▼	1.5					**0.2' TO 1.5'** AIR									
665.1	6.0					**1.5' TO 6'** WATER									
662.8	8.3				CL	**6' TO 8.3'** (CL) LEAN CLAY, SOFT TO VERY SOFT, SATURATED, UPPER 0.5' IS OOZE LIKE, SOME SHELLS AND ORGANICS, BROWNISH BLACK	80	1							
660.1	11.0				ML/ CL	**8.3' TO 11'** (ML/CL) LEAN CLAY, MEDIUM STIFF, WET, OCCASIONAL SHELLS AND ORGANICS, GRAY	90	2							
658.9	12.2				SM	**11' TO 12.2'** (SM) SILTY SAND, LOOSE, WET, TANNISH GRAY	70	3							
657.1	14.0					**12.2' TO 14'** INTERBEDDED, INTERBEDDED SILTY SAND AND SILTY CLAY	85	4							

0.0 2.5 5.0 7.5 10.0 12.5

Pulled casing and allowed hole to collapse

DRAFT

Boring Designation 17-5M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 3	LOCATION COORDINATES: N 4,936,391.0 E 542,215.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Kevin Nelson		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 669.9	
		15. DATE BORING	STARTED / COMPLETED: 8/23/17
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 671.4	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 11.5		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
671.2	0.2					**0' TO 0.2'** BARGE DECK									SPT=140 lbs @ 30" drop, safety hammer with cathead used
669.9 ▼	1.5					**0.2' TO 1.5'** AIR									
						1.5' TO 3.4' WATER									
668.0	3.4														
					CL/ CH	**3.4' TO 5.8'** (CL/CH) LEAN CLAY, SOFT TO MEDIUM STIFF, SATURATED, 3.4' TO 3.9' ABUNDANT ORGANICS, GRAY	76	1							
665.6	5.8														
					SC	**5.8' TO 9.7'** (SC) CLAYEY SAND, LOOSE, SATURATED, LAMINATED, 8.4' INCREASE IN LAMINATION THICKNESS, 8.9' INCREASE IN SAND CONTENT, GRAY	90	2							
							90	3							
661.7	9.7														
					CL	**9.7' TO 11.5'** (CL) LEAN CLAY, MEDIUM STIFF, SATURATED TO WET, LAMINATED, GRAY	80	4							
659.9	11.5														

0.0 2.5 5.0 7.5 10.0

Pulled casing and allowed hole to collapse

DRAFT

Boring Designation 17-6M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 6	LOCATION COORDINATES: N 4,936,891.0 E 541,787.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Kevin Nelson		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 669.9	
		15. DATE BORING	STARTED / COMPLETED: 8/23/17
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 671.4	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 14.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
671.2	0.2					**0' TO 0.2'** BARGE DECK									SPT=140 lbs @ 30" drop, safety hammer with cathead used
669.9 ▼	1.5					**0.2' TO 1.5'** AIR									
						1.5' TO 7.7' WATER									
663.7	7.7				CL	**7.7' TO 10.2'** (CL) LEAN CLAY, SOFT, SATURATED, TOP 0.5' IS OOZE LIKE, BLACKISH BROWN	70	1							
661.2	10.2				SP-SM	**10.2' TO 14'** (SP-SM) POORLY GRADED SAND WITH SILT, SAND FINE TO MEDIUM, LOOSE, SATURATED, BROWNISH TAN	25	2							
							0								
657.4	14.0														

0.0 2.5 5.0 7.5 10.0 12.5

Pulled casing and allowed hole to collapse

DRAFT

Boring Designation 17-12M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 3 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 13	LOCATION COORDINATES: N 4,935,629.0 E 543,386.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Kevin Nelson		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 670.6	
		15. DATE BORING	STARTED / COMPLETED: 10/31/17
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 672.1	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 40.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
671.9	0.2					**0' TO 0.2'** BARGE DECK									SPT=140 lbs @ 30" drop, safety hammer with cathead used
						0.2' TO 1.5' AIR									
670.6 ▼	1.5					**1.5' TO 6'** WATER									
666.1	6.0	0 0 0 0	0		CL	**6' TO 10.4'** (CL) LEAN CLAY, VERY SOFT, WET, OOZE LIKE, SOME ORGANICS, SOME WOOD DEBRIS, TANNISH GRAY. **(LACUSTRINE)**	0								
		0 0 0 0	0				35								
661.7	10.4				SM	**10.4' TO 15.3'** (SM) SILTY SAND, SAND FINE TO MEDIUM, LOOSE, SATURATED, OCC. LAMINATIONS, GRAY. **(ALLUVIUM)**	43								
		1 0 3 2	3				60	1	0	84				34	
656.8	15.3				ML	**15.3' TO 20.2'** (ML) SILT WITH SAND, SAND FINE TO MEDIUM, LOOSE TO VERY LOOSE, WET TO SATURATED, LAMINATED, SOME ORGANICS/WOOD, GRAY. **(ALLUVIUM)**	80								
		0 0 0 2	0				100	2	0	20		38	11	54	

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

Boring Designation 17-12M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 2 OF 3 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 13	LOCATION COORDINATES: N 4,935,629.0 E 543,386.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Kevin Nelson		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 670.6	
		15. DATE BORING	STARTED / COMPLETED: 10/31/17
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 672.1	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 40.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
651.9	20.2				MH	**20.2' TO 24'** (MH) ORGANIC CLAY, SAND FINE, SOFT TO MEDIUM STIFF, WET, LAMINATED, TRACE WOODY DEBRIS, GRAY. **(LACUSTRINE)**	90								
648.1	24.0	0 0 2 2	2		CL	**24' TO 33.8'** (CL) SANDY LEAN CLAY, SAND FINE, SOFT TO MEDIUM STIFF, WET, LAMINATED, TRACE WOODY DEBRIS, GRAY. **(LACUSTRINE)**	90	3				52	23	45	
							93								
		0 0 2 2	2				95								
							53								
638.3	33.8	2 2 2 2	4		CH	**33.8' TO 40'** (CH) FAT CLAY, SAND FINE, MEDIUM STIFF, WET, LAMINATED, GRAY. **(LACUSTRINE)**	80	4				77	45	52	
							43								
632.1	40.0	2 2 2 2	4				75								

20.0 22.5 25.0 27.5 30.0 32.5 35.0 37.5 40.0

Boring Designation 17-12M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 3 OF 3 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 13	LOCATION COORDINATES: N 4,935,629.0 E 543,386.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Kevin Nelson		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 670.6	
		15. DATE BORING	STARTED / COMPLETED: 10/31/17
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 672.1	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 40.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
						Pulled casing and allowed hole to collapse									

DRAFT

Boring Designation 17-13M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM	HORIZONTAL NAD83 / VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT	3" Chopper Bit
2. HOLE NUMBER: 11	LOCATION COORDINATES: N 4,934,942.0 E 544,394.0	11. MANUFACTURER'S DESIGNATION OF DRILL	Jerk Line
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Kevin Nelson		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER	670.6
		15. DATE BORING	STARTED: / COMPLETED: 11/1/17
6. THICKNESS OF OVERBURDEN	---	16. ELEVATION TOP OF BORING	672.1
7. DEPTH DRILLED INTO ROCK	---	17. TOTAL CORE RECOVERY FOR BORING	N/A
8. TOTAL DEPTH OF BORING	35.0	18. SIGNATURE AND TITLE OF INSPECTOR	Geologist

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
671.9	0.2					**0' TO 0.2'** BARGE DECK									SPT=140 lbs @ 30" drop, safety hammer with cathead used
						0.2' TO 1.5' AIR									
670.6 ▼	1.5					**1.5' TO 4'** WATER									
668.1	4.0				SM	**4' TO 8'** (SM) SILTY SAND, SAND FINE, LOOSE, SATURATED, OCC. ORGANICS, BROWN TO GRAY. **(ALLUVIUM)**	27	1							
664.1	8.0	0 0 0 1	0		CL	**8' TO 12.3'** (CL) LEAN CLAY, SAND FINE, SOFT, WET, SCATTERED ORGANICS, DARK BROWN TO GRAY. **(LACUSTRINE)**	100	2							
659.8	12.3						87								
		0 2 4 3	6		SP-SM	**12.3' TO 15.6'** (SP-SM) POORLY GRADED SAND WITH SILT, SAND FINE TO MEDIUM, LOOSE, SATURATED, INTERBEDDED, TANNISH GRAY. **(ALLUVIUM)**	90								
656.5	15.6				CL	**15.6' TO 35'** (CL) LEAN CLAY, SAND FINE, MEDIUM DENSE TO SOFT, WET, POORLY DEFINED LAMINATIONS, TRACE ORGANICS, GRAY. **(LACUSTRINE)**	67								
		2 2 2 2	4				80	3							

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

Boring Designation 17-13M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 2 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 11	LOCATION COORDINATES: N 4,934,942.0 E 544,394.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Kevin Nelson		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 670.6	
		15. DATE BORING	STARTED / COMPLETED: 11/1/17
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 672.1	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 35.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
						15.6' TO 35' (CL) LEAN CLAY, SAND FINE, MEDIUM DENSE TO SOFT, WET, POORLY DEFINED LAMINATIONS, TRACE ORGANICS, GRAY. **(LACUSTRINE)** *(continued)*	80								
		3 2 3 2	5				100								
							90								
		3 2 3 2	5				100	4							
							40								
637.1	35.0	2 1 2 2	3				80								

20.0 22.5 25.0 27.5 30.0 32.5 35.0

Pulled casing and allowed hole to collapse

Lost SPT shoe down hole, abandoned hole

DRAFT

Boring Designation 17-14M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 14	LOCATION COORDINATES: N 4,934,852.0 E 542,943.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Kevin Nelson		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 670.6	
		15. DATE BORING	STARTED / COMPLETED: 11/1/17
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 672.1	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 35.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
671.9	0.2					**0' TO 0.2'** BARGE DECK									SPT=140 lbs @ 30" drop, safety hammer with cathead used
						0.2' TO 1.5' AIR									
670.6 ▼	1.5					**1.5' TO 4.3'** WATER									
667.8	4.3				CL	**4.3' TO 13.3'** (CL) LEAN CLAY, SAND FINE, SOFT, WET, OCC. SILT LAMINATIONS, BECOMING LAMINATED 10.3', TANNISH GRAY. **(LACUSTRINE)**	14								
		0 2 2 2	4				45	1				49	23	44	
							73								
658.8	13.3	2 2 1 2	3		ML	**13.3' TO 16.5'** (ML) SANDY SILT, SAND FINE, LOOSE, SATURATED, GRAY. **(ALLUVIUM)**	75	2	0	14		33	7	34	
655.6	16.5						60								
		2 1 2 1	3		CL	**16.5' TO 25.7'** (CL) LEAN CLAY, SAND FINE, SOFT TO MEDIUM STIFF, WET, LAMINATED, POORLY DEFINED LAMINATIONS BELOW 20.2', GRAY TO DARK GRAY. **(LACUSTRINE)**	75	3				48	23	51	

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

Boring Designation 17-14M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 2 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 14	LOCATION COORDINATES: N 4,934,852.0 E 542,943.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Kevin Nelson		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 670.6	
		15. DATE BORING	STARTED / COMPLETED: 11/1/17
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 672.1	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 35.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
						16.5' TO 25.7' (CL) LEAN CLAY, SAND FINE, SOFT TO MEDIUM STIFF, WET, LAMINATED, POORLY DEFINED LAMINATIONS BELOW 20.2', GRAY TO DARK GRAY. **(LACUSTRINE)** *(continued)*	63								
		2 2 2 2	4				70								
646.4	25.7														
					CH	**25.7' TO 35'** (CH) FAT CLAY, SAND FINE, SOFT TO MEDIUM DENSE, WET, DARK GRAY. **(LACUSTRINE)**	83								
		2 1 2 2	3				70	4				64	34	49	
							77								
		2 2 2 2	4				85								
637.1	35.0														

Pulled casing and allowed hole to collapse

DRAFT

Boring Designation 19-15M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 21	LOCATION COORDINATES: N 4,935,090.0 E 543,179.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 673.9	
		15. DATE BORING	STARTED / COMPLETED: 6/17/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 675.4	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 25.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
675.2	0.2					**0' TO 0.2'** BARGE DECK									All samples taken with rope driven cathead Boring obtained from a floating plant
673.9 ▼	1.5					**0.2' TO 1.5'** AIR									
						1.5' TO 7' WATER									
668.4	7.0														
666.4	9.0	0 0 1 2	1		SP-SM	**7' TO 9'** (SP-SM) POORLY GRADED SAND WITH SILT, SAND FINE TO MEDIUM, LOOSE, SATURATED, LAMINATED, TRACE ORGANICS, ABUNDANT WOOD FRAGMENTS IN DRILL-OUT FROM 9.0' TO 10.0', GRAY	30	1								Set 4" casing to 10.0' and cleaned hole with 3" chopper bit and water
															Drill Out
					SP	**10' TO 22.1'** (SP) POORLY GRADED SAND, SAND FINE TO MEDIUM, LOOSE, SATURATED, LAMINATED, WITH ORGANICS, OCCASIONAL SHELLS, OCCASIONAL PLANT FRAGMENTS, WOODY ZONE FROM 16.7' TO 17.0', GRAY	47	2								Set 4" casing to 11.0' and cleaned hole to 13.0' with 3" chopper bit and drilling mud
		1 2 2 1	4				60								
							67	3							Set 4" casing to 15.0' and cleaned hole to 18.0' with 3" chopper bit and drilling mud. Reset casing to 11.5'
		2 2 2 2	4				40								Clean hole to 20.0' with 3" chopper bit. Reset casing to 12.0'

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

Boring Designation 19-15M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 2 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM	HORIZONTAL NAD83 / VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT	3" Chopper Bit
2. HOLE NUMBER: 21	LOCATION COORDINATES: N 4,935,090.0 E 543,179.0	11. MANUFACTURER'S DESIGNATION OF DRILL	Jerk Line
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER	673.9
		15. DATE BORING	STARTED: / COMPLETED: 6/17/19
6. THICKNESS OF OVERBURDEN	---	16. ELEVATION TOP OF BORING	675.4
7. DEPTH DRILLED INTO ROCK	---	17. TOTAL CORE RECOVERY FOR BORING	N/A
8. TOTAL DEPTH OF BORING	25.0	18. SIGNATURE AND TITLE OF INSPECTOR	Geologist

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS	
653.3	22.1						80	4							Clean hole to 25.0' with 3" chopper bit	20.0
					CL	**22.1' TO 23.9'** (CL) SANDY LEAN CLAY, SAND FINE TO MEDIUM, WET, OCCASIONAL ORGANICS, GRAY											22.5
651.5	23.9	1 2	3				85	5								
650.4	25.0	1 1			CL	**23.9' TO 25'** (CL) SILTY CLAY, SOFT, WET, TRACE FINE SAND, GRAY										25.0
															BOH	

Pulled casing and allowed hole to collapse

DRAFT

Boring Designation 19-16M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 20	LOCATION COORDINATES: N 4,935,388.0 E 544,058.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 673.8	
		15. DATE BORING	STARTED / COMPLETED: 6/18/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 675.3	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 35.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
675.1	0.2					**0' TO 0.2'** BARGE DECK									All samples taken with rope driven cathead Boring obtained from a floating plant
673.8 ▼	1.5					**0.2' TO 1.5'** AIR									
						1.5' TO 5.2' WATER									
670.1	5.2														
669.2	6.1				SP	**5.2' TO 6.1'** (SP) POORLY GRADED SAND, SAND MEDIUM, LOOSE, SATURATED, BROWN TO GRAY									Set 4" casing to 8.0' and clean hole to 8.0' with 3" chopper bit and bentonite mud
		1 1 1 0	2			**6.1' TO 10.4'** SOFT TO LOOSE, SATURATED, SANDY CLAY INTERBEDDED WITH SAND, LOW TO NO PLASTICITY, GRAY. SANDY LEAN CLAY INTERBEDDED WITH POORLY GRADED SAND	43 40	1				16	NP	29	Set casing to 10.0' and clean hole to 10.0' with 3" chopper bit
664.9	10.4														Clean hole to 13.0' with 3" chopper bit
					CL	**10.4' TO 13.5'** (CL) SANDY LEAN CLAY, SAND MEDIUM, SOFT, WET, LAMINATED, OCCASIONAL SHELLS, SILTY, GRAY	80	2			47	25	1	34	
661.8	13.5	1 2 1 2	3		SM	**13.5' TO 16.8'** (SM) SILTY SAND, SOFT, WET, LAMINATED, TRACE FINE SAND, GRAY	65	3				27	NP	36	Clean hole to 15.0' and clean hole with 3" chopper bit and water
658.5	16.8						100								Clean hole to 20.0' with 3" chopper bit
					CL	**16.8' TO 28'** (CL) SILTY CLAY, SOFT, WET, TRACE FINE SAND, OCCASIONAL ORGANICS, SLIGHTLY SPONGY, GRAY									
		1 0 1 1	1				75	4				43	16	47	

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

Boring Designation 19-16M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 2 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 20	LOCATION COORDINATES: N 4,935,388.0 E 544,058.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 673.8	
		15. DATE BORING	STARTED / COMPLETED: 6/18/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 675.3	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 35.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
						16.8' TO 28' (CL) SILTY CLAY, SOFT, WET, TRACE FINE SAND, OCCASIONAL ORGANICS, SLIGHTLY SPONGY, GRAY *(continued)*	100								Clean hole to 25.0' with 3" chopper bit
		1 1 1 2	2				60	5							
							100								Clean hole to 30.0' with 3" chopper bit
647.3	28.0														
645.3	30.0	1 1 2 1	3		CL	**28' TO 30'** (CL) SILTY CLAY, SPONGY, WET, LAMINATED, OCCASIONAL ORGANICS, GRAY	85	6				45	18	48	
					CL/ CH	**30' TO 35'** (CL/CH) SILTY CLAY, SOFT TO SPONGY, WET, LAMINATED, OCCASIONAL ORGANICS, GRAY	100								Clean hole to 35.0' with 3" chopper bit
		1 2 2 1	4				100	7							
640.3	35.0														BOH

Pulled casing and allowed hole to collapse

DRAFT

Boring Designation 19-17M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 18	LOCATION COORDINATES: N 4,935,719.0 E 543,028.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 673.6	
		15. DATE BORING	STARTED / COMPLETED: 6/18/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 675.1	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 27.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
674.9	0.2					**0' TO 0.2'** BARGE DECK									All samples taken with rope driven cathead Boring obtained from a floating plant
						0.2' TO 1.5' AIR									
673.6 ▼	1.5					**1.5' TO 7.2'** WATER									
667.9	7.2														
		1 0 0 0	0		ML	**7.2' TO 9.2'** (ML) CLAYEY SILT, VERY SOFT, SATURATED, OOZE LIKE, WITH ORGANICS, "OOZE-LIKE", GRAY	50	1				42	15	82	
665.9	9.2														Drill Out Set 4" casing to 10.0' and clean hole to 10.0' with 3" chopper bit
664.2	10.9					**10' TO 10.9'** ROTTED LOG									
					Wd										
					ML	**10.9' TO 20.6'** (ML) CLAYEY SILT, SOFT TO SPONGY, WET, LAMINATED, WITH FINE SAND, WITH ORGANICS, SHELLS BELOW 18.5', GRAY	100								
		1 1 0 1	1				75	2			49			42	
							80								Clean hole to 20.0' with 3" chopper bit after resetting casing to 12.5'
		0 1 1 3	2				55	3						30	

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

Boring Designation 19-17M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 2 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83 / VERTICAL NAVD88	
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 18	LOCATION COORDINATES: N 4,935,719.0 E 543,028.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 673.6	
		15. DATE BORING	STARTED / COMPLETED: 6/18/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 675.1	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 27.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
654.5	20.6														Clean hole to 23.0' with 3" chopper bit. Mix 80 gallon water with 5 lbs. bentonite. reset casing to 14.0'
					SP	**20.6' TO 27'** (SP) POORLY GRADED SAND, LOOSE, SATURATED, OCCASIONAL SHELL FRAGMENTS, TRACE SILT, GRAY	70								
		3 3 3 4	6				100	4							Clean hole to 25.0' with chopper bit
		2 2 2 2	4				100	5							
648.1	27.0														BOH

20.0

22.5

25.0

Pulled casing and allowed hole to collapse

DRAFT

Boring Designation 19-18M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM	HORIZONTAL NAD83 / VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT	3" Chopper Bit
2. HOLE NUMBER: 19	LOCATION COORDINATES: N 4,935,302.0 E 542,922.0	11. MANUFACTURER'S DESIGNATION OF DRILL	Jerk Line
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER	673.6
		15. DATE BORING	STARTED: / COMPLETED: 6/18/19
6. THICKNESS OF OVERBURDEN	---	16. ELEVATION TOP OF BORING	675.1
7. DEPTH DRILLED INTO ROCK	---	17. TOTAL CORE RECOVERY FOR BORING	N/A
8. TOTAL DEPTH OF BORING	30.0	18. SIGNATURE AND TITLE OF INSPECTOR	Geologist

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
674.9	0.2					**0' TO 0.2'** BARGE DECK									All samples taken with rope driven cathead Boring obtained from a floating plant
673.6 ▼	1.5					**0.2' TO 1.5'** AIR									
						1.5' TO 7.9' WATER									
667.2	7.9														
665.1	10.0	1 0 0 1	0		ML	**7.9' TO 10'** (ML) CLAYEY SILT, VERY SOFT, WET, WITH ORGANICS, OCCASIONAL PLANT FRAGMENTS, GRAY	90	1				42	16	50	
					ML	**10' TO 20'** (ML) CLAYEY SILT, SOFT TO LOOSE, SATURATED, LAMINATED, WITH ORGANICS, TRACE FINE SAND, OCCASIONAL PLANT FRAGMENTS, GRAY	93	2							Set 4" casing to 10.0' and clean hole to 10.0' with 3" chopper bit and water
		1 0 1 1	1				85				70	36	9	47	Reset casing to 12.5'. Mix 80 gallons of water with 5 lbs of bentonite. Clean hole to 13.0' with 3" chopper bit
							100								Clean hole to 20.0' with 3" chopper bit
655.1	20.0	1 0 1 0	1				100	3				36	7	50	

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

Boring Designation 19-18M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 2 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 19	LOCATION COORDINATES: N 4,935,302.0 E 542,922.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 673.6	
		15. DATE BORING	STARTED / COMPLETED: 6/18/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 675.1	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 30.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
					CL	**20' TO 30'** (CL) SILTY CLAY, SPONGY, WET, LAMINATED, WITH ORGANICS, GRAY	90								Clean hole to 25.0' with 3" chopper bit
		1 1 1 1	2				60	4				40	15	51	
							87								
		1 1 1 1	2				70	5				49	21	52	
645.1	30.0														BOH

20.0
22.5
25.0
27.5
30.0

Pulled casing and allowed hole to collapse

Boring Designation 19-19M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 17	LOCATION COORDINATES: N 4,935,602.0 E 542,444.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 673.2	
		15. DATE BORING	STARTED / COMPLETED: 6/19/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 674.7	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 30.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
674.5	0.2					**0' TO 0.2'** BARGE DECK									All samples taken with rope driven cathead Boring obtained from a floating plant
						0.2' TO 1.5' AIR									
673.2 ▼	1.5					**1.5' TO 8.5'** WATER									
666.2	8.5	0 0 0	0		CH	**8.5' TO 10.9'** (CH) SILTY CLAY, VERY SOFT, SATURATED, OOZE LIKE, ORGANIC SILTY CLAY, BLACK TO DARK GRAY	100	1				69	36	111	Set 4" casing to 10.0'. Clean hole to 10.0' with 3" chopper bit and water
663.8	10.9				ML	**10.9' TO 20'** (ML) CLAYEY SILT, VERY SOFT TO SPONGY, WET, LAMINATED, ORGANIC, DILATES EASILY, TRACE FINE SAND BELOW ~14.0', DARK GRAY	87	2				35	7	45	Reset casing to 13.5'. clean hole to 15.0' with 3" chopper bit
		1 1 0 0	1				65								
							100	3			76	33	8	44	Clean hole to 20.0' with 3" chopper bit
654.7	20.0	1 0 0 1	0				55								

Boring Designation 19-19M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 2 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 17	LOCATION COORDINATES: N 4,935,602.0 E 542,444.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 673.2	
		15. DATE BORING	STARTED / COMPLETED: 6/19/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 674.7	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 30.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
					CL	**20' TO 30'** (CL) SILTY CLAY, SOFT TO SPONGY, WET, LAMINATED, OCCASIONAL ORGANICS, TEARS WHEN SHEARED, GRAY	70								Clean hole to 25.0' with 3" chopper bit
		1 0 0 1	0				80	4				43	16	52	
							100								
		1 0 1 0	1				100	5				49	23	53	
644.7	30.0														BOH

20.0 22.5 25.0 27.5 30.0

Pulled casing and allowed hole to collapse

DRAFT

Boring Designation 19-20M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM	HORIZONTAL: NAD83 / VERTICAL: NAVD88
		10. SIZE AND TYPE OF BIT	3" Chopper Bit
2. HOLE NUMBER: 16	LOCATION COORDINATES: N 4,935,910.0 E 542,688.0	11. MANUFACTURER'S DESIGNATION OF DRILL	Jerk Line
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER	673.0
		15. DATE BORING	STARTED: / COMPLETED: 6/20/16
6. THICKNESS OF OVERBURDEN	---	16. ELEVATION TOP OF BORING	674.5
7. DEPTH DRILLED INTO ROCK	---	17. TOTAL CORE RECOVERY FOR BORING	N/A
8. TOTAL DEPTH OF BORING	32.0	18. SIGNATURE AND TITLE OF INSPECTOR	Geologist

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
674.3	0.2					**0' TO 0.2'** BARGE DECK									All samples taken with rope driven cathead Boring obtained from a floating plant
						0.2' TO 1.5' AIR									
673.0 ▼	1.5					**1.5' TO 7.4'** WATER									
667.1	7.4														
666.6	7.9	0 0 1 1	1		OL	**7.4' TO 7.9'** (OL) ORGANIC SILT, SATURATED, OOZE LIKE, ROTTED PLANTS	70	1				23	2	44	Set 4" casing to 10.0'. Clean hole to 10.0' with 3" chopper bit and water
665.1	9.4				CL	**7.9' TO 9.4'** (CL) SANDY LEAN CLAY, SOFT, SATURATED, WITH ORGANICS, GRAY									
					ML	**10' TO 12.1'** (ML) CLAYEY SILT, SOFT, WET TO SATURATED, LAMINATED, TRACE FINE SAND, ORGANIC RICH, GRAY TO BROWN	70	2				24	4	35	Reset casing to 12.5'. Clean hole to 13.0' with 3" chopper bit
662.4	12.1														
		1 0 1 0	1		ML	**12.1' TO 20'** (ML) CLAYEY SILT, SOFT, WET, LAMINATED, WITH ORGANICS, GRAY	100	3			97	39	11	44	
							100								Clean hole to 20.0' with 3" chopper bit
654.5	20.0	1 0 1 1	1				100	4				35	9	41	

Boring Designation 19-20M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 2 OF 2 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 16	LOCATION COORDINATES: N 4,935,910.0 E 542,688.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 673.0	
		15. DATE BORING	STARTED / COMPLETED: 6/20/16
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 674.5	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 32.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
					CL	**20' TO 26.9'** (CL) SILTY CLAY, SOFT TO SPONGY, WET, LAMINATED, TRACE FINE SAND, OCCASIONAL SHELL FRAGMENTS, GRAY	100								
		1 0 1 1	1				85	5				45	19	54	
647.6	26.9						93	6							Clean hole to 28.0' with 3" chopper bit
					SP	**26.9' TO 29.4'** (SP) POORLY GRADED SAND WITH GRAVEL, GRAVEL FINE SAND MEDIUM, MEDIUM DENSE, SATURATED, TRACE CLAY, CLAY AND SHELLS AT CONTACT, DARK GRAY									
645.1	29.4	8 9 7 7	16				80								Clean hole to 30.0' with 3" chopper bit
					SP	**29.4' TO 32'** (SP) POORLY GRADED SAND, SAND FINE TO MEDIUM, LOOSE, SATURATED, TRACE FINE GRAVEL, GRAY									
642.5	32.0	5 3 4 4	7				75	7							

Pulled casing and allowed hole to collapse

BOH

20.0 22.5 25.0 27.5 30.0

DRAFT

Boring Designation 19-21M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 3 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 15	LOCATION COORDINATES: N 4,936,424.0 E 541,895.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 673.0	
		15. DATE BORING	STARTED / COMPLETED: 6/20/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 674.5	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 40.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
674.3	0.2					**0' TO 0.2'** BARGE DECK									All samples taken with rope driven cathead Boring obtained from a floating plant
673.0 ▼	1.5					**0.2' TO 1.5'** AIR									
						1.5' TO 5.3' WATER									
669.2	5.3				CL	**5.3' TO 8.2'** (CL) SILTY CLAY, VERY SOFT, SATURATED, OOZE LIKE, WITH ORGANICS, TRACE FINE SAND, LAMINATED, DARK GRAY	72	1				47	22	64	Set 4" casing to 8.0'. Clean hole to 8.0' with 3" chopper bit and water
666.3	8.2	1 3 2 1	5		SP	**8.2' TO 10.2'** (SP) POORLY GRADED SAND, SAND FINE TO MEDIUM, LOOSE, SATURATED, TRACE SILT, GRAY	55	2							Set 4" casing to 10.0'. Clean hole to 10.0' with 3" chopper bit and water
664.3	10.2														
663.4	11.1				SC	**10.2' TO 11.1'** (SC) CLAYEY SAND, LOOSE, SATURATED, LAMINATED, WITH ORGANICS, OCCASIONAL WOOD, GRAY	40	3							Reset 4" casing to 10.0' and clean hole to 10.0' with 3" chopper bit Reset 4" casing to 10.5' and clean hole to 13.0' with 3" chopper bit
					ML	**11.1' TO 15.3'** (ML) CLAYEY SILT, LOOSE TO SOFT, SATURATED, LAMINATED, WITH ORGANICS, TRACE FINE SAND, DILATES EASILY, GRAY									
		1 1 0 2	1				65	4			66	28	6	42	Clean hole to 15.0' with 3" chopper bit
659.2	15.3														
					CL	**15.3' TO 21'** (CL) SILTY CLAY, VERY SOFT, WET, LAMINATED, OCCASIONAL ORGANICS, GRAY	70								Clean hole to 20.0' with 3" chopper bit
		1 0 1 0	1				100	5				45	18	58	

0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

Boring Designation 19-21M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 2 OF 3 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 15	LOCATION COORDINATES: N 4,936,424.0 E 541,895.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 673.0	
		15. DATE BORING	STARTED / COMPLETED: 6/20/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 674.5	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 40.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
653.5	21.0														Clean hole to 25.0' with 3" chopper bit
					CL/CH	**21' TO 25.3'** (CL/CH) SILTY CLAY, SOFT, WET, LAMINATED, TRACE FINE SAND, OCCASIONAL SHELL FRAGMENTS, GRAY	100				90	31	4	34	
		1 1 1 1	2				100	6							
649.2	25.3														Reset casing to 11.5' and clean hole to 30.0' with 3" chopper bit and bentonite drilling mud
					CH	**25.3' TO 40'** (CH) SILTY CLAY, SOFT, WET, LAMINATED, OCCASIONAL SHELL FRAGMENTS, GRAY	100								
		1 2 1 2	3				65	7				61	31	60	
							77								Clean hole to 33.0' with 3" chopper bit
		1 0 1 1	1				90	8				64	36	69	Clean hole to 35.0' with 3" chopper bit
							100								
		1 1 1 1	2				100	9				68	38	75	
634.5	40.0														

Boring Designation 19-21M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 3 OF 3 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 15	LOCATION COORDINATES: N 4,936,424.0 E 541,895.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 673.0	
		15. DATE BORING	STARTED / COMPLETED: 6/20/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 674.5	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 40.0		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/ 0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
						Pulled casing and allowed hole to collapse									BOH

DRAFT

Boring Designation 19-22M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 23	LOCATION COORDINATES: N 4,935,964.0 E 543,356.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 671.7	
		15. DATE BORING	STARTED / COMPLETED: 6/24/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 673.2	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 12.8		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
673.0	0.2					**0' TO 0.2'** BARGE DECK									Alconox wash with river rinse Boring obtained from a floating plant
						0.2' TO 1.5' AIR									
671.7 ▼	1.5					**1.5' TO 9.8'** WATER									
663.4	9.8				CL	**9.8' TO 12.8'** (CL) LEAN CLAY, VERY SOFT TO SOFT, SATURATED, WITH SHELL FRAGMENTS, TRACE FINE TO MEDIUM SAND, TRACE ORGANICS, DARK GRAY	19-22M-1								set casing to 10.8' and clean hole with 3" chopper bit to 10.8'
							19-22M-2								
660.4	12.8														BOH

Pulled casing and allowed hole to collapse

0.0 2.5 5.0 7.5 10.0 12.5

DRAFT

Boring Designation 19-23M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 22	LOCATION COORDINATES: N 4,936,028.0 E 542,504.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 671.7	
		15. DATE BORING	STARTED / COMPLETED: 6/24/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 673.2	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 14.6		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
673.0	0.2					**0' TO 0.2'** BARGE DECK									Alconox wash with river rinse
671.7 ▼	1.5					**0.2' TO 1.5'** AIR									Boring obtained from a floating plant
						1.5' TO 8.2' WATER									
665.0	8.2				CL	**8.2' TO 11.2'** (CL) LEAN CLAY, SOFT, SATURATED, TRACE FINE TO MEDIUM SAND, TRACE ORGANICS, DARK GRAY		19-23M-1							
662.0	11.2				CL	**11.2' TO 14.6'** (CL) SANDY LEAN CLAY, SAND FINE TO MEDIUM, SOFT, SATURATED, WITH SAND LAMINATIONS, TRACE SILT, GRAY		19-23M-2							set casing to 11.2' and clean hole with 3" chopper bit to 11.2'
658.6	14.6														BOH

0.0 2.5 5.0 7.5 10.0 12.5

Pulled casing and allowed hole to collapse

DRAFT

Boring Designation 19-24M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 24	LOCATION COORDINATES: N 4,935,758.0 E 542,303.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 671.7	
		15. DATE BORING	STARTED / COMPLETED: 6/24/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 673.2	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 14.8		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
673.0	0.2					**0' TO 0.2'** BARGE DECK									Alconox wash with river rinse Boring obtained from a floating plant
671.7 ▼	1.5					**0.2' TO 1.5'** AIR									
						1.5' TO 9' WATER									
664.2	9.0				CL	**9' TO 11.5'** (CL) LEAN CLAY, VERY SOFT, SATURATED, TRACE FINE TO MEDIUM SAND, TRACE ORGANICS, DARK GRAY		19-24M-1							
661.7	11.5				CL	**11.5' TO 14.8'** (CL) SANDY LEAN CLAY, SOFT, SATURATED, WITH SAND LAMINATIONS, DARK GRAY		19-24M-2							Set casing to 11.5' and clean hole with 3" chopper bit to 11.5'
658.4	14.8														BOH

Pulled casing and allowed hole to collapse

0.0
2.5
5.0
7.5
10.0
12.5

DRAFT

Boring Designation 19-25M

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: Pool 4 - Section 204		9. COORDINATE SYSTEM: HORIZONTAL NAD83	VERTICAL NAVD88
		10. SIZE AND TYPE OF BIT: 3" Chopper Bit	
2. HOLE NUMBER: 21	LOCATION COORDINATES: N 4,935,081.0 E 543,194.0	11. MANUFACTURER'S DESIGNATION OF DRILL: Jerk Line	
3. DRILLING AGENCY: US-CE-C		12. TOTAL SAMPLES	DISTURBED: --- / UNDISTURBED: ---
4. NAME OF DRILLER: Colin Riddick		13. TOTAL NUMBER CORE BOXES	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: --- / BEARING	14. ELEVATION GROUND WATER: 671.6	
		15. DATE BORING	STARTED / COMPLETED: 6/25/19
6. THICKNESS OF OVERBURDEN: ---		16. ELEVATION TOP OF BORING: 673.1	
7. DEPTH DRILLED INTO ROCK: ---		17. TOTAL CORE RECOVERY FOR BORING: N/A	
8. TOTAL DEPTH OF BORING: 12.5		18. SIGNATURE AND TITLE OF INSPECTOR: Geologist	

ELEV	DEPTH	Blows/0.5 ft	N_f	N_{60}	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	Laboratory: Gravel	Sand	Fines	LL	PI	MC	REMARKS
672.9	0.2					**0' TO 0.2'** BARGE DECK									Alconox wash with river rinse Boring obtained from a floating plant
						0.2' TO 1.5' AIR									
671.6 ▼	1.5					**1.5' TO 7.1'** WATER									
666.0	7.1				SP	**7.1' TO 12.5'** (SP) POORLY GRADED SAND, LOOSE TO FIRM, SATURATED, LAMINATED, TRACE SILT STRATA OR LENSES, TRACE SHELL FRAGMENTS, BROWNISH GRAY		19-25M-1							
								19-25M-2							Set casing to 9.5' and clean hole with 3" chopper bit to 9.5'
660.6	12.5														BOH

0.0 2.5 5.0 7.5 10.0 12.5

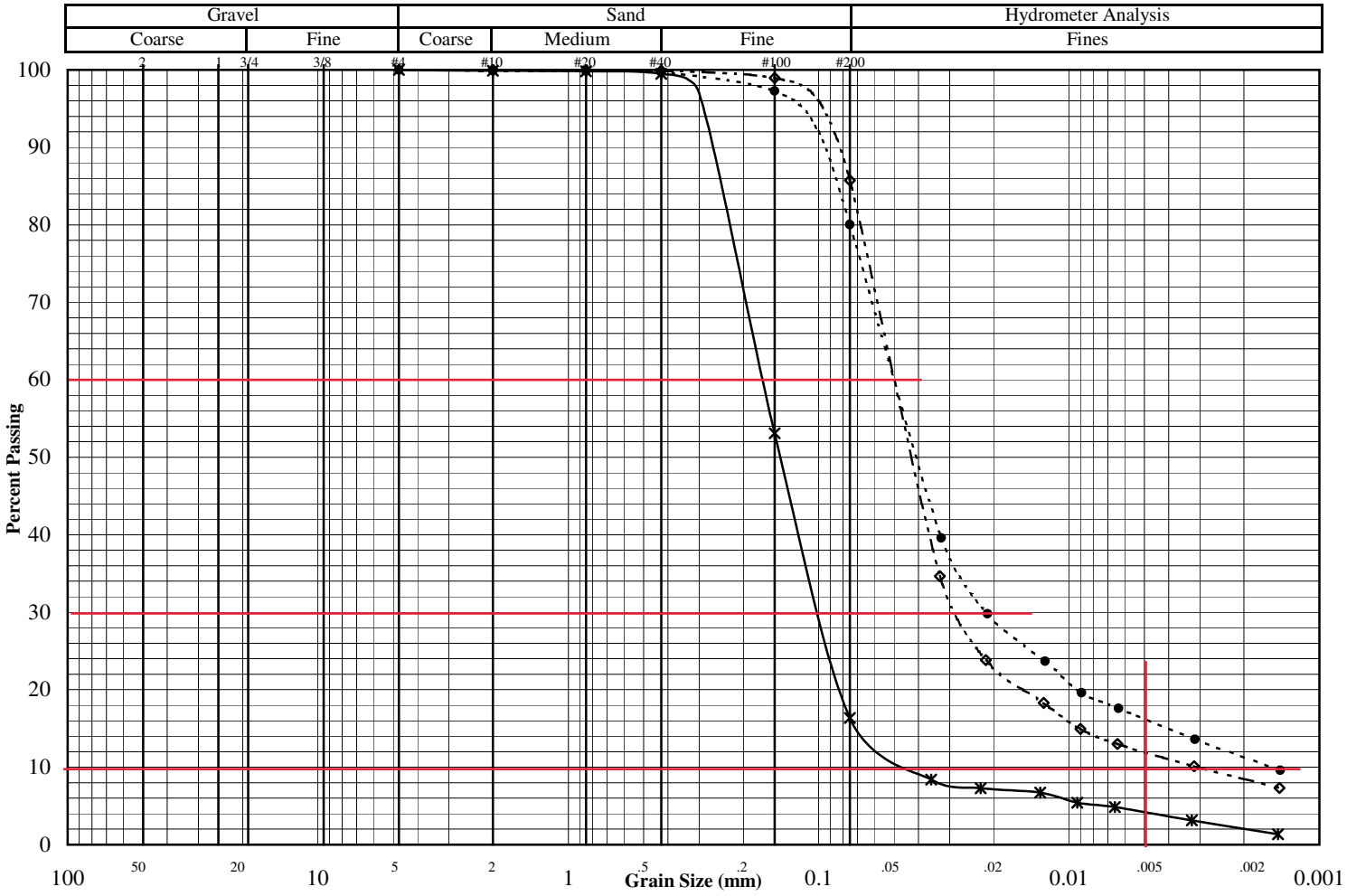
Pulled casing and allowed hole to collapse

Grain Size Distribution ASTM D7928/D6913

Job No. : **11353**

Project:	Upper Pool 4 CAP 204	Test Date:	3/27/18
Reported To:	USACE-Geotech & Geology Branch	Report Date:	3/30/18

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	17-12M	1	13-13.5	Jar	Silty Sand, slightly organic (SM)
●	17-12M	2	18-18.5	Jar	Silt w/sand, slightly organic (ML)
◇	17-14M	2	14-14.5	Jar	Silt, slightly organic (ML)



Other Tests

	*	●	◇
Liquid Limit		38	33
Plastic Limit		27	26
Plasticity Index		11	7
Water Content	34.3	53.6	34.1
Dry Density (pcf)			
Specific Gravity	2.65*	2.61*	2.65*
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			

(* = assumed)

Percent Passing

	*	●	◇
Mass (g)	238.7	161.0	129.8
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0	100.0	
#10	99.9	99.9	100.0
#20	99.8	99.8	100.0
#40	99.5	99.7	99.9
#100	53.1	97.3	99.0
#200	16.4	80.0	85.7

	*	●	◇
D_{60}			
D_{30}			
D_{10}			
C_U			
C_C			

Remarks:

9530 James Ave South

SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Grain Size Distribution ASTM D7928/D6913

Job No. : **11353**

Project:	Upper Pool 4 CAP 204	Test Date:	3/27/18
Reported To:	USACE-Geotech & Geology Branch	Report Date:	3/30/18

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	17-12M	1	13-13.5	Jar	Silty Sand, slightly organic (SM)
Spec 2	17-12M	2	18-18.5	Jar	Silt w/sand, slightly organic (ML)
Spec 3	17-14M	2	14-14.5	Jar	Silt, slightly organic (ML)

Sieve Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"		2"	
1.5"		1.5"		1.5"	
1"		1"		1"	
3/4"		3/4"		3/4"	
3/8"		3/8"		3/8"	
#4	100.0	#4	100.0	#4	
#10	99.9	#10	99.9	#10	100.0
#20	99.8	#20	99.8	#20	100.0
#40	99.5	#40	99.7	#40	99.9
#100	53.1	#100	97.3	#100	99.0
#200	16.4	#200	80.0	#200	85.7

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.036	8.4	0.032	39.6	0.033	34.6
0.023	7.3	0.021	29.8	0.021	23.8
0.013	6.7	0.012	23.7	0.013	18.3
0.009	5.4	0.009	19.6	0.009	15.0
0.007	4.9	0.006	17.6	0.006	13.0
0.003	3.1	0.003	13.6	0.003	10.1
0.001	1.3	0.001	9.6	0.001	7.3

Remarks

Specimen 1	Specimen 2	Specimen 3

9530 James Ave South

SOIL ENGINEERING TESTING, INC.

Bloomington, MN 55431

Laboratory Test Summary

Project: Upper Pool 4 CAP 204 Job: 11353

Client: USACE-Geotech & Geology Branch Date: 4/2/2018

Sample Information & Classification

Boring #	17-12M	17-12M	17-12M	17-12M	17-14M	17-14M	17-14M	17-14M
Sample #	1	2	3	4	1	2	3	4
Depth (ft)	13-13.5	18-18.5	23-23.5	34-34.5	8-8.5	14-14.5	18-18.5	28-28.5
Type or BPF	Jar	Jar	Jar	Jar	Jar	Jar	Jar	Jar
Material Classification	Silty Sand, slightly organic (SM)	Silt w/sand, slightly organic (ML)	Organic Silt (OH/MH)	Fat Clay, slightly organic (CH)	Organic Clay (OL)	Silt, slightly organic (ML)	Lean Clay w/sand, slightly organic (CL)	Fat Clay (CH/OH)

Moisture Contents (ASTM:D2216) & Atterberg Limits (ASTM:D4318)

Moisture Content (%)	34.3	53.6	44.6	51.7	43.8	34.1	51.1	48.9
Liquid Limit		38	52	77	49	33	48	64
Plastic Limit		27	29	32	26	26	25	30
Plasticity Index		11	23	45	23	7	23	34

Sample Information & Classification

Boring #								
Sample #								
Depth (ft)								
Type or BPF								
Material Classification								

Moisture Contents (ASTM:D2216) & Atterberg Limits (ASTM:D4318)

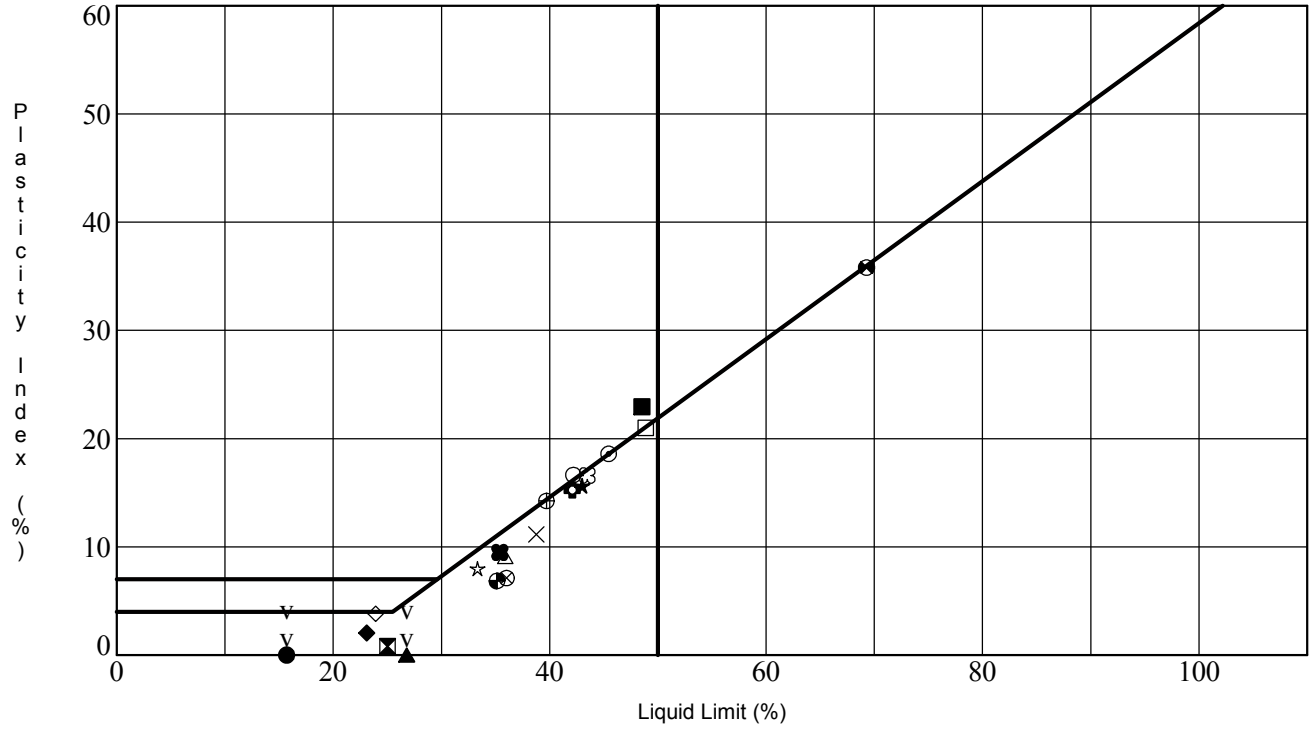
Moisture Content (%)								
Liquid Limit								
Plastic Limit								
Plasticity Index								

Borehole	Depth feet	Liquid Limit	Plastic Limit	Plasticity Index	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Organic Content (%)	Specific Gravity	Electrical Resistivity (ohm-cm)
19-16M	8	16	23	NP			29.2				
19-16M	11	25	24	1	47.2	SM	33.9			2.663	
19-16M	13.5	27	28	NP			36.4				
19-16M	18	43	27	16			46.9				
19-16M	28	45	27	18			47.7				
19-17M	7.5	42	27	15			82.2				
19-17M	8						30.2				
19-17M	13				48.7		41.8				
19-18M	9	42	26	16			50.3				
19-18M	12	36	27	9	69.5	ML	46.8				
19-18M	18	36	29	7			49.8				
19-18M	23	40	25	15			51.4				
19-18M	28	49	28	21			52.3				
19-19M	8.5	69	33	36			111.3				
19-19M	12	35	28	7			45.1				
19-19M	17	33	25	8	76.2	ML	44.0				
19-19M	23	43	27	16			52.4				
19-19M	28	49	26	23			52.9				
19-20M	8	23	21	2			43.9				
19-20M	11	24	20	4			35.3				
19-20M	13	39	28	11	96.8	ML	43.8			2.64	
19-20M	18	35	26	9			41.5				
19-20M	23	45	26	19			53.6				
19-21M	6	47	25	22			64.5				
19-21M	13	28	22	6	65.7	CL-ML	41.9				
19-21M	18	45	27	18			58.2				
19-21M	21	31	27	4	90.0	ML	34.1			2.688	
19-21M	28	61	30	31			60.1				
19-21M	33	64	28	36			69.1				
19-21M	38	68	30	38			75.5				

Braun Project B1913000
Upper Pool CAP 204

LABORATORY RESULTS SUMMARY

BRAUN INTERTEC

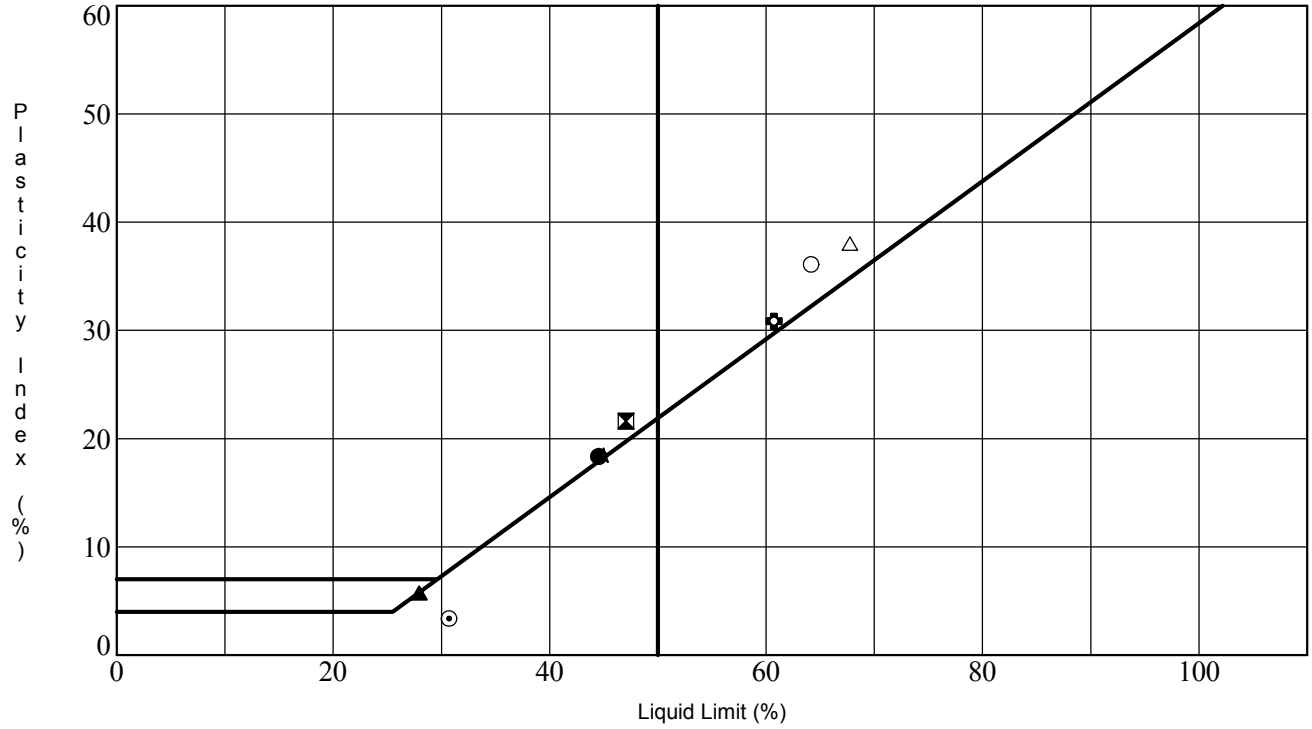


Specimen Identification			LL	PL	PI	Fines	Classification
●	19-16M	8.0'	16	23	NP		
⊠	19-16M	11.0'	25	24	1	47	SILTY SAND(SM)
▲	19-16M	13.5'	27	28	NP		
★	19-16M	18.0'	43	27	16		
⊙	19-16M	28.0'	45	27	18		
✿	19-17M	7.5'	42	27	15		
○	19-18M	9.0'	42	26	16		
△	19-18M	12.0'	36	27	9	70	SANDY SILT(ML)
⊗	19-18M	18.0'	36	29	7		
⊕	19-18M	23.0'	40	25	15		
□	19-18M	28.0'	49	28	21		
⊛	19-19M	8.5'	69	33	36		
◕	19-19M	12.0'	35	28	7		
☆	19-19M	17.0'	33	25	8	76	SILT with SAND(ML)
⊠	19-19M	23.0'	43	27	16		
■	19-19M	28.0'	49	26	23		
◆	19-20M	8.0'	23	21	2		
◇	19-20M	11.0'	24	20	4		
×	19-20M	13.0'	39	28	11	97	SILT(ML)
✖	19-20M	18.0'	35	26	9		

Braun Project B1913000
Upper Pool CAP 204

ATTERBERG LIMITS RESULTS

BRAUN INTERTEC



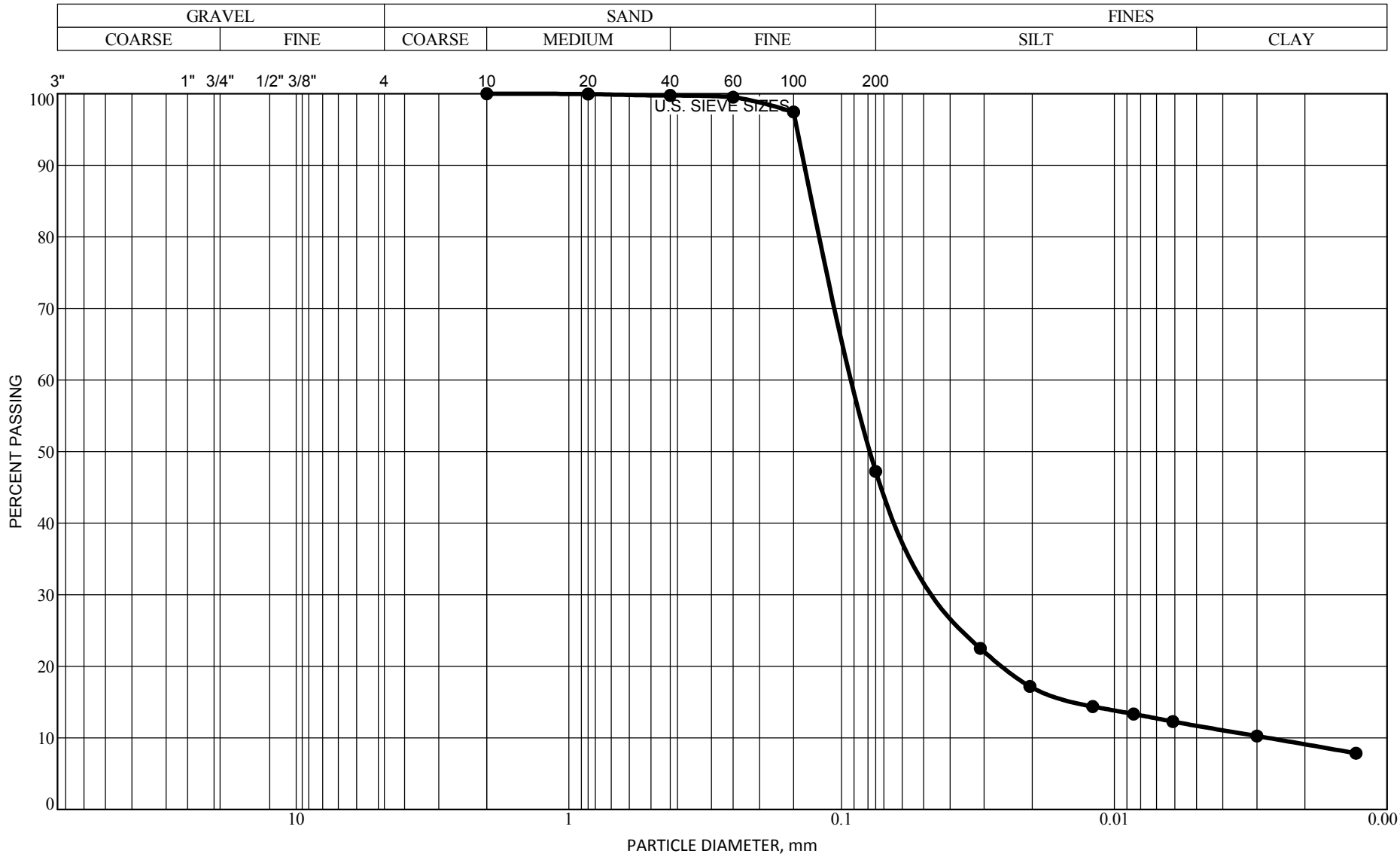
	Specimen Identification		LL	PL	PI	Fines	Classification
●	19-20M	23.0'	45	26	19		
⊠	19-21M	6.0'	47	25	22		
▲	19-21M	13.0'	28	22	6	66	SANDY SILTY CLAY(CL-ML)
★	19-21M	18.0'	45	27	18		
⊙	19-21M	21.0'	31	27	4	90	SILT(ML)
✿	19-21M	28.0'	61	30	31		
○	19-21M	33.0'	64	28	36		
△	19-21M	38.0'	68	30	38		

Braun Project B1913000
Upper Pool CAP 204

ATTERBERG LIMITS RESULTS

BRAUN INTERTEC

GRAIN SIZE ACCUMULATION CURVE (ASTM)



BRAUN INTERTEC

Braun Project B1913000
Upper Pool CAP 204

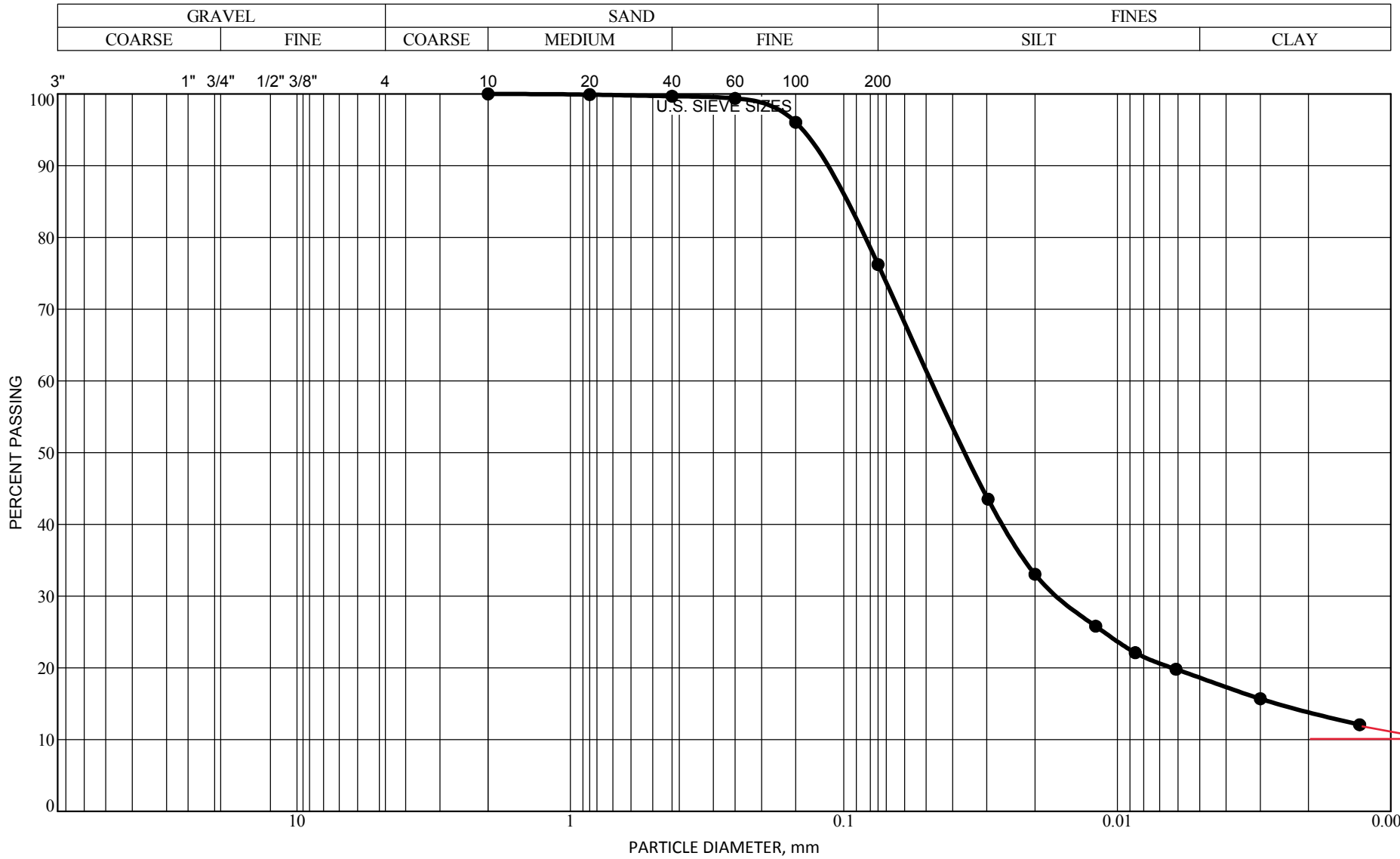
BORING: 19-16M DEPTH: 11.0'

GRAVEL	0.0%	
SAND	52.8%	
SILT	35.5%	
CLAY	11.7%	
D60=0.089		Cu=32.6
D30=0.041		Cc=6.7
D10=0.003		

CLASSIFICATION:
SILTY SAND(SM)

GS ASTM F:\BADX\SOILS\GINT\2019\B1913000.GPJ BRAUN_V8_CURRENT.GDT 12/9/19 11:43

GRAIN SIZE ACCUMULATION CURVE (ASTM)



BRAUN INTERTEC

Braun Project B1913000
Upper Pool CAP 204

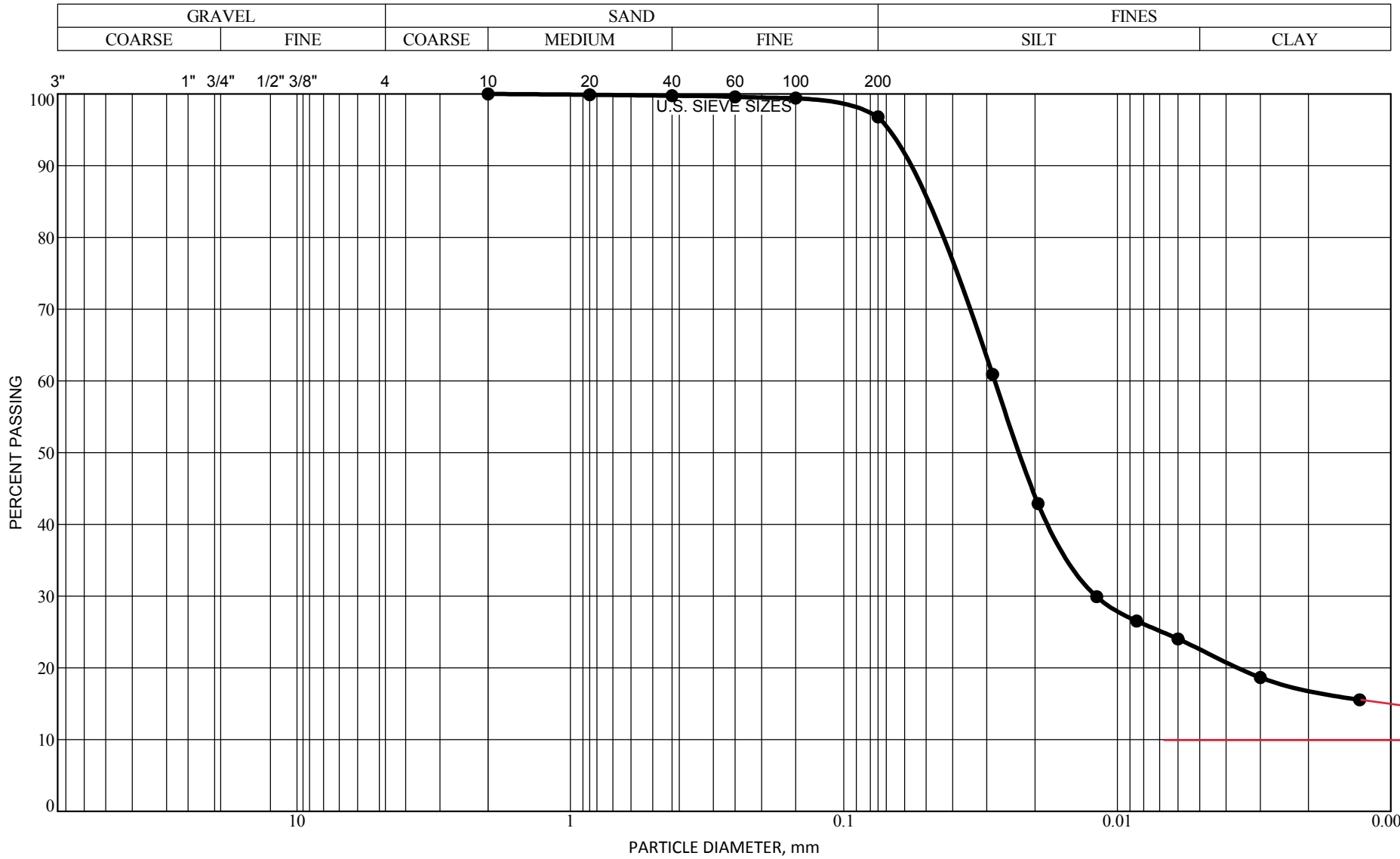
BORING: 19-19M DEPTH: 17.0'

GRAVEL	0.0%
SAND	23.8%
SILT	57.6%
CLAY	18.7%
D60=0.047	Cu=
D30=0.016	Cc=
D10=	

CLASSIFICATION:
SILT with SAND(ML)

GS ASTM F:\BADX\SOILS\GINT\2019\B1913000.GPJ BRAUN_V8_CURRENT.GDT 12/9/19 11:43

GRAIN SIZE ACCUMULATION CURVE (ASTM)



BRAUN INTERTEC

Braun Project B1913000
Upper Pool CAP 204

BORING: 19-20M DEPTH: 13.0'

GRAVEL	0.0%
SAND	3.2%
SILT	74.2%
CLAY	22.6%
D60=0.028	Cu=
D30=0.012	Cc=
D10=	

CLASSIFICATION:
SILT(ML)

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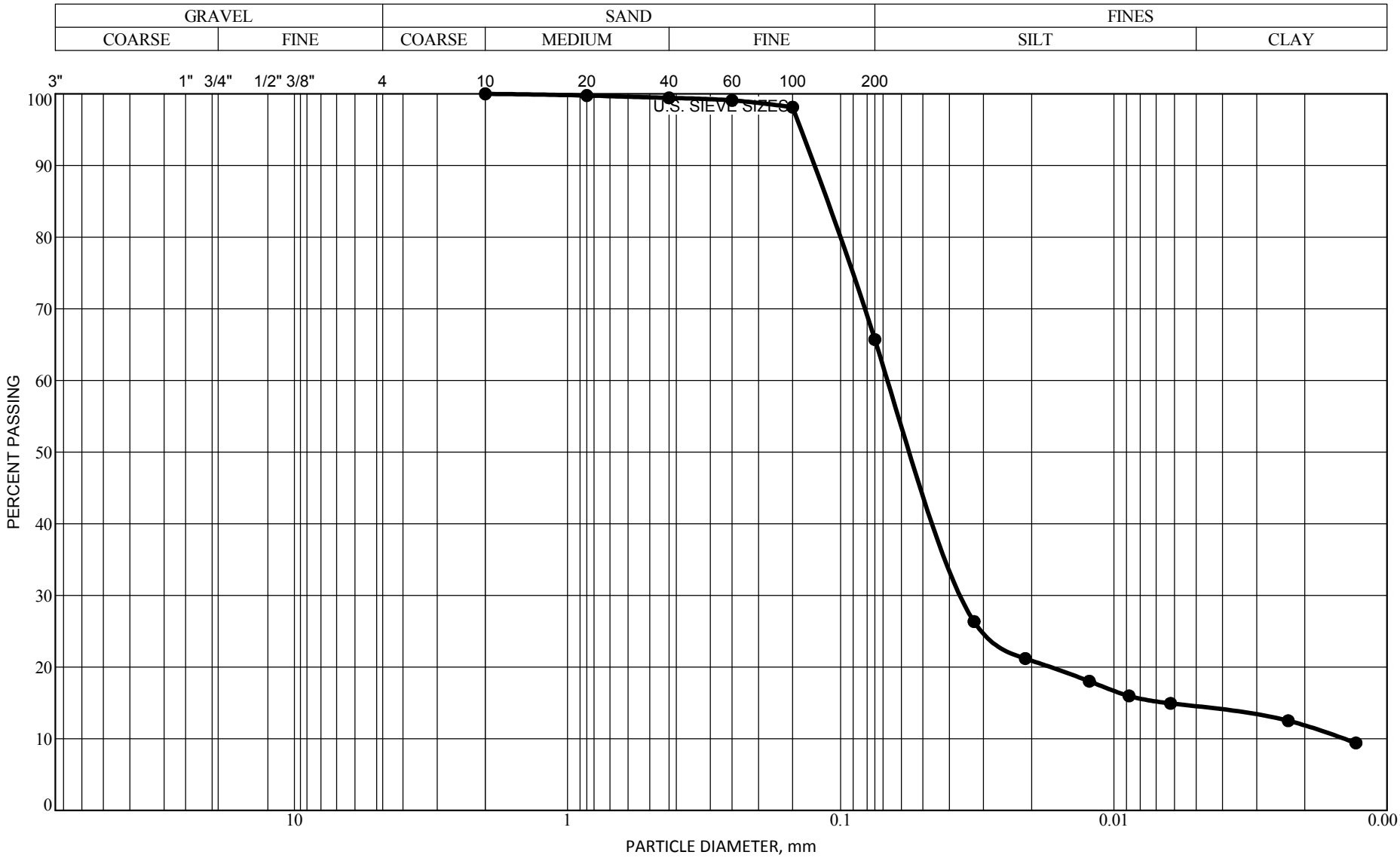
GRAIN SIZE ACCUMULATION CURVE (ASTM)



BRAUN INTERTEC

Braun Project B1913000
Upper Pool CAP 204

BORING: 19-21M DEPTH: 13.0'

GRAVEL	0.0%
SAND	34.3%
SILT	51.3%
CLAY	14.4%
D60=0.066	Cu=45.9
D30=0.035	Cc=12.8
D10=0.001	

CLASSIFICATION:
SANDY SILTY CLAY(CL-ML)

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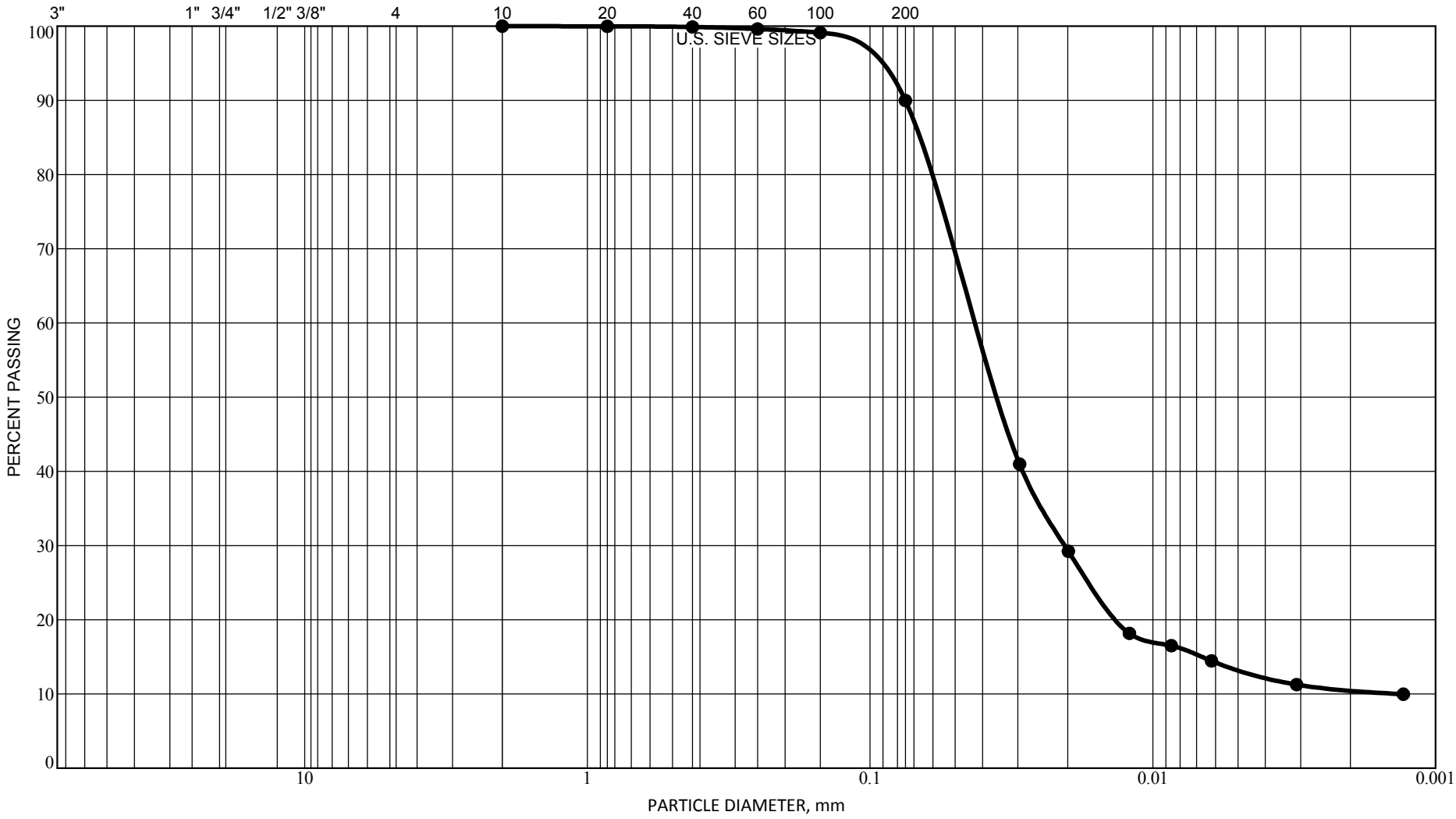
GRAIN SIZE ACCUMULATION CURVE (ASTM)

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



BRAUN INTERTEC

Braun Project B1913000

Upper Pool CAP 204

BORING: 19-21M DEPTH: 21.0'

GRAVEL	0.0%
SAND	10.0%
SILT	76.5%
CLAY	13.5%
D60=0.042	Cu=32.0
D30=0.020	Cc=7.4
D10=0.001	

CLASSIFICATION:
SILT(ML)

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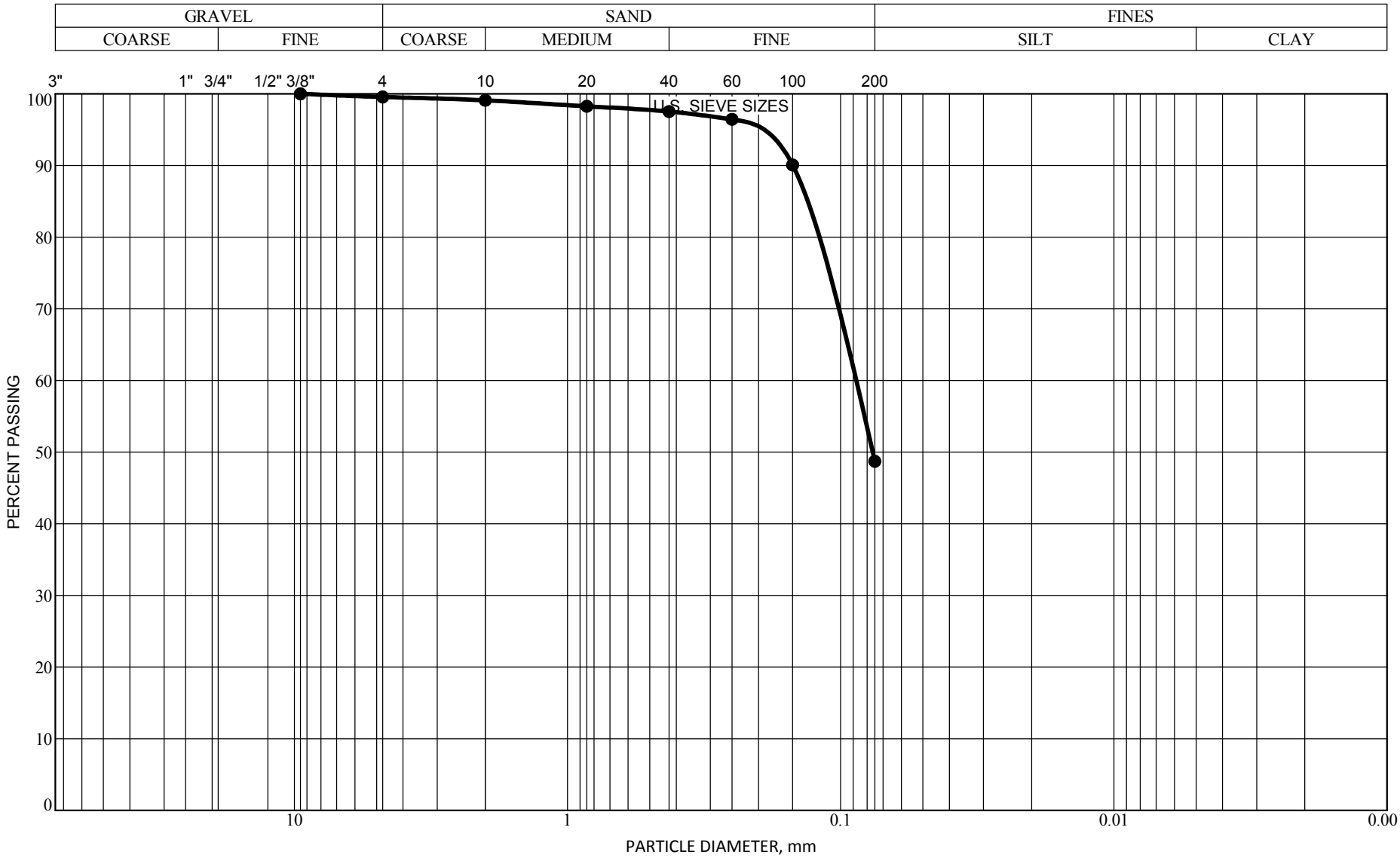
GRAIN SIZE ACCUMULATION CURVE (ASTM)



BRAUN INTERTEC

Braun Project B1913000
Upper Pool CAP 204

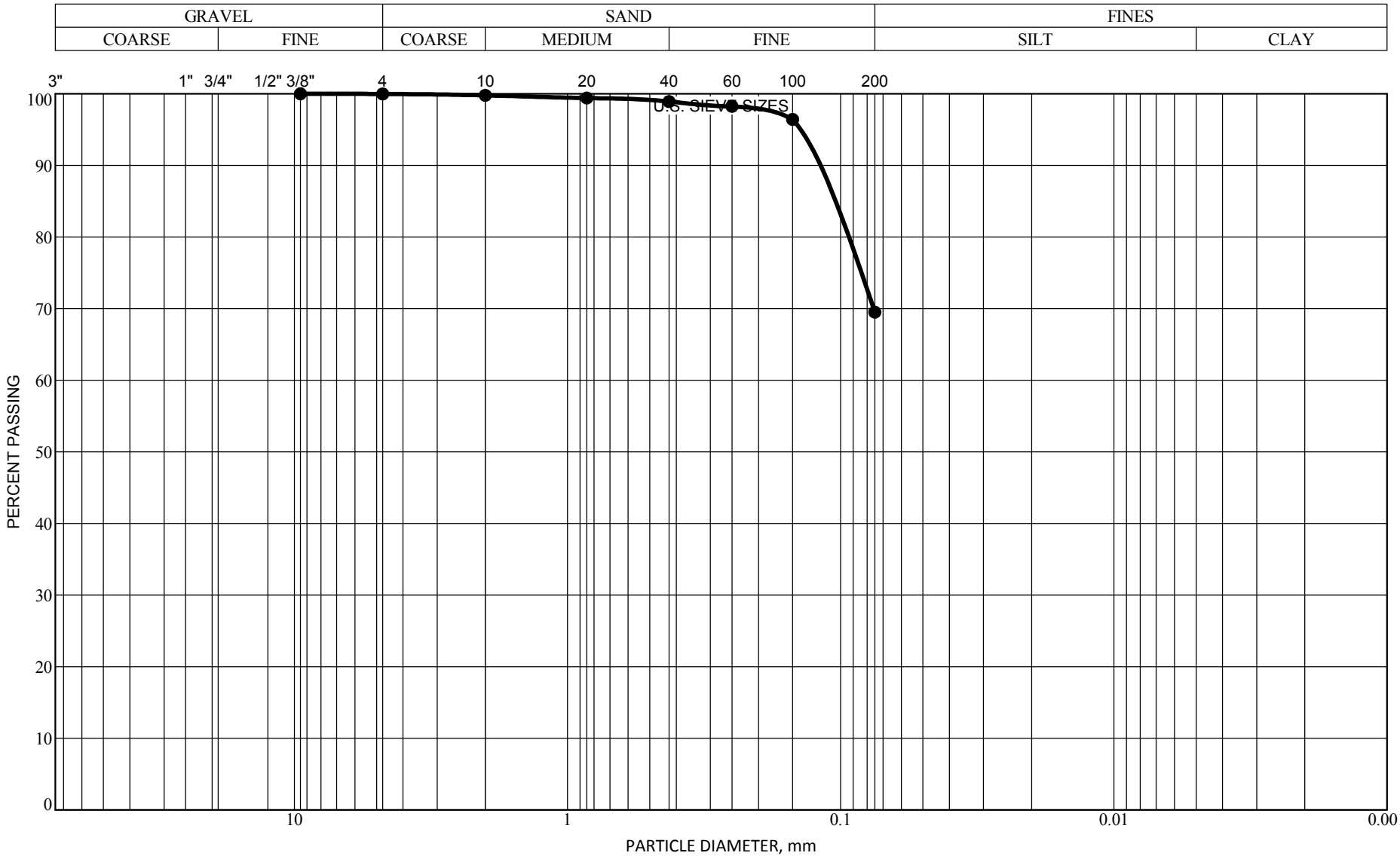
BORING: 19-17M DEPTH: 13.0'

GRAVEL	0.4%
SAND	50.8%
FINES	48.7%
D60=0.091	Cu=
D30=	Cc=
D10=	

CLASSIFICATION:
SILTY SAND(SM)

GS ASTM F:\BADX\SOILS\GINT\2019\B1913000.GPJ BRAUN_V8_CURRENT.GDT 12/9/19 11:44

GRAIN SIZE ACCUMULATION CURVE (ASTM)



BRAUN INTERTEC

Braun Project B1913000
Upper Pool CAP 204

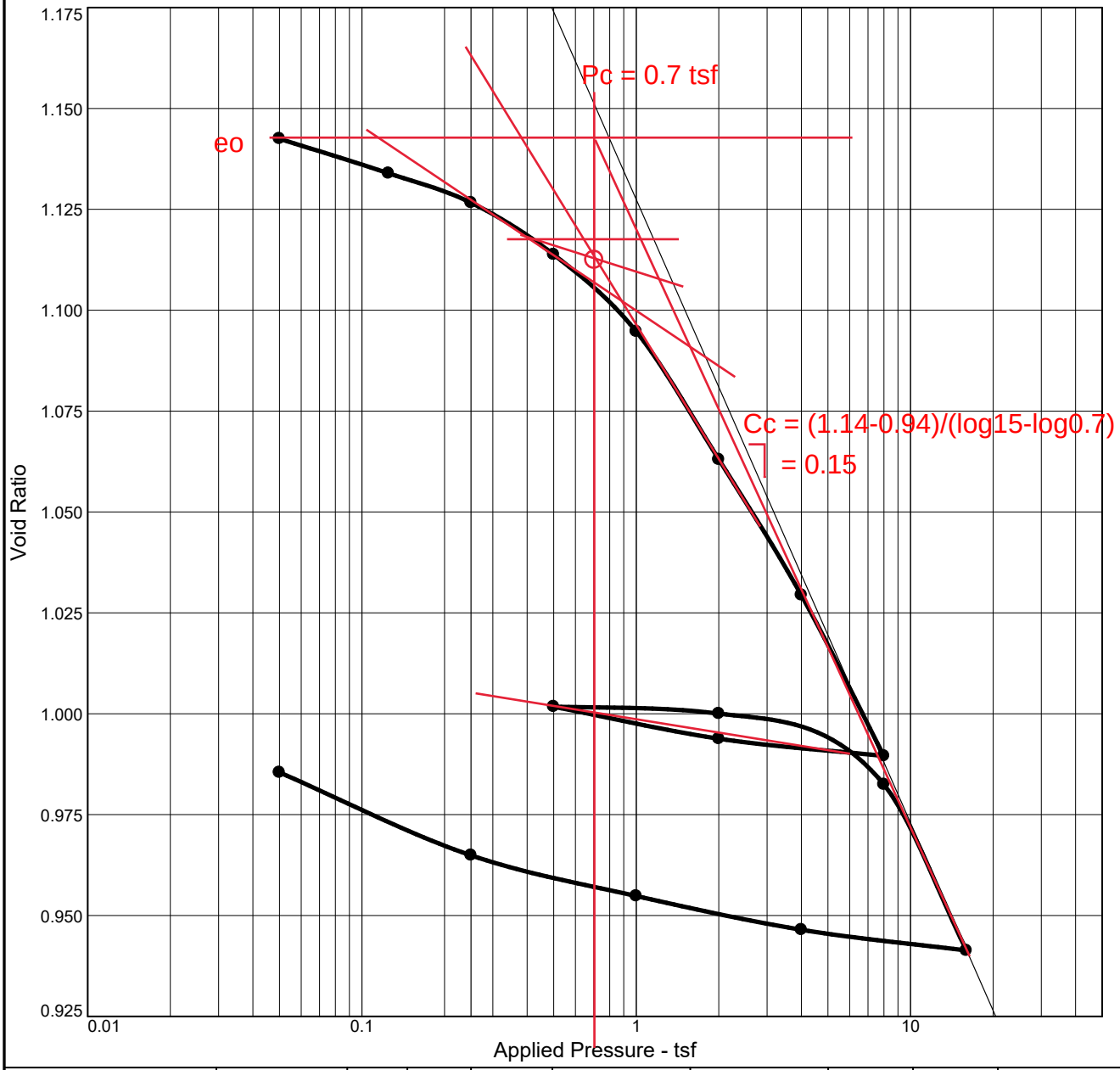
BORING: 19-18M DEPTH: 12.0'

GRAVEL	0.0%
SAND	30.5%
FINES	69.5%
D60=	Cu=
D30=	Cc=
D10=	

CLASSIFICATION:
SANDY SILT(ML)

GS ASTM F:\BADX\SOILS\GINT\2019\B1913000.GPJ BRAUN_V8_CURRENT.GDT 12/9/19 11:44

CONSOLIDATION TEST



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.0 %	40.0 %	83.3	25	1	2.86		~~1.2~~	~~0.15~~	~~0.03~~	1.143

MATERIAL DESCRIPTION	USCS	AASHTO
SILTY SAND, brown (SM)		

Project No. B1913000 **Client:** USACE

Project: Upper Pool CAP 204
W912ES19P0092

Source of Sample: 19-16MU **Depth:** 11-13'

Remarks:
ASTM D 2435

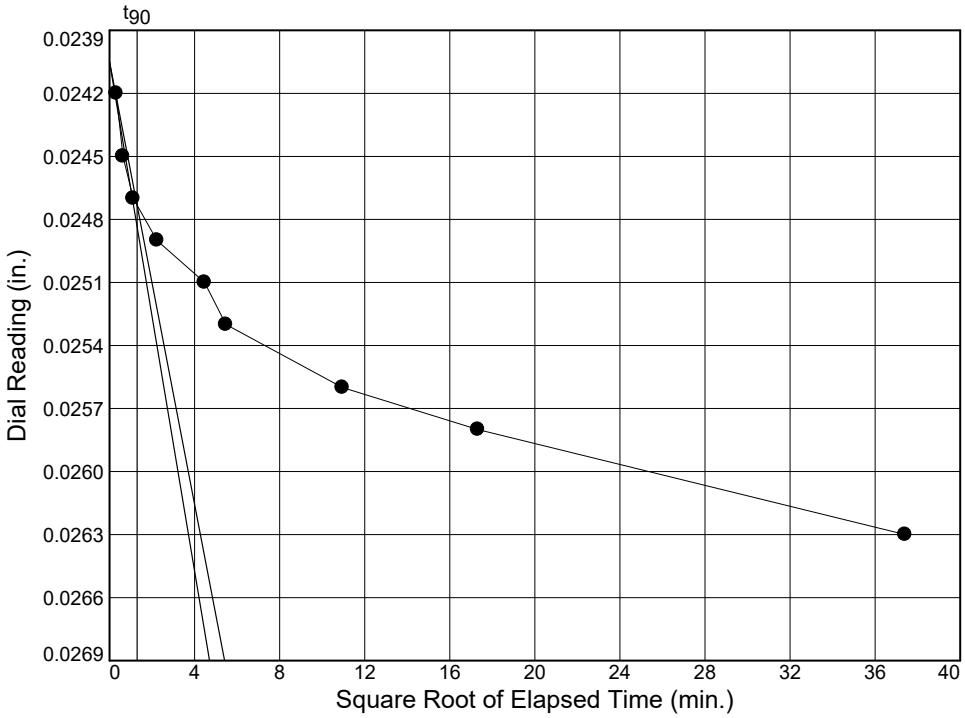
BRAUN INTERTEC

Figure

Dial Reading vs. Time

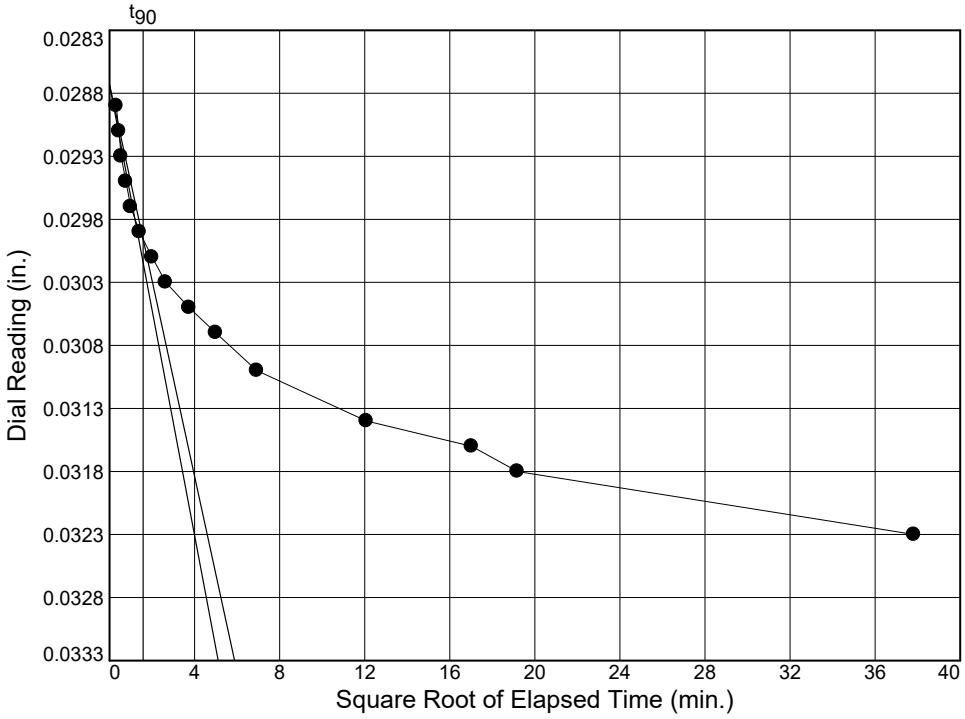
Project No.: B1913000
Project: Upper Pool CAP 204

Source of Sample: 19-16MU Depth: 11-13'



Load No.= 3
Load= 0.25 tsf
D_0 = 0.0240
D_{90} = 0.0247
D_{100} = 0.0248
T_{90} = 1.68 min.

C_v @ T_{90}
1.246 ft.^{2}/day



Load No.= 4
Load= 0.50 tsf
D_0 = 0.0287
D_{90} = 0.0300
D_{100} = 0.0301
T_{90} = 2.49 min.

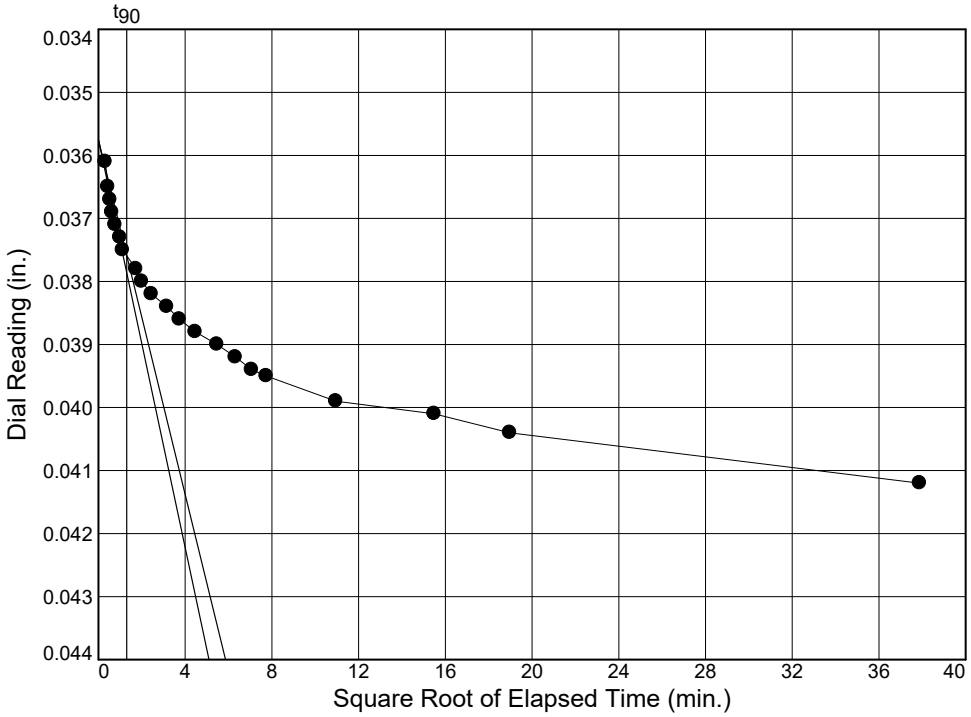
C_v @ T_{90}
0.833 ft.^{2}/day

Figure

Dial Reading vs. Time

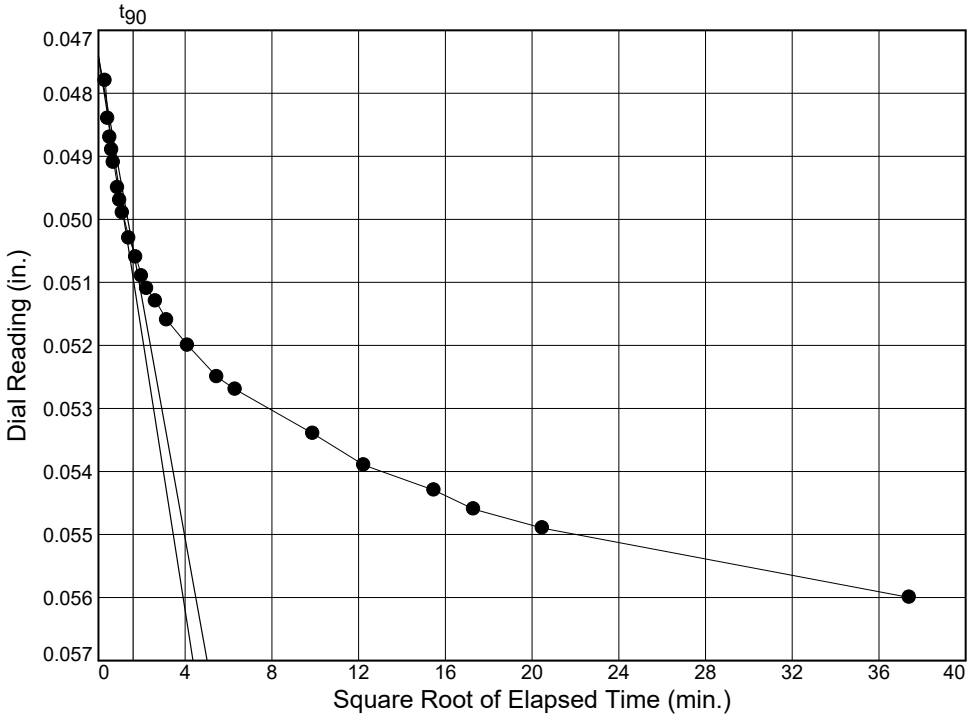
Project No.: B1913000
Project: Upper Pool CAP 204

Source of Sample: 19-16MU Depth: 11-13'



Load No.= 5
Load= 1.00 tsf
D_0 = 0.0358
D_{90} = 0.0376
D_{100} = 0.0378
T_{90} = 1.71 min.

C_v @ T_{90}
1.199 ft.^{2}/day



Load No.= 6
Load= 2.00 tsf
D_0 = 0.0474
D_{90} = 0.0505
D_{100} = 0.0508
T_{90} = 2.56 min.

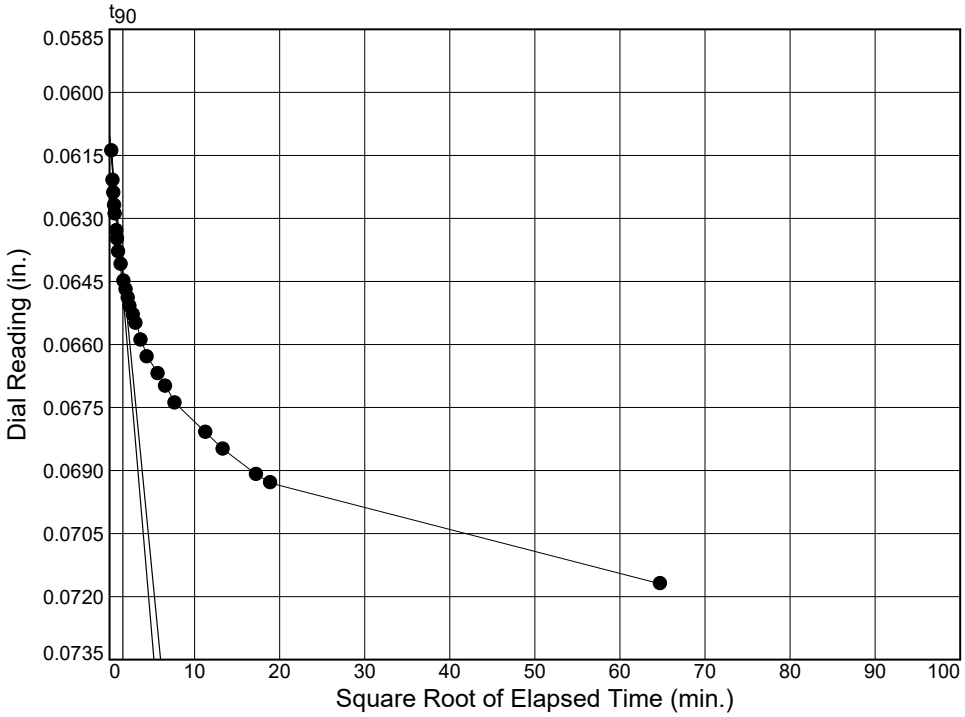
C_v @ T_{90}
0.780 ft.^{2}/day

Figure

Dial Reading vs. Time

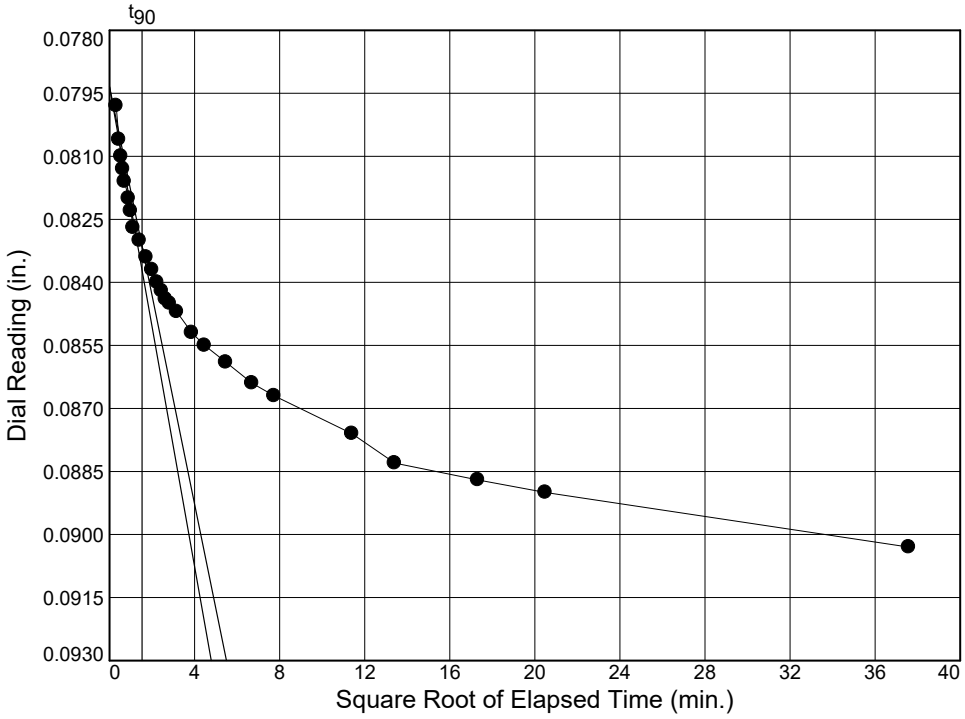
Project No.: B1913000
Project: Upper Pool CAP 204

Source of Sample: 19-16MU Depth: 11-13'



Load No.= 7
Load= 4.00 tsf
D_0 = 0.0610
D_{90} = 0.0643
D_{100} = 0.0647
T_{90} = 2.48 min.

C_v @ T_{90}
0.780 ft.^{2}/day



Load No.= 8
Load= 8.00 tsf
D_0 = 0.0793
D_{90} = 0.0831
D_{100} = 0.0836
T_{90} = 2.35 min.

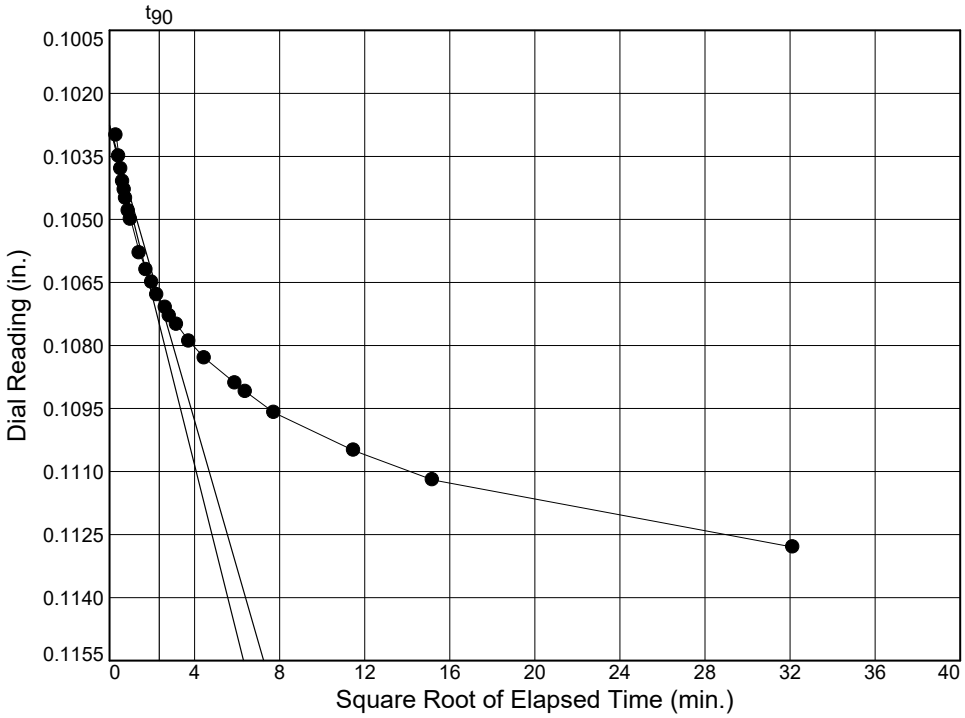
C_v @ T_{90}
0.794 ft.^{2}/day

Figure

Dial Reading vs. Time

Project No.: B1913000
Project: Upper Pool CAP 204

Source of Sample: 19-16MU Depth: 11-13'



Load No.= 13
Load= 16.00 tsf
D_0 = 0.1028
D_{90} = 0.1069
D_{100} = 0.1073
T_{90} = 5.49 min.

C_v @ T_{90}
0.324 ft.^{2}/day

Figure

CONSOLIDATION TEST DATA

12/11/2019

Client: USACE
Project: Upper Pool CAP 204
W912ES19P0092
Project Number: B1913000
Location: 19-16MU
Depth: 11-13'
Material Description: SILTY SAND, brown (SM)
Liquid Limit: 25 **Plasticity Index:** 1
Testing Remarks: ASTM D 2435

Test Specimen Data

NATURAL MOISTURE
Wet w+t = 96.39 g.
Dry w+t = 78.08 g.
Tare Wt. = 32.30 g.
Moisture = 40.0 %

VOID RATIO
Spec. Gr. = 2.86
Est. Ht. Solids = 0.467 in.
Init. V.R. = 1.143
Init. Sat. = 100.0 %

AFTER TEST
Wet w+t = 377.10 g.
Dry w+t = 344.27 g.
Tare Wt. = 233.54 g.
Moisture = 29.6 %

UNIT WEIGHT
Height = 1.000 in.
Diameter = 2.495 in.
Weight = 149.74 g.
Dry Dens. = 83.3 pcf

TEST START
Height = 1.000 in.
Diameter = 2.495 in.

Dry Wt. = 110.73 g.

End-Of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	Deformation (in.)	C_v ($ft.^2$/day)	C_α	Void Ratio	% Strain
start	0.01850		0.00000			1.143	
0.05	0.01890	0.00000	0.00040			1.142	0.0 Comprs.
0.13	0.02300	0.00010	0.00440			1.134	0.4 Comprs.
0.25	0.02650	0.00020	0.00780	1.246		1.127	0.8 Comprs.
0.50	0.03270	0.00040	0.01380	0.833		1.114	1.4 Comprs.
1.00	0.04200	0.00080	0.02270	1.199		1.095	2.3 Comprs.
2.00	0.05720	0.00120	0.03750	0.780		1.063	3.7 Comprs.
4.00	0.07330	0.00160	0.05320	0.780		1.029	5.3 Comprs.
8.00	0.09250	0.00220	0.07180	0.794		0.990	7.2 Comprs.
2.00	0.08950	0.00120	0.06980			0.994	7.0 Comprs.
0.50	0.08500	0.00040	0.06610			1.002	6.6 Comprs.
2.00	0.08820	0.00280	0.06690			1.000	6.7 Comprs.
8.00	0.09640	0.00280	0.07510			0.982	7.5 Comprs.
16.00	0.11560	0.00280	0.09430	0.324		0.941	9.4 Comprs.
4.00	0.11200	0.00160	0.09190			0.946	9.2 Comprs.
1.00	0.10730	0.00080	0.08800			0.955	8.8 Comprs.
0.25	0.10200	0.00020	0.08330			0.965	8.3 Comprs.
0.05	0.09220	0.00000	0.07370			0.985	7.4 Comprs.

Compression index (C_c), tsf = 0.15 **Preconsolidation pressure (P_p), tsf =** 1.2 **Void ratio at P_p (e_m) =** 1.088
Recompression index (C_r) = 0.03

Pressure: 0.05 tsf | **TEST READINGS** | **Load No. 1**

No.	Elapsed Time	Dial Reading
1	0	0.01850
2	1440	0.01890

Void Ratio = 1.142 **Compression =** 0.0%

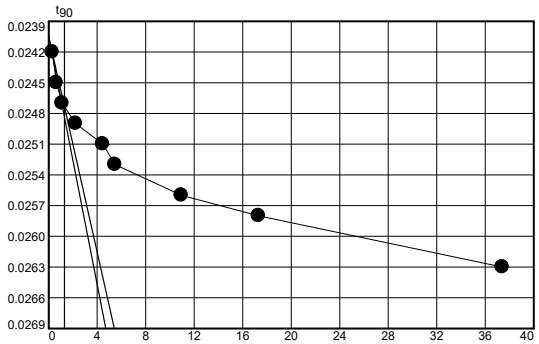
Pressure: 0.13 tsf | **TEST READINGS** | **Load No. 2**

No.	Elapsed Time	Dial Reading
1	0	0.01890
2	1440	0.02300

Void Ratio = 1.134 **Compression =** 0.4%

Pressure: 0.25 tsf | **TEST READINGS** | **Load No. 3**

No.	Elapsed Time	Dial Reading
1	0	0.02300
2	.1	0.02440
3	.4	0.02470
4	1.25	0.02490
5	5	0.02510
6	20	0.02530
7	30	0.02550
8	120	0.02580
9	300	0.02600
10	1400	0.02650

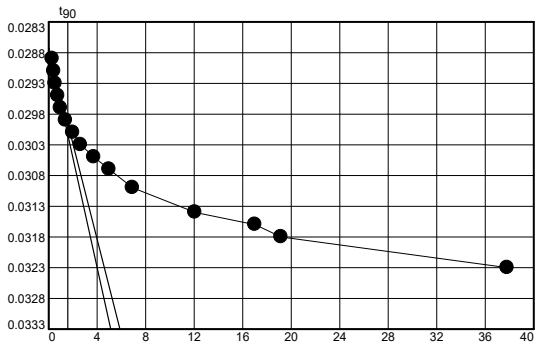


Void Ratio = 1.127 **Compression =** 0.8%

D_0 = 0.0240 **D_{90} =** 0.0247 **D_{100} =** 0.0248 **C_V at 1.68 min. =** 1.246 ft.^{2}/day

Pressure: 0.50 tsf | **TEST READINGS** | **Load No. 4**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.02650	11	25	0.03110
2	.1	0.02930	12	48	0.03140
3	.2	0.02950	13	146	0.03180
4	.3	0.02970	14	290	0.03200
5	.6	0.02990	15	368	0.03220
6	1	0.03010	16	1431	0.03270
7	2	0.03030			
8	4	0.03050			
9	7	0.03070			
10	14	0.03090			

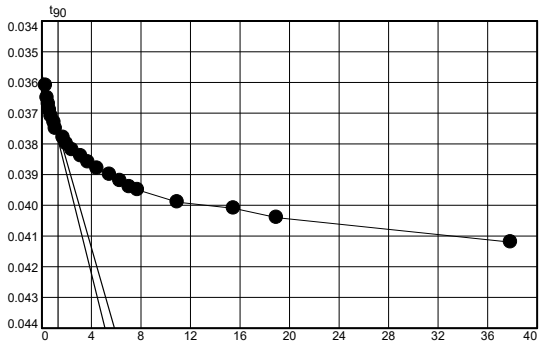


Void Ratio = 1.114 **Compression =** 1.4%

D_0 = 0.0287 **D_{90} =** 0.0300 **D_{100} =** 0.0301 **C_V at 2.49 min. =** 0.833 ft.^{2}/day

Pressure: 1.00 tsf | **TEST READINGS** | **Load No. 5**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.03270	12	10	0.03920
2	.1	0.03690	13	14	0.03940
3	.2	0.03730	14	20	0.03960
4	.3	0.03750	15	30	0.03980
5	.4	0.03770	16	40	0.04000
6	.6	0.03790	17	50	0.04020
7	1	0.03810	18	60	0.04030
8	1.25	0.03830	19	120	0.04070
9	3	0.03860	20	240	0.04090
10	4	0.03880	21	360	0.04120
11	6	0.03900	22	1435	0.04200

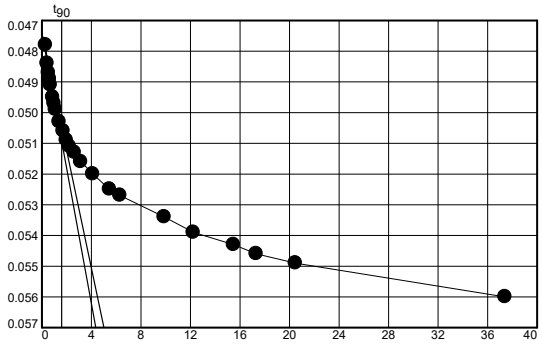


Void Ratio = 1.095 **Compression =** 2.3%

D_0 = 0.0358 **D_{90} =** 0.0376 **D_{100} =** 0.0378 **C_V at 1.71 min. =** 1.199 ft.^{2}/day

Pressure: 2.00 tsf | **TEST READINGS** | **Load No. 6**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.04200	13	5	0.05230
2	.1	0.04900	14	7	0.05250
3	.2	0.04960	15	10	0.05280
4	.3	0.04990	16	17	0.05320
5	.4	0.05010	17	30	0.05370
6	.5	0.05030	18	40	0.05390
7	.8	0.05070	19	98	0.05460
8	1	0.05090	20	150	0.05510
9	1.25	0.05110	21	240	0.05550
10	2	0.05150	22	300	0.05580
11	3	0.05180	23	420	0.05610
12	4	0.05210	24	1400	0.05720

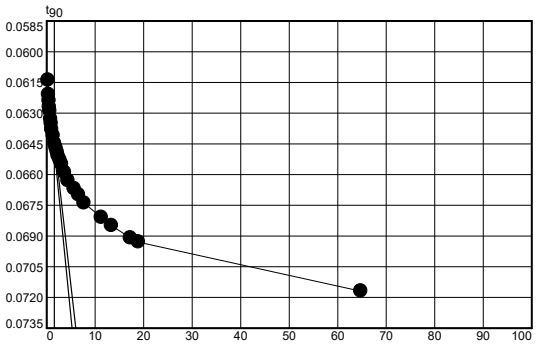


Void Ratio = 1.063 **Compression =** 3.7%

D_0 = 0.0474 **D_{90} =** 0.0505 **D_{100} =** 0.0508 **C_V at 2.56 min. =** 0.780 ft.^{2}/day

Pressure: 4.00 tsf	TEST READINGS	Load No. 7

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.05720	14	6	0.06670
2	.1	0.06300	15	8	0.06690
3	.2	0.06370	16	10	0.06710
4	.3	0.06400	17	14	0.06750
5	.4	0.06430	18	20	0.06790
6	.5	0.06450	19	33	0.06830
7	.8	0.06490	20	44	0.06860
8	1	0.06510	21	60	0.06900
9	1.25	0.06540	22	129	0.06970
10	2	0.06570	23	180	0.07010
11	3	0.06610	24	300	0.07070
12	4	0.06630	25	360	0.07090
13	5	0.06650	26	4200	0.07330

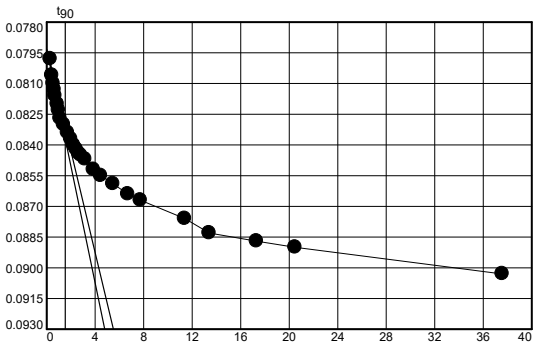


Void Ratio = 1.029 **Compression =** 5.3%

D_0 = 0.0610 **D_{90} =** 0.0643 **D_{100} =** 0.0647 **C_V at 2.48 min. =** 0.780 ft.^{2}/day

Pressure: 8.00 tsf	TEST READINGS	Load No. 8

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.07330	15	7	0.08660
2	.1	0.08200	16	8	0.08670
3	.2	0.08280	17	10	0.08690
4	.3	0.08320	18	15	0.08740
5	.4	0.08350	19	20	0.08770
6	.5	0.08380	20	30	0.08810
7	.8	0.08420	21	45	0.08860
8	1	0.08450	22	60	0.08890
9	1.25	0.08490	23	130	0.08980
10	2	0.08520	24	180	0.09050
11	3	0.08560	25	300	0.09090
12	4	0.08590	26	420	0.09120
13	5	0.08620	27	1413	0.09250
14	6	0.08640			



Void Ratio = 0.990 **Compression =** 7.2%

D_0 = 0.0793 **D_{90} =** 0.0831 **D_{100} =** 0.0836 **C_V at 2.35 min. =** 0.794 ft.^{2}/day

Pressure: 2.00 tsf	TEST READINGS	Load No. 9

No.	Elapsed Time	Dial Reading
1	0	0.09250
2	1387	0.08950

Void Ratio = 0.994 **Compression =** 7.0%

Pressure: 0.50 tsf	TEST READINGS	Load No. 10

No.	Elapsed Time	Dial Reading
1	0	0.08950
2	4200	0.08500

Void Ratio = 1.002 **Compression =** 6.6%

Pressure: 2.00 tsf	TEST READINGS	Load No. 11

No.	Elapsed Time	Dial Reading
1	0	0.08500
2	2880	0.08820

Void Ratio = 1.000 **Compression =** 6.7%

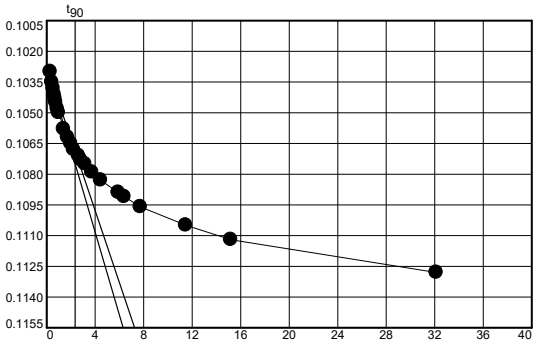
Pressure: 8.00 tsf	TEST READINGS	Load No. 12

No.	Elapsed Time	Dial Reading
1	0	0.08820
2	1440	0.09640

Void Ratio = 0.982 **Compression =** 7.5%

Pressure: 16.00 tsf	TEST READINGS	Load No. 13

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.09640	13	5	0.10960
2	.1	0.10580	14	7	0.10990
3	.2	0.10630	15	8	0.11010
4	.3	0.10660	16	10	0.11030
5	.4	0.10690	17	14	0.11070
6	.5	0.10710	18	20	0.11110
7	.6	0.10730	19	35	0.11170
8	.8	0.10760	20	41	0.11190
9	1	0.10780	21	60	0.11240
10	2	0.10860	22	132	0.11330
11	3	0.10900	23	231	0.11400
12	4	0.10930	24	1033	0.11560



Void Ratio = 0.941 **Compression =** 9.4%

D_0 = 0.1028 **D_{90} =** 0.1069 **D_{100} =** 0.1073 **C_V at 5.49 min. =** 0.324 ft.^{2}/day

Pressure: 4.00 tsf	TEST READINGS	Load No. 14

No.	Elapsed Time	Dial Reading
1	0	0.11560
2	1473	0.11200

Void Ratio = 0.946 **Compression =** 9.2%

Pressure: 1.00 tsf	TEST READINGS	Load No. 15

No.	Elapsed Time	Dial Reading
1	0	0.11200
2	1441	0.10730

Void Ratio = 0.955 **Compression =** 8.8%

Pressure: 0.25 tsf	TEST READINGS	Load No. 16

No.	Elapsed Time	Dial Reading
1	0	0.10730
2	4200	0.10200

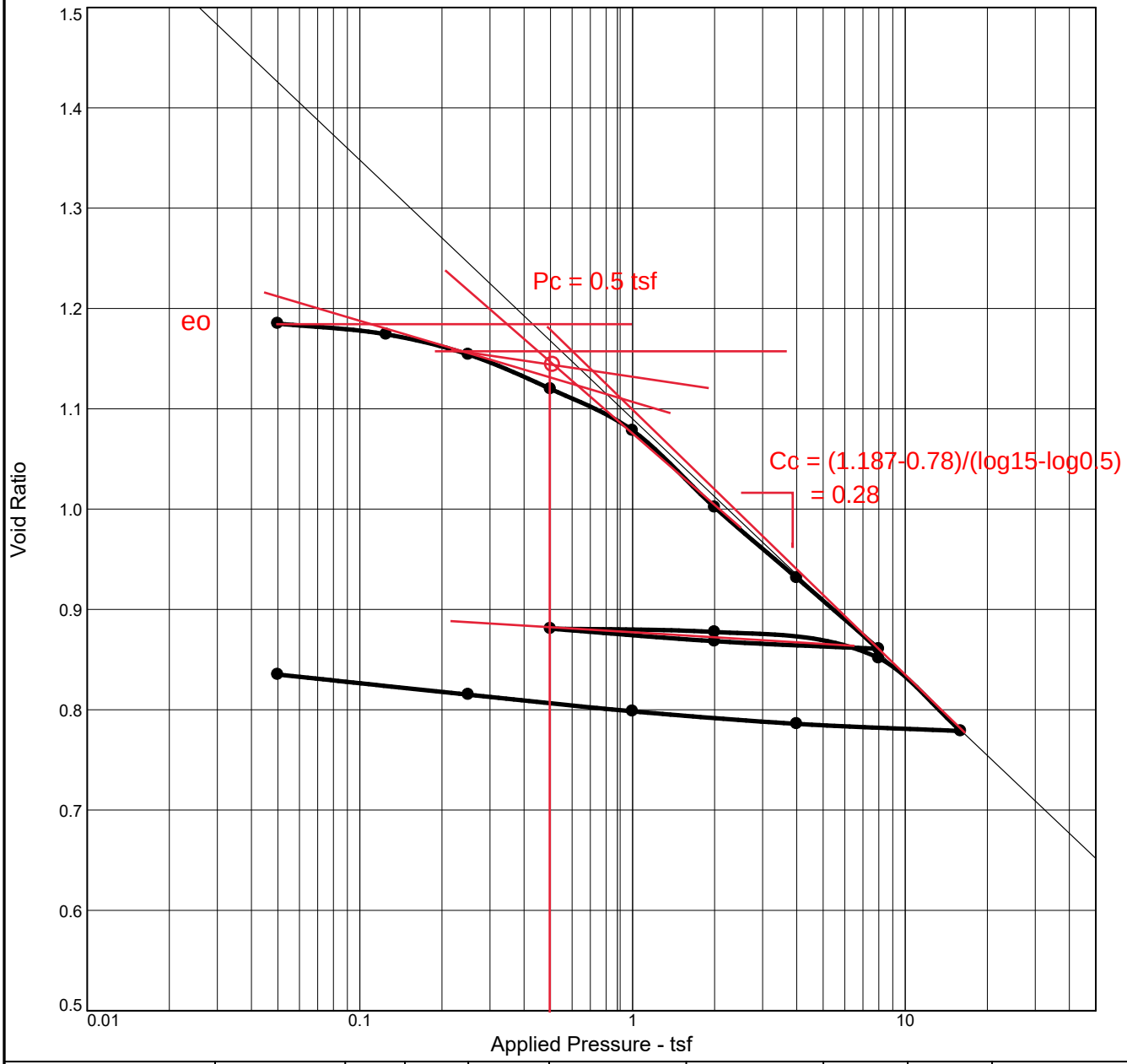
Void Ratio = 0.965 **Compression =** 8.3%

Pressure: 0.05 tsf	TEST READINGS	Load No. 17

No.	Elapsed Time	Dial Reading
1	0	0.10200
2	1470	0.09220

Void Ratio = 0.985 **Compression =** 7.4%

CONSOLIDATION TEST



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
97.1 %	42.7 %	77.1	39	11	2.70		1.1	0.26	0.05	1.187

MATERIAL DESCRIPTION	USCS	AASHTO
SILT, brown (ML)		

Project No. B1913000 **Client:** USACE

Project: Upper Pool CAP 204
W912ES19P0092

Source of Sample: 19-20MU **Depth:** 13-15'

Remarks:
ASTM D 2435

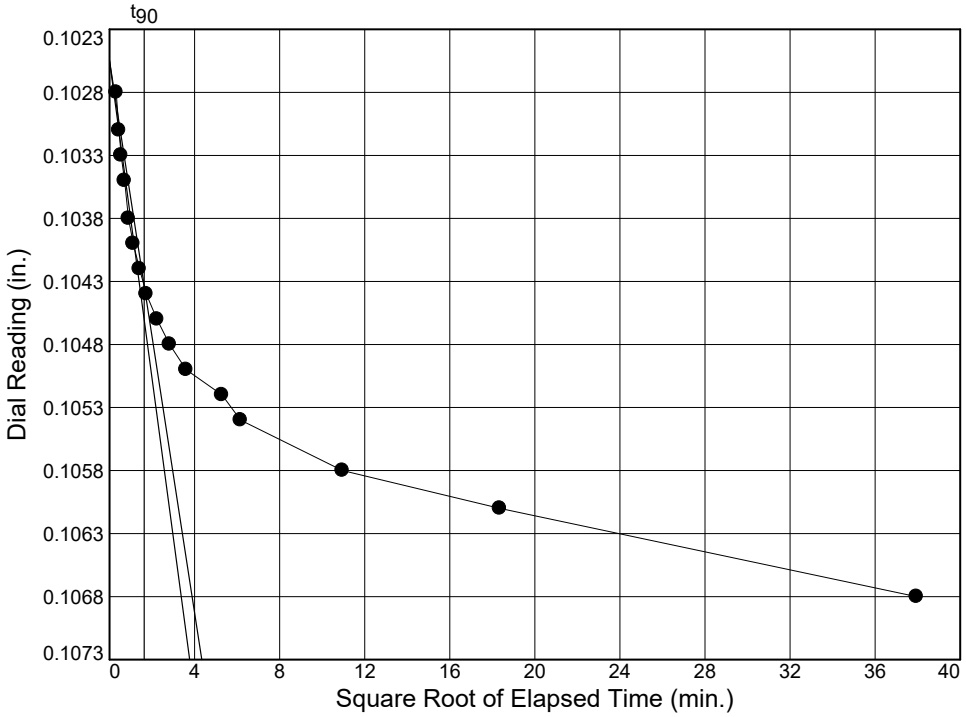
BRAUN INTERTEC

Figure

Dial Reading vs. Time

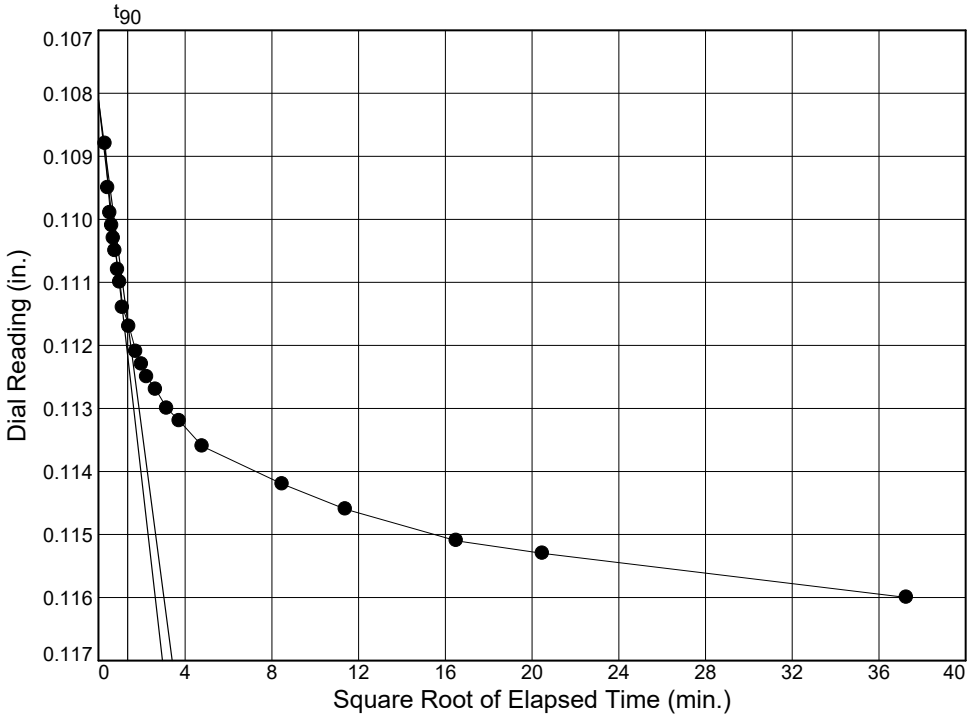
Project No.: B1913000
Project: Upper Pool CAP 204

Source of Sample: 19-20MU Depth: 13-15'



Load No.= 2
Load= 0.13 tsf
D_0 = 0.1025
D_{90} = 0.1043
D_{100} = 0.1045
T_{90} = 2.67 min.

C_v @ T_{90}
0.791 ft.^{2}/day



Load No.= 3
Load= 0.25 tsf
D_0 = 0.1081
D_{90} = 0.1116
D_{100} = 0.1120
T_{90} = 1.82 min.

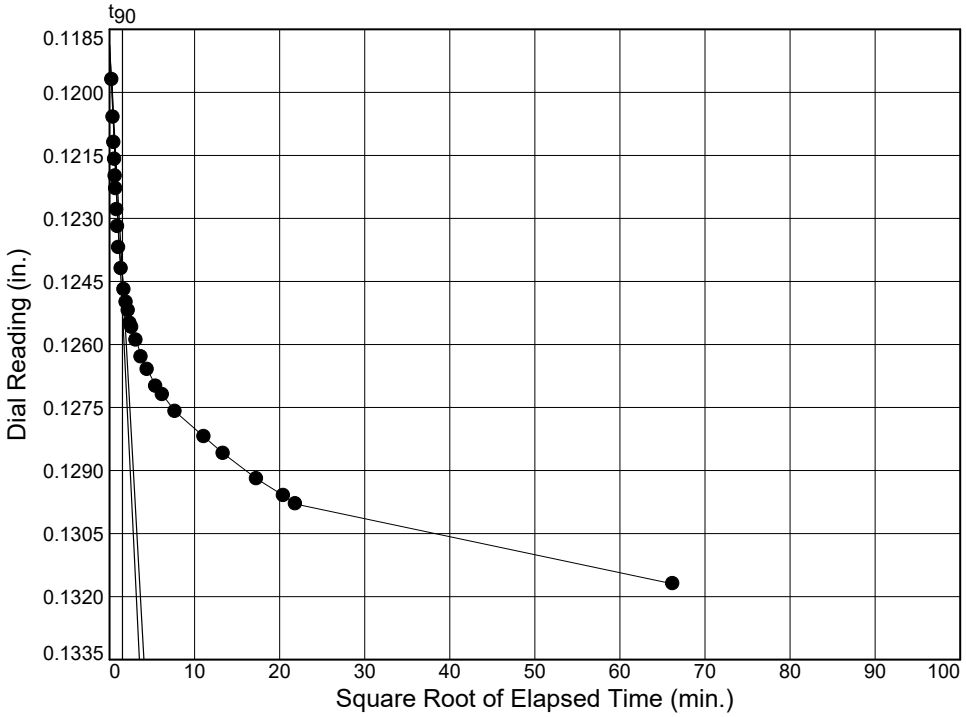
C_v @ T_{90}
1.141 ft.^{2}/day

Figure

Dial Reading vs. Time

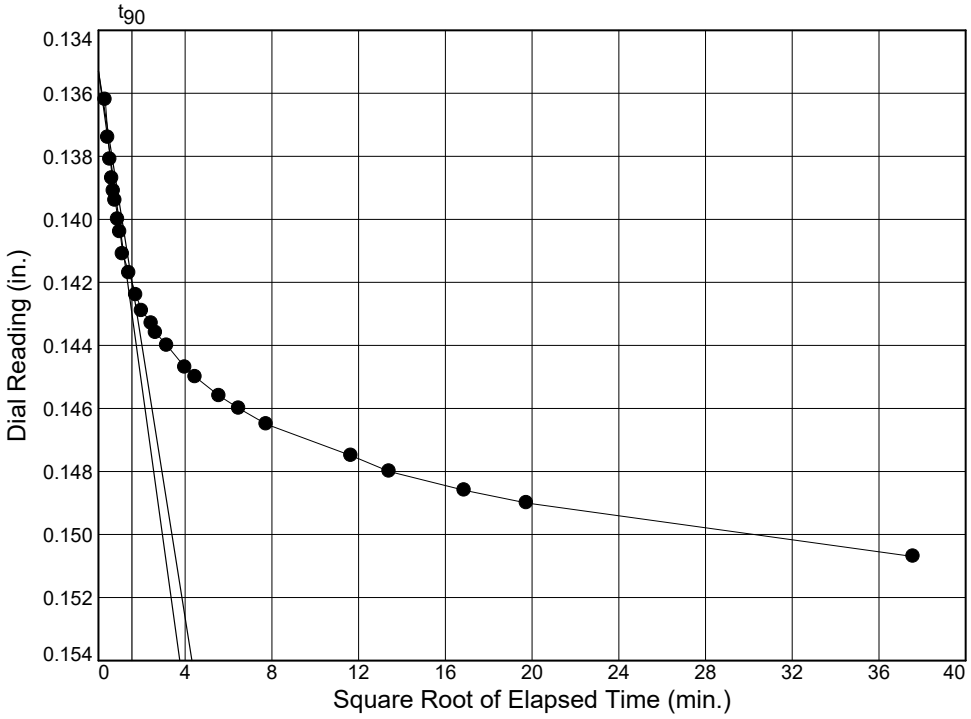
Project No.: B1913000
Project: Upper Pool CAP 204

Source of Sample: 19-20MU Depth: 13-15'



Load No.= 4
Load= 0.50 tsf
D_0 = 0.1189
D_{90} = 0.1244
D_{100} = 0.1250
T_{90} = 2.32 min.

C_v @ T_{90}
0.875 ft.^{2}/day



Load No.= 5
Load= 1.00 tsf
D_0 = 0.1353
D_{90} = 0.1420
D_{100} = 0.1427
T_{90} = 2.38 min.

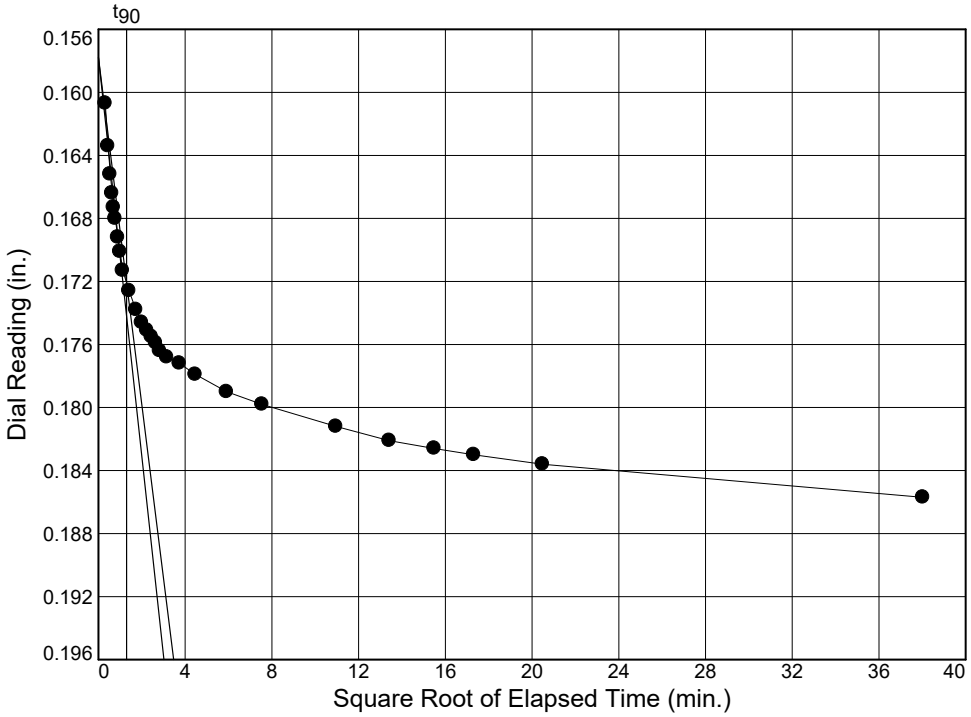
C_v @ T_{90}
0.823 ft.^{2}/day

Figure

Dial Reading vs. Time

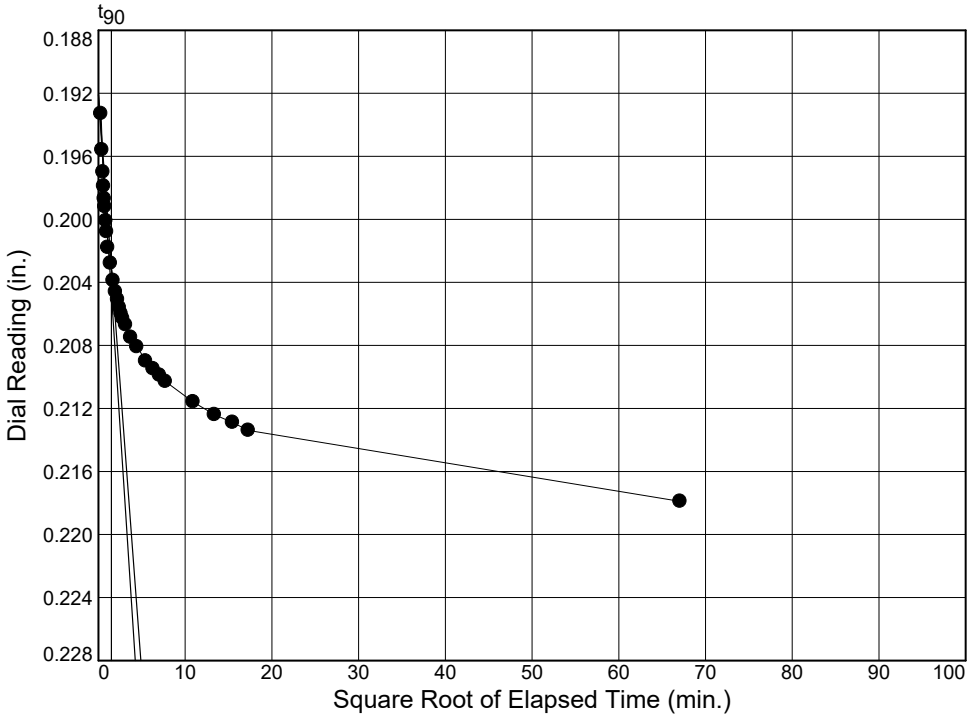
Project No.: B1913000
Project: Upper Pool CAP 204

Source of Sample: 19-20MU Depth: 13-15'



Load No.= 6
Load= 2.00 tsf
D_0 = 0.1578
D_{90} = 0.1721
D_{100} = 0.1737
T_{90} = 1.69 min.

C_v @ T_{90}
1.093 ft.^{2}/day



Load No.= 7
Load= 4.00 tsf
D_0 = 0.1921
D_{90} = 0.2031
D_{100} = 0.2043
T_{90} = 2.24 min.

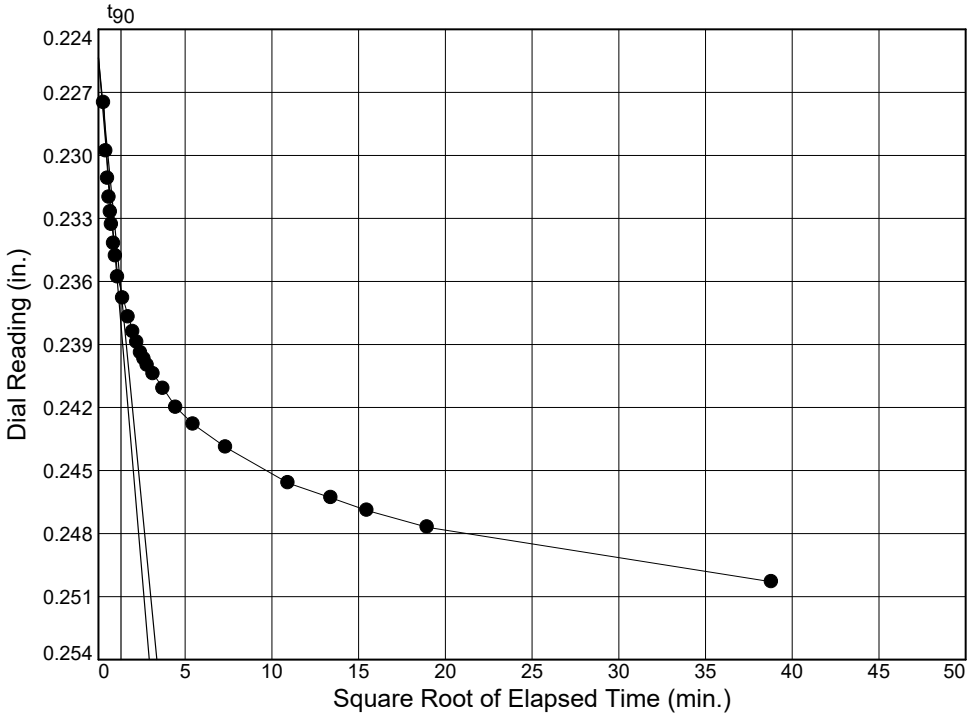
C_v @ T_{90}
0.765 ft.^{2}/day

Figure

Dial Reading vs. Time

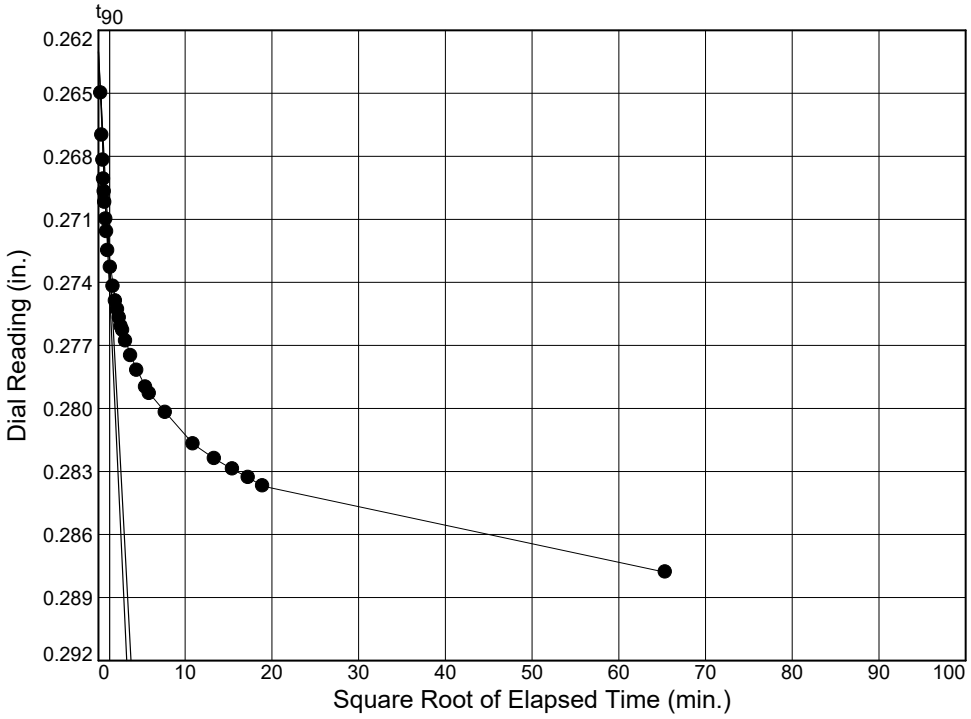
Project No.: B1913000
Project: Upper Pool CAP 204

Source of Sample: 19-20MU Depth: 13-15'



Load No.= 8
Load= 8.00 tsf
D_0 = 0.2254
D_{90} = 0.2364
D_{100} = 0.2376
T_{90} = 1.69 min.

C_v @ T_{90}
0.945 ft.^{2}/day



Load No.= 13
Load= 16.00 tsf
D_0 = 0.2630
D_{90} = 0.2730
D_{100} = 0.2741
T_{90} = 1.66 min.

C_v @ T_{90}
0.881 ft.^{2}/day

Figure

CONSOLIDATION TEST DATA

12/11/2019

Client: USACE
Project: Upper Pool CAP 204
W912ES19P0092
Project Number: B1913000
Location: 19-20MU
Depth: 13-15'
Material Description: SILT, brown (ML)
Liquid Limit: 39 **Plasticity Index:** 11
Testing Remarks: ASTM D 2435

Test Specimen Data

NATURAL MOISTURE
Wet w+t = 108.50 g.
Dry w+t = 85.70 g.
Tare Wt. = 32.29 g.
Moisture = 42.7 %

VOID RATIO
Spec. Gr. = 2.70
Est. Ht. Solids = 0.458 in.
Init. V.R. = 1.187
Init. Sat. = 97.1 %

AFTER TEST
Wet w+t = 360.16 g.
Dry w+t = 330.59 g.
Tare Wt. = 230.54 g.
Moisture = 29.6 %

UNIT WEIGHT
Height = 1.001 in.
Diameter = 2.495 in.
Weight = 141.27 g.
Dry Dens. = 77.1 pcf

TEST START
Height = 1.001 in.
Diameter = 2.495 in.

Dry Wt. = 100.05 g.

End-Of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	Deformation (in.)	C_v ($ft.^2$/day)	C_α	Void Ratio	% Strain
start	0.10090		0.00000			1.187	
0.05	0.10190	0.00000	0.00100			1.185	0.1 Comprs.
0.13	0.10710	0.00030	0.00590	0.791		1.174	0.6 Comprs.
0.25	0.11670	0.00070	0.01510	1.141		1.154	1.5 Comprs.
0.50	0.13310	0.00140	0.03080	0.875		1.120	3.1 Comprs.
1.00	0.15270	0.00200	0.04980	0.823		1.078	5.0 Comprs.
2.00	0.18800	0.00230	0.08480	1.093		1.002	8.5 Comprs.
4.00	0.22070	0.00280	0.11700	0.765		0.931	11.7 Comprs.
8.00	0.25360	0.00330	0.14940	0.945		0.861	14.9 Comprs.
2.00	0.24910	0.00230	0.14590			0.868	14.6 Comprs.
0.50	0.24250	0.00140	0.14020			0.881	14.0 Comprs.
2.00	0.24660	0.00400	0.14170			0.878	14.2 Comprs.
8.00	0.25850	0.00400	0.15360			0.852	15.3 Comprs.
16.00	0.29180	0.00400	0.18690	0.881		0.779	18.7 Comprs.
4.00	0.28730	0.00280	0.18360			0.786	18.3 Comprs.
1.00	0.28080	0.00200	0.17790			0.798	17.8 Comprs.
0.25	0.27190	0.00070	0.17030			0.815	17.0 Comprs.
0.05	0.26200	0.00000	0.16110			0.835	16.1 Comprs.

Compression index (C_c), tsf = 0.26 **Preconsolidation pressure (P_p), tsf =** 1.1 **Void ratio at P_p (e_m) =** 1.071
Recompression index (C_r) = 0.05

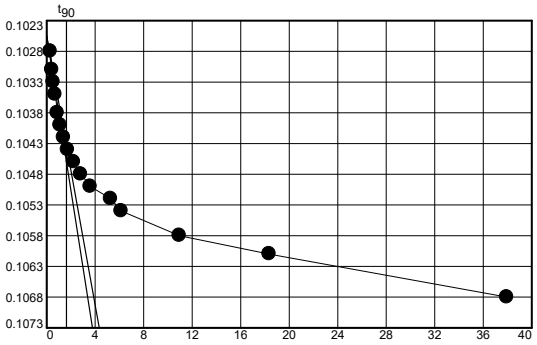
Pressure: 0.05 tsf | **TEST READINGS** | **Load No. 1**

No.	Elapsed Time	Dial Reading
1	0	0.10090
2	1440	0.10190

Void Ratio = 1.185 **Compression =** 0.1%

Pressure: 0.13 tsf | **TEST READINGS** | **Load No. 2**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.10190	11	8	0.10510
2	.1	0.10310	12	13	0.10530
3	.2	0.10340	13	28	0.10550
4	.3	0.10360	14	38	0.10570
5	.5	0.10380	15	120	0.10610
6	.8	0.10410	16	337	0.10640
7	1.25	0.10430	17	1440	0.10710
8	2	0.10450			
9	3	0.10470			
10	5	0.10490			

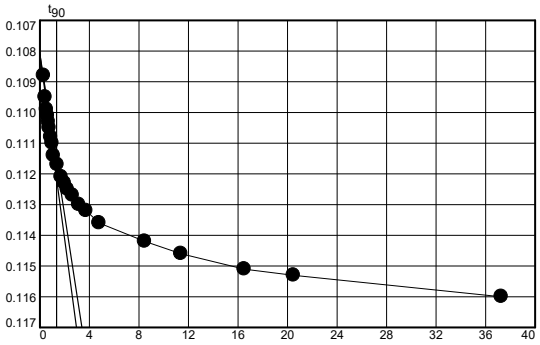


Void Ratio = 1.174 **Compression =** 0.6%

D_0 = 0.1025 **D_{90} =** 0.1043 **D_{100} =** 0.1045 **C_V at 2.67 min. =** 0.791 ft.^{2}/day

Pressure: 0.25 tsf | **TEST READINGS** | **Load No. 3**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.10710	13	4	0.11300
2	.1	0.10950	14	5	0.11320
3	.2	0.11020	15	7	0.11340
4	.3	0.11060	16	10	0.11370
5	.4	0.11080	17	14	0.11390
6	.5	0.11100	18	23	0.11430
7	.6	0.11120	19	72	0.11490
8	.8	0.11150	20	130	0.11530
9	1	0.11170	21	273	0.11580
10	1.25	0.11210	22	420	0.11600
11	2	0.11240	23	1390	0.11670
12	3	0.11280			

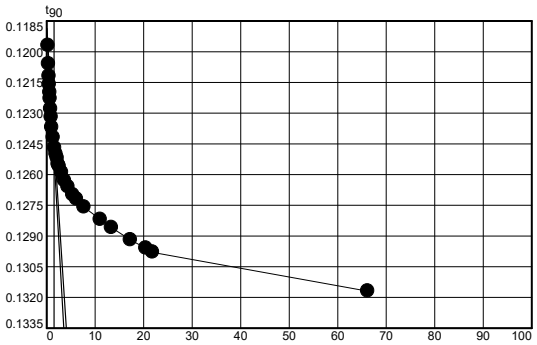


Void Ratio = 1.154 **Compression =** 1.5%

D_0 = 0.1081 **D_{90} =** 0.1116 **D_{100} =** 0.1120 **C_V at 1.82 min. =** 1.141 ft.^{2}/day

Pressure: 0.50 tsf | **TEST READINGS** | **Load No. 4**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.11670	15	6	0.12690
2	.1	0.12110	16	7	0.12700
3	.2	0.12200	17	10	0.12730
4	.3	0.12260	18	14	0.12770
5	.4	0.12300	19	20	0.12800
6	.5	0.12340	20	30	0.12840
7	.6	0.12370	21	39	0.12860
8	.8	0.12420	22	60	0.12900
9	1	0.12460	23	124	0.12960
10	1.25	0.12510	24	180	0.13000
11	2	0.12560	25	300	0.13060
12	3	0.12610	26	420	0.13100
13	4	0.12640	27	480	0.13120
14	5	0.12660	28	4391	0.13310

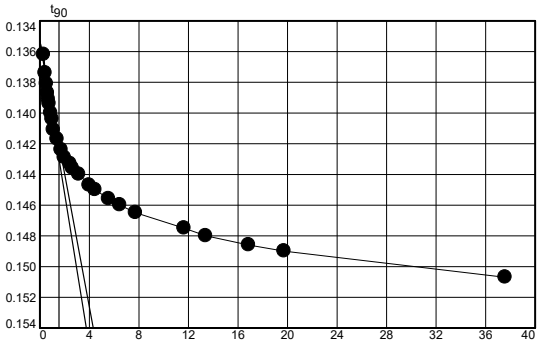


Void Ratio = 1.120 **Compression =** 3.1%

D_0 = 0.1189 **D_{90} =** 0.1244 **D_{100} =** 0.1250 **C_V at 2.32 min. =** 0.875 ft.^{2}/day

Pressure: 1.00 tsf | **TEST READINGS** | **Load No. 5**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.13310	14	6	0.14530
2	.1	0.13820	15	7	0.14560
3	.2	0.13940	16	10	0.14600
4	.3	0.14010	17	16	0.14670
5	.4	0.14070	18	20	0.14700
6	.5	0.14110	19	31	0.14760
7	.6	0.14140	20	42	0.14800
8	.8	0.14200	21	60	0.14850
9	1	0.14240	22	136	0.14950
10	1.25	0.14310	23	180	0.15000
11	2	0.14370	24	285	0.15060
12	3	0.14440	25	390	0.15100
13	4	0.14490	26	1413	0.15270

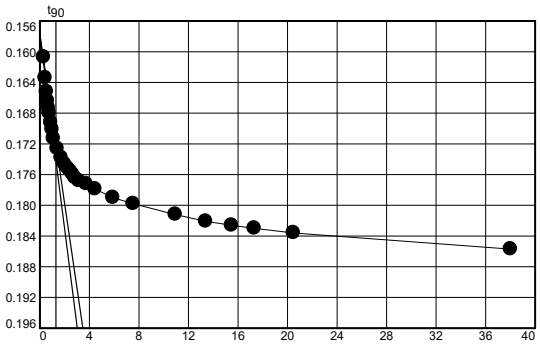


Void Ratio = 1.078 **Compression =** 5.0%

D_0 = 0.1353 **D_{90} =** 0.1420 **D_{100} =** 0.1427 **C_V at 2.38 min. =** 0.823 ft.^{2}/day

Pressure: 2.00 tsf | **TEST READINGS** | **Load No. 6**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.15270	15	6	0.17780
2	.1	0.16300	16	7	0.17820
3	.2	0.16570	17	8	0.17870
4	.3	0.16750	18	10	0.17910
5	.4	0.16870	19	14	0.17950
6	.5	0.16960	20	20	0.18020
7	.6	0.17030	21	35	0.18130
8	.8	0.17150	22	57	0.18210
9	1	0.17240	23	120	0.18350
10	1.25	0.17360	24	180	0.18440
11	2	0.17490	25	240	0.18490
12	3	0.17610	26	300	0.18530
13	4	0.17690	27	420	0.18590
14	5	0.17740	28	1446	0.18800

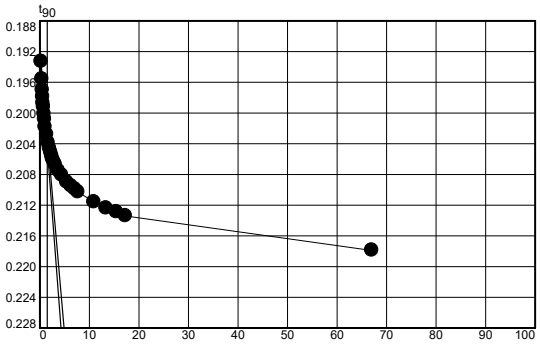


Void Ratio = 1.002 **Compression =** 8.5%

D_0 = 0.1578 **D_{90} =** 0.1721 **D_{100} =** 0.1737 **C_V at 1.69 min. =** 1.093 ft.^{2}/day

Pressure: 4.00 tsf | **TEST READINGS** | **Load No. 7**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.18800	16	7	0.20880
2	.1	0.19610	17	8	0.20910
3	.2	0.19840	18	10	0.20950
4	.3	0.19980	19	14	0.21030
5	.4	0.20070	20	20	0.21090
6	.5	0.20150	21	30	0.21180
7	.6	0.20200	22	40	0.21230
8	.8	0.20290	23	50	0.21270
9	1	0.20360	24	60	0.21310
10	1.25	0.20460	25	120	0.21440
11	2	0.20560	26	180	0.21520
12	3	0.20670	27	240	0.21570
13	4	0.20740	28	300	0.21620
14	5	0.20790	29	4500	0.22070
15	6	0.20840			

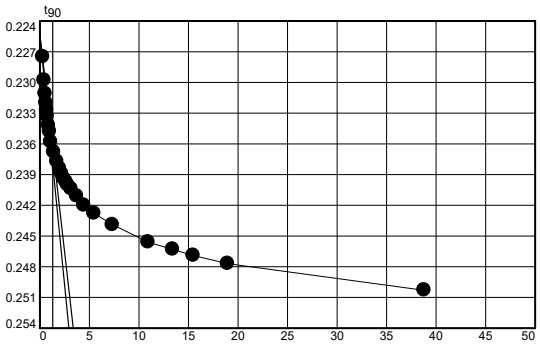


Void Ratio = 0.931 **Compression =** 11.7%

D_0 = 0.1921 **D_{90} =** 0.2031 **D_{100} =** 0.2043 **C_V at 2.24 min. =** 0.765 ft.^{2}/day

Pressure: 8.00 tsf | **TEST READINGS** | **Load No. 8**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.22070	15	6	0.24270
2	.1	0.23080	16	7	0.24300
3	.2	0.23310	17	8	0.24330
4	.3	0.23440	18	10	0.24370
5	.4	0.23530	19	14	0.24440
6	.5	0.23600	20	20	0.24530
7	.6	0.23660	21	30	0.24610
8	.8	0.23750	22	54	0.24720
9	1	0.23810	23	120	0.24890
10	1.25	0.23910	24	180	0.24960
11	2	0.24010	25	240	0.25020
12	3	0.24100	26	360	0.25100
13	4	0.24170	27	1507	0.25360
14	5	0.24220			



Void Ratio = 0.861 **Compression =** 14.9%

D_0 = 0.2254 **D_{90} =** 0.2364 **D_{100} =** 0.2376 **C_V at 1.69 min. =** 0.945 ft.^{2}/day

Pressure: 2.00 tsf | **TEST READINGS** | **Load No. 9**

No.	Elapsed Time	Dial Reading
1	0	0.25360
2	1440	0.24910

Void Ratio = 0.868 **Compression =** 14.6%

Pressure: 0.50 tsf | **TEST READINGS** | **Load No. 10**

No.	Elapsed Time	Dial Reading
1	0	0.24910
2	1440	0.24250

Void Ratio = 0.881 **Compression =** 14.0%

Pressure: 2.00 tsf | **TEST READINGS** | **Load No. 11**

No.	Elapsed Time	Dial Reading
1	0	0.24250
2	1440	0.24660

Void Ratio = 0.878 **Compression =** 14.2%

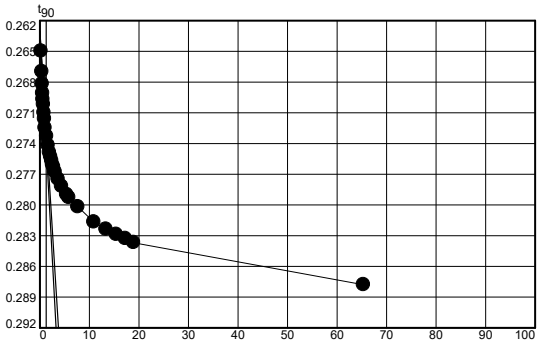
Pressure: 8.00 tsf | **TEST READINGS** | **Load No. 12**

No.	Elapsed Time	Dial Reading
1	0	0.24660
2	1450	0.25850

Void Ratio = 0.852 **Compression =** 15.3%

Pressure: 16.00 tsf | **TEST READINGS** | **Load No. 13**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.25850	16	7	0.28010
2	.1	0.26900	17	8	0.28030
3	.2	0.27100	18	10	0.28080
4	.3	0.27220	19	14	0.28150
5	.4	0.27310	20	20	0.28220
6	.5	0.27370	21	30	0.28300
7	.6	0.27420	22	35	0.28330
8	.8	0.27500	23	60	0.28420
9	1.	0.27560	24	120	0.28570
10	1.25	0.27650	25	180	0.28640
11	2	0.27730	26	240	0.28690
12	3	0.27820	27	300	0.28730
13	4	0.27890	28	360	0.28770
14	5	0.27930	29	4278	0.29180
15	6	0.27970			



Void Ratio = 0.779 **Compression =** 18.7%

D_0 = 0.2630 **D_{90} =** 0.2730 **D_{100} =** 0.2741 **C_V at 1.66 min. =** 0.881 ft.^{2}/day

Pressure: 4.00 tsf | **TEST READINGS** | **Load No. 14**

No.	Elapsed Time	Dial Reading
1	0	0.29180
2	1456	0.28730

Void Ratio = 0.786 **Compression =** 18.3%

Pressure: 1.00 tsf | **TEST READINGS** | **Load No. 15**

No.	Elapsed Time	Dial Reading
1	0	0.28730
2	1440	0.28080

Void Ratio = 0.798 **Compression =** 17.8%

Pressure: 0.25 tsf	TEST READINGS	Load No. 16

No.	Elapsed Time	Dial Reading
1	0	0.28080
2	1440	0.27190

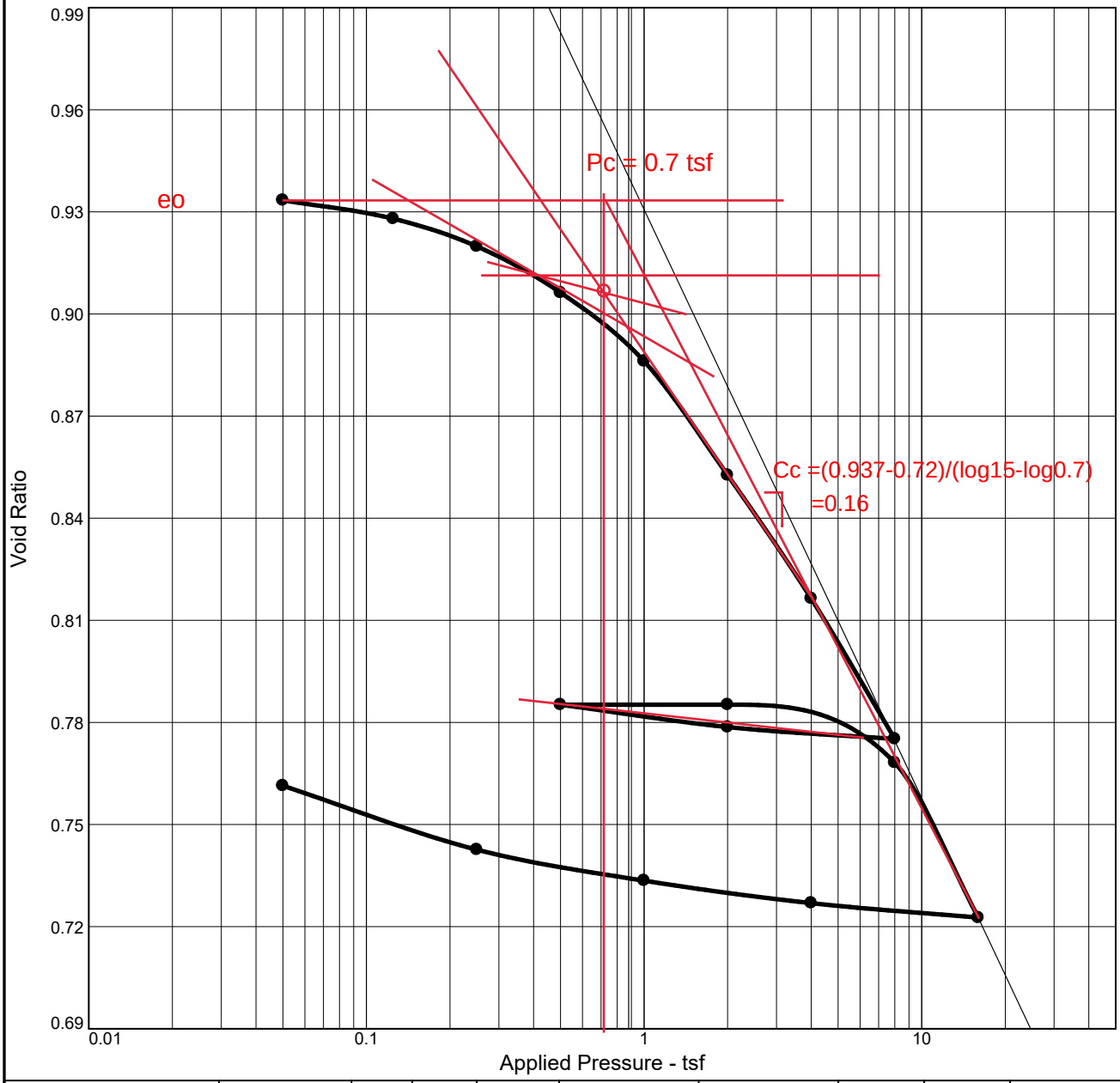
Void Ratio = 0.815 **Compression =** 17.0%

Pressure: 0.05 tsf	TEST READINGS	Load No. 17

No.	Elapsed Time	Dial Reading
1	0	0.27190
2	1440	0.26200

Void Ratio = 0.835 **Compression =** 16.1%

CONSOLIDATION TEST



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
99.4 %	34.5 %	87.0	31	4	2.70		~~2.1~~	~~0.17~~	~~0.03~~	0.937

MATERIAL DESCRIPTION	USCS	AASHTO
SILT, brown (ML)		

Project No. B1913000 **Client:** USACE

Project: Upper Pool CAP 204
W912ES19P0092

Source of Sample: 19-21MU **Depth:** 21-23'

Remarks:
ASTM D 2435

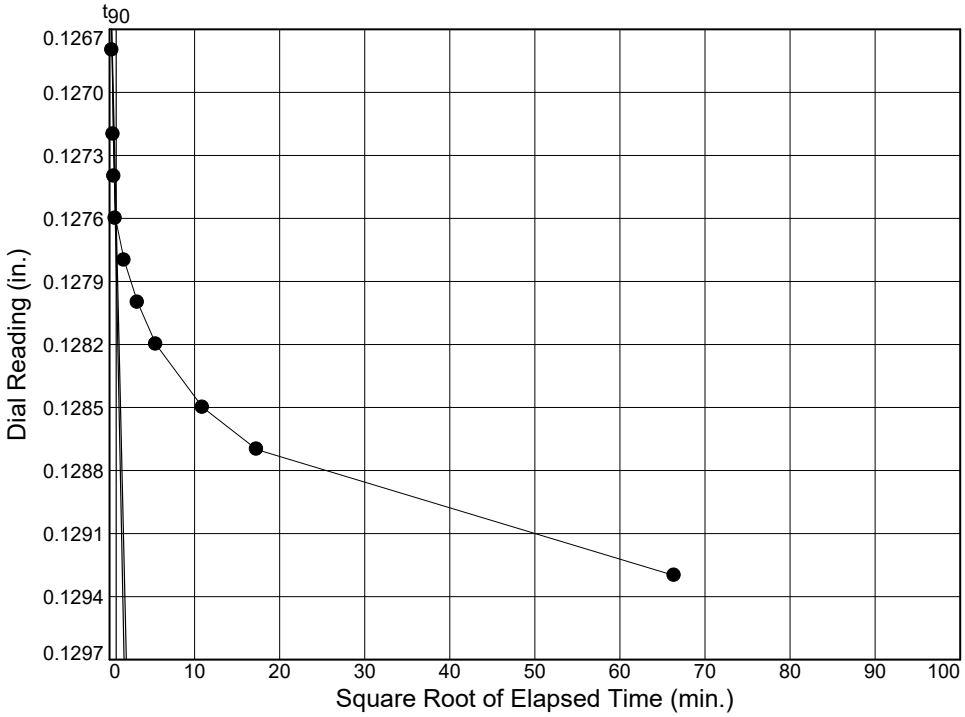
BRAUN INTERTEC

Figure

Dial Reading vs. Time

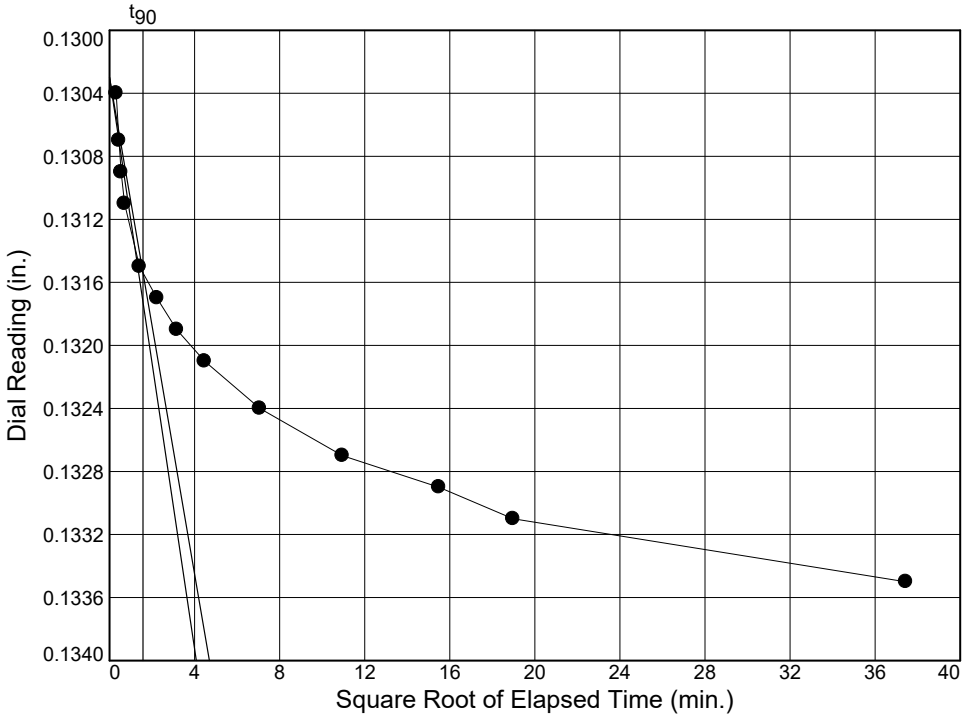
Project No.: B1913000
Project: Upper Pool CAP 204

Source of Sample: 19-21MU Depth: 21-23'



Load No.= 2
Load= 0.13 tsf
D_0 = 0.1262
D_{90} = 0.1276
D_{100} = 0.1278
T_{90} = 0.62 min.

C_v @ T_{90}
3.390 ft.^{2}/day



Load No.= 3
Load= 0.25 tsf
D_0 = 0.1303
D_{90} = 0.1315
D_{100} = 0.1317
T_{90} = 2.48 min.

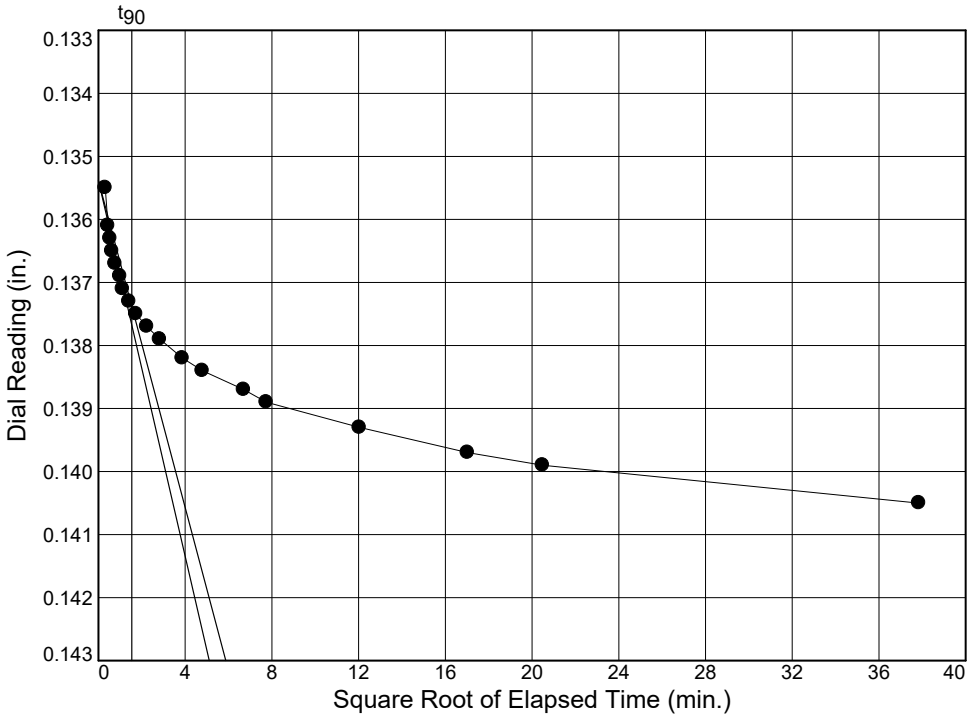
C_v @ T_{90}
0.842 ft.^{2}/day

Figure

Dial Reading vs. Time

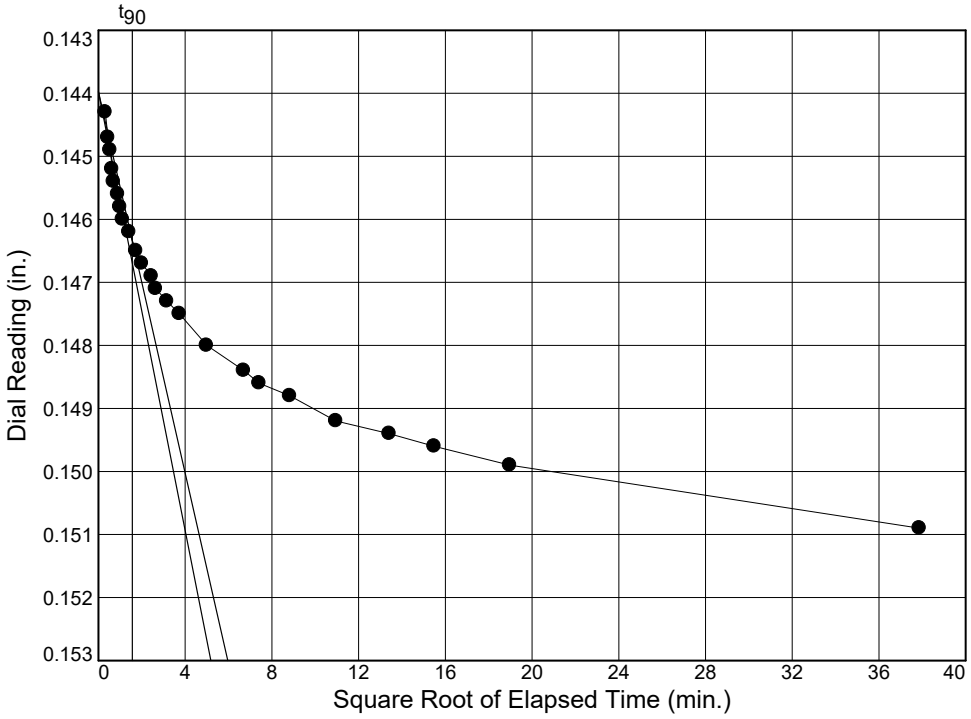
Project No.: B1913000
Project: Upper Pool CAP 204

Source of Sample: 19-21MU Depth: 21-23'



Load No.= 4
Load= 0.50 tsf
D_0 = 0.1354
D_{90} = 0.1374
D_{100} = 0.1376
T_{90} = 2.37 min.

C_v @ T_{90}
0.874 ft.^{2}/day



Load No.= 5
Load= 1.00 tsf
D_0 = 0.1440
D_{90} = 0.1463
D_{100} = 0.1466
T_{90} = 2.44 min.

C_v @ T_{90}
0.833 ft.^{2}/day

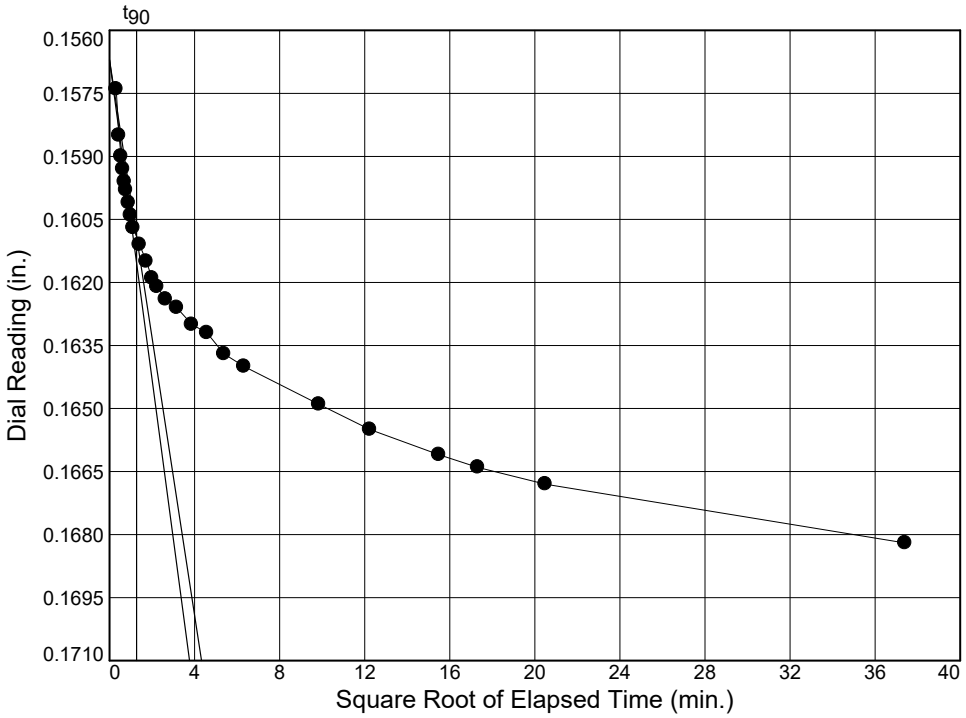
Figure

Braun Intertec

Dial Reading vs. Time

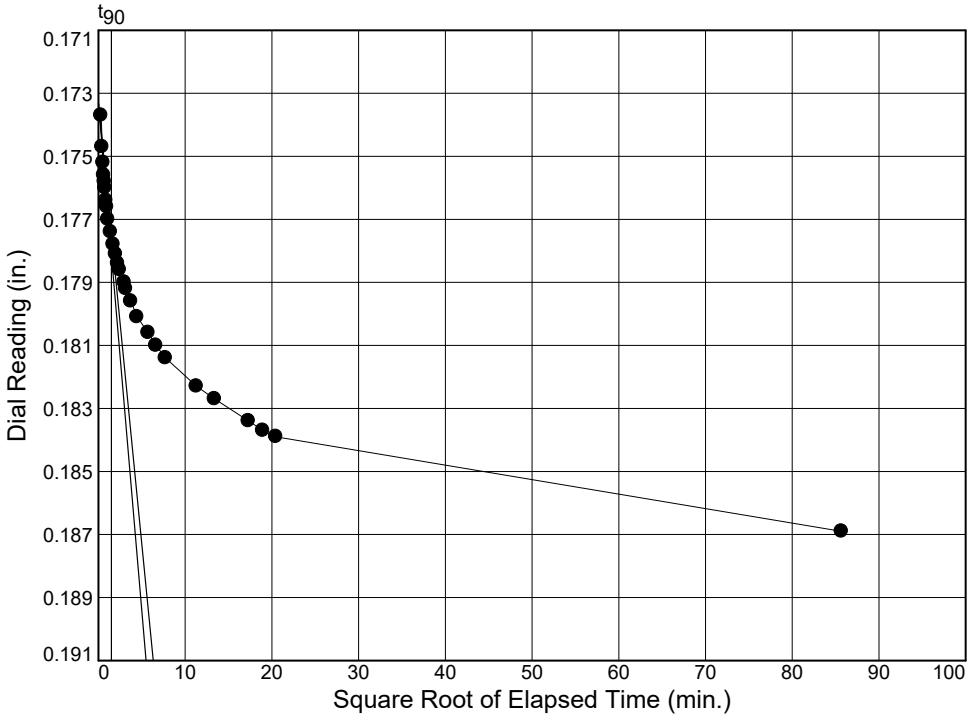
Project No.: B1913000
Project: Upper Pool CAP 204

Source of Sample: 19-21MU Depth: 21-23'



Load No.= 6
Load= 2.00 tsf
D_0 = 0.1567
D_{90} = 0.1609
D_{100} = 0.1614
T_{90} = 1.62 min.

C_v @ T_{90}
1.218 ft.^{2}/day



Load No.= 7
Load= 4.00 tsf
D_0 = 0.1733
D_{90} = 0.1775
D_{100} = 0.1780
T_{90} = 2.24 min.

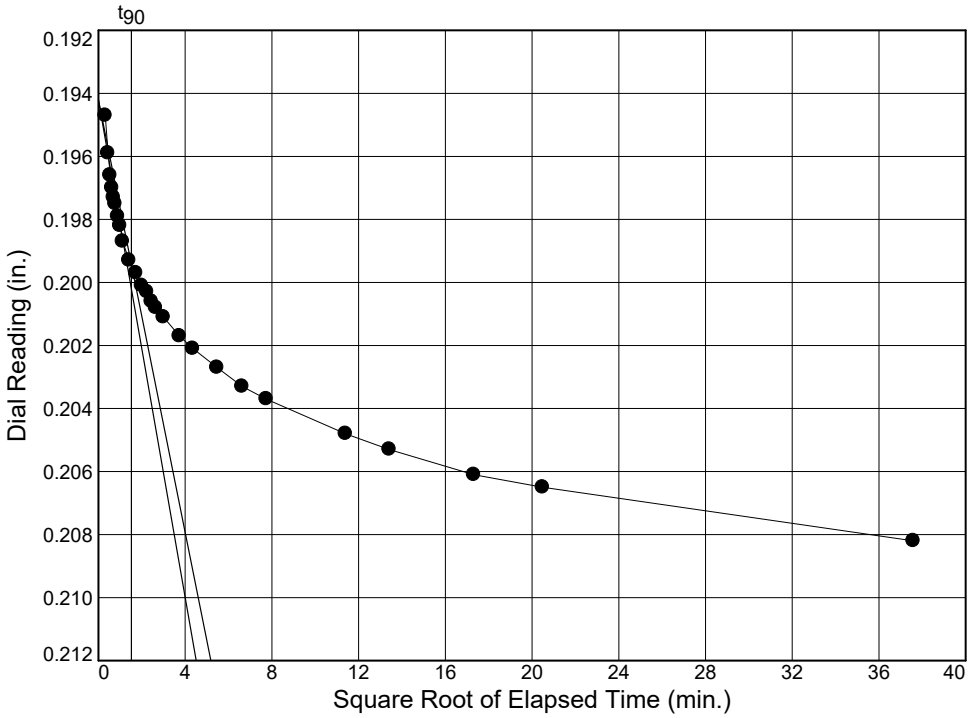
C_v @ T_{90}
0.848 ft.^{2}/day

Figure

Dial Reading vs. Time

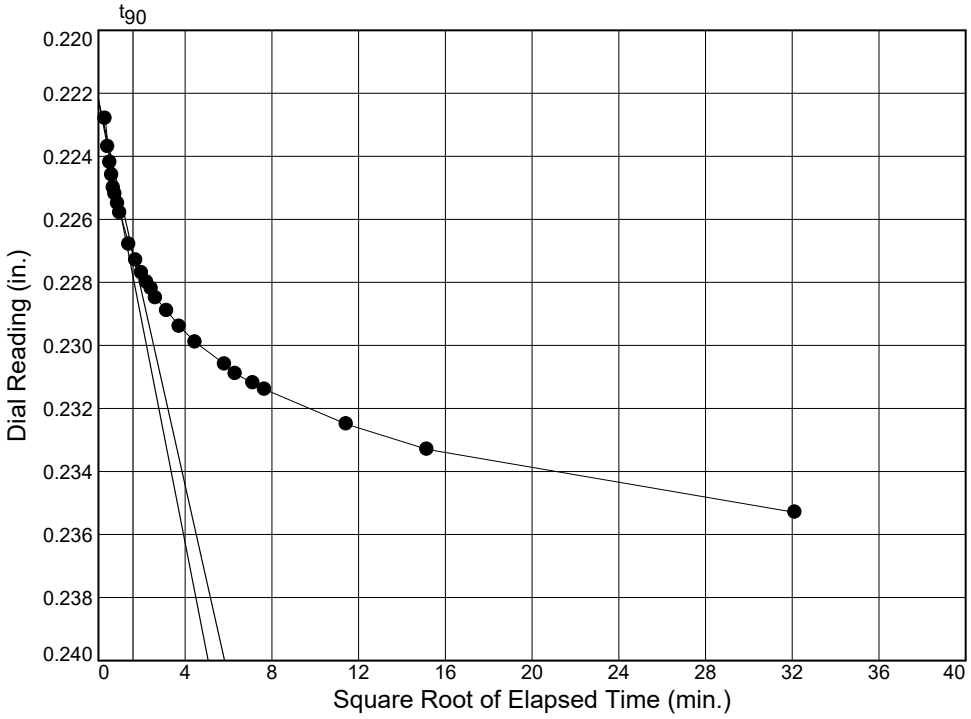
Project No.: B1913000
Project: Upper Pool CAP 204

Source of Sample: 19-21MU Depth: 21-23'



Load No.= 8
Load= 8.00 tsf
D_0 = 0.1942
D_{90} = 0.1994
D_{100} = 0.2000
T_{90} = 2.32 min.

C_v @ T_{90}
0.786 ft.^{2}/day



Load No.= 13
Load= 16.00 tsf
D_0 = 0.2222
D_{90} = 0.2271
D_{100} = 0.2276
T_{90} = 2.54 min.

C_v @ T_{90}
0.679 ft.^{2}/day

Figure

CONSOLIDATION TEST DATA

12/11/2019

Client: USACE
Project: Upper Pool CAP 204
W912ES19P0092
Project Number: B1913000
Location: 19-21MU
Depth: 21-23'
Material Description: SILT, brown (ML)
Liquid Limit: 31 **Plasticity Index:** 4
Testing Remarks: ASTM D 2435

Test Specimen Data

NATURAL MOISTURE
Wet w+t = 94.46 g.
Dry w+t = 78.53 g.
Tare Wt. = 32.35 g.
Moisture = 34.5 %

VOID RATIO
Spec. Gr. = 2.70
Est. Ht. Solids = 0.516 in.
Init. V.R. = 0.937
Init. Sat. = 99.4 %

AFTER TEST
Wet w+t = 378.43 g.
Dry w+t = 346.81 g.
Tare Wt. = 235.05 g.
Moisture = 28.3 %

UNIT WEIGHT
Height = 1.000 in.
Diameter = 2.495 in.
Weight = 150.27 g.
Dry Dens. = 87.0 pcf

TEST START
Height = 1.000 in.
Diameter = 2.495 in.

Dry Wt. = 111.76 g.

End-Of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	Deformation (in.)	C_v ($ft.^2$/day)	C_α	Void Ratio	% Strain
start	0.12460		0.00000			0.937	
0.05	0.12650	0.00000	0.00190			0.933	0.2 Comprs.
0.13	0.12950	0.00020	0.00470	3.390		0.928	0.5 Comprs.
0.25	0.13380	0.00030	0.00890	0.842		0.920	0.9 Comprs.
0.50	0.14100	0.00050	0.01590	0.874		0.906	1.6 Comprs.
1.00	0.15180	0.00090	0.02630	0.833		0.886	2.6 Comprs.
2.00	0.16960	0.00140	0.04360	1.218		0.853	4.4 Comprs.
4.00	0.18880	0.00190	0.06230	0.848		0.816	6.2 Comprs.
8.00	0.21090	0.00270	0.08360	0.786		0.775	8.4 Comprs.
2.00	0.20780	0.00140	0.08180			0.779	8.2 Comprs.
0.50	0.20350	0.00050	0.07840			0.785	7.8 Comprs.
2.00	0.20660	0.00360	0.07840			0.785	7.8 Comprs.
8.00	0.21540	0.00360	0.08720			0.768	8.7 Comprs.
16.00	0.23890	0.00360	0.11070	0.679		0.723	11.1 Comprs.
4.00	0.23500	0.00190	0.10850			0.727	10.8 Comprs.
1.00	0.23060	0.00090	0.10510			0.733	10.5 Comprs.
0.25	0.22530	0.00030	0.10040			0.743	10.0 Comprs.
0.05	0.21530	0.00000	0.09070			0.761	9.1 Comprs.

Compression index (C_c), tsf = 0.17 **Preconsolidation pressure (P_p), tsf =** 2.1 **Void ratio at P_p (e_m) =** 0.851
Recompression index (C_r) = 0.03

Braun Intertec

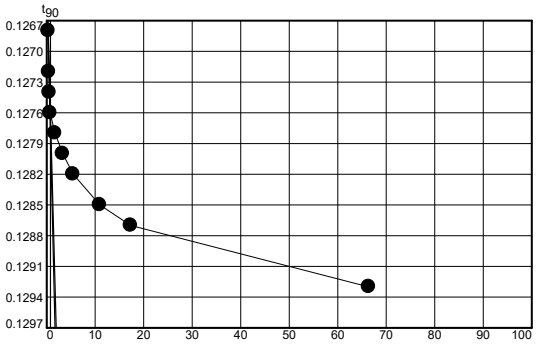
Pressure: 0.05 tsf | **TEST READINGS** | **Load No. 1**

No.	Elapsed Time	Dial Reading
1	0	0.12460
2	1440	0.12650

Void Ratio = 0.933 **Compression =** 0.2%

Pressure: 0.13 tsf | **TEST READINGS** | **Load No. 2**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.12650	11	4411	0.12950
2	.1	0.12700			
3	.2	0.12740			
4	.3	0.12760			
5	.5	0.12780			
6	3	0.12800			
7	11	0.12820			
8	30	0.12840			
9	120	0.12870			
10	300	0.12890			

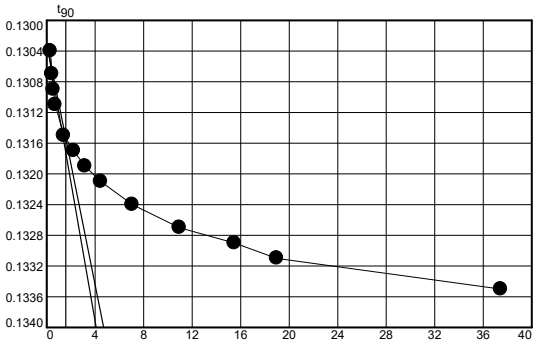


Void Ratio = 0.928 **Compression =** 0.5%

D_0 = 0.1262 **D_{90} =** 0.1276 **D_{100} =** 0.1278 **C_V at 0.62 min. =** 3.390 ft.^{2}/day

Pressure: 0.25 tsf | **TEST READINGS** | **Load No. 3**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.12950	11	120	0.13300
2	.1	0.13070	12	240	0.13320
3	.2	0.13100	13	360	0.13340
4	.3	0.13120	14	1402	0.13380
5	.5	0.13140			
6	2	0.13180			
7	5	0.13200			
8	10	0.13220			
9	20	0.13240			
10	50	0.13270			

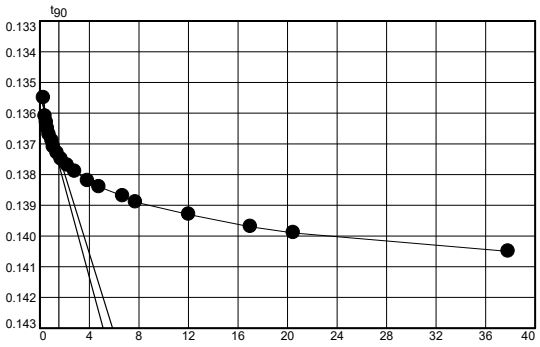


Void Ratio = 0.920 **Compression =** 0.9%

D_0 = 0.1303 **D_{90} =** 0.1315 **D_{100} =** 0.1317 **C_V at 2.48 min. =** 0.842 ft.^{2}/day

Pressure: 0.50 tsf | **TEST READINGS** | **Load No. 4**

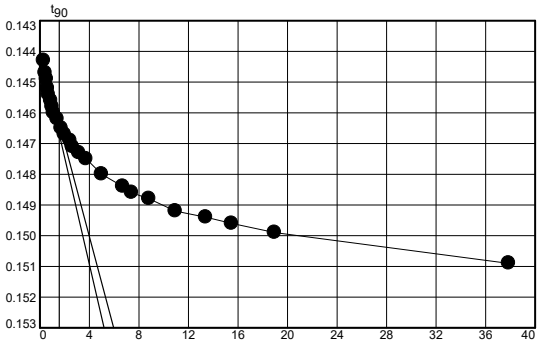
No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.13380	11	5	0.13820
2	.1	0.13600	12	8	0.13840
3	.2	0.13660	13	15	0.13870
4	.3	0.13680	14	23	0.13890
5	.4	0.13700	15	45	0.13920
6	.6	0.13720	16	60	0.13940
7	1	0.13740	17	145	0.13980
8	1.25	0.13760	18	290	0.14020
9	2	0.13780	19	420	0.14040
10	3	0.13800	20	1432	0.14100



Void Ratio = 0.906 **Compression =** 1.6%
D_0 = 0.1354 **D_{90} =** 0.1374 **D_{100} =** 0.1376 **C_V at 2.37 min. =** 0.874 ft.^{2}/day

Pressure: 1.00 tsf | **TEST READINGS** | **Load No. 5**

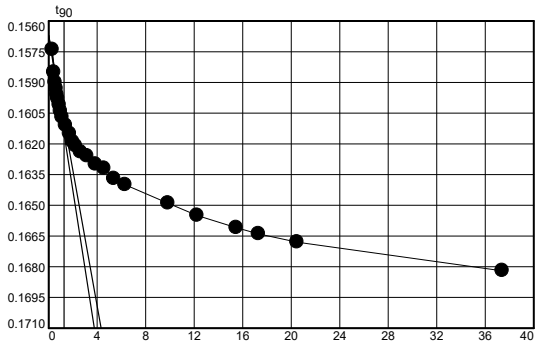
No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.14100	14	7	0.14800
2	.1	0.14520	15	10	0.14820
3	.2	0.14560	16	14	0.14840
4	.3	0.14580	17	25	0.14890
5	.4	0.14610	18	45	0.14930
6	.5	0.14630	19	55	0.14950
7	.8	0.14650	20	78	0.14970
8	1	0.14670	21	120	0.15010
9	1.25	0.14690	22	180	0.15030
10	2	0.14710	23	240	0.15050
11	3	0.14740	24	360	0.15080
12	4	0.14760	25	1434	0.15180
13	6	0.14780			



Void Ratio = 0.886 **Compression =** 2.6%
D_0 = 0.1440 **D_{90} =** 0.1463 **D_{100} =** 0.1466 **C_V at 2.44 min. =** 0.833 ft.^{2}/day

Pressure: 2.00 tsf | **TEST READINGS** | **Load No. 6**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.15180	14	5	0.16350
2	.1	0.15880	15	7	0.16380
3	.2	0.15990	16	10	0.16400
4	.3	0.16040	17	15	0.16440
5	.4	0.16070	18	21	0.16460
6	.5	0.16100	19	29	0.16510
7	.6	0.16120	20	40	0.16540
8	.8	0.16150	21	97	0.16630
9	1	0.16180	22	150	0.16690
10	1.25	0.16210	23	240	0.16750
11	2	0.16250	24	300	0.16780
12	3	0.16290	25	420	0.16820
13	4	0.16330	26	1400	0.16960

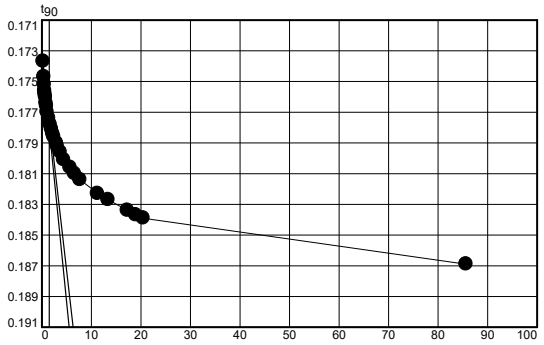


Void Ratio = 0.853 **Compression =** 4.4%

D_0 = 0.1567 **D_{90} =** 0.1609 **D_{100} =** 0.1614 **C_V at 1.62 min. =** 1.218 ft.^{2}/day

Pressure: 4.00 tsf | **TEST READINGS** | **Load No. 7**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.16960	15	6	0.18050
2	.1	0.17560	16	9	0.18090
3	.2	0.17660	17	10	0.18110
4	.3	0.17710	18	14	0.18150
5	.4	0.17750	19	20	0.18200
6	.5	0.17770	20	33	0.18250
7	.6	0.17790	21	44	0.18290
8	.8	0.17830	22	60	0.18330
9	1	0.17850	23	128	0.18420
10	1.25	0.17890	24	180	0.18460
11	2	0.17930	25	300	0.18530
12	3	0.17970	26	360	0.18560
13	4	0.18000	27	420	0.18580
14	5	0.18030	28	7346	0.18880

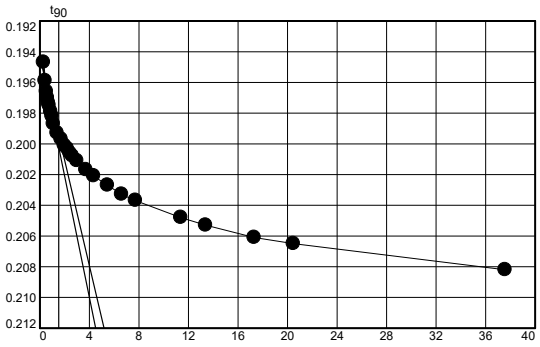


Void Ratio = 0.816 **Compression =** 6.2%

D_0 = 0.1733 **D_{90} =** 0.1775 **D_{100} =** 0.1780 **C_V at 2.24 min. =** 0.848 ft.^{2}/day

Pressure: 8.00 tsf | **TEST READINGS** | **Load No. 8**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.18880	15	6	0.20330
2	.1	0.19740	16	7	0.20350
3	.2	0.19860	17	9	0.20380
4	.3	0.19930	18	14	0.20440
5	.4	0.19970	19	19	0.20480
6	.5	0.20000	20	30	0.20540
7	.6	0.20020	21	44	0.20600
8	.8	0.20060	22	60	0.20640
9	1	0.20090	23	130	0.20750
10	1.25	0.20140	24	180	0.20800
11	2	0.20200	25	300	0.20880
12	3	0.20240	26	420	0.20920
13	4	0.20280	27	1413	0.21090
14	5	0.20300			



Void Ratio = 0.775 **Compression =** 8.4%

D_0 = 0.1942 **D_{90} =** 0.1994 **D_{100} =** 0.2000 **C_V at 2.32 min. =** 0.786 ft.^{2}/day

Pressure: 2.00 tsf | **TEST READINGS** | **Load No. 9**

No.	Elapsed Time	Dial Reading
1	0	0.21090
2	1388	0.20780

Void Ratio = 0.779 **Compression =** 8.2%

Pressure: 0.50 tsf | **TEST READINGS** | **Load No. 10**

No.	Elapsed Time	Dial Reading
1	0	0.20780
2	1440	0.20350

Void Ratio = 0.785 **Compression =** 7.8%

Pressure: 2.00 tsf | **TEST READINGS** | **Load No. 11**

No.	Elapsed Time	Dial Reading
1	0	0.20350
2	2880	0.20660

Void Ratio = 0.785 **Compression =** 7.8%

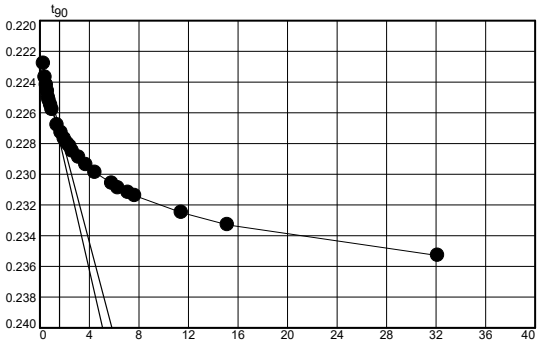
Pressure: 8.00 tsf | **TEST READINGS** | **Load No. 12**

No.	Elapsed Time	Dial Reading
1	0	0.20660
2	1440	0.21540

Void Ratio = 0.768 **Compression =** 8.7%

Pressure: 16.00 tsf | **TEST READINGS** | **Load No. 13**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0	0.21540	14	6	0.23180
2	.1	0.22640	15	7	0.23210
3	.2	0.22730	16	10	0.23250
4	.3	0.22780	17	14	0.23300
5	.4	0.22820	18	20	0.23350
6	.5	0.22860	19	34	0.23420
7	.6	0.22880	20	40	0.23450
8	.8	0.22910	21	51	0.23480
9	1.	0.22940	22	59	0.23500
10	2	0.23040	23	131	0.23610
11	3	0.23090	24	230	0.23690
12	4	0.23130	25	1033	0.23890
13	5	0.23160			



Void Ratio = 0.723 **Compression =** 11.1%

D_0 = 0.2222 **D_{90} =** 0.2271 **D_{100} =** 0.2276 **C_V at 2.54 min. =** 0.679 ft.^{2}/day

Pressure: 4.00 tsf | **TEST READINGS** | **Load No. 14**

No.	Elapsed Time	Dial Reading
1	0	0.23890
2	1440	0.23500

Void Ratio = 0.727 **Compression =** 10.8%

Pressure: 1.00 tsf | **TEST READINGS** | **Load No. 15**

No.	Elapsed Time	Dial Reading
1	0	0.23500
2	1441	0.23060

Void Ratio = 0.733 **Compression =** 10.5%

Pressure: 0.25 tsf	TEST READINGS	Load No. 16

No.	Elapsed Time	Dial Reading
1	0	0.23060
2	4200	0.22530

Void Ratio = 0.743 **Compression =** 10.0%

Pressure: 0.05 tsf	TEST READINGS	Load No. 17

No.	Elapsed Time	Dial Reading
1	0	0.22530
2	1473	0.21530

Void Ratio = 0.761 **Compression =** 9.1%

Calculated by: GSW
Date: 12/23/2019
Calculation: Consolidation Settlement
Location: Boring 17-12M

Material	γ (pcf)	LL	C_c	e_o
ML "ooze-like"	90	70	0.54	1.1
SM	115			
CL	110	52	0.378	1.1
CH	110	77	0.603	1.1
dredge sand	115			
water	62.4			

Assumptions:

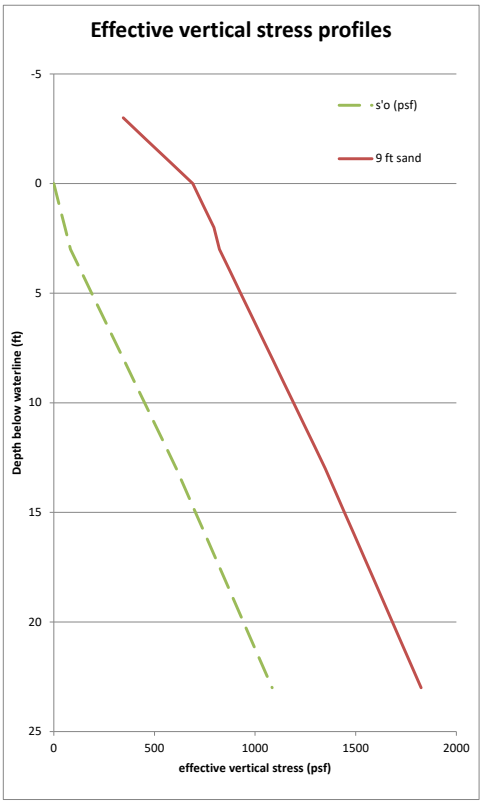
1 Soils are normally consolidated at LCP
2 C_c is approximated with Cc = 0.009(LL-10), per Terzaghi and Peck (1967)
3 Assume 1 ft lateral displacement of upper "ooze-like" layer,

TOTAL 1.6 FT
20 IN

Boring 19-12M LCP = 666

	Elev (ft)	depth (ft)	u (psf)	σ_o (psf)	σ'_o (psf)	σ (psf)	σ'_p (psf)	S	S (cumulative) (ft)
	672	-6				0	0		
Planned GSE = 671	671	-5				115	115		
	670	-4				230	230		
	669	-3				345	345		
	668	-2				460	460		
	667	-1				575	575		
Existing GSE = 666	666	0	0	0	0	690	690		
	665	1	62.4	90	27.6	805	742.6		
	664	2	124.8	180	55.2	920	795.2		
	663	3	187.2	270	82.8	1010	822.8	0.256439	1.648918
	662	4	249.6	385	135.4	1125	875.4	0	1.392479
	661	5	312	500	188	1240	928	0	1.392479
	660	6	374.4	615	240.6	1355	980.6	0	1.392479
	659	7	436.8	730	293.2	1470	1033.2	0	1.392479
	658	8	499.2	845	345.8	1585	1085.8	0	1.392479
	657	9	561.6	960	398.4	1700	1138.4	0	1.392479
	656	10	624	1075	451	1815	1191	0	1.392479
	655	11	686.4	1190	503.6	1930	1243.6	0	1.392479
	654	12	748.8	1305	556.2	2045	1296.2	0	1.392479
	653	13	811.2	1420	608.8	2160	1348.8	0	1.392479
	652	14	873.6	1530	656.4	2270	1396.4	0.059011	1.392479
	651	15	936	1640	704	2380	1444	0.056159	1.333467
	650	16	998.4	1750	751.6	2490	1491.6	0.05358	1.277308
	649	17	1060.8	1860	799.2	2600	1539.2	0.051235	1.223729
	648	18	1123.2	1970	846.8	2710	1586.8	0.049093	1.172493
	647	19	1185.6	2080	894.4	2820	1634.4	0.047129	1.1234
	646	20	1248	2190	942	2930	1682	0.04532	1.076271
	645	21	1310.4	2300	989.6	3040	1729.6	0.043647	1.030952
	644	22	1372.8	2410	1037.2	3150	1777.2	0.042097	0.987304
	643	23	1435.2	2520	1084.8	3260	1824.8	0.040656	0.945207
	642	24	1497.6	2630	1132.4	3370	1872.4	0.039312	0.904551
	641	25	1560	2740	1180	3480	1920	0.038055	0.865239
	640	26	1622.4	2850	1227.6	3590	1967.6	0.036878	0.827184
	639	27	1684.8	2960	1275.2	3700	2015.2	0.035773	0.790305
	638	28	1747.2	3070	1322.8	3810	2062.8	0.034733	0.754532
	637	29	1809.6	3180	1370.4	3920	2110.4	0.053844	0.719799
	636	30	1872	3290	1418	4030	2158	0.052368	0.665955
	635	31	1934.4	3400	1465.6	4140	2205.6	0.050971	0.613587
	634	32	1996.8	3510	1513.2	4250	2253.2	0.049648	0.562616
	633	33	2059.2	3620	1560.8	4360	2300.8	0.048393	0.512968
End of boring = 645	632	34	2121.6	3730	1608.4	4470	2348.4	0.0472	0.464575
	631	35	2184	3840	1656	4580	2396	0.046065	0.417375
	630	36	2246.4	3950	1703.6	4690	2443.6	0.044985	0.37131
	629	37	2308.8	4060	1751.2	4800	2491.2	0.043954	0.326325
	628	38	2371.2	4170	1798.8	4910	2538.8	0.04297	0.282372
	627	39	2433.6	4280	1846.4	5020	2586.4	0.042029	0.239402
	626	40	2496	4390	1894	5130	2634	0.041129	0.197373
	625	41	2558.4	4500	1941.6	5240	2681.6	0.040267	0.156244
	624	42	2620.8	4610	1989.2	5350	2729.2	0.039441	0.115977
	623	43	2683.2	4720	2036.8	5460	2776.8	0.038648	0.076535
	622	44	2745.6	4830	2084.4	5570	2824.4	0.037887	0.037887

Assumed bottom of compressible stratum = 622



Calculated by: GSW
Date: 12/23/2019
Calculation: Consolidation Settlement
Location: Boring 19-17M

Material	γ (pcf)	LL	C_c	e_o
CL-ML "ooze-like"	90	70	0.54	1
CL-ML, CL, CL-CH	110	45	0.32	1
Foundation sands and si	115			
dredge sand	115			
water	62.4			

Assumptions:

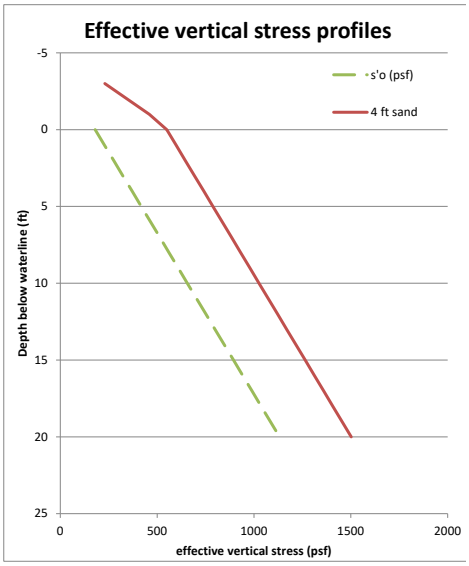
1 Soils are normally consolidated at LCP
2 C_c is approximated with Cc = 0.009(LL-10), per Terzaghi and Peck (1967)
3 Assume lateral displacement of 1 ft upper "ooze-like" layer

TOTAL	0.6	FT
	7	IN

LCP = 666

4 ft sand

Boring 19-17M	Elev (ft) - bottom of increment	depth (ft)	u (psf)	σ_o (psf)	σ'_o (psf)	σ (psf)	σ'_p (psf)	S	S (cumulative) (ft)
	672	-6							
	671	-5							
Planned GSE = 671	670	-4				115	115		
	669	-3				230	230		
	668	-2				345	345		
Existing GSE = 668	667	-1		90	90	460	460		
	666	0		180	180	550	550	0.130974	0.602056
	665	1	62.4	290	227.6	660	597.6	0.06603	0.471082
	664	2	124.8	400	275.2	770	645.2	0.058282	0.405052
	663	3	187.2	510	322.8	880	692.8	0.052239	0.34677
	662	4	249.6	620	370.4	990	740.4	0.047375	0.294531
	661	5	312	730	418	1100	788	0.043368	0.247156
	660	6	374.4	840	465.6	1210	835.6	0.040003	0.203788
	659	7	436.8	950	513.2	1320	883.2	0.037134	0.163786
	658	8	499.2	1060	560.8	1430	930.8	0.034658	0.126651
	657	9	561.6	1170	608.4	1540	978.4	0.032497	0.091994
	656	10	624	1280	656	1650	1026	0.030593	0.059497
	655	11	686.4	1390	703.6	1760	1073.6	0.028904	0.028904
	654	12	748.8	1500	751.2	1870	1121.2		0
	653	13	811.2	1610	798.8	1980	1168.8		0
	652	14	873.6	1720	846.4	2090	1216.4		0
	651	15	936	1830	894	2200	1264		0
	650	16	998.4	1940	941.6	2310	1311.6		0
	649	17	1060.8	2050	989.2	2420	1359.2		0
	648	18	1123.2	2160	1036.8	2530	1406.8		0
	647	19	1185.6	2270	1084.4	2640	1454.4		0
	646	20	1248	2380	1132	2750	1502		0



Calculated by: GSW
Date: 12/23/2019
Calculation: Consolidation Settlement
Location: Boring 19-18M

Material	γ (pcf)	LL	C_c	e_o
CL/ML "ooze"	90	70	0.54	1
CL-ML, CL, CL-CH	110	40	0.27	1
dredge sand	115			
water	62.4			

Assumptions:

1 Soils are normally consolidated at LCP
2 C_c is approximated with Cc = 0.009(LL-10), per Terzaghi and Peck (1967)
3 Assume 1 ft lateral displacement of upper "ooze-like" layer,

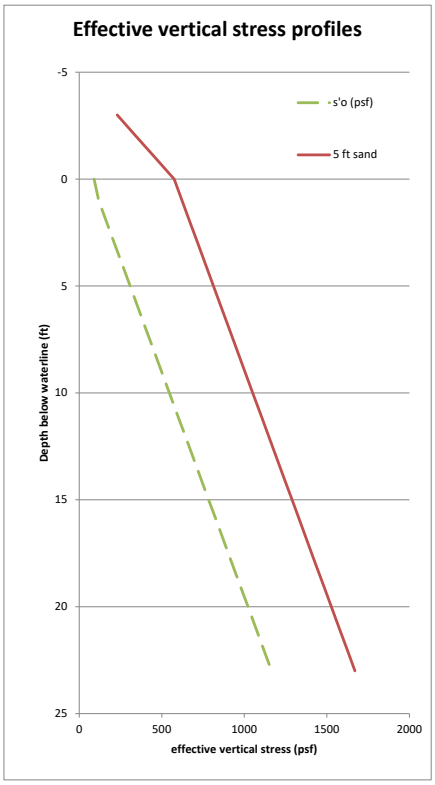
TOTAL 1.4 FT
17 IN

LCP = 666

5 ft sand

Boring 19-18M	Elev (ft) - bottom of increment	depth (ft)	u (psf)	σ_o (psf)	σ'_o (psf)	σ (psf)	σ'_p (psf)	S	S (cumulative) (ft)
	672	-6							
	671	-5							
Planned GSE = 671	670	-4				115	115		
	669	-3				230	230		
	668	-2				345	345		
	667	-1				460	460		
Existing GSE = 667	666	0		90	90	575	575		
	665	1	62.4	180	117.6	685	622.6	0.195426	1.377429
	664	2	124.8	290	165.2	795	670.2	0.082106	1.182002
	663	3	187.2	400	212.8	905	717.8	0.071284	1.099896
	662	4	249.6	510	260.4	1015	765.4	0.063213	1.028612
	661	5	312	620	308	1125	813	0.056908	0.965398
	660	6	374.4	730	355.6	1235	860.6	0.051818	0.908491
	659	7	436.8	840	403.2	1345	908.2	0.047609	0.856672
	658	8	499.2	950	450.8	1455	955.8	0.044062	0.809063
	657	9	561.6	1060	498.4	1565	1003.4	0.041026	0.765001
	656	10	624	1170	546	1675	1051	0.038395	0.723975
	655	11	686.4	1280	593.6	1785	1098.6	0.036092	0.68558
	654	12	748.8	1390	641.2	1895	1146.2	0.034056	0.649488
	653	13	811.2	1500	688.8	2005	1193.8	0.032243	0.615432
	652	14	873.6	1610	736.4	2115	1241.4	0.030618	0.583189
	651	15	936	1720	784	2225	1289	0.029151	0.552571
	650	16	998.4	1830	831.6	2335	1336.6	0.027822	0.52342
	649	17	1060.8	1940	879.2	2445	1384.2	0.02661	0.495598
	648	18	1123.2	2050	926.8	2555	1431.8	0.025501	0.468988
	647	19	1185.6	2160	974.4	2665	1479.4	0.024482	0.443487
	646	20	1248	2270	1022	2775	1527	0.023542	0.419005
End of boring = 645	645	21	1310.4	2380	1069.6	2885	1574.6	0.022673	0.395463
	644	22	1372.8	2490	1117.2	2995	1622.2	0.021866	0.37279
	643	23	1435.2	2600	1164.8	3105	1669.8	0.021116	0.350923
	642	24	1497.6	2710	1212.4	3215	1717.4	0.020415	0.329807
	641	25	1560	2820	1260	3325	1765	0.019761	0.309392
	640	26	1622.4	2930	1307.6	3435	1812.6	0.019147	0.289631
	639	27	1684.8	3040	1355.2	3545	1860.2	0.01857	0.270485
	638	28	1747.2	3150	1402.8	3655	1907.8	0.018028	0.251915
	637	29	1809.6	3260	1450.4	3765	1955.4	0.017516	0.233887
	636	30	1872	3370	1498	3875	2003	0.017033	0.216371
	635	31	1934.4	3480	1545.6	3985	2050.6	0.016576	0.199338
	634	32	1996.8	3590	1593.2	4095	2098.2	0.016143	0.182763
	633	33	2059.2	3700	1640.8	4205	2145.8	0.015732	0.16662
	632	34	2121.6	3810	1688.4	4315	2193.4	0.015342	0.150888
	631	35	2184	3920	1736	4425	2241	0.01497	0.135546
	630	36	2246.4	4030	1783.6	4535	2288.6	0.014617	0.120576
	629	37	2308.8	4140	1831.2	4645	2336.2	0.01428	0.105959
	628	38	2371.2	4250	1878.8	4755	2383.8	0.013958	0.091679
	627	39	2433.6	4360	1926.4	4865	2431.4	0.01365	0.077722
	626	40	2496	4470	1974	4975	2479	0.013355	0.064072
	625	41	2558.4	4580	2021.6	5085	2526.6	0.013074	0.050716
	624	42	2620.8	4690	2069.2	5195	2574.2	0.012803	0.037643
	623	43	2683.2	4800	2116.8	5305	2621.8	0.012544	0.024839
	622	44	2745.6	4910	2164.4	5415	2669.4	0.012295	0.012295

Assumed bottom of compressible stratum = 622



Calculated by: GSW
Date: 12/23/2019
Calculation: Consolidation Settlement
Location: Boring 19-19M

Material	γ (pcf)	LL	C_c	e_o
CH ("ooze-like")	90	69	0.53	1
CL-ML, CL, CL-CH	110	40	0.27	1
dredge sand	115			
water	62.4			

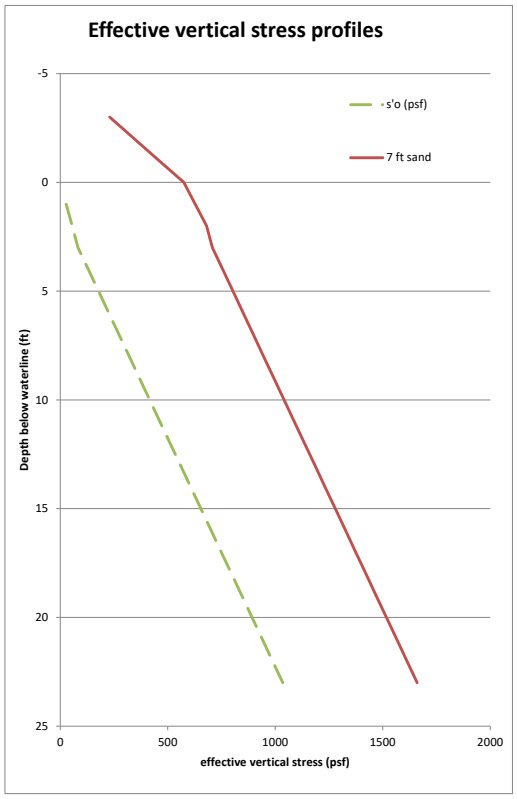
Assumptions:

1 Soils are normally consolidated at LCP
2 Cc is approximated with Cc = 0.009(LL-10)
3 Assume lateral displacement of 2 ft "ooze-like" material

TOTAL	1.7	FT
	20	IN

	LCP = 666							7 ft sand	
Boring 19-19M	Elev (ft)	- botto depth (ft)	u (psf)	σ_o (psf)	σ'_o (psf)	σ (psf)	σ'_p (psf)	S	S (cumulative) (ft)
	672	-6							
	671	-5							
Planned GSE = 671	670	-4				115	115		
	669	-3				230	230		
	668	-2				345	345		
	667	-1				460	460		
	666	0				575	575		
Existing GSE = 666	665	1	62.4	90	27.6	690	627.6		
	664	2	124.8	180	55.2	805	680.2		
	663	3	187.2	270	82.8	895	707.8	0.247414	1.681662
	662	4	249.6	380	130.4	1005	755.4	0.102991	1.434247
	661	5	312	490	178	1115	803	0.08833	1.331256
	660	6	374.4	600	225.6	1225	850.6	0.077812	1.242926
	659	7	436.8	710	273.2	1335	898.2	0.06978	1.165114
	658	8	499.2	820	320.8	1445	945.8	0.063391	1.095334
	657	9	561.6	930	368.4	1555	993.4	0.058159	1.031942
	656	10	624	1040	416	1665	1041	0.053778	0.973784
	655	11	686.4	1150	463.6	1775	1088.6	0.050048	0.920005
	654	12	748.8	1260	511.2	1885	1136.2	0.046827	0.869958
	653	13	811.2	1370	558.8	1995	1183.8	0.044013	0.823131
	652	14	873.6	1480	606.4	2105	1231.4	0.041531	0.779118
	651	15	936	1590	654	2215	1279	0.039325	0.737587
	650	16	998.4	1700	701.6	2325	1326.6	0.037348	0.698262
	649	17	1060.8	1810	749.2	2435	1374.2	0.035566	0.660914
	648	18	1123.2	1920	796.8	2545	1421.8	0.033951	0.625348
	647	19	1185.6	2030	844.4	2655	1469.4	0.03248	0.591397
	646	20	1248	2140	892	2765	1517	0.031134	0.558917
End of boring = 645	645	21	1310.4	2250	939.6	2875	1564.6	0.029897	0.527783
	644	22	1372.8	2360	987.2	2985	1612.2	0.028757	0.497886
	643	23	1435.2	2470	1034.8	3095	1659.8	0.027702	0.469129
	642	24	1497.6	2580	1082.4	3205	1707.4	0.026723	0.441428
	641	25	1560	2690	1130	3315	1755	0.025812	0.414705
	640	26	1622.4	2800	1177.6	3425	1802.6	0.024962	0.388893
	639	27	1684.8	2910	1225.2	3535	1850.2	0.024167	0.363931
	638	28	1747.2	3020	1272.8	3645	1897.8	0.023421	0.339765
	637	29	1809.6	3130	1320.4	3755	1945.4	0.022721	0.316343
	636	30	1872	3240	1368	3865	1993	0.022062	0.293622
	635	31	1934.4	3350	1415.6	3975	2040.6	0.02144	0.271561
	634	32	1996.8	3460	1463.2	4085	2088.2	0.020853	0.25012
	633	33	2059.2	3570	1510.8	4195	2135.8	0.020298	0.229267
	632	34	2121.6	3680	1558.4	4305	2183.4	0.019771	0.208969
	631	35	2184	3790	1606	4415	2231	0.019272	0.189198
	630	36	2246.4	3900	1653.6	4525	2278.6	0.018797	0.169926
	629	37	2308.8	4010	1701.2	4635	2326.2	0.018345	0.151129
	628	38	2371.2	4120	1748.8	4745	2373.8	0.017915	0.132784
	627	39	2433.6	4230	1796.4	4855	2421.4	0.017505	0.114869
	626	40	2496	4340	1844	4965	2469	0.017113	0.097364
	625	41	2558.4	4450	1891.6	5075	2516.6	0.016738	0.080251
	624	42	2620.8	4560	1939.2	5185	2564.2	0.016379	0.063513
	623	43	2683.2	4670	1986.8	5295	2611.8	0.016036	0.047134
	622	44	2745.6	4780	2034.4	5405	2659.4	0.015707	0.031098
	621	45	2808	4890	2082	5515	2707	0.015391	0.015391

Assumed bottom of compressible stratum = 621



Calculated by: GSW
Date: 12/23/2019
Calculation: Consolidation Settlement
Location: Boring 19-20M

Material	γ_{sat} (pcf)	LL	C_c	e_o
CH ("ooze-like")	90	69	0.53	1
CL-ML, CL, CL-CH	110	24	0.13	1
CL	110	40	0.27	1
gravelly sand (m. dense	115			
dredge sand	115			
water	62.4			

Assumptions:

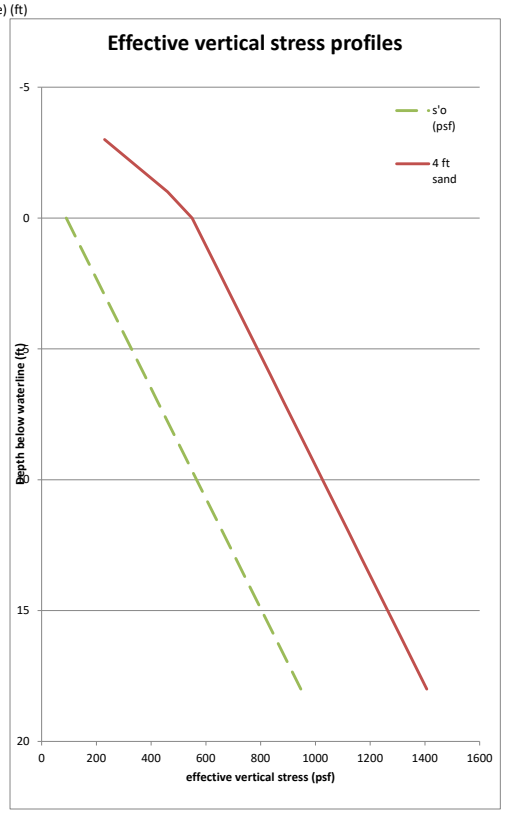
1 Soils are normally consolidated at LCP
2 Cc is approximated with Cc = 0.009(LL-10)
3 Does not account for lateral displacement of upper "ooze-like" layer

TOTAL	0.8	FT
	10	IN

LCP = 666

4 ft sand

Boring 19-20M	Elev (ft) - bot	depth (ft)	u (psf)	σ_o (psf)	σ'_o (psf)	σ (psf)	σ'_p (psf)	S	S (cumulative) (ft)
	672	-6							
	671	-5							
Planned GSE = 671	670	-4				115	115		
	669	-3				230	230		
	668	-2				345	345		
	667	-1				460	460		
Existing GSE = 667	666	0		90	90	550	550	0.208715	0.813158
	665	1	62.4	200	137.6	660	597.6	0.040181	0.604443
	664	2	124.8	310	185.2	770	645.2	0.034149	0.564262
	663	3	187.2	420	232.8	880	692.8	0.029838	0.530113
	662	4	249.6	530	280.4	990	740.4	0.026566	0.500274
	661	5	312	640	328	1100	788	0.051388	0.473708
	660	6	374.4	750	375.6	1210	835.6	0.046882	0.42232
	659	7	436.8	860	423.2	1320	883.2	0.043134	0.375438
	658	8	499.2	970	470.8	1430	930.8	0.039963	0.332304
	657	9	561.6	1080	518.4	1540	978.4	0.03724	0.292341
	656	10	624	1190	566	1650	1026	0.034875	0.255101
	655	11	686.4	1300	613.6	1760	1073.6	0.032799	0.220226
	654	12	748.8	1410	661.2	1870	1121.2	0.030962	0.187427
	653	13	811.2	1520	708.8	1980	1168.8	0.029324	0.156465
	652	14	873.6	1630	756.4	2090	1216.4	0.027854	0.127141
	651	15	936	1740	804	2200	1264	0.026526	0.099287
	650	16	998.4	1850	851.6	2310	1311.6	0.025321	0.072761
	649	17	1060.8	1960	899.2	2420	1359.2	0.024223	0.047439
	648	18	1123.2	2070	946.8	2530	1406.8	0.023217	0.023217
gravelly sand (N = 16)	647								
	646								
	645								
	644								
	643								
End of boring = 643	642								



Assumed bottom of compressible stratum = 621

Calculated by: GSW
Date: 12/23/2019
Calculation: Consolidation Settlement
Location: Boring 19-21M

Material	γ (pcf)	LL	C_c	e_o
CL/ML ooze	90	70	0.54	1
CL-ML, CL, CL-CH	110	45	0.32	1
CH	110	64	0.49	1
Foundation sands and s	115		0	0
dredge sand	115			
water	62.4			

Assumptions:

1 Soils are normally consolidated at LCP
2 Cc is approximated with Cc = 0.009(LL-10)
3 Assume 2 ft lateral displacement of "ooze-like" material

TOTAL	1.3	FT
	15	IN

LCP = 666

Boring 19-21M	Elev (ft) - botte	depth (ft)	u (psf)	σ_o (psf)	σ'_o (psf)	**5 ft sand** σ (psf)	σ'_p (psf)	S	S (cumulative) (ft)
Planned GSE = 672	672	-6				0	0		
	671	-5				115	115		
	670	-4				230	230		
Existing GSE = 669	669	-3		0	0	345	345		
	668	-2		90	90	460	460		
	667	-1		180	180	570	570	0.135163	1.283301
	666	0	0	270	270	680	680	0.108309	1.148138
	665	1	62.4	385	322.6	795	732.6	0	1.039829
SP, SC (N = 5)	664	2	124.8	500	375.2	910	785.2	0	1.039829
	663	3	187.2	615	427.8	1025	837.8	0	1.039829
	662	4	249.6	725	475.4	1135	885.4	0.042538	1.039829
	661	5	312	835	523	1245	933	0.039592	0.997291
	660	6	374.4	945	570.6	1355	980.6	0.037038	0.957699
	659	7	436.8	1055	618.2	1465	1028.2	0.034799	0.920661
	658	8	499.2	1165	665.8	1575	1075.8	0.032821	0.885862
	657	9	561.6	1275	713.4	1685	1123.4	0.031059	0.853041
	656	10	624	1385	761	1795	1171	0.02948	0.821982
	655	11	686.4	1495	808.6	1905	1218.6	0.028055	0.792502
	654	12	748.8	1605	856.2	2015	1266.2	0.026764	0.764447
	653	13	811.2	1715	903.8	2125	1313.8	0.025587	0.737683
	652	14	873.6	1825	951.4	2235	1361.4	0.024511	0.712096
	651	15	936	1935	999	2345	1409	0.023522	0.687586
	650	16	998.4	2045	1046.6	2455	1456.6	0.022611	0.664064
	649	17	1060.8	2155	1094.2	2565	1504.2	0.021768	0.641453
	648	18	1123.2	2265	1141.8	2675	1551.8	0.032379	0.619685
	647	19	1185.6	2375	1189.4	2785	1599.4	0.031257	0.587307
	646	20	1248	2485	1237	2895	1647	0.030211	0.55605
	645	21	1310.4	2595	1284.6	3005	1694.6	0.029233	0.525839
	644	22	1372.8	2705	1332.2	3115	1742.2	0.028316	0.496606
	643	23	1435.2	2815	1379.8	3225	1789.8	0.027456	0.46829
	642	24	1497.6	2925	1427.4	3335	1837.4	0.026647	0.440834
	641	25	1560	3035	1475	3445	1885	0.025884	0.414187
	640	26	1622.4	3145	1522.6	3555	1932.6	0.025164	0.388303
	639	27	1684.8	3255	1570.2	3665	1980.2	0.024483	0.363138
	638	28	1747.2	3365	1617.8	3775	2027.8	0.023838	0.338655
	637	29	1809.6	3475	1665.4	3885	2075.4	0.023227	0.314817
	636	30	1872	3585	1713	3995	2123	0.022646	0.29159
	635	31	1934.4	3695	1760.6	4105	2170.6	0.022093	0.268944
End of boring = 634	634	32	1996.8	3805	1808.2	4215	2218.2	0.021567	0.246851
	633	33	2059.2	3915	1855.8	4325	2265.8	0.021066	0.225284
	632	34	2121.6	4025	1903.4	4435	2313.4	0.020587	0.204218
	631	35	2184	4135	1951	4545	2361	0.02013	0.183631
	630	36	2246.4	4245	1998.6	4655	2408.6	0.019692	0.163501
	629	37	2308.8	4355	2046.2	4765	2456.2	0.019274	0.143809
	628	38	2371.2	4465	2093.8	4875	2503.8	0.018872	0.124535
	627	39	2433.6	4575	2141.4	4985	2551.4	0.018488	0.105662
	626	40	2496	4685	2189	5095	2599	0.018118	0.087175
	625	41	2558.4	4795	2236.6	5205	2646.6	0.017763	0.069057
	624	42	2620.8	4905	2284.2	5315	2694.2	0.017422	0.051293
	623	43	2683.2	5015	2331.8	5425	2741.8	0.017094	0.033871
	622	44	2745.6	5125	2379.4	5535	2789.4	0.016778	0.016778

Assumed bottom of compressible strata = 622