155 East Broad Street
20th Floor
Columbus, Ohio, 43215

o: 614-222-1330
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October 30, 2020

Ms. Tanowa M. Troupe
Ohio Power Siting Board
PUCO Docketing Division
180 East Broad Street, 11th Floor
Columbus, OH 43215-3716

Re: Case No. 16-253-GA-BTX
Staff Report Condition No. 39

Dear Ms. Troupe:

Please find attached the Geotechnical Engineering Report for the Central Corridor Pipeline project.

Duke Energy Ohio sets forth this communication to certify our adherence with Condition No. 39 of the OPSB's Opinion, Order and Certificate pertaining to Case No. 16-253-GA-BTX.

Please contact me if you have any questions.

Sincerely,

Emily A. Olive, CP
Paralegal

Terracon GeoReport

Geotechnical Engineering Report

C350 Central Corridor Pipeline Expansion
Cincinnati, Hamilton County, Ohio

July 11, 2018; Revised October 7, 2020
Terracon Project No. N1175384

Prepared for:
Duke Energy Corporation, LLC
Cincinnati, Ohio

Prepared by:
Terracon Consultants, Inc.
Cincinnati, Ohio

July 11, 2018; Revised October 7, 2020

Terracon GeoReport

Duke Energy Corporation, LLC
139 East 4th Street
Cincinnati, Ohio 45202

Attn: Mr. James Olberding, PMP – Project Engineer
E: james.olberding@duke-energy.com

Re: Geotechnical Engineering Report
C350 Central Corridor Pipeline Expansion
Cincinnati, Hamilton County, Ohio
Terracon Project No. N1175384

Dear Mr. Olberding:

We have completed the Geotechnical Services for the proposed C350 Central Corridor pipeline project. This study was performed in general accordance with Terracon Proposal No. PN1175384 dated October 5, 2017 and April 1, 2020. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning miscellaneous structure foundations, earthwork and the installation of pipeline for the project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Anurupa S. Kumar, EIT
Staff Geotechnical Engineer

STATE OF OHIO
CRAIG M. DAVIS
E-65462
REGISTERED PROFESSIONAL ENGINEER
10/6/2020

Craig M. Davis, P.E.
Senior Engineer

for: George C. Webb, P.E.
Senior Principal

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon GeoReport logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
EXPLORATION PLANS
EXPLORATION RESULTS (Boring Logs and Laboratory Data)
USDA SOIL SURVEY
SUPPORTING INFORMATION (General Notes and Unified Soil Classification System)
PHOTOGRAPHS OF SITE CONDITIONS
SAFETY RECORDS

Geotechnical Engineering Report

C350 Central Corridor Pipeline Expansion

Cincinnati, Hamilton County, Ohio

Terracon Project No. N1175384

July 11, 2018; Revised October 7, 2020

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Central Corridor pipeline expansion to be located at in Cincinnati, Hamilton County, Ohio. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Short-term groundwater conditions
- Excavation support
- Laboratory testing results
- Utility backfill/Earthwork considerations
- Associated structure foundations

The initial (2017) geotechnical engineering scope of services for this project included the advancement of twenty-four test borings to depths ranging from approximately 20 to 101.5 feet below existing site grades. In 2020, Duke requested that five additional borings (20-2 and 20-4 through 20-7) be completed for additional geotechnical information along the pipeline corridor. Borings 20-4 through 20-7 were advanced to depths ranging from approximately 20 to 25 below existing site grades. Test boring (20-2) was terminated at the request of Duke Energy at a depth of 4.5 feet below existing site grades, upon encountering a gasoline odor in the soil sample collected from 3 to 4.5 feet.

A geotechnical engineering study was completed by Terracon in 2016/2017. Four of the borings from the 2016/2017 study (S-1, B-1, B-2 and B-3) have been included in this report as they are located along the north end of the pipe alignment, which terminates at the proposed Highpoint Park Substation.

Maps showing the site and boring locations are shown in the **Exploration Plan** section. The **Exploration and Testing Procedures** section of this report contains a description of the procedures carried out by Terracon during our field exploration and laboratory testing for this project. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section of this report.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly-available geologic and topographic maps.

Item	Description
Parcel Information	Project is located in Cincinnati, Hamilton County, Ohio. The pipeline will start at an existing pipeline at Highpoint that is north of I-275 and east of Conray Road, heading south along Reed Hartman Highway and then west along Glendale-Milford to US 42. The pipeline then continues in the general south direction along US 42, terminating at a new gas transmission station in Norwood, south of Carthage Court (39.17811°, -84.45460°). See **Exploration Plan**.
Current Ground Cover	The proposed pipeline has varied ground cover along the alignment consisting of bare ground, grass and concrete and asphalt pavement.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed in the project planning stage. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	■ Technical Guidelines – Subsurface Investigation and Geotechnical Report – Duke 350 Pipeline and Station ■ Google Earth files of proposed pipeline alignment and proposed geotechnical and environmental boring locations ■ Email and phone correspondence with design team (Burns and McDonell Consultants Inc. and Duke Energy) including boring locations and depths
Proposed Structures	The project consists of the design and installation of a 20-inch diameter steel natural gas pipeline that will span approximately 13 miles. The alignment plans to have 3 major crossings that use horizontal directional drilling (HDD) technology for trenchless installation applications and additional crossings that utilize pilot bore technologies.

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Proposed Structures</td><td>Details of proposed structures to be constructed along the pipeline alignment are listed below.
<table>
<tr><th>Structure</th><th>Axial (kips)</th><th>Shear (kips)</th><th>Moment (kip-ft.)</th><th>Foundation</th><th>Location</th></tr>
<tr><td>Control Building</td><td>28</td><td>2.8</td><td>20</td><td>Slab or Drilled Shaft</td><td>Highpoint & Norwood Stations</td></tr>
<tr><td>Skid</td><td>20</td><td>1</td><td>0.5</td><td>Slab or Spread Footer</td><td>Highpoint & Norwood Stations</td></tr>
<tr><td>Heater</td><td>100</td><td>5</td><td>50</td><td>Slab or Spread Footer</td><td>Highpoint & Norwood Stations</td></tr>
<tr><td>MLV</td><td>10</td><td>0.5</td><td>2.5</td><td>Below Grade Slab</td><td>Summit Park and DOW Chemical</td></tr>
</table></td></tr>
<tr><td>Invert Depth</td><td>The invert of the pipe is generally planned to be approximately 6 to 6.5 feet below ground surface with a minimum 4 feet of cover. The depth of proposed crossings below existing grades is unknown at this time.</td></tr>
</table>

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction. The geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation, foundation options and pavement options. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely. We divided the pipeline alignment into two general physiographic regions, namely the Highland Area and Lowland Area.

The Highland areas are situated in a glacial ground moraine upland with a variable depth of overburden soil and bedrock. The lowland area is located within the Deep Stage age "Norwood Trough", where a wide variety of natural glacial deposits exist and the depth to bedrock is typically greater than 100 feet deep.

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types. In-situ, the transition between materials may be gradual. The following tables provide the general geotechnical characterization per region.

Highland Area

Test Boring locations S1, B1, B2, B3

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency /Density
Surface	1.5 inches	Topsoil	N/A
	3	Aggregate Base	N/A
1	2.5 to 5[1]	Fill: Lean clay, with silt, trace sand and gravel, brown	N/A
2	10 to 25	Clay: Low to medium plasticity, with sand and gravel, brown	Stiff to very stiff, with some soft zones
3	30 to 85[2]	■ Sandy clay/Lean clay/silty clay: Grayish brown to gray, with sand and gravel seams, with limestone fragments and gravel (Glacial Till) ■ Gravel, sand and silt: Brown/gray, some silt (Glacial Outwash) ■ Fat clay: trace gravel, bluish gray ■ Lean Clay: brown, with limestone fragments, trace gravel and sand (Residuum)	■ Sandy clay/Lean clay/ silty clay: hard ■ Sand and Gravel: medium dense to dense ■ Fat clay: Very stiff with soft/wet seams ■ Lean Clay: hard
4	Undetermined: Borings terminated within this stratum at depths ranging from approximately 100 to 102.9 feet	Interbedded Shale and Limestone: brown to gray, completely weathered to highly weathered	Weak to very weak (in terms of rock strength)

1. Stratum 1 was encountered in Borings B1 and B2.
2. Boring SB-1 was terminated at a depth of 22.5 feet in Stratum 3.

Test Boring locations WB-14, WB-15, 20-4, 20-5, 20-6, WB-24 and WB-16

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/Density
Surface	4 to 6 inches	Topsoil	N/A
	1	Pavement and Aggregate Base	N/A
1	1.5 to 9[1]	Fill: Lean to fat clay, trace gravel and sand, some brick fragments	N/A
2	3 to 25[2]	Clay: Low to medium plasticity, with sand and gravel, brown	Medium stiff to very stiff
3	10.5 to 21.5[3]	Lean Clay/Fat Clay: brown, with limestone fragments, trace gravel and sand (Residuum) [2]	Very stiff to hard
4	Undetermined: Borings terminated within this stratum at depths ranging from approximately 16.4 to 25 feet	Interbedded Shale and Limestone: brown to gray, completely weathered to highly weathered	Weak to very weak (in terms of rock strength)

3. Stratum 1 was not encountered in Borings WB-15, WB-16 and WB-24.
4. Boring WB-14 and 20-4 were terminated at depths ranging from 21.5 feet to 25 feet in Stratum 2.
5. Boring WB-15 was terminated at a depth of 21.5 feet in Stratum 3.

Glacial till is a dense conglomerate of silt, clay, sand and gravel that has been mixed, deposited and consolidated by the actions of glacial ice movement. It is commonly encountered with cobble-size fragments and meltwater channel deposits of silt and sand. These channels occasionally transmit groundwater. Glacial till is typically overconsolidated due to its depositional

Glacial outwash soils are deposited by the meltwater of glaciers in advance of the glacier ice or after periods of recession. Due to this depositional method, these deposits are highly stratified in plan location and elevation. These soils consist of sands and gravels. On occasion, they include cobble and boulder sized fractions. Silt and clay layers may also be encountered amongst otherwise granular soils.

Residual soils are derived by near-surface weathering of the parent bedrock to a cohesive soil and are characterized by a soil-like consistency with trace bedding planes and horizontally-aligned limestone fragments indicative of the parent material.
The USDA National Resources Conservation Service Soil Survey indicated that soil conditions encountered at test boring locations along the pipeline alignment in the Highland area consists of Eden silt clay loam and Jonesboro-Rossmoyne silt loam soils. Based on the estimated top of bedrock and geological literature published by the U. S. Geological Survey and the Ohio Geological Survey, the bedrock encountered along the pipeline alignment consists of both the Ordovician Fairview Formation and Waynesville and Arnheim Formation. The Waynesville and

Arnheim Formation is anticipated to be encountered in proximity to test boring WB-16 and typically consists of about 70% of shale and 30% of limestone. The Fairview Formation typically consists of about 35 to 40% of shale, 50% of limestone and 5 to15% of siltstone.

Lowland Area

The southern portion of the gas main alignment lies within the Deep Stage "Norwood Trough", where glacial meltwater scoured a deep valley. The Norwood Trough is the abandoned section of the major intra-glacial drainage system of the Cincinnati area, having its axis established deep into bedrock. Glacial sediments consisting of outwash sand and gravel, lakebed silt and clay, and glacial clay (till) now fill this broad, deep, and extensive feature. These sediments are the remnants of meltwaters of retreating glaciers, still-water deposits of glacial lakes, and the direct deposits made by invading ice lobes into the valley. The test borings in the lowland area encountered these soils interbedded throughout the test boring depths, indicating several advances and retreats of the glaciers

Test Boring locations WB-1 through WB-13, 20-7, WB-17, WB-18, WB-19, WB-20, WB-22

Stratum	Approximate Depth to Bottom of Stratum (feet) [1]	Material Description	Consistency/ Density
Surface	2 to 10 inches	Topsoil	N/A
Surface	7.5 to 12.5	Fill: Lean clay, mixed brown, with silt and rock fragments	N/A
3	Undetermined: Borings terminated within this stratum at depths ranging from approximately 16.5 to 101.5 feet	■ Lean clay: brown/gray, trace gravel and sand ■ Lean clay: brown/gray, trace gravel and sand, varved (Lacustrine) ■ Sandy clay/Lean clay: Brown to gray, with sand and silt seams, trace gravel (Glacial Till) ■ Gravel, sand and silt: Brown/gray, some silt (Glacial Outwash)	■ Lean clay: stiff to hard, with some medium stiff zones ■ Lean clay: stiff to hard ■ Sandy clay/Lean clay: very stiff to hard, some medium stiff to stiff zones ■ Sand and Gravel: medium dense to dense, with some very loose to loose and very dense zones

1. Below existing ground surface

The USDA National Resources Conservation Service Soil Survey indicated that soil conditions encountered at the lowland area boring locations along the pipeline alignment consists of Eden silt clay loam, Genesee loam and Patton silty clay loam soils. Based on encountered soil

conditions up to 12.5 feet of fill was encountered, underlain by native cohesive glacial till soils, interbedded with gravel and sand layers of thickness varying from about 2.5 feet to 20 feet. Some cobbles/boulders were encountered below existing surface grade in the glacial till layer based on the SPT refusal values and the poor sample recovery values.

Corrosivity

Soil minimum electrical resistivity, redox potential, sulfide, and pH tests were performed on one selected representative bulk soil sample collected at planned test boring locations. The tests were performed in accordance with AWWA C105/A21.5 and ASTM A674-10. The values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction. The minimum electrical resistivity, pH, redox potential and sulfide test results are summarized in the table below and are shown in the **Exploration Results** section of this report.

Test No.	Boring ID	Sample Depth Interval (feet)	Minimum Electrical Resistivity (Ohm-cm)	pH	Redox Potential (mV)	Sulfides[1]
1	WB-1	2.5 to 6.5	5238	7.14	+687	Negative
2	WB-1A	2.5 to 6.5	3540	7.56	+680	Negative
3	WB-2	2.5 to 6.5	3346	7.69	+726	Negative
4	WB-2A	2.5 to 6.5	6790	7.31	+682	Negative
5	WB-3	0.0 to 3.5	1891	7.84	+677	Negative
6	WB-5	4.5 to 7.5	2231	7.82	+675	Negative
7	WB-7	4.5 to 7.5	4462	7.22	+699	Negative
8	WB-9	4.5 to 7.5	2377	7.39	+711	Negative
9	WB-11	2.5 to 6.5	2231	8.14	+669	Negative
10	WB-14	4.0 to 6.5	7372	7.83	+715	Negative
11	WB-16	3.0 to 5.5	4462	7.73	+732	Negative
12	WB-18	3.0 to 5.5	1891	7.08	+686	Negative
13	WB-20	4.5 to 7.5	3346	7.40	+700	Negative
14	WB-22	4.0 to 6.5	1552	7.07	+700	Negative
15	WB-24	4.5 to 7.5	1552	7.20	+702	Negative
16	20-4	8.5 to 10	970	8.11	+687	Negative
17	20-5	8.5 to 10	1164	8.06	+686	Negative
18	20-6	8.5 to 10	2425	7.50	+683	Negative
19	20-7	8.5 to 10	3298	7.55	+684	Negative
20	S1	4.5 to 7.5	1649	8.02	+714	Negative

1. Negative – below detection levels

Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. In addition, delayed water levels were also obtained in some borings. The water levels observed in the boreholes can be found on the boring logs in **Exploration Results**, and are summarized below.

Boring Number	Approximate Depth to Groundwater while Drilling (feet) [1]	Approximate Depth to Groundwater after Drilling (feet) [1]
WB-1	12.5	Not encountered
WB-1A	Not encountered	14.7 (20 hr. reading)
WB-2A	35	16.9 (120 hr. reading)
WB-3	31	56.6 (1 hr. reading)
WB-3A	Not encountered	25.7 (1 hr. reading)
WB-5	Not encountered	9 (1 hr. reading)
WB-10	Not encountered	20.9 (24 hr. reading)
WB-11	Not encountered	11.6 (1 hr. reading)
WB-12	Not encountered	61.5 (1 hr. reading)
WB-13	Not encountered	13.5 (1 hr. reading)
WB-17	13.5	Not encountered
WB-20	Not encountered	2 (1 hr. reading)
WB-22	17	7.2 (1 hr. reading)
WB-24	Not encountered	16.1 (1 hr. reading)
20-4	Not encountered	Not encountered
20-5	11	9 (1 hr. reading)[2]
20-6	Not encountered	4.75 (1 hr. reading)[2]
20-7	Not encountered	Not encountered
B1	30.1	13.5[2]
B2	10.1	10.7[2]
B3	16.8	9.2[2]
S1	8.7	5.2

1. Below ground surface.
2. Water was added to boring to facilitate rock coring, and likely affected the water level observed after drilling.

Groundwater was not observed in the remaining borings while drilling, or for the short duration the borings could remain open. However, this does not necessarily mean the borings terminated above groundwater, or the water levels summarized above are stable groundwater levels. Due to the low permeability of the soils encountered in the borings, a relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long term observations in piezometers or

observation wells sealed from the influence of surface water are often required to define static groundwater levels in materials of this type.

Groundwater seepage may be encountered in excavations within the existing fill where perched water may be present. Perched groundwater seepage may be encountered at the existing fill/natural soil interface. Seepage should also be expected at the top of bedrock and within the bedrock itself. Based on our test borings, we anticipate that any perched groundwater seepage encountered within open excavations can typically be controlled with conventional sump pumping. Excavations below the groundwater table will likely require dewatering.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs.

Gas Pockets/PID Readings

Gas was encountered in test boring WB-1 at a depth of about 34 feet below the ground surface, approximate elevation of 523.5 feet. The gas was observed by the drill crew and then detected using a Photoionization Detector (PID) device, that measures in parts-per-million (ppm). No sampling or testing of the gas was performed at the test borings, but it is expected to be methane, based on Terracon's experience with the area. Drilling was postponed in WB-1 to allow gas pressure to dissipate prior to abandonment. In WB-9, the PID readings was attributed to a possible past, shallow spill and not trapped gas. A PID reading was noted from a depth of about 0.2 to 3 feet below ground but no gas pocket was encountered during drilling.

GEOTECHNICAL OVERVIEW

Based on the proposed pipeline alignment and encountered test boring conditions, the pipeline passes through varied subsurface conditions consisting of cohesive clay/silty clay and non-cohesive silt, sand and gravel soils. Hard glacial till and varved lacustrine deposits were encountered in the lowland borings. Some cobbles and boulders were encountered based on the SPT refusal values and the poor sample recovery values. Bedrock was encountered at test borings 20-5, 20-6, WB-16 and WB-24 at depths ranging from about 10.5 to 15.8 feet.

Lean clay and cohesive silt were encountered. These soils could become unstable during typical earthwork and construction traffic especially after precipitation events. Drainage measures for the control building and other structures along the pipeline alignment should be implemented early in the construction sequence and maintained after construction to avoid potential issues. If possible, the earthwork should be performed during the warmer and drier time of the year. If earthwork is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist.

Boring S1 was located in close proximity to the proposed Highpoint Park Substation, a portion of which is to be constructed in an existing wetland area. Based on the wet ground conditions observed at the site and the subsurface conditions encountered in the test boring (S-1), it is anticipated that unstable subgrade conditions will be of particular concern during and after construction. We recommend that precautions be taken to reduce the flow of groundwater from adjacent wetland areas onto the substation site. Temporary dewatering may be required for pipe installation trenches. Equipment pads should be undercut to stiff soils and replaced with low-strength concrete. To provide support of vehicle loads during and after construction, a geosynthetic should be place on the subgrade prior to the aggregate pavement for purposes of reinforcement/separation. Further discussion regarding construction at Highpoint Park Station has been included in our **Earthwork** and **Shallow Foundations** section.

Fat plastic clays were encountered in test boring 20-7 and WB-24, which can be prone to shrink-swell movements due to moisture changes resulting from construction exposure. Fill was encountered in test borings WB-3, WB-3A, WB-4, WB-5, WB-9, WB-10, WB-11, WB-12, WB-13, WB-17, WB-18, WB-19, WB-22, 20-4, 20-5, 20-6 and 20-7 to depths ranging from 1.5 feet to 35 feet.

A gas pocket was encountered in test boring WB-1 at depth of about 34 feet below existing ground surface.

The **Geotechnical Characterization** section and the individual boring logs in the **Exploration Results** section of this report can serve as a reference for the subsurface conditions that may be encountered along excavations for pits along the individual pipeline alignment sections. Additional site preparation recommendations for open-cut and trenchless excavation and backfill of pipeline pits are provided in the **Earthwork** section.

Mr. Craig M. Davis, P.E. of Terracon met with Mr. Gary Hebbeler of Duke Energy on March 26, 2020 to review two areas along the alignment where the design team is concerned with slope stability during the construction of the pipeline. These areas consist of:

1. Area 1 is a 600-foot long section of the alignment that is located on the east side of Roselawn Park, on the west side of the railroad right-of-way. This area is located on an embankment/mound that, based on comparisons of aerial imagery, was likely created during the construction of the adjacent baseball complex. This section of the pipeline will be installed by open-cut methods. The face of the embankment is at a slope of about 4 horizontal to 1 vertical. Soils are expected to consist of cohesive fill. In our opinion, slope instability will not occur as a result of standard open-cut excavation procedures. Care should be taken during construction to prevent standing water, the stockpiling of spoils on the slope, and/or permanent steepening of the embankment.

2. Area 2 is a 200-foot long section where the railroad crosses Losantiville Road and where the gas main construction will extend alongside the railroad bridge abutment. The slope of the embankment that supports the railroad bridge is about 4H:1V. On the north side of Losantiville Road, west of the railroad, the area is a maintained grass lawn. On the east side of the railroad, the area consists of a lightly-vegetated slope and the driveway to the adjacent properties to the north and east. On the east side of the driveway, a new storm sewer system has been installed, including 2 new catch basins.

   On the south side of Losantiville Road, the area consists of a relatively flat driveway extending to commercial properties. Storm water collects in this area and flows into a culvert/inlet into the storm sewer system.

   According to Mr. Hebbeler, the pipeline alignment can be adjusted to extend perpendicular to the railroad from the east side to the west side, and then again south down the southern driveway. Horizontal directional drilling will used to extend under the railroad. Open-cut methods will be used through Losantiville Road. With this alignment, the pipeline construction will avoid impacting the foundation system of the railroad bridge abutments.

Site preparation recommendations including subgrade improvement and fill placement are provided in the **Earthwork** section.

Based on the provided initial loading conditions and structure dimensions for the control building, MLV and skid and heater structures, we recommend that the structures are supported on spread footings. The **Foundations** section addresses support of the building bearing on native stiff to hard lean clay or engineered fill. The **Floor Slabs** section addresses slab-on-grade support of the building.

General Comments section provides an understanding of the report limitations.

EARTHWORK

Site Preparation

Earthwork for the control buildings, MLV, heater and skid strictures along the pipeline alignment will include clearing and grubbing, excavations and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations

include critical quality control criteria as necessary to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pipeline construction.

Prior to placing any fill, existing vegetation and root mat should be removed. Complete stripping of the topsoil should be performed in the proposed structure locations. The subgrade should be proof-rolled with a vehicle such as a fully-loaded tandem-axle dump truck. The proof-rolling should be performed under the direction of the Geotechnical Engineer. Areas excessively deflecting under the proof-roll should be delineated and subsequently addressed by the Geotechnical Engineer. Such areas should either be removed, bridged or stabilized depending upon the subgrade support requirements. Excessively wet or dry material should either be removed, or moisture conditioned and recompacted.

At the Highpoint Park substation, it is anticipated that prior to construction, a cut-off trench will be excavated along the north property boundary and backfilled with low-strength concrete (otherwise know as low-strength mortar/controlled low-strength material) to reduce the infiltration of groundwater from the wetland into the substation site. The depth of this cutoff should be field-determined based upon the conditions that exist at that time. Subsequent to the stripping of any vegetation and topsoil, the subgrade stiffness should be evaluated by Terracon to identify areas that may require a geosynthetic separation/reinforcement layer beneath the aggregate pavement. Additional undercutting (up to about 12 inches) may be required to provide sufficient aggregate thickness in conjunction with the geosynthetic. Composite geogrid/geotextile products, such as Tensar TX160FG, are typically applicable to the expected conditions. The aggregate section should be spread over such products in an end-dump-and-push process to reduce vehicle loads on the subgrade.

It is expected that the soils removed by the trenching for the underground utilities at the substation will be soft, saturated and potentially organic. It will be difficult to recompacted these soils as backfill in the trenches. In order to provide support to the aggregate pavement section, underground utilities/pipework at the substation should be backfilled with low-strength concrete.

Existing Fill

Existing fill may be encountered in the four proposed structure locations based on finalized building and structure siting and grading. We consider the existing fill to be uncontrolled and compressible. Support of footings and floor slabs on or above existing fill soils is discussed in this report. However, even with the recommended construction procedures, there is an inherent risk that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill, but can be reduced by following the recommendations contained in this report.

If Duke Energy elects to construct the footings and floor slabs on existing fill, the following protocol should be followed. Prior to footing and slab placement, the area should be undercut a minimum

of 3 feet within the footing area and 1.5 feet within the floor slab area. Once this undercut is performed, and the subgrade has passed the proof-roll test, the existing, and undocumented fill that was removed may be evaluated for reuse as structural fill below the floor slabs.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below or within 10 feet of structures or pavements. General fill is material used to achieve grade outside of these areas. Earthen materials used for structural fill should meet the following material property requirements:

Soil Type [1]	USCS Classification	Acceptable Location for Placement
Lean Clay	CL (LL<40 & PI>15)	All locations and elevations
Lean Clay	CL (40<LL<50)	>3 feet below slab-on-grade
Well graded granular and silty gravel	GM-GW GM [2]	All locations and elevations, provided adequate drainage is provided.

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris, and have a maximum particle size of 4 inches. Frozen material should not be used. Fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.
2. Similar to ODOT 304 crushed limestone aggregate, limestone screenings, or granular material such as sand, gravel or crushed stone containing at least 15% low plasticity fines.

On-site soils may be used as structural fill provided they meet the material property requirements listed above.

Pipeline Excavations

We anticipate that construction of the horizontal directional drilling (HDD) crossing and the guided bore crossing for the pipe alignment may require excavation of receiving and launching pits for the pilot bores. Anticipating pits for the crossings may be performed in the vicinity of test boring location, the **Geotechnical Characterization** section and the boring logs in the **Exploration Results** section of this report can serve as a reference for the subsurface conditions that mat be encountered along excavations for pits along the individual pipeline alignment sections.

All open excavations for receiving or launching pits should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, as well as other applicable codes, and in accordance with any applicable local, state and federal safety regulations. The contractor should be aware that excavation depths and slope inclination should

in no instance exceed those specified by these guidelines and regulations. Flatter slopes than those indicated by these guidelines/regulations may be required depending upon the soil conditions encountered and other external factors. Colluvium soils may be encountered which may have comparably low side slope stability in open-cut faces. These guidelines/regulations are strictly enforced and, if not followed, the owner and contractor could be liable and subjected to substantial penalties. Under no circumstances should the information provided below be interpreted to mean that Terracon is assuming responsibility for construction site safety and the contractor's activities. Construction site safety is the sole responsibility of the contractor, who should also be solely responsible for the means, methods and sequencing of construction operations.

Perched groundwater is often encountered at the existing fill/natural soil interface, within existing fill, at the overburden soil/bedrock interface or within seams, bedding planes or fractures within the bedrock. The volume of the groundwater contained within these pockets, seams or layers of silt, sand and gravel will depend upon the thickness and lateral extent of these features. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Low volumes of groundwater, anticipated in the cohesive lean clay soils, can likely be controlled using sumps and pumps. More elaborate dewatering systems such as well points or dewatering wells may likely be required for excavations below the encountered groundwater elevations in the cohesionless granular and silt soils anticipated in along the pipeline alignment, and would need to be designed by a specialty contractor. Excavations performed without dewatering can disturb the pipeline bearing soils, which can result in excessive settlement at the pit locations. In areas where soils sensitive to disturbance and construction traffic are exposed at the bottom of the pits, it would be advantageous to place a concrete mat/pad to protect the exposed soils and provide a suitable working surface for equipment and personnel.

Care should be taken during excavation to protect the structural integrity of any adjacent underground utilities that will remain in-place. The settlement tolerances of adjacent structures or improvements should be considered when determining the excavation methods. Depending upon factors such as the depth of excavation, the location of existing improvements, utilities, groundwater and soil conditions, temporary sheeting, shoring and underpinning may be required. Particular caution should be exercised if excavations are performed near existing underground utility lines. Existing backfill for utility lines is often poorly compacted and the limits of the old excavation can form a ready failure surface. The OSHA trench safety guidelines for adequate side slopes based on soil types may not apply in these situations. Existing underground utilities should be shored and braced as required to maintain their integrity and appropriately designed trench boxes or sheeting and bracing should be used to provide for worker safety. The design of any retention system for launching or receiving pits should not only take into account the lateral forces but also the tolerable lateral deflections. The contractor's "competent person" should also

establish a minimum lateral distance from the crest of the slope or excavation for all spoil piles and construction equipment. Likewise, the contractor's "competent person" should establish protective measures for exposed slope faces.

Trenchless Excavations for Pipeline

We understand that the construction of the horizontal directional drilling (HDD) crossings and guided bore installation for the pipeline alignment has been proposed. Location of crossings is unknown at the time of issue of this report. Therefore, it cannot be accurately relied on to determine the soil profile along the alignment during advancement. Due to the variability in the soils conditions encountered it cannot be accurately determined which portions that will require advancing through cohesive and granular soils located along the alignment. The contractor will need to take into consideration that the crossings may need to be performed in both cohesive and granular soil materials (mixed-face conditions). The pipeline installation may also occur below the groundwater table, as indicated by the groundwater levels encountered during subsurface investigation.

Due to the variable subsurface conditions encountered and the highly variable geology along the pipe realignment, the presence of large rock fragments/cobbles/boulders are expected at various elevations within the soil profile. Field exploration methods using test do not reliably characterize the size and spatial variations of particles 1-inch or greater in diameter. The contractor should consider the possibility of encountering large-size inclusions in selecting the appropriate method and equipment. Due to the presence of granular soils, design of any drilling fluids required to maintain the pilot holes or the directional drilling excavations will need to be specified accordingly.

The steel casing should be designed to withstand all jacking loads plus soil loads. Voids should be prevented from forming outside of the pipe as the shield is advanced. Where unavoidable voids are created outside the casing during the advance of the casing, or due to the removal of material at the front of the casing, such voids should be immediately filled with sand, clay bentonite, or other non-decomposable material and rammed into place. When the casing has been completely installed, all voids filled with temporary material should be finally filled with Portland cement grout pumped through the grout holes in the casing by starting at the low end or point along the alignment.

Backfill of Pipeline Pits

After the HDD/guide bore is performed, the launching and receiving pits will need to be backfilled. We recommend that backfill consist of approved materials free of organic matter and debris. Well-graded granular materials (i.e. sands and gravels) would likely be better suited to backfill the pits having limited room to operate heavy compaction equipment. Compaction of granular backfill materials is typically less sensitive to moisture variations and is usually more readily accomplished in confined excavations where lighter, walk-behind compaction equipment is typically used. If

cohesive materials are used to backfill the pits, the lifts may need to be limited to 3 to 4 inches in thickness and more moisture correction of the soil will likely be required. With the exception of topsoil, the majority of the encountered on-site soils are suitable for use as pit backfill. Topsoil and organic soils are not considered suitable for use as backfill material. The compaction requirements for the pit backfill have been listed herein.

Fill Compaction Requirements

Fill for the pipeline pits and structures to be constructed along the pipeline alignment should meet the following compaction requirements.

Item	Structural Fill
Maximum Lift Thickness	■ 8-inches or less in loose thickness when heavy, self-propelled compaction equipment is used. ■ 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used. ■ If cohesive soils are used in conjunction with lightweight compaction equipment, the loose lift thickness may need to be reduced to 3 to 4 inches.
Minimum Compaction Requirements [1, 2]	■ Non-structural areas: At least 95%, but not more than 100%, of the material's Standard Proctor maximum dry density (ASTM D698). ■ Structural areas: At least 98%, but not more than 100%, of the material's Standard Proctor maximum dry density (ASTM D698).
Water Content Range – Cohesive Soils	Within 3 percentage points of the optimum moisture content value as determined by the Standard Proctor test at the time of placement
Water Content Range – Granular Materials [3]	Workable moisture levels

1. The moisture content and compaction should be measured for each lift of engineered fill during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. If the granular material is a coarse sand, gravel or crushed stone of uniform size or has a low fines content, compaction comparison to relative density (ASTM D4235 and D4254) may be more appropriate. In this case, granular materials should be compacted to at least 60% of the materials maximum relative density.
3. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled.

Construction Observation and Testing

We recommend the exposed subgrade and each lift of compacted fill be tested, evaluated and reworked, as necessary, until approved by the geotechnical engineer's representative prior to placement of additional lifts. At a minimum, we recommend that each lift of fill be tested for density and moisture content at a frequency of one test for every 2,500 square feet of compacted fill in

the building areas and every 5,000 square feet in pavement areas. We recommend one density and moisture content test for every 50 linear feet of compacted utility trench backfill.

SHALLOW FOUNDATIONS

It has been proposed to construct control buildings, skid and heater structures at the Highpoint and Norwood Stations (in proximity to borings B-14 and B-22), supported on spread footings or drilled shafts. MLV structures are also proposed to be constructed at Summit Park and DOW Chemicals (in proximity to borings B-16 and B-5), supported on spread footings. Based on the design loads and structure dimensions provided by Duke Energy, if the site has been prepared in accordance with the requirements noted in **Earthwork** the following preliminary design parameters are applicable for shallow foundations.

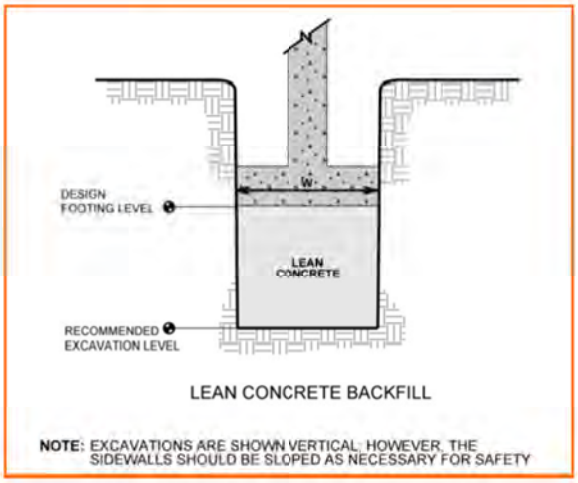
Preliminary Design Parameters – Compressive Loads

Item	Description
Maximum net allowable bearing pressure on existing soils [1]	2,000 psf (foundation bearing on undisturbed at least stiff native cohesive soils)
Required Bearing Stratum [2]	At least stiff native lean clay soils or structural fill. Bearing stratum should be verified by Terracon.
Minimum Foundation Dimensions	Columns: 30 inches Continuous: 18 inches
Minimum Embedment below Finished Grade for Frost Protection	30 inches
Estimated Total Settlement from Structural Loads [3]	If the footings are bearing in native, at-least-stiff soils, a total settlement less than 1-inch may occur. To limit settlement to less than about 1-inch in areas where soft to medium stiff soils are exposed, the footings should bear on about 3 feet of compacted engineered fill.
Estimated Differential Settlement[3]	About 2/3 of total settlement

1. Additional test borings can be performed at proposed structure locations, that may allow for a higher allowable bearing pressure recommendation. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. The maximum net allowable foundation pressure has been provided in general accordance with the *2015 International Building Code*, Chapter 18, Section 1804, Table 1804.2.
2. Unsuitable or soft soils should be undercut, and the footings should be deepened to bear on the competent bearing stratum or could bear on lean concrete (minimum f'_c=1,000 psf) extending from the foundation base to competent bearing stratum.
3. Settlements as a result of the assumed structural loads as noted in **Project Description**. No specific loads have been provided to date. Actual settlement will vary based on loading, subgrade conditions, and construction techniques.

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

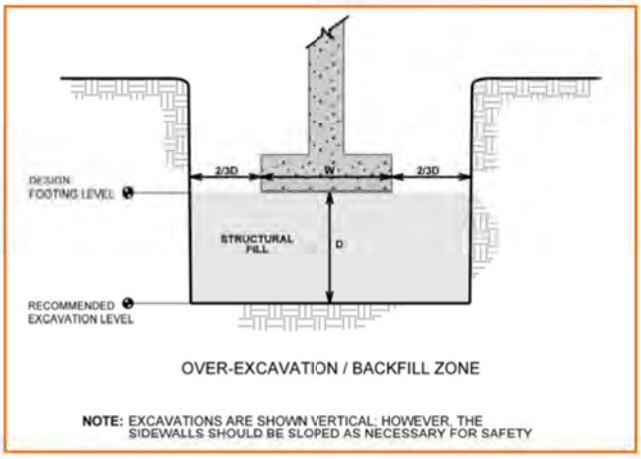
If unsuitable bearing soils having high plasticity or less than stiff consistency are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete (minimum f'_c=1,000 psf) backfill placed in the excavations. If highly plastic soils are encountered at the proposed footing bearing level, a minimum 1- foot undercut below proposed footing level is recommended. This is illustrated on the sketch below.



LEAN CONCRETE BACKFILL

NOTE: EXCAVATIONS ARE SHOWN VERTICAL; HOWEVER, THE SIDEWALLS SHOULD BE SLOPED AS NECESSARY FOR SAFETY

Over-excavation for structural fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation, with structural fill material placed, as recommended in the **Earthwork** section.



At the Highpoint Park Station, it is recommended that footing/equipment pad excavations be extended to stiff soils by undercutting as described above and backfilled with lean concrete to the design bottom-of-footing level.

As an alternative to the deeper trenched footings, the foundation may consist of grade beams and drilled shafts. If additional information is required on the use of drilled shafts and grade beam, please contact Terracon.

Grading and Drainage

All grades must provide effective drainage away from the building and structures during and after construction and should be maintained throughout the life of the structure. Water retained next to the building and structures can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. Estimated movements described in this report are based on effective drainage for the life of the structure. The roof should have gutters/drains with downspouts that discharge into the storm sewers.

Exposed ground should be sloped and maintained at a minimum 5 percent away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted as necessary as part of the structure's maintenance program. Where paving abuts the structure a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations for the proposed structures, are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs-on-grade and pavement. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over, or adjacent to, construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted, prior to floor slab and pavement construction and observed by Terracon.

Trees or other vegetation whose root systems have the ability to remove excessive moisture from the subgrade soils should not be planted next to the building. Soil shrinkage from moisture removal can result in noticeable settlements that can cause distress to the building structural elements and pavements. Trees and shrubbery should be kept away from the exterior edges of the foundation element a distance at least equal to 1.5 times their expected mature height and at least 10 feet from the building, whichever is greater.

Utility Trench Backfill

Utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exterior. The plug material should consist of cementitious flowable fill or low permeability lean clay. The trench plug material should be placed to surround the utility line. If used, the clay trench plug material should be placed and compacted to comply with the water content and compaction recommendations for structural fill stated previously in this report.

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7.

Description	Value for Highland Area	Value for Lowland Area
2015 International Building Code Site Classification (IBC) [1]	C [2]	D [2]
Site Latitude (°)	39.25069 to 39.17898	39.17898 to 39.14264
Site Longitude (°)	-84.3762 to -84.3931	-84.39310 to -84.4041
Spectral Acceleration for a Short Period, S_S (g) [3]	0.143	0.144
Spectral Acceleration for a 1-Second Period, S_1 (g) [4]	0.077	0.077
Site Coefficient, F_a [5]	1.2	1.6
Site Coefficient, F_v [6]	1.7	2.4
Spectral Acceleration for a Short Period (Design), S_{DS} (g) [1]	0.115	0.154
S_{D1} = Spectral Acceleration for a 1-Second Period (Design), S_{D1} (g) [1]	0.087	0.123

1. Seismic site classification in general accordance with the *2015 International Building Code*, which refers to ASCE 7.
2. The 2012 International Building Code (IBC) uses a site profile extending to a depth of 100 feet for seismic site classification. Borings at this site were extended to a maximum depth of 101.3 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.
3. These values were obtained using online seismic design maps and tools provided by the USGS (http://earthquake.usgs.gov/hazards/designmaps/).

FLOOR SLABS

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and. positive drainage of the aggregate base beneath the floor slab.

Floor Slab Design Parameters

Item	Description
Floor Slab Support [1]	At least stiff natural soils or at least 1.5 feet of engineered fill soils
Estimated Modulus of Subgrade Reaction [2]	150 pounds per square inch per inch (psi/in) for point loading considerations
Aggregate base course/capillary break[3]	4 inches of free draining granular material

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon tested index properties, our experience with the subgrade condition, the requirement noted in **Site Preparation**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.
3. Free-draining granular material should have less than 5 percent fines (material passing the #200 sieve). Other design considerations such as cold temperatures and condensation development could warrant more extensive design provisions.

The use of a vapor retarder should be considered beneath concrete slabs-on-grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy-duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing, or other means.

Floor Slab Construction Considerations

Finished subgrade within and for at least 10 feet beyond the floor slab should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed and structural fill should be added to replace the

resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should approve the condition of the floor slab subgrade immediately prior to placement of the floor slab base course, reinforcing steel and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Our field exploration work included the coordination, drilling and sampling of 27 exploratory geotechnical borings. However, test borings WB-21 and WB-23 could not be drilled due to utility conflicts. Test boring WB-6 was not drilled, as boring access was not granted by the property owner.

The current and archive field exploration program consisted of the following:

Number of Borings	Boring Depth (feet) [1]	Location
4 (2016/2017)	22.5 to 102.9	C350 Alignment Borings
24 (2017)	20 to 101.5	C350 Alignment Borings
4 (2020)	20 to 25	Additional C350 Alignment Borings

1. Below ground surface

Boring Layout and Elevations: We used a handheld GPS equipment to locate borings with an estimated horizontal and vertical accuracy of +/-1 feet.

Subsurface Exploration Procedures: We advanced soil borings with a track-mounted drill rig using hollow-stem augers. Six samples were obtained in the upper 15 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was performed using split-barrel sampling procedures. In the split-barrel sampling procedure, a standard 2-inch outer-diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration was recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, have been indicated on the boring logs at the test depths. The samples were placed in appropriate containers, taken to our soil laboratory for testing, and classified by a geotechnical engineer. In addition, we observed and recorded groundwater levels during drilling and sampling.

Upon encountering bedrock, samples were collected by overdriving the split-barrel sampling spoon. Rock coring was not performed.

Our exploration team prepared field boring logs as part of standard drilling operations including sampling depths, penetration distances, and other relevant sampling information. Field logs include visual classifications of materials encountered during drilling, and our interpretation of subsurface conditions between samples. Final boring logs, prepared from field logs, represent the

geotechnical engineer's interpretation, and include modifications based on observations and laboratory tests.

Abandonment: We backfilled the borings with cement-bentonite grout after completion and the pavement surfaces were patched with cold-mix asphalt. Because backfill material often settles below the surface after a period, we recommend boreholes are checked periodically and backfilled, if necessary.

The borings completed in 2020, were backfilled with auger cuttings and then capped with a 18-inch concrete plug to mitigate settlement.

Laboratory Testing

The project engineer reviewed field data and assigned various laboratory tests to better understand the engineering properties of various soil and rock strata. Soil minimum electrical resistivity, redox potential, sulfide content and pH testing was also performed in accordance with AWWA C105/A21.5 and ASTM A674-10 to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction. Procedural standards noted below are for reference to methodology in general.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- ASTM D7012 Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures
- AWWA 4500 H pH Value Determination Method approved by Standard Methods Committee, 2000
- ASTM C 1580 Standard Test Method for Water-Soluble Sulfate in Soil
- AWWA 4500-S D Presence of Sulfide Determination Method approved by Standard Methods Committee, 2000
- ASTM D512 Standard Test Methods for Chloride Ion in Water
- AWWA 2580 Oxidation-Reduction Potential (ORP) Determination Method approved by Standard Methods Committee, 1997
- AWWA 2540 Total Salts Determination Method approved by Standard Methods Committee, 1997
- ASTM G 57 Standard Test Method for Field Measurement of Soil Resistivity using the Wenner Four-Electrode Method

Our laboratory testing program included examination of soil samples by an engineer. Based on the material's texture and plasticity, we have described and classified soil samples in accordance with the Unified Soil Classification System (USCS). Bedrock samples obtained were classified using locally-accepted practices for engineering purpose. Boring log rock classification is determined using our Description of Rock Properties Standards.

Our field exploration work also included the staking, drilling and sampling of 12 environmental borings (E-101 through E-111 and E-114) using a Geo-probe rig. Burns and McDonnel was responsible for the handling and laboratory testing of the samples. Photographs of the site conditions prior to drilling and after drilling are shown in the **Photographs of Site Conditions** section.

EXPLORATION PLANS

Terracon GeoReport

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

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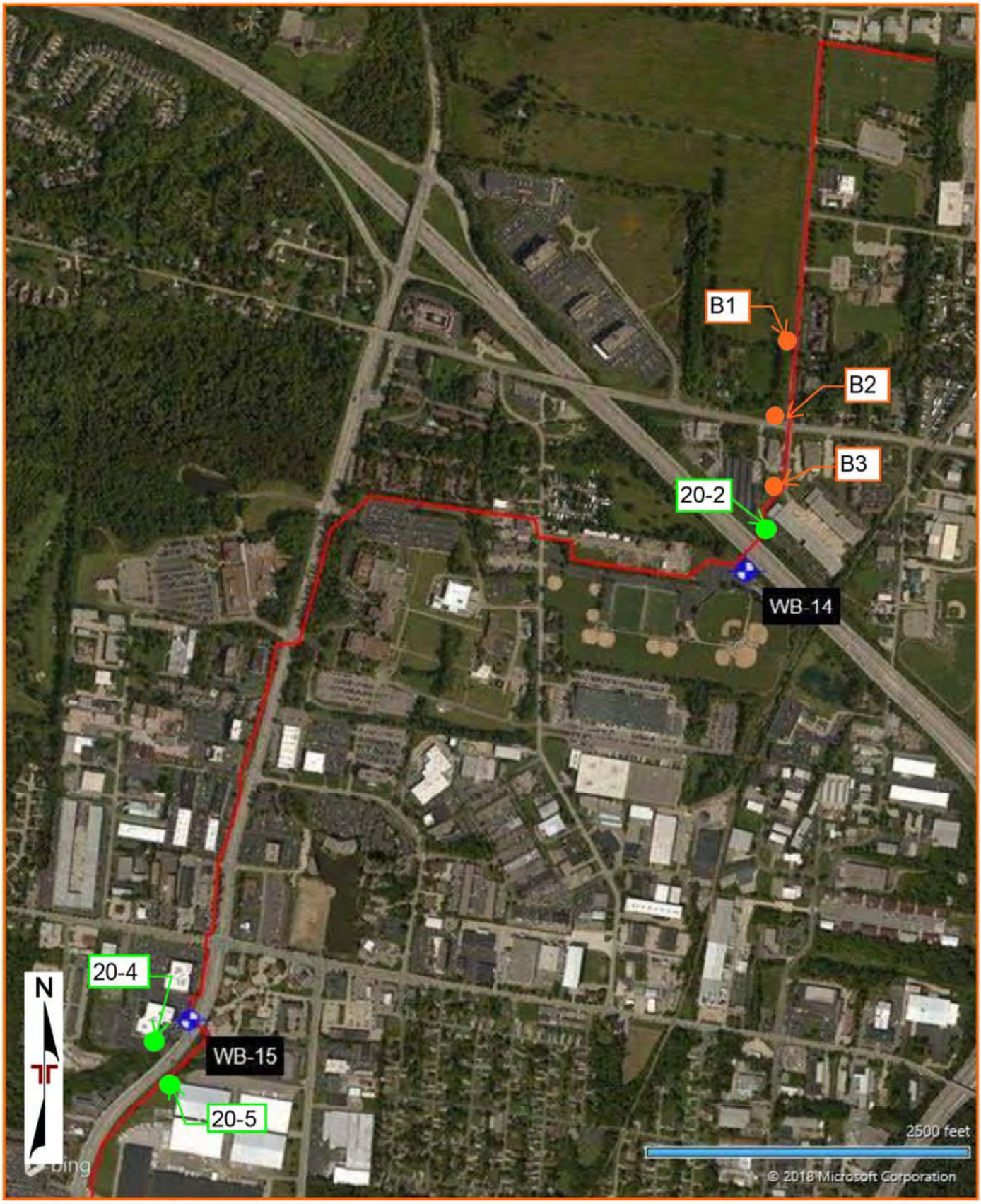

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EXPLORATION PLAN

Central Corridor Pipeline C350 ■ Hamilton County, OH

June 22, 2018 ■ Terracon Project No. N1175384

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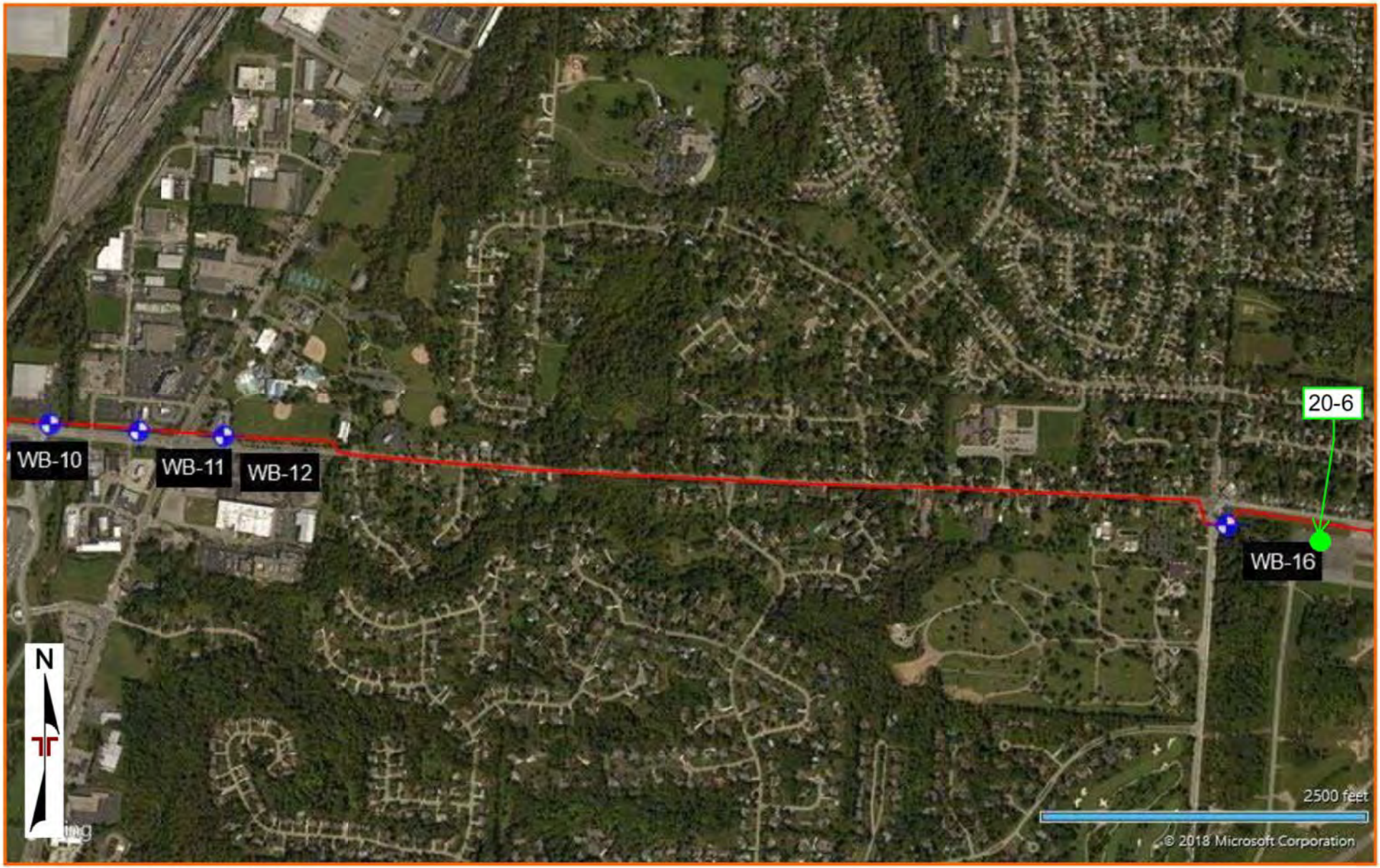

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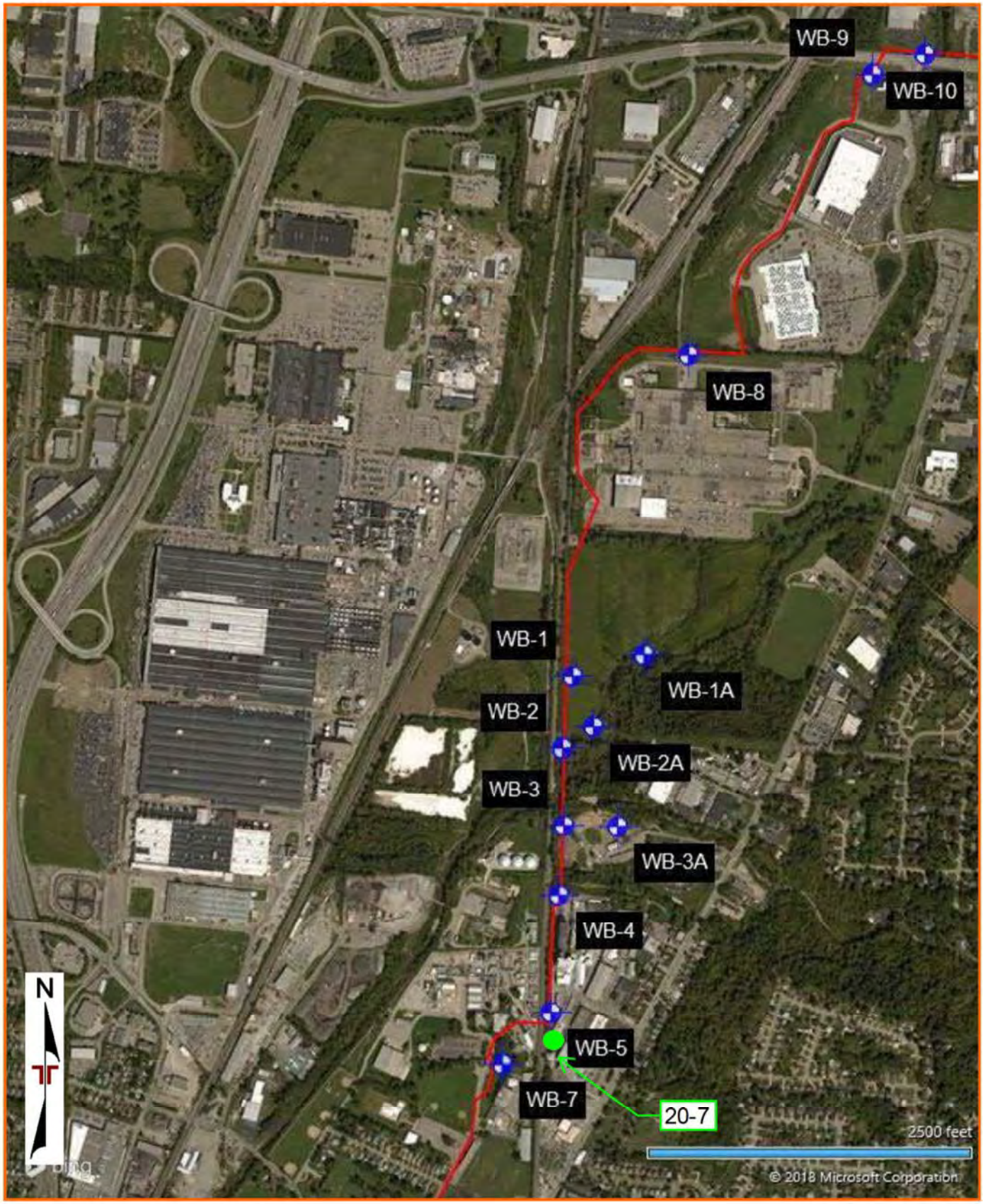

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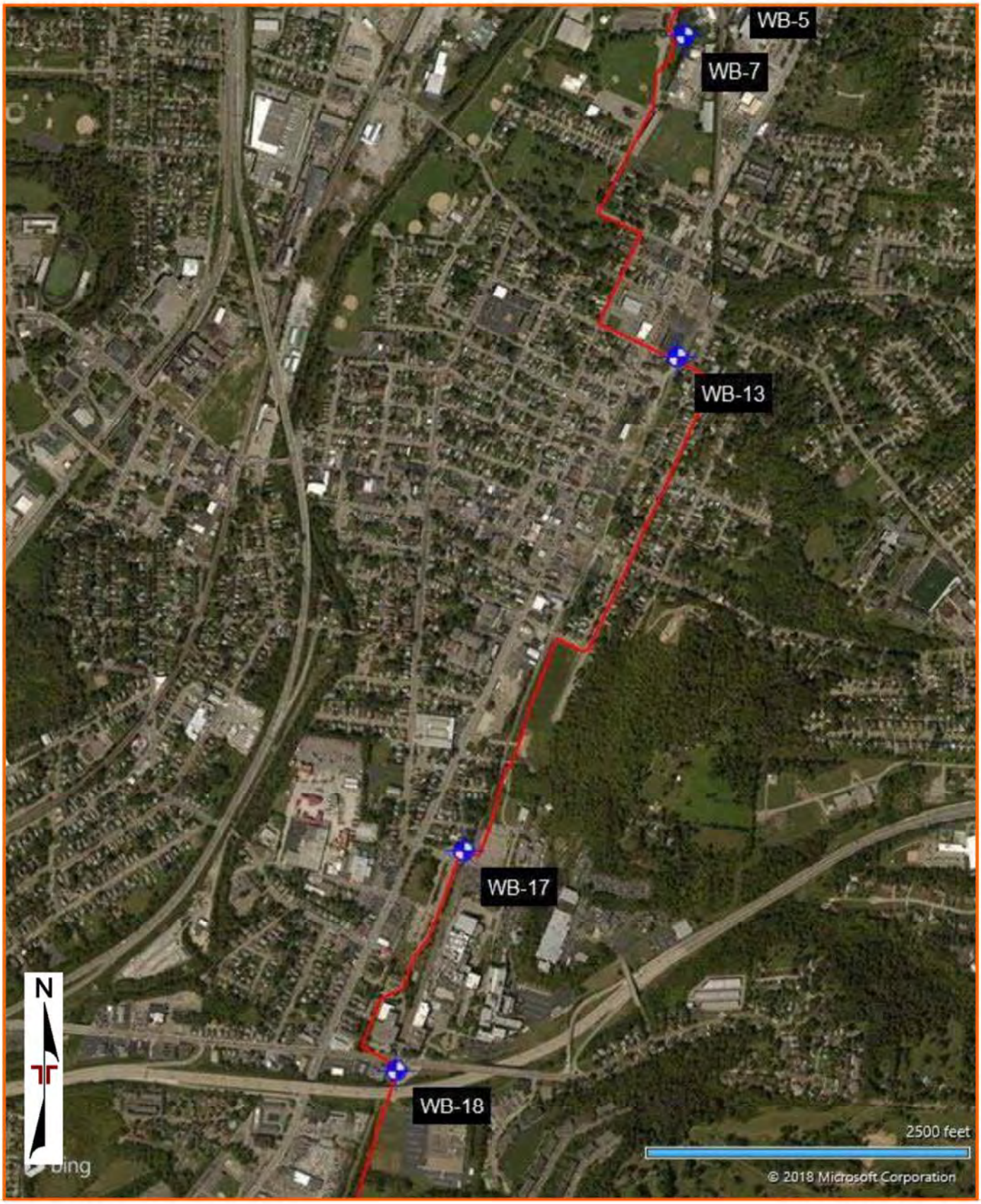

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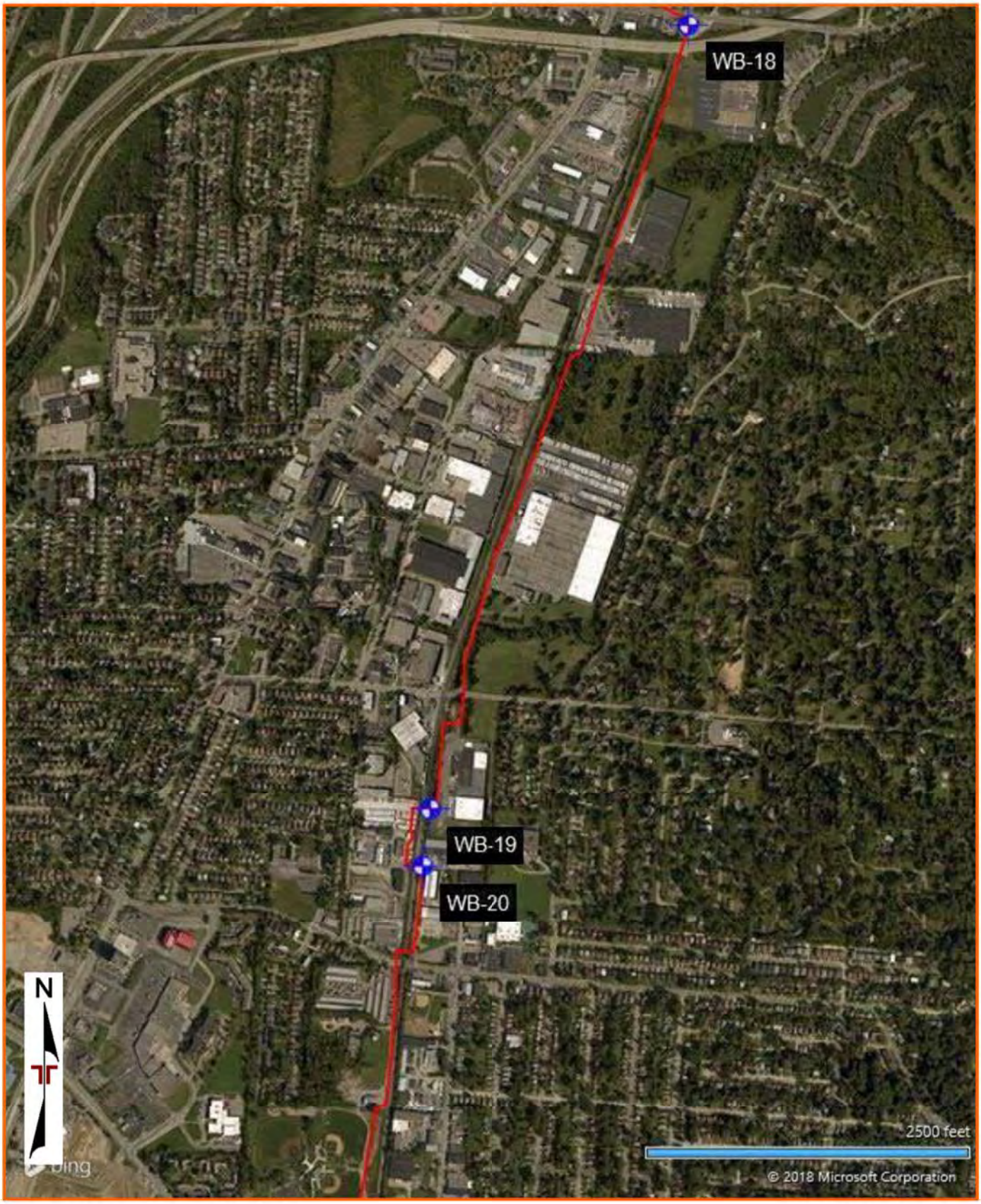

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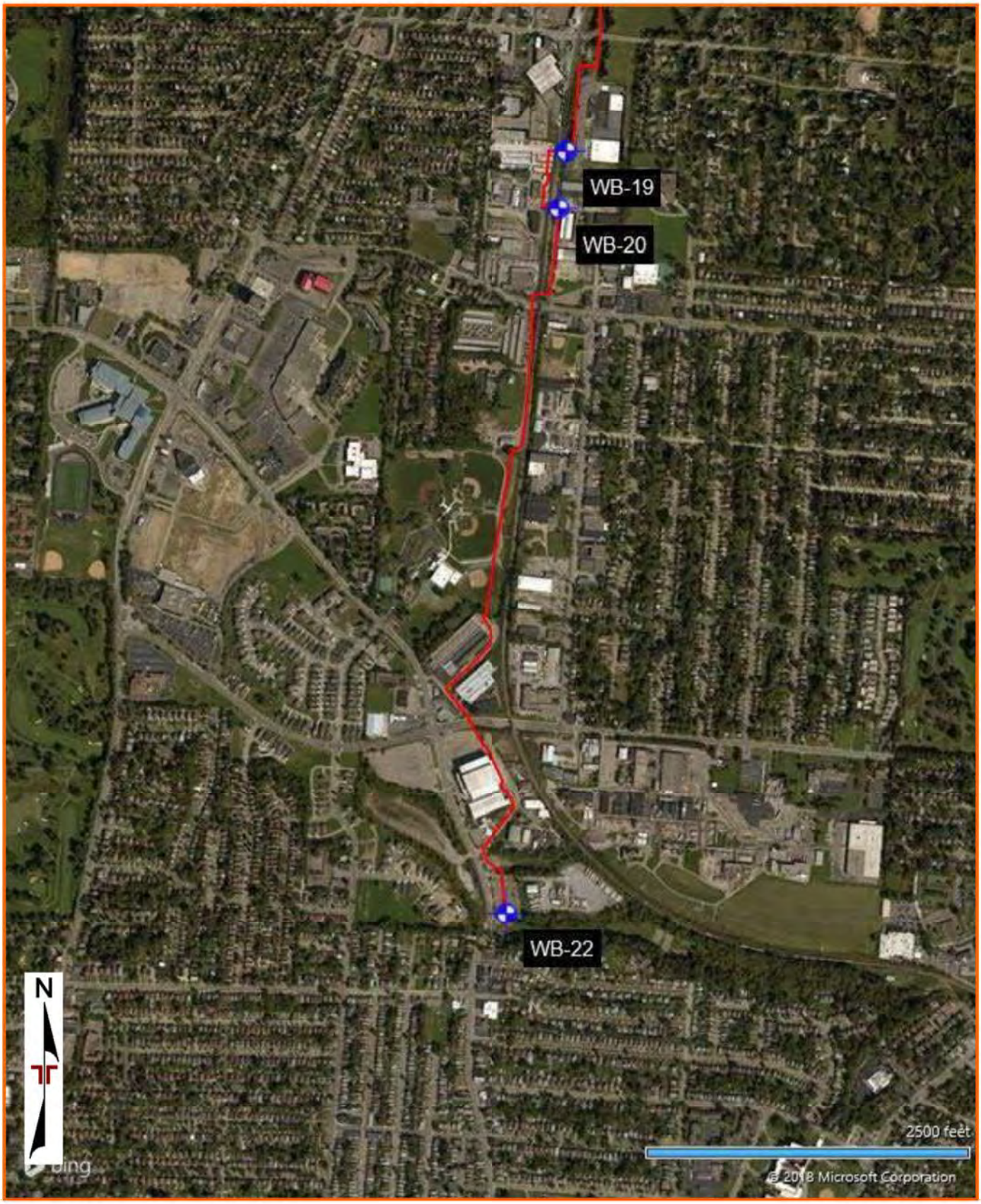


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

BORING LOG NO. B1

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.283118° Longitude: -84.360281°
Northing: 472755.148 Easting: 1441979.264

Surface Elev.: 861.5 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	FILL - LEAN CLAY (CL), with striations of dark brown, with silt, trace black concretions, light brown, soft							
2.5	859		X	89	2-2-2 N=4	0.5 (HP)	26	
	LEAN CLAY (CL), trace sand, trace organics, dark reddish brown to brown, very stiff		X	100	4-6-9 N=15	4.5+ (HP)	19	
		5	X	100	6-8-11 N=19	3.75 (HP)	19	38-17-21
			X	94	4-7-8 N=15	4.0 (HP)	20	
10.0	851.5	10						
	LEAN CLAY (CL), trace sand, trace gravel, light reddish brown with light gray, very stiff		X	100	5-7-9 N=16	3.5 (HP)	19	
15.0	846.5	15						
	LEAN CLAY (CL), with silt, with gravel, dark grayish brown, (sample wet when retrieved)		X	89	6-25-27 N=52		12	
20.0	841.5	20						
	LEAN CLAY (CL), with silt, trace sand, with gravel, dark gray, hard, GLACIAL TILL (sample wet)		X	94	15-24-26 N=50	4.5+ (HP)	11	
25.0	836.5	25						
	POORLY GRADED SAND AND GRAVEL		X	100	9-23-47 N=70	4.5+ (HP)	8	
26.1	**(SP)**, brown, dense, wet 835.5							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Water used below 31.5' to core rock.

WATER LEVEL OBSERVATIONS

Water observed @ 30.2' during driling

Water observed @ 13.6' after 24 hours

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-06-2016 | Boring Completed: 02-06-2016

Drill Rig: Track | Driller: J. Mathis

Project No.: N1165468

BORING LOG NO. B1

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.283118° Longitude: -84.360281°
Northing: 472755.148 Easting: 1441979.264

Surface Elev.: 861.5 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	RQD%	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
30.0	831.5	30	▽		100	50/3"				11		
31.5	830											
					42		6					
		35			24		0					
		40			93		58		52.66	9	139	
		45			100		61					
		50			93		76					

LEAN CLAY (CL), with gravel, trace sand and limestone fragments, dark gray, very hard to stiff, (sample is wet) *(continued)*

SHALE, trace limestone, gray, very weak

SHALE, gray weak shale interbedded with thin strong gray limestone layers,

Limestone layer: 4" @ 33.7'
Limestone layer: 6" @34.3'
Limestone layer: 2" @ 42'
Limestone layer: 1.75" @ 42.6'
Limestone layer: 1" @ 45.7'
Limestone layer: 2" @ 46.2'
Limestone layer: 2.25" @ 47.5'
Limestone layer: 2.25" @ 48.9'
Limestone layer: 4.25"@ 51.3'
Limestone layer: 1.50" @ 51.8'
Limestone layer: 1" @ 52.4'
Limestone layer: 3.75" @ 54.7'
Limestone layer: 1" @ 55.5'
Limestone layer: 1.75" @ 59.4'
Limestone layer: 2" @ 59.9'
Limestone layer: 1/4" @ 60.4'
Limestone layer: 1.5" @ 61.2'
Limestone layer: 2" @ 61.5'
Limestone layer: 1/2" @ 62.4'
Limestone layer: 1.25" @ 62.6'
Limestone layer: 1" @ 62.9'
Limestone layer: 1" @ 64.6'
Limestone layer: 2.50" @ 65.3'
Limestone layer: 3" @ 67'
Limestone layer: 10" @ 67.7'
Limestone layer: 5" @ 73.9'
Limestone layer: 3" @ 74.6'
Limestone layer: 2" @ 76.5'
Limestone layer: 3" @ 76.8'
Limestone layer: 4" @ 78.4'

Shale: 87% Limestone: 13%"

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed @ 30.2' during driling*

▽ *Water observed @ 13.6' after 24 hours*

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-06-2016 | Boring Completed: 02-06-2016
Drill Rig: Track | Driller: J. Mathis
Project No.: N1165468

BORING LOG NO. B1

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.283118° Longitude: -84.360281°
Northing: 472755.148 Easting: 1441979.264

Surface Elev.: 861.5 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	RECOVERY (%)	RQD%	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
		55	100	80				
		60	100	53	340.22	6	147	
		65	100	99				
		70	100	87				
		75	100	97				
79.0	782.5	80			2303.99	4	154	

SHALE, gray weak shale interbedded with thin strong gray limestone layers,

Limestone layer: 4" @ 33.7'
Limestone layer: 6" @34.3'
Limestone layer: 2" @ 42'
Limestone layer: 1.75" @ 42.6'
Limestone layer: 1" @ 45.7'
Limestone layer: 2" @ 46.2'
Limestone layer: 2.25" @ 47.5'
Limestone layer: 2.25" @ 48.9'
Limestone layer: 4.25"@ 51.3'
Limestone layer: 1.50" @ 51.8'
Limestone layer: 1" @ 52.4'
Limestone layer: 3.75" @ 54.7'
Limestone layer: 1" @ 55.5'
Limestone layer: 1.75" @ 59.4'
Limestone layer: 2" @ 59.9'
Limestone layer: 1/4" @ 60.4'
Limestone layer: 1.5" @ 61.2'
Limestone layer: 2" @ 61.5'
Limestone layer: 1/2" @ 62.4'
Limestone layer: 1.25" @ 62.6'
Limestone layer: 1" @ 62.9'
Limestone layer: 1" @ 64.6'
Limestone layer: 2.50" @ 65.3'
Limestone layer: 3" @ 67'
Limestone layer: 10" @ 67.7'
Limestone layer: 5" @ 73.9'
Limestone layer: 3" @ 74.6'
Limestone layer: 2" @ 76.5'
Limestone layer: 3" @ 76.8'
Limestone layer: 4" @ 78.4'

Shale: 87% Limestone: 13%" *(continued)*

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbrevialions.

Notes:

WATER LEVEL OBSERVATIONS

Water observed @ 30.2' during driling

Water observed @ 13.6' after 24 hours

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-06-2016 | Boring Completed: 02-06-2016
Drill Rig: Track | Driller: J. Mathis
Project No.: N1165468

BORING LOG NO. B1

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.283118° Longitude: -84.360281°
Northing: 472755.148 Easting: 1441979.264

Surface Elev.: 861.5 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	RECOVERY (%)	RQD%	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
			100	90			
84.0	777.5	85			2498.96	3	154
			100	95			
		90					
			100	93			
		95					
			98	92			
		100	44	38			
101.0	760.5						

LIMESTONE, gray strong fossiliferous interbedded with thin gray very weak shale seams,

Shale layer: 1/2"@79.4'
Shale layer: 8"@79.8'
Shale layer: 2"@80.3'
Shale layer: 2"@81.6'
Shale layer: 2"@81.9'
Shale layer: 4.25"@83.1'

Limestone: 68% Shale: 32% *(continued)*

SHALE, weak shale interbedded with thin strong gray limestone layers,

Limestone layer: 3" @ 85.3'
Limestone layer: 4" @ 87.0'
Limestone layer: 1" @ 87.4'
Limestone layer: 1/2" @ 87.6'
Limestone layer: 3" @ 87.8'
Limestone layer: 1.5" @ 91.5'
Limestone layer: 1" @ 91.9'
Limestone layer: 2" @ 92.1'
Limestone layer: 2.5" @ 92.4'
Limestone layer: 2.75" @ 93.1'
Limestone layer: 1.25" @ 93.4'
Limestone layer: 1" @ 95.4'
Limestone layer: 3" @ 95.8'
Limestone layer: 4" @ 96.4'
Limestone layer: 6" @ 97.5'
Limestone layer: 3" @ 98.3'
Limestone layer: 2" @ 100.2'
Limestone layer: 4" @ 100.5'

Shale: 78% Limestone: 22%

Boring Terminated at 101 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed @ 30.2' during driling
Water observed @ 13.6' after 24 hours

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-06-2016 | Boring Completed: 02-06-2016
Drill Rig: Track | Driller: J. Mathis
Project No.: N1165468

BORING LOG NO. B2

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.281319° Longitude: -84.360661°
Northing: 472102.357 Easting: 1441858.16

Surface Elev.: 849.5 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	RQD%	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
					100	2-3-5 N=8		4.5 (HP)		14		
					100	3-6-4 N=10		3.25 (HP)		15		
5.0	844.5	5			22	5-4-5 N=9		2.0 (HP)		18		
					94	2-3-5 N=8		1.25 (HP)		27		
10.0	839.5	10	▽ ▽		100	3-10-11 N=21		4.5+ (HP)		8		25-14-11

FILL - LEAN CLAY (CL), trace silt, trace sand with gravel, brown with reddish brown, very stiff to hard, moist

LEAN CLAY (CL), with silt, with gravel, trace limestone fragments, olive brown to blueish gray, stiff, moist

LEAN CLAY (CL), with iron concretions, with silt, trace sand, trace gravel, trace limestone fragments, brown, very stiff to hard, moist

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Water added at 45' to core rock.

WATER LEVEL OBSERVATIONS

▽ *Water observed @ 10.1' during driling*

▽ *Water observed @ 10.7 upon completion of drilling*

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-08-2017 | Boring Completed: 02-09-2017

Drill Rig: Track | Driller: J. Mathis

Project No.: N1165468

BORING LOG NO. B2

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.281319° Longitude: -84.360661°
Northing: 472102.357 Easting: 1441858.16

Surface Elev.: 849.5 (Ft.)

DEPTH ELEVATION (Ft.)

GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	RQD%	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
	15			100	6-8-8 N=16		4.5+ (HP)		10		
	20			100	16-15-42 N=57		4.5+ (HP)		25		

LEAN CLAY (CL), with iron concretions, with silt, trace sand, trace gravel, trace limestone fragments, brown, very stiff to hard, moist *(continued)*

Fine sand, water bearing seam encountered from 15' to 15.5'

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed @ 10.1' during drilling

Water observed @ 10.7 upon completion of drilling

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-08-2017 | Boring Completed: 02-09-2017

Drill Rig: Track | Driller: J. Mathis

Project No.: N1165468

BORING LOG NO. B2

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.281319° Longitude: -84.360661°
Northing: 472102.357 Easting: 1441858.16

Surface Elev.: 849.5 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	LEAN CLAY (CL), with iron concretions, with silt, trace sand, trace gravel, trace limestone fragments, brown, very stiff to hard, moist *(continued)*	25	100	15-40-50/4"	4.5+ (HP)	13	
30.0	819.5						
	SANDY LEAN CLAY (CL), trace limestone fragments, bluish gray with olive brown mottles, very stiff, moist	30	39	11-22-25 N=47	2.5 (HP)	27	36-18-18
35.0	814.5						
	LEAN CLAY (CL), trace fissures, laminations and limestone fragments, tannish brown with gray, very stiff to hard, (RESIDUAL)	35	61	16-21-28 N=49	4.5+ (HP)		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed @ 10.1' during drilling

Water observed @ 10.7 upon completion of drilling

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-08-2017 | Boring Completed: 02-09-2017

Drill Rig: Track | Driller: J. Mathis

Project No.: N1165468

BORING LOG NO. B2

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.281319° Longitude: -84.360661°
Northing: 472102.357 Easting: 1441858.16

Surface Elev.: 849.5 (Ft.)

DEPTH ELEVATION (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	RECOVERY (%)	FIELD TEST RESULTS	RQD%	LABORATORY HP (tsf)
LEAN CLAY (CL), trace fissures, laminations and limestone fragments, tannish brown with gray, very stiff to hard, (RESIDUAL) *(continued)*						
		40	94	8-22-24 N=46		4.5+ (HP)
45.3	804	45	100	50/4"		
			86		60	

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed @ 10.1' during driling

Water observed @ 10.7 upon completion of drilling

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-08-2017 | Boring Completed: 02-09-2017

Drill Rig: Track | Driller: J. Mathis

Project No.: N1165468

BORING LOG NO. B2

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.281319° Longitude: -84.360661°
Northing: 472102.357 Easting: 1441858.16

Surface Elev.: 849.5 (Ft.)

DEPTH ELEVATION (Ft.)

DEPTH (Ft.)	RECOVERY (%)	RQD%	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
50	100	97	269.52	8	143
55	100	64	3847.39	1	165
60					

SHALE, gray very weak shale interbedded with thin gray strong fossiliferous limestone layers,
Limestone layer: 1.50" @ 45.6'
Limestone layer: 1.50" @ 46.2'
Limestone layer: 1" @ 46.4'
Limestone layer: 3/4" @ 46.8'
Limestone layer: 2.25" @ 47.5'
Limestone layer: 10.50" @ 48.8'
Limestone layer: 6.50" @ 49.3'
Limestone: 23% Shale: 77%

Shale: 56% Limestone: 44% *(continued)*

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed @ 10.1' during drilling

Water observed @ 10.7 upon completion of drilling

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-08-2017 | Boring Completed: 02-09-2017
Drill Rig: Track | Driller: J. Mathis
Project No.: N1165468

BORING LOG NO. B2

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.281319° Longitude: -84.360661°
Northing: 472102.357 Easting: 1441858.16

Surface Elev.: 849.5 (Ft.)

DEPTH	ELEVATION (Ft.)	
		SHALE, gray very weak shale interbedded with thin gray strong fossiliferous limestone layers,
		Limestone layer: 1.50" @ 45.6'
		Limestone layer: 1.50" @ 46.2'
		Limestone layer: 1" @ 46.4'
		Limestone layer: 3/4" @ 46.8'
		Limestone layer: 2.25" @ 47.5'
		Limestone layer: 10.50" @ 48.8'
		Limestone layer: 6.50" @ 49.3'
		Limestone: 23% Shale: 77%
		Shale: 56% Limestone: 44% *(continued)*
		SHALE, gray very weak shale interbedded with thin gray strong fossiliferous limestone layers,
		Limestone layer: 1" @ 53.2'
		Limestone layer: 5" @ 54.4'
		Limestone layer: 9.50" @ 55.4'
		Limestone layer: 1" @ 58.7'
64.5	785	Limestone layer: 8" @ 60.3'
		Limestone layer: 3.25" @ 60.9'
		Limestone layer: 4" @ 62.4'
		Limestone: 23% Shale: 77%
		SHALE, gray very weak shale interbedded with thin gray strong fossiliferous limestone layers,
		Limestone layer: 1" @ 53.2'
		Limestone layer: 5" @ 54.4'
		Limestone layer: 9.50" @ 55.4'
		Limestone layer: 1" @ 58.7'
		Limestone layer: 8" @ 60.3'
		Limestone layer: 3.25" @ 60.9'
		Limestone layer: 4" @ 62.4'
		Limestone: 23% Shale: 77% *(continued)*
		SHALE, gray very weak to weak shale with thin fossiliferous strong limestone layers,
		Limestone layer: 1/2" @ 64.8'
		Limestone layer: 1" @ 65.2'
		Limestone layer: 5.75" @ 65.8'
		Limestone layer: 1.50" @ 66.4'
		Limestone layer: 1/2" @ 66.5'
		Limestone layer: 2.25" @ 66.8'
		Limestone layer: 1.25" @ 66.9'
		Limestone layer: 2.25" @ 67.1'
		Limestone layer: 1.50" @ 67.4'
		Limestone layer: 2.75" @ 67.7'
		Limestone layer: 2" @ 67.9'
		Limestone layer: 1.50" @ 68.3'
		Limestone layer: 1.50" @ 68.7'
		Limestone layer: 2.50" @ 68.9'
		Limestone layer: 3" @ 69.2'

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	RQD%	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
			100		91					
65			100		94					
70							1270.86	5	153	

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed @ 10.1' during driling

Water observed @ 10.7 upon completion of drilling

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-08-2017 | Boring Completed: 02-09-2017
Drill Rig: Track | Driller: J. Mathis
Project No.: N1165468

BORING LOG NO. B2

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.281319° Longitude: -84.360661°
Northing: 472102.357 Easting: 1441858.16

Surface Elev.: 849.5 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	RECOVERY (%)	RQD%	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
			100	94			
	Limestone layer: 1.50" @ 70.2'						
	Limestone layer: 1/2" @ 71.4'						
	Limestone layer: 1/2" @ 71.5'						
	Limestone layer: 1/2" @ 71.6'						
	Limestone layer: 1.50" @ 71.8'						
	Limestone layer: 1.75" @ 72.5'						
	Limestone layer: 3.5" @ 73.4'						
74.0	Limestone layer: 3" @ 73.8'						
	775.5						
	Shale: 63% Limestone: 37%						
	SHALE, gray weak shale interbedded with gray strong limestone layers,						
	Limestone layer: 2.75" @ 74.3'	75					
	Limestone layer: 1.50" @ 74.5'						
	Limestone layer: 3/4" @ 75.3'						
	Limestone layer: 1.50" @ 75.7'						
	Limestone layer: 1" @ 75.9'						
	Limestone layer: 2.25" @ 76.1'						
	Limestone layer: 2.25" @ 77.8'						
	Limestone layer: 8.25" @ 78.6'						
	Limestone layer: 3/4" @ 79.6'						
	Limestone layer: 2.25" @ 80.1'		98	91			
	Limestone layer: 3.25" @ 80.5'						
	Limestone layer: 1.25" @ 81.0'						
	Limestone layer: 9" @ 82.1'						
	Limestone layer: 3" @ 82.8'						
	Limestone layer: 1.25" @ 83.2'						
	Limestone layer: 1/2" @ 83.8'						
	Limestone layer: 2.75" @ 84.2'						
	Limestone layer: 1.50" @ 84.5'						
	Limestone layer: 2" @ 84.8'						
	Limestone layer: 1.75" @ 85.7'						
	Limestone layer: 1/4" @ 85.9'						
	Limestone layer: 1" @ 86.2'	80					
	Limestone layer: 3/4" @ 86.6'						
	Limestone layer: 1.50" @ 86.7'						
	Limestone layer: 2.50" @ 87.2'						
	Limestone layer: 1" @ 87.5'						
	Limestone layer: 3.75" @ 87.8'						
	Limestone layer: 1.50" @ 88.4'				1461.65	4	155
	Limestone layer: 2.50" @ 88.6'						
	Shale: 56% Limestone: 44%		100	99			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed @ 10.1' during drilling

Water observed @ 10.7 upon completion of drilling

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-08-2017 | Boring Completed: 02-09-2017
Drill Rig: Track | Driller: J. Mathis
Project No.: N1165468

BORING LOG NO. B2

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.281319° Longitude: -84.360661°
Northing: 472102.357 Easting: 1441858.16

Surface Elev.: 849.5 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	RQD%	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
88.7	761	85			100		98					
		90			100		82		1007.91	5	151	
		95										

LIMESTONE, gray strong fossiliferous limestone with thin gray weak shale seams and layers,
Shale layer: 3/4" @ 89.2'
Shale layer: 1" @ 89.9'
Shale layer: 1" @ 90.2'
Shale layer: 3/4" @ 91.0'
Shale layer: 3/4" @ 91.3'
Shale layer: 1/2" @ 91.8'
Shale layer: 5.50 @ 92.1'
Shale layer: 6.75" @ 92.9'
Shale layer: 4" @ 93.5'
Shale layer: 1/2" @ 93.9'
Shale layer: 3.25" @ 94.9'
Shale layer: 1/2" @ 95.4'
Shale layer: 1/2" @ 95.7'
Shale layer: 1/2" @ 95.9'
Shale layer: 2" @ 96.0'
Shale layer: 2" @ 96.2'
Shale layer: 1/2" @ 96.5'
Shale layer: 1/4" @ 97.2'
Shale layer: 1/4" @ 98.5'
Shale layer: 1/4" @ 99.2'
Shale layer: 1/2" @ 99.9'
Shale layer: 1/4" @ 100.1'
Shale layer: 1" @ 100.2'
Shale layer: 1" @ 100.6'
Shale layer: 2.25" @ 101.8'
Shale layer: 2.50" @ 102.2'

Shale: 23% Limestone: 77%

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbrevialions.

Notes:

WATER LEVEL OBSERVATIONS

Water observed @ 10.1' during driling

Water observed @ 10.7 upon completion of drilling

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-08-2017 | Boring Completed: 02-09-2017
Drill Rig: Track | Driller: J. Mathis
Project No.: N1165468

BORING LOG NO. B2

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.281319° Longitude: -84.360661°
Northing: 472102.357 Easting: 1441858.16

Surface Elev.: 849.5 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	RQD%	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
					100		100		5182.40	0	166	
		100			67		67					
102.9	746.5											

Boring Terminated at 102.9 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed @ 10.1' during driling

Water observed @ 10.7 upon completion of drilling

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-08-2017 | Boring Completed: 02-09-2017

Drill Rig: Track | Driller: J. Mathis

Project No.: N1165468

BORING LOG NO. B3

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.280032° Longitude: -84.360603°
Northing: 471633.185 Easting: 1441864.797

Surface Elev.: 862.7 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.2	862.5	**TOPSOIL (1.5 INCHES)**
		LEAN CLAY (CL), with trace gravel and oxide nodules, brown and gray mottled, very stiff, moist
7.0	855.5	
		LEAN CLAY (CL), with trace silt and gravel, light brown, soft, very moist
9.5	853	
		LEAN CLAY TO SILTY CLAY (CL-ML), with trace oxide nodules and fine sand, brown, very stiff, moist
13.0	849.5	
		SANDY LEAN CLAY (CL), trace gravel, brown, dense
18.0	844.5	
		LEAN CLAY (CL), with trace gravel, gray, very stiff, moist
23.0	839.5	
		SANDY LEAN CLAY (CL), with gravel, gray, medium stiff, moist
28.0	834.5	
		WELL GRADED SAND (SW), brown and gray, medium dense to dense, wet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	RQD%	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
			94	3-4-6 N=10		2.25 (HP)		25		
			100	3-6-8 N=14		4.5 (HP)		17		
5			89	4-7-10 N=17		4.5 (HP)		19		
	▽		67	3-7-16 N=23		0.25 (HP)		24		
10			89	7-10-9 N=19		4.5+ (HP)		12		21-14-7
15	▽		94	9-16-24 N=40				14		
20			100	11-13-16 N=29		4.5+ (HP)		12		23-13-10
25			100	7-19-14 N=33		0.5 (HP)		12		
30			100	2-5-7 N=12				25		
35			89	9-11-11 N=22				21		
40			94	7-9-11 N=20				16		
45										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed @ 16.8 during driling*

▽ *Water observed @ 9.2' upon completion of drilling*

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-14-2017 | Boring Completed: 02-15-2017

Drill Rig: Track | Driller: J. Mathis

Project No.: N1165468

BORING LOG NO. B3

PROJECT: Duke C350 Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.280032° Longitude: -84.360603°
Northing: 471633.185 Easting: 1441864.797

Surface Elev.: 862.7 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
48.0	814.5	**WELL GRADED SAND (SW)**, brown and gray, medium dense to dense, wet *(continued)*
53.0	809.5	**SILT (ML)**, trace clay, gray, dense, very moist
63.0	799.5	**POORLY GRADED SAND (SP)**, with trace clay, gray, dense, moist
73.0	789.5	**SILT (ML)**, with trace sand, gray, medium dense to dense, moist
85.0	777.5	**FAT CLAY (CH)**, with trace gravel, bluish gray, very stiff, with soft/ wet seams, moist

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	RQD%	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
50			100	9-17-26 N=43				13		
55			100	11-14-17 N=31				25		NP
60			100	3-13-18 N=31				22		
65			100	6-11-23 N=34				21		
70			100	10-14-16 N=30				17		
75			61	6-10-13 N=23				19		
80			100	7-11-15 N=26		3.5 (HP)		26		
85			100	8-8-57 N=65		0.25 (HP)		34		
90			98		35		112.40	8	148	

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed @ 16.8 during driling

Water observed @ 9.2' upon completion of drilling

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-14-2017 | Boring Completed: 02-15-2017

Drill Rig: Track | Driller: J. Mathis

Project No.: N1165468

BORING LOG NO. B3

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.280032° Longitude: -84.360603°
Northing: 471633.185 Easting: 1441864.797

Surface Elev.: 862.7 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	RECOVERY (%)	RQD%	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)
		SHALE, with interbedded hard limestone layers, gray, very weak to weak,				128.76	6	144
		Limestone layer: 3" @ 85.0'		100	43			
		Limestone layer: 1" @ 85.5'						
		Limestone layer: 1" @ 85.7'						
		Limestone layer: 1.25" @ 86.6'	95					
		Limestone layer: 1.5" @ 86.9'						
		Limestone layer: 3.5" @ 87.2'						
		Limestone layer: 1.5" @ 87.8'		100	47			
		Limestone layer: 1" @ 89.9'						
100.0	762.5	Limestone layer: 1.5" @ 90.4'	100					
		Limestone layer: 4" @ 91.4'						
		Limestone layer: 4" @ 92.0'						
		Limestone layer: 5" @ 94.0'						
		Limestone layer: 2.5" @ 96.1'						
		Limestone layer: 2.5" @ 97.8'						
		Limestone layer: 3" @ 98.7'						
		Limestone: 20% Shale: 80% *(continued)*						
		Boring Terminated at 100 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger and NX Rock Core

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed @ 16.8 during driling

Water observed @ 9.2' upon completion of drilling

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 02-14-2017 | Boring Completed: 02-15-2017

Drill Rig: Track | Driller: J. Mathis

Project No.: N1165468

BORING LOG NO. S1

PROJECT: Duke C350- Central Corridor Pipeline

CLIENT: Duke Energy
Cincinnati, Ohio

SITE:
Cincinnati, OH

LOCATION See Exploration Plan

Latitude: 39.288353° Longitude: -84.354237°
Northing: 474626.293 Easting: 1443728.724

Surface Elev.: 873.7 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	RQD%	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
		FILL - AGGREGATE BASE (36"), gray crushed limestone with lean clay, medium dense, moist				67	11-12-6 N=18						
3.0	870.5					33	13-11-6 N=17						
		LEAN CLAY (CL), trace root hairs, trace silt, gray, soft to medium stiff				94	2-2-3 N=5		0.5 (HP)		24		30-19-11
4.5	869												
		LEAN CLAY (CL), gray with red mottles, stiff, moist	5	▽		100	2-3-4 N=7		1.0 (HP)		29		
						100	3-5-6 N=11		2.5 (HP)		21		
				▽		67	3-6-6 N=12		2.25 (HP)		20		
			10			72	3-5-7 N=12		2.5 (HP)		22		
12.0	861.5					100	3-6-8 N=14		2.75 (HP)		20		
		LEAN CLAY (CL), trace gravel, light gray with reddish and dark brown mottles, very stiff, moist				100	3-5-7 N=12		3.0 (HP)		22		44-19-25
						16	2-5-6 N=11		1.75 (HP)		21		
			15			89	8-10-12 N=22		3.75 (HP)		12		
18.0	855.5					89	3-5-8 N=13		3.50 (HP)		15		
		LEAN CLAY (CL), trace gravel, brown with reddish-orange mottles, stiff, very moist				61	1-3-2 N=5		1.5 (HP)		16		
19.5	854												
		SANDY LEAN CLAY (CL), trace gravel, grayish-brown, medium stiff, very moist to wet	20			44	3-10-11 N=21				21		
21.0	852.5												
		SANDY LEAN CLAY (CL), with gravel,(GLACIAL TILL), gray, very stiff, moist				50	1-7-12 N=19		4.5+ (HP)		10		
22.5	851												
		Boring Terminated at 22.5 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic, 81.9%, 8/15/2016

Advancement Method:
3.25" Hollow Stem Auger

Abandonment Method:
Boring backfilled with tremie placed grout.

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed @ 8.8 ' during drilling*

▽ *Water observed @ 5.2' after 1 hour*

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 01-23-2017 | Boring Completed: 01-23-2017

Drill Rig: Track | Driller: J. Mathis

Project No.: N1165468

BORING LOG NO. 20-4

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.26796° Longitude: -84.377598°

Surface Elev.: 828.9 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	N_{60}	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.5	828.5									
6 inches										
FILL - LEAN CLAY, trace gravel, sand and brick fragments, brown					83	2-2-3 N=5	7	1.5 (HP)	19	
					100	2-2-3 N=5	7	0.5 (HP)	21	
					27	1-3-4 N=7	10	1.0 (HP)	20	
		5			100	4-5-7 N=12	18	2.0 (HP)	21	
					83	3-4-3 N=7	10	2.0 (HP)	21	
					78	2-2-3 N=5	7	2.0 (HP)	23	38-13-25
9.0	820									
LEAN CLAY, trace sand and gravel, brownish gray, medium stiff					83	2-3-6 N=9	13	0.5 (HP)		
		10			79	PUSH TUBE		0.5 (HP)	15	
					100	4-4-4 N=8	12	1.5 (HP)	25	
15.0	814	15								
LEAN CLAY, trace sand and gravel, gray, hard										
		20			100	4-7-8 N=15	22	4.5 (HP)	20	
					100	4-5-9 N=14	21	4.0 (HP)	22	
25.0	804	25								
Boring Terminated at 25 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch Continuous-Flight Hollow-Stem Augers
2-inch Split-Barrel Sampler
3-inch thin-walled tube sampler

Abandonment Method:
Boring backfilled with auger cuttings and surface capped with concrete plug.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

No water observed after drilling

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 04-03-2020 | Boring Completed: 04-03-2020

Drill Rig: CME 55X | Driller: KH

Project No.: N1175384

BORING LOG NO. 20-5

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.26734° Longitude: -84.377473°

Surface Elev.: 825.4 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.4	825	3 inches
1.5	824	**FILL - LEAN CLAY** , trace sand, brown
3.0	822.5	**LEAN CLAY**, trace sand, brown, hard
10.5	815	**LEAN CLAY**, with limestone fragments and relic bedding planes, brownish gray, hard (Residuum)
15.0	810.5	**INTERBEDDED SHALE AND LIMESTONE** : Shale: gray, slightly weathered, extremely weak to very weak Limestone: light gray, unweathered, strong
25.0	800.5	**INTERBEDDED SHALE AND LIMESTONE** : Shale (75%) :gray, slightly weathered to unweathered, very weak to weak, bed thickness varies from 1 inch to 8 inches Limestone (25%): light gray, unweathered, strong, bed thickness varies from 1 inch to 5 inches
		Boring Terminated at 25 Feet

DEPTH (Ft.)	RECOVERY (%)	FIELD TEST RESULTS	N_{60}	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	89	2-4-5 N=9	13	2.5 (HP)	18	
	61	4-9-11 N=20	30	4.0 (HP)	16	
	83	8-28-12 N=40	59	4.5 (HP)	16	
5	89	9-11-16 N=27	40	4.5 (HP)	13	
	100	13-14-16 N=30	44	4.5 (HP)	11	35-17-18
	22	50/4"		4.5 (HP)		
	94	20-43-48 N=91	135	4.5 (HP)		
10	50	34-50/3"				
	83	23-31-50/3"				
15	51					
20	100					
25						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch Continuous-Flight Hollow-Stem Augers
2-inch Split-Barrel Sampler
NQ2 Rock Core Barrel

Abandonment Method:
Boring backfilled with auger cuttings and surface capped with concrete plug.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed at 11' during drilling

Water observed at 9' after 1 hour

Water added to facilitate rock coring.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 04-03-2020 | Boring Completed: 04-03-2020

Drill Rig: CME 55X | Driller: KH

Project No.: N1175384

BORING LOG NO. 20-6

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.252147° Longitude: -84.392191°

Surface Elev.: 846.3 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.5	846	**FILL - FAT CLAY (CH)**, with brick and wood fragments, grayish brown to gray
9.0	837.5	**LEAN CLAY**, with limestone fragments, grayish brown, hard (Residuum)
12.5	834	**INTERBEDDED SHALE AND LIMESTONE** : Shale: gray, slightly weathered, extremely weak to very weak Limestone: light gray, unweathered, strong
15.0	831.5	**INTERBEDDED SHALE AND LIMESTONE**: Shale (20%): gray, slightly weathered to unweathered, very weak to weak, bed thickness varies from 1/2 inch to 4 inches Limestone (80%): light gray, unweathered, strong, bed thickness varies from 1 inch to 4 inches
20.0	826.5	***Boring Terminated at 20 Feet***

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	N_{60}	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
			50	4-2-5 N=7	10	4.5 (HP)	20	
			67	2-3-3 N=6	9	2.0 (HP)	27	
			89	3-3-5 N=8	12	1.25 (HP)	27	
5	▽		94	3-5-7 N=12	18	1.5 (HP)	29	61-16-45
			100	4-4-8 N=12	18	1.5 (HP)	27	
			100	4-6-36 N=42	62	1.5 (HP)	27	
10			100	42-26-19 N=45	67	4.5 (HP)		
			50	50/2"			4	
			11	50/2"				
15			96					
20								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch Continuous-Flight Hollow-Stem Augers
2-inch Split-Barrel Sampler
NQ2 Rock Core Barrel

Abandonment Method:
Boring backfilled with auger cuttings and surface capped with concrete plug.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

▽ *Water observed at 4'9" after 1 hour*

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 04-06-2020 | Boring Completed: 04-06-2020

Drill Rig: CME 55X | Driller: KH

Project No.: N1175384

BORING LOG NO. 20-7

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: **Hamilton County**
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.234016° Longitude: -84.436445°

Surface Elev.: 580.3 (Ft.)

DEPTH	ELEVATION (Ft.)	
0.5	580	6 inches
		FILL - LEAN CLAY, with concrete and asphalt fragments, brown
7.5	573	
		LEAN CLAY, with cobbles. trace gravel, brownish gray, very siff to hard
13.5	567	
		LEAN CLAY, trace sand, gray, medium stiff to stiff
25.0	555.5	***Boring Terminated at 25 Feet***

DEPTH (Ft.)	RECOVERY (%)	FIELD TEST RESULTS	N_{60}	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	67	2-3-3 N=6	9	0.5 (HP)	10	
	89	4-5-4 N=9	13	1.0 (HP)	15	
	56	3-2-2 N=4	6	1.5 (HP)	23	
5	56	2-1-1 N=2	3	0.5 (HP)	21	
	33	1-2-5 N=7	10	0.75 (HP)	24	
	83	PUSH TUBE		3.0 (HP)	19	
10	0	8-7-10 N=17	25			
	67	4-5-9 N=14	21	4.5 (HP)	20	
	78	4-3-3 N=6	9	0.75 (HP)	19	
15						
	100	3-3-5 N=8	12	2.75 (HP)	25	
20						
	100	4-3-5 N=8	12	2.5 (HP)	30	
25						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3.25-inch Continuous-Flight Hollow-Stem Augers
2-inch Split-Barrel Sampler
3-inch thin-walled tube sampler

Abandonment Method:
Boring backfilled with auger cuttings and surface capped with concrete plug.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Bulk Sample collected from auger cuttings.

WATER LEVEL OBSERVATIONS

No water observed during drilling

No water observed after driling

Water added to facilitate rock coring.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 04-06-2020 | Boring Completed: 04-06-2020

Drill Rig: CME 55X | Driller: KH

Project No.: N1175384

BORING LOG NO. WB-1

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2413° Longitude: -84.4358°

Surface Elev.: 559.6 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
		LEAN CLAY, some silt, trace root hairs, brown, soft to medium stiff
7.5	552	
		SILTY CLAY (CL-ML), with sand, occasional sand and gravel seams, grayish-brown with black mottles, very soft to medium stiff
15.0	544.5	
		SILTY CLAY (CL-ML), some sand, trace gravel, gray, very stiff to hard (Glacial Till)
35.0	524.5	
36.5	523	**SAND**, with cobbles, tannish-brown, medium dense
		Boring Terminated at 36.5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
			89	1-2-3 N=5	1.0 (HP)		17	
			89	3-4-4 N=8	2.0 (HP)		16	
5			78	1-2-3 N=5			9	
			100	1-2-1 N=3			24	
10			100	0-0-0 N=0			25	
	▽		89	0-0-5 N=5			22	
15			100	12-6-9 N=15	3.75 (HP)		16	23-16-7
20			67	4-9-12 N=21	4.25 (HP)		12	
25			100	3-6-9 N=15	4.0 (HP)		14	
30			100	3-4-11 N=15	3.25 (HP)		15	
35			53	6-9-12 N=21			10	

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Gas pocket encountered at 34 feet.

WATER LEVEL OBSERVATIONS

▽ *Water observed at 12.5' during drilling*

No water observed after drilling.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-15-2017 | Boring Completed: 11-16-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-1A

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2418° Longitude: -84.4339°

Surface Elev.: 554.4 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT	ATTERBERG LIMITS LL-PL-PI
		LEAN CLAY, with silt, trace root hairs, brown, very soft to medium stiff, moist			61	2-3-3 N=6	2.5 (HP)		28	
				X	50	0-0-0 N=0	2.0 (HP)		27	
5.0	549.5	**POORLY GRADED SAND (SP)**, with silty clay and gravel, olive-brown and gray, very loose to loose	5	X	61	2-1-2 N=3	2.5 (HP)		12	
				X	72	1-2-2 N=4	1.5 (HP)		17	
10.0	544.5	**LEAN CLAY (CL)**, some gravel and sand, trace silt, occasional sand seams, olive-brown, stiff to very stiff (Glacial Till)	10	X	83	3-3-6 N=9	3.0 (HP)		9	
				X	67	6-45-14 N=59	3.0 (HP)		11	
			15	X	78	3-5-6 N=11	2.75 (HP)		12	
			20	X	100	3-5-6 N=11			14	27-14-13
			25	X	100	5-6-11 N=17	4.0 (HP)		12	
31.5	523	--Auger cuttings identified granular soil @ 30'	30							
		Boring Terminated at 31.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

No water observed after drilling.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-16-2017 | Boring Completed: 11-16-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-2

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2398° Longitude: -84.4361°

Surface Elev.: 557.1 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		LEAN CLAY, trace silt, sand and root hairs, brown with black mottles, stiff to very stiff				100	2-3-3 N=6	3.25 (HP)		27	
						67	6-7-9 N=16	3.25 (HP)		22	
5.0	552	**LEAN CLAY (CL)**, some silt and fine sand, gray with reddish-brown and black mottles, stiff	5			100	4-6-7 N=13	2.0 (HP)		23	36-19-17
8.4	548.5	**SAND**, trace silt, brown, loose				100	2-3-3 N=6			16	
10.0	547	**LEAN CLAY (CL)**, with silt lenses, medium plasticity, gray, very stiff (Lacustrine)	10			67	3-4-5 N=9	2.5 (HP)		27	49-20-29
13.3	544					89	2-2-6 N=8	1.75 (HP)		37	
15.0	542	**LEAN CLAY**, with silt lenses, brown, stiff (Lacustrine)	15	▽							
		SAND, some silt, fine grained, brown, medium dense				100	8-11-16 N=27			23	
20.0	537	**LEAN CLAY**, with cobbles, sand and silt, gray, very stiff (Glacial Till)	20			78	7-14-31 N=45	3.0 (HP)		12	
			25			16	23-25-38 N=63			12	
30.0	527	**SILTY SAND (SM)**, fine to medium grained, brown, medium dense to dense	30			94	6-11-17 N=28			19	
			35			100	6-9-12 N=21			22	

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

▽ *Water observed at 14.7' after 20 hour.*

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-20-2017 | Boring Completed: 11-20-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-2

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: **Hamilton County**
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2398° Longitude: -84.4361°

Surface Elev.: 557.1 (Ft.)

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
			40		X	100	5-6-11 N=17			25	
			45		X	100	3-4-8 N=12			21	
			50		X	100	8-10-13 N=23			18	
			55		X	100	10-14-17 N=31			25	
			60		X	100	9-14-23 N=37			23	
65.0	492		65		X	100	9-21-24 N=45	3.5 (HP)		10	
			70		X	67	26-42-48 N=90	4.0 (HP)		10	16-14-2
			75		X	94	36-32-27 N=59	4.5+ (HP)		13	

SILTY SAND (SM), fine to medium grained, brown, medium dense to dense *(continued)*

SILT (ML), with clay and cobbles, some sand, brownish-gray to brown, very dense (Glacial Till)

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

Water observed at 14.7' after 20 hour.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-20-2017 | Boring Completed: 11-20-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-2

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2398° Longitude: -84.4361°

Surface Elev.: 557.1 (Ft.)

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
80.0	477		80								
					X	100	11-16-22 N=38			18	
			85								
					X	100	14-11-10 N=21			20	
			90								
					X	94	17-16-30 N=46			12	
			95								
					X	100	7-10-16 N=26			17	
100.9	456		100		X	100	30-50/5"			10	

SILT (ML), with clay and cobbles, some sand, brownish-gray to brown, very dense (Glacial Till) *(continued)*

SILTY SAND (SM), with cobbles, fine to medium grained, brownish-gray, medium dense to very dense

Boring Terminated at 100.9 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

Water observed at 14.7' after 20 hour.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-20-2017 | Boring Completed: 11-20-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-2A

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: **Hamilton County**
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2402° Longitude: -84.4353°

Surface Elev.: 554.9 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
		LEAN CLAY, with silt, trace to little sand, trace root hairs, brown to tannish-brown with black mottles, medium stiff
6.0	549	
		POORLY GRADED SAND (SP), trace gravel and silt, reddish-brown to brown, medium dense
7.9	547	
		LEAN CLAY (CL), with silt, little sand, trace gravel and cobbles, gray, stiff to hard (Glacial Till)
		-- Possible cobbles/boulder encountered from 10 feet to 14 feet.
35.0	520	
		SILT (ML), with sand, some clay, gray, medium dense

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
			89	3-3-3 N=6	1.25 (HP)		23	
			100	3-3-4 N=7	1.25 (HP)		18	
5			78	3-2-2 N=4			16	
			89	8-9-11 N=20	3.5 (HP)		14	
10			16	8-12-12 N=24			13	
			89	8-10-14 N=24	3.25 (HP)		13	
15	▽		100	6-8-9 N=17	4.5+ (HP)		13	26-14-12
20			100	5-5-7 N=12	2.25 (HP)		14	
25			100	2-4-5 N=9	0.75 (HP)		18	
30			53	3-5-5 N=10	1.0 (HP)		15	
35	▽		94	3-8-13 N=21	2.75 (HP)		18	

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed at 35' during drilling*

▽ *Water observed at 16.9' after 120 hours.*

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-21-2017 | Boring Completed: 11-22-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-2A

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2402° Longitude: -84.4353°

Surface Elev.: 554.9 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	40.0	515	40								
SILT (ML), with sand, some clay, gray, medium dense *(continued)*											
SILTY SAND (SM), with coarse gravel and cobbles, brownish-gray, medium dense to dense					X	83	12-7-15 N=22			19	
			45		X	78	5-11-8 N=19			14	
			50		X	33	9-6-8 N=14			23	
			55		X	72	12-15-20 N=35			22	
			60		X	0	9-13-16 N=29				
	65.0	490	65		X	100	7-8-12 N=20	2.25 (HP)		21	
LEAN CLAY (CL), occasional silt lenses, varved structure, gray, very sitff (Lacustrine)			70		X	100	7-10-14 N=24	3.0 (HP)		20	23-15-8
			75		X	100	6-9-14 N=23	3.25 (HP)		18	

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed at 35' during drilling

Water observed at 16.9' after 120 hours.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-21-2017 | Boring Completed: 11-22-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-2A

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2402° Longitude: -84.4353°

Surface Elev.: 554.9 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
LEAN CLAY (CL), occasional silt lenses, varved structure, gray, very sitff (Lacustrine) *(continued)*										
80.0	475	80		X	100	8-12-29 N=41			15	
SILTY SAND (SM), trace coarse gravel, fine grained, gray, dense to very dense										
85.0	470	85		X	100	19-26-33 N=59			22	
POORLY GRADED SAND (SP), with silt, grayish brown, dense to very dense		90		X	100	18-29-34 N=63			14	
		95		X	67	9-23-25 N=48			24	
		100		X	100	11-15-23 N=38			22	
101.5	453.5									
Boring Terminated at 101.5 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed at 35' during drilling

Water observed at 16.9' after 120 hours.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-21-2017 | Boring Completed: 11-22-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-3

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2382° Longitude: -84.4361°

Surface Elev.: 584.4 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
FILL, lean clay, with silt and gravel, trace sand, brown and black										
				X	39	3-2-1 N=3	3.25 (HP)		10	
-- Possible void encountered at 2.5 feet to 6.5 feet (No recovery)				X	0	0-0-0 N=0				
		5		X	0	2-0-0 N=0				
				X	0	2-2-2 N=4				
10.0	574.5	10								
FILL, clayey gravel, with silt and sand, glass and slag, brown with black				X	78	4-6-5 N=11	3.0 (HP)		22	
				X	39	2-2-4 N=6			14	
		15		X	44	3-3-3 N=6			21	
		20		X	11	5-3-1 N=4			25	
		25		X	39	3-1-1 N=2			24	
30.0	554.5	30								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed at 31' during drilling

Water observed at 56.6' after 1 hour.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-07-2017 | Boring Completed: 11-08-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-3

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2382° Longitude: -84.4361°

Surface Elev.: 584.4 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		FILL, lean clay, with silt, sand, slag and glass, trace rock fragments, bluish gray to black		▽		94	3-4-3 N=7	2.5 (HP)		22	32-24-8
35.0	549.5	**SILTY SAND (SM)**, with cobbles, trace clay, tannish brown and dark gray, medium dense	35			72	6-8-6 N=14			12	
			40			94	5-11-12 N=23			15	
45.0	539.5	**SAND**, some boulder and gravel, brown, medium dense	45			100	21-50			5	
50.0	534.5	**LEAN CLAY (CL)**, with silt and sand, trace cobbles, gray, hard (Glacial Till)	50			16	21-20-37 N=57	4.5+ (HP)		12	
			55	▽		100	9-15-30 N=45	4.5+ (HP)		11	
			60								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed at 31' during drilling*

▽ *Water observed at 56.6' after 1 hour.*

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-07-2017 | Boring Completed: 11-08-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-3

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2382° Longitude: -84.4361°

Surface Elev.: 584.4 (Ft.)

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	LEAN CLAY (CL), with silt and sand, trace cobbles, gray, hard (Glacial Till) *(continued)*										
						100	9-20-27 N=47	4.5+ (HP)		12	
			65								
						100	10-12-16 N=28	4.5+ (HP)		18	29-16-13
			70								
						100	20-23-34 N=57	4.5+ (HP)		14	
			75								
						100	8-12-16 N=28	4.5+ (HP)		25	
80.0	504.5		80								
	SILTY SAND (SM), trace silt, brown, medium dense					100	3-7-12 N=19			21	
81.5	503										
	Boring Terminated at 81.5 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water observed at 31' during drilling

Water observed at 56.6' after 1 hour.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-07-2017 | Boring Completed: 11-08-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-3A

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2381° Longitude: -84.4346°

Surface Elev.: 576.0 (Ft.)

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DESCRIPTION	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT	ATTERBERG LIMITS LL-PL-PI
			FILL, lean clay, with sand, trace silt, cobbles and rock fragments, brown to black			33	3-4-3 N=7			16	
					X	72	4-3-3 N=6	4.0 (HP)		16	
5					X	94	1-1-2 N=3			18	
					X	0	1-2-1 N=3				
10					X	72	1-2-1 N=3	1.25 (HP)		15	
					X	44	3-2-1 N=3			15	
15					X	39	6-8-12 N=20			19	
20			-- Trace nails and plastic fragments encountered at 20 feet		X	33	49-25-6 N=31			61	
25.0	551		**SILTY SAND (SM)**, with gravel, cobbles and rock fragments, brown, medium dense	▽	X	22	7-8-11 N=19			9	
30.0	546										
25											
30											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling
Water observed at 25.7' after 1 hour.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-07-2017 | Boring Completed: 11-07-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-3A

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: **Hamilton County**
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2381° Longitude: -84.4346°

Surface Elev.: 576.0 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT	ATTERBERG LIMITS LL-PL-PI
		LEAN CLAY (CL), with sand, some silt and gravel, mottled orange-brown, stiff (Glacial Till)				94	3-5-6 N=11	2.75 (HP)		13	21-13-8
			35			61	5-8-3 N=11	1.5 (HP)		12	
	40.0	536									
		SILTY SAND (SM), light brown, medium dense	40			83	18-12-23 N=35			10	
			45			89	7-8-10 N=18			19	
			50			100	6-10-11 N=21			80	
	51.5	524.5									
		Boring Terminated at 51.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling
Water observed at 25.7' after 1 hour.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-07-2017 | Boring Completed: 11-07-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-4

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2367° Longitude: -84.4362°

Surface Elev.: 584.2 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT	ATTERBERG LIMITS LL-PL-PI
FILL, sand and gravel, cinders and ash, gray and black				78	7-6-4 N=10	4.5+ (HP)		8	
				67	2-4-4 N=8			20	
3.0	581								
LEAN CLAY, little sand and silt, tannish-brown, stiff to hard (Glacial Till)				83	2-2-5 N=7	3.5 (HP)		14	
		5		83	3-7-6 N=13	4.25 (HP)		13	
				100	4-5-8 N=13	2.75 (HP)		14	
7.5	576.5								
LEAN CLAY (CL), with silt, brown with orange striations, very stiff to hard (Lacustrine)				100	7-8-10 N=18	4.5+ (HP)		19	39-23-16
		10		100	4-7-10 N=17	3.5 (HP)		23	
12.5	571.5								
LEAN CLAY, some sand, trace gravel, brown with iron mottles, hard (Glacial Till)				100	5-13-15 N=28			11	
15.0	569								
SILTY SAND (SM), with gravel, reddish-brown, very dense		15			10-8-4 N=12			21	
16.5	567.5								
Boring Terminated at 16.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

No water observed after drilling.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-08-2017 | Boring Completed: 11-08-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-5

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2342° Longitude: -84.4364°

Surface Elev.: 581.3 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		FILL, sand and gravel, trace silt and brick fragments, brown				89	6-7-8 N=15			8	
						67	28-16-12 N=28			6	
3.2	578	**SILTY CLAY (CL-ML)**, with trace sand and root hairs, tannish-brown, soft to stiff				100	2-3-3 N=6	2.25 (HP)		23	
6.0	575.5	**LEAN CLAY**, with silt and sand, trace gravel, brown with gray mottles, stiff to very stiff (Glacial Till)	5			100	3-2-2 N=4	0.25 (HP)		20	23-17-6
						16	4-6-7 N=13			15	
9.0	572.5			▽		50	4-5-14 N=19	4.25 (HP)		13	
		SILT (ML), with trace clay, varved structure, brown, hard (Lacustrine)	10			100	4-8-11 N=19	4.5 (HP)		19	24-22-2
13.5	568					100	4-8-11 N=19	4.5+ (HP)		18	
		LEAN CLAY, with silt lenses, varved structure, gray, hard (Lacustrine)	15			100	6-7-6 N=13	4.5+ (HP)		23	
16.5	565	***Boring Terminated at 16.5 Feet***									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

▽ *Water observed at 9' after 1 hour.*

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-08-2017 | Boring Completed: 11-08-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-7

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2331° Longitude: -84.4378°

Surface Elev.: 563.7 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.7	563	**TOPSOIL (8 inches)**
4.5	559	**POORLY GRADED SAND (SP)**, some clay, fine grained, dark brown, very loose
6.0	557.5	**SANDY CLAY (SC)**, mottled brown, trace gray, soft
9.0	554.5	**SILT (ML)**, some clay and gravel, brown, stiff
10.5	553	**LEAN CLAY**, with sand and gravel, brownish gray, very stiff (Glacial Till)
		Boring Terminated at 10.5 Feet

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT	ATTERBERG LIMITS LL-PL-PI
		100	1-2-1 N=3	1.75 (HP)		17	
		100	2-3-3 N=6	1.75 (HP)		15	
		53	2-2-2 N=4	0.5 (HP)		13	
5		89	3-2-1 N=3	0.75 (HP)		36	
		78	4-4-5 N=9	2.25 (HP)		12	
		78	4-5-6 N=11	2.0 (HP)		11	NP
10		78	4-6-8 N=14	3.0 (HP)		13	

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

No water observed after drilling.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 12-04-2017 | Boring Completed: 12-04-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-8

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2481° Longitude: -84.4327°

Surface Elev.: 590.5 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.5	590	**TOPSOIL (6 inches)**
		LEAN CLAY (CL), with calcareous nodules, brown, medium stiff to stiff
4.5	586	
		SILTY CLAY (CL-ML), trace fine sand, brown, stiff
9.0	581.5	
		LEAN CLAY, with sand, trace gravel, brown, very stiff (Glacial Till)
10.5	580	
		LEAN CLAY (CL), with sand, occasional silt seams, gray, very stiff to hard (Glacial Till)

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		89	2-3-3 N=6	2.25 (HP)		14	
		44	2-2-1 N=3	1.75 (HP)		18	
		53	2-1-1 N=2	2.50 (HP)		16	27-14-13
5		67	2-2-3 N=5	2.75 (HP)		19	
		78	3-3-3 N=6	2.25 (HP)		12	
		89	3-4-4 N=8	2.50 (HP)		23	
10		44	8-10-9 N=19	2.0 (HP)		11	
15		89	13-17-19 N=36	4.5 (HP)		8	
20							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

No water observed after drilling.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 12-04-2017 | Boring Completed: 12-04-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-8

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2481° Longitude: -84.4327°

Surface Elev.: 590.5 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT	ATTERBERG LIMITS LL-PL-PI
	LEAN CLAY (CL), with sand, occasional silt seams, gray, very stiff to hard (Glacial Till) *(continued)*				67	17-11-16 N=27	4.0 (HP)		11	
		25								
26.5	564				89	12-8-8 N=16	2.75 (HP)		17	31-18-13
	Boring Terminated at 26.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

No water observed after drilling.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 12-04-2017 | Boring Completed: 12-04-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-9

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2541° Longitude: -84.4276°

Surface Elev.: 580.5 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT	ATTERBERG LIMITS LL-PL-PI
0.2	580.5	**TOPSOIL (2 inches)**								
		FILL, silty clay, with sand and gravel, trace asphalt and limestone fragments, brown			100	2-4-3 N=7	1.25 (HP)		12	
					100	4-8-9 N=17	4.5+ (HP)		11	
4.5	576				100	7-10-14 N=24	4.5+ (HP)		10	
		FILL, lean clay, with silt and limestone fragments, trace gravel, gray with brown striations	5		100	11-12-14 N=26	4.5+ (HP)		8	19-13-6
7.5	573				89	6-6-9 N=15	4.5+ (HP)		12	
		LEAN CLAY (CL), trace gravel, gray with brown mottles, stiff (Lacustrine)			100	4-5-10 N=15	1.75 (HP)		28	30-16-14
9.0	571.5									
		LEAN CLAY, with sand, trace silt and gravel, light brown with orangish brown mottles, very stiff (Lacustrine)	10		100	6-6-7 N=13	3.25 (HP)		17	
13.2	567.5									
		LEAN CLAY, with silt, gray, hard			100	7-8-9 N=17	4.5+ (HP)		13	
15.0	565.5		15							
		LEAN CLAY, with sand, trace silt and gravel, olive gray, hard			100	10-9-9 N=18	4.5+ (HP)		16	
16.5	564									
		Boring Terminated at 16.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

A PID reading was noted from a depth of about 0.2 to 3 feet below ground but no gas pocket was encountered during drilling.

WATER LEVEL OBSERVATIONS

No water observed during drilling

No water observed after drilling.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 11-01-2017 | Boring Completed: 11-01-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-10

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2545° Longitude: -84.4262°

Surface Elev.: 574.6 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.3	574.5	**TOPSOIL (3 inches)**
		FILL, lean clay, with silt, sand and rock fragments, brown with dark brown striations
12.5	562	
		LEAN CLAY, with silt, dark olive brown, medium stiff (Loess)
15.0	559.5	
		LEAN CLAY, with silt, trace sand, dark brown, medium stiff
20.0	554.5	
		WELL GRADED SAND (SW), with gravel, some silt, gray, medium dense to dense
30.0	544.5	
		GRAVEL, some sand, gray, dense

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
			44	3-2-5 N=7	1.75 (HP)		16	
			100	6-8-13 N=21	3.0 (HP)		20	
5			5	6-7-6 N=13	3.5 (HP)		17	
			39	2-2-4 N=6	1.5 (HP)		21	
10			39	1-7-9 N=16	2.75 (HP)		18	
			67	4-3-3 N=6	0.5 (HP)		24	
15			39	2-3-4 N=7	1.5 (HP)		22	
20	▽		78	6-8-8 N=16				
25			100	2-4-8 N=12				
30			50	10-13-24 N=37				
35			67	12-18-18 N=36				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

▽ *Water observed at 20.9' after 24 hours.*

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 10-30-2017 | Boring Completed: 10-31-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-10

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan
Latitude: 39.2545° Longitude: -84.4262°
Surface Elev.: 574.6 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
40.0	534.5	40								
GRAVEL, some sand, gray, dense *(continued)*										
LEAN CLAY, with silt, trace coarse sand and gravel, gray, hard (Glacial Till)				X	50	10-14-13 N=27	4.5+ (HP)		12	
		45		X	39	15-18-22 N=40	4.5+ (HP)		14	
		50		X	100	6-20-27 N=47	3.75 (HP)		14	
		55		X	100	24-27-39 N=66	4.5+ (HP)		11	
		60		X	27	17-26-36 N=62			18	
-- No sample was recovered at 65' as possible boulders were encountered.		65			0	15-31-50 N=81				
70.0	504.5	70		X	100	13-6-6 N=12				
SAND, fine grained, brown, medium dense										
75.0	499.5	75		X	72	8-22-38 N=60				
SILTY SAND (SM), fine grained, brown, dense to very dense										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling
Water observed at 20.9' after 24 hours.

Terracon
611 Lunsen Park Dr
Cincinnati, OH

Boring Started: 10-30-2017 | Boring Completed: 10-31-2017
Drill Rig: Track | Driller: A. Moore
Project No.: N1175384

BORING LOG NO. WB-10

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: **Hamilton County**
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2545° Longitude: -84.4262°

Surface Elev.: 574.6 (Ft.)

DEPTH ELEVATION (Ft.)

GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	80		X	94	9-17-22 N=39				
	85		X	100	22-28-29 N=57				
	90		X	83	20-31-36 N=67				
	95			100	17-11-12 N=23				
				83	6-14-22 N=36				
	100								

SILTY SAND (SM), fine grained, brown, dense to very dense
(continued)

-- Medium dense at 95 feet.

101.5 473

Boring Terminated at 101.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling
Water observed at 20.9' after 24 hours.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 10-30-2017 Boring Completed: 10-31-2017

Drill Rig: Track Driller: A. Moore

Project No.: N1175384

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL N1175384 DUKE C350V PIPELINE.GPJ TERRACON_DATATEMPLATE.GDT 6/21/18

BORING LOG NO. WB-11

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: **Hamilton County**
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2543° Longitude: -84.4238°

Surface Elev.: 568.1 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.8	567.5	**TOPSOIL (10 inches)**
		FILL, lean clay, with silt, trace root hairs, brown with orange mottles
7.6	560.5	-- Gray sand seam encountered at 7.5 feet.
		LEAN CLAY, with silt, trace sand and dark brown concretions, light olive brown with orange mottles, stiff to very stiff
10.0	558	**GRAVEL**, with sand, light brown, medium dense
12.5	555.5	**POORLY GRADED SAND (SP)**, light brown, very loose to loose
23.5	544.5	**GRAVEL**, with sand, brown, medium dense to dense

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		67	2-3-5 N=8	3.25 (HP)		10	
		78	9-7-8 N=15	2.5 (HP)		25	
5		100	4-5-7 N=12	1.5 (HP)		24	47-20-27
		16	2-1-2 N=3	2.0 (HP)		26	
10		94	8-13-13 N=26				
		94	4-2-2 N=4			10	
15		100	3-3-6 N=9				
20		100	4-2-3 N=5				
25		100	8-8-10 N=18				
30		100	4-11-23 N=34				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

Water observed at 11.6' after 1 hour.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 10-27-2017 | Boring Completed: 10-27-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-11

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: **Hamilton County**
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2543° Longitude: -84.4238°

Surface Elev.: 568.1 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
			35		X	100	14-11-14 N=25				
			40		X	100	22-21-21 N=42				
			45		X	100	9-11-21 N=32	4.5+ (HP)			
			50		X	94	24-22-24 N=46	4.5+ (HP)		11	
			55		X	83	11-16-21 N=37	4.5+ (HP)		11	
			60		X	89	16-22-24 N=46			14	

GRAVEL, with sand, brown, medium dense to dense
(continued)

44.5 — 523.5

LEAN CLAY, with sand and gravel, olive-brown to gray, hard
(Glacial Till)

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

Water observed at 11.6' after 1 hour.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 10-27-2017 | Boring Completed: 10-27-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-11

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: **Hamilton County**
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2543° Longitude: -84.4238°

Surface Elev.: 568.1 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
LEAN CLAY, with sand and gravel, olive-brown to gray, hard (Glacial Till) *(continued)*								
63.5	504.5							
SAND, trace silt, gray, dense		65		100	10-15-22 N=37		16	
68.5	499.5							
LEAN CLAY, with sand and cobbles, gray, hard (Glacial Till)		70		75	50/2"		10	
		75		100	21-23-23 N=46	3.5 (HP)	14	
78.5	489.5							
SAND, trace silt, fine grained, gray, dense				100	25-20-25 N=45		31	
80.0	488							
Boring Terminated at 80 Feet		80						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling
Water observed at 11.6' after 1 hour.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 10-27-2017 | Boring Completed: 10-27-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-12

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: **Hamilton County**
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2542° Longitude: -84.4215°

Surface Elev.: 579.6 (Ft.)

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT	ATTERBERG LIMITS LL-PL-PI
0.4	579		**TOPSOIL (4 inches)**									
			FILL, lean clay, with silt, tannish brown to dark brown with brown striations				78	3-7-7 N=14			9	
							94	9-6-6 N=12	4.0 (HP)		15	
				5			100	4-4-6 N=10	2.5 (HP)		17	
							44	4-6-5 N=11	4.5+ (HP)		14	
				10			27	3-4-5 N=9	4.5+ (HP)		13	
12.5	567		**SANDY LEAN CLAY (CL)**, with cobbles, brown, medium stiff to very stiff (Glacial Till)				67	4-6-8 N=14	0.75 (HP)		11	
				15			100	5-6-9 N=15	3.5 (HP)		15	25-14-11
20.8	559		**SAND**, fine grained, olive-brown, loose	20			89	4-3-3 N=6	4.0 (HP)			
25.0	554.5		**SANDY LEAN CLAY (CL)**, with silt, occasional sand seams, gray, very stiff to hard (Glacial Till)	25			83	10-10-14 N=24	4.5+ (HP)			
				30								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling
Water observed at 61.5' after 1 hour.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 10-25-2017 | Boring Completed: 10-26-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-12

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2542° Longitude: -84.4215°

Surface Elev.: 579.6 (Ft.)

DEPTH | ELEVATION (Ft.)

GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT	ATTERBERG LIMITS LL-PL-PI
				100	6-9-14 N=23	4.5+ (HP)			
	35			100	5-8-12 N=20	2.5 (HP)		13	24-13-11
	40			100	4-8-13 N=21	3.0 (HP)			
	45			39	11-12-15 N=27	1.5 (HP)			
	50			89	9-12-14 N=26	2.0 (HP)			
	55			100	16-15-30 N=45	4.5+ (HP)		10	21-12-9
	60								

SANDY LEAN CLAY (CL), with silt, occasional sand seams, gray, very stiff to hard (Glacial Till) *(continued)*

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling
Water observed at 61.5' after 1 hour.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 10-25-2017 | Boring Completed: 10-26-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-12

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2542° Longitude: -84.4215°

Surface Elev.: 579.6 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	60.8	519									
	SANDY LEAN CLAY, with silt and cobbles, gray, very stiff to hard (Glacial Till)			▽	X	100	16-34-35 N=69	2.5+ (HP)			
			65		X	100	27-32-50/5"	4.5+ (HP)			
			70		X	100	24-27-45 N=72	4.5+ (HP)			
	-- Cobbles/boulders encountered at 75 feet.		75		X	100	50/3"				
	81.5	498	80		X	83	11-26-32 N=58	4.25 (HP)			
	Boring Terminated at 81.5 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *No water observed during drilling*
Water observed at 61.5' after 1 hour.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 10-25-2017 | Boring Completed: 10-26-2017
Drill Rig: Track | Driller: A. Moore
Project No.: N1175384

BORING LOG NO. WB-13

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2263° Longitude: -84.438°

Surface Elev.: 573.5 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		FILL, lean clay, trace sand, tannish brown with orangish brown mottles									
						78	2-2-4 N=6	1.0 (HP)		22	
						89	4-6-8 N=14	3.0 (HP)		23	
5.5	568		5			94	3-4-4 N=8	2.75 (HP)		23	36-19-17
		FILL, trace gravel, with slag, black				33	5-3-4 N=7			19	
						5	2-2-1 N=3			18	
8.5	565	**SILTY SAND (SM)**, trace gravel, light brown, very loose				100	0-2-1 N=3	0.25 (HP)		14	
			10								
12.5	561	**LEAN CLAY (CL)**, with sand, trace gravel, brown to brownish gray, hard (Glacial Till)		▽		100	6-11-12 N=23	4.5+ (HP)		12	28-15-13
			15								
16.5	557					100	10-29-29 N=58	4.5+ (HP)		7	
		Boring Terminated at 16.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

▽ *Water observed at 13.5' after 1 hour.*

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 12-03-2017 | Boring Completed: 12-03-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-14

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan
Latitude: 39.2781° Longitude: -84.3616°
Surface Elev.: 859.2 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT	ATTERBERG LIMITS LL-PL-PI
0.7	858.5	**ASPHALT (8.75 inches)**									
1.0	858.2	**AGGREGATE BASE (3.25 inches)**									
2.5	856.7	**FILL**, lean clay, with sand and iron concretions, brown to olive-brown				100	3-4-6 N=10	3.0 (HP)		17	
		LEAN CLAY, with silt, trace sand, light gray with olive-brown mottles, medium stiff				100	4-4-4 N=8	4.5+ (HP)		17	
5.5	853.7		5			100	3-3-4 N=7	2.0 (HP)		27	
		LEAN CLAY, with silt, trace sand, dark brown with gray, stiff to very stiff				100	7-7-8 N=15	4.25 (HP)		18	
8.5	850.7					94	4-8-10 N=18	3.75 (HP)		17	
		LEAN CLAY (CL), with silt and sand, trace root hairs, mottled brown and gray with iron mottles, stiff to very stiff	10			100	5-5-7-9 N=12	3.0 (HP)		17	36-17-19
12.5	846.7										
		LEAN CLAY, with silt, trace sand, bluish-gray and brown, medium stiff				100	3-3-4 N=7	2.5 (HP)		26	
15.0	844.2		15								
		LEAN CLAY, with sand, silt and large iron concretions, trace gravel, reddish-brown, very stiff				100	8-8-12 N=20	4.5+ (HP)		17	
20.0	839.2		20								
		LEAN CLAY (CL), with sand, trace silt, medium plasticity, brown, stiff				100	4-4-5 N=9	4.5+ (HP)		24	48-19-29
21.5	837.7										
		Boring Terminated at 21.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.
Surface capped with asphalt.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

No water observed after drilling.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 10-23-2017 | Boring Completed: 10-23-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-15

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2686° Longitude: -84.3768°

Approximate Surface Elev: 835 (Ft.)+/-

DEPTH	ELEVATION (Ft.)	Description
0.6	834.5+/-	**TOPSOIL (6 inches)**
		LEAN CLAY (CL), with sand, trace gravel, brown, medium stiff
3.0	832+/-	
		LEAN CLAY (CL), with sand, trace gravel, brown to olive-brown, stiff to very stiff (Glacial Till)
6.0	829+/-	
		LEAN CLAY, with sand, with iron oxide stains and concretions, brown to reddish brown, stiff to very stiff
14.0	821+/-	
		LEAN CLAY (CL), medium plasticity, brown with gray mottles, very stiff to hard
19.0	816+/-	
		LEAN CLAY, with limestone fragments, medium plasticity, olive-brown, hard (Residuum)
21.5	813.5+/-	
		Boring Terminated at 21.5 Feet

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT	ATTERBERG LIMITS LL-PL-PI
		89	0-3-3 N=6	2.0 (HP)		18	
		67	1-2-4 N=6	2.0 (HP)		19	32-17-15
5		100	4-7-7 N=14	3.5 (HP)		16	
		100	4-5-7 N=12	3.75 (HP)		17	34-18-16
		100	5-6-8 N=14	4.0 (HP)		14	
		100	4-6-9 N=15	4.5+ (HP)		19	
10		100	3-5-6 N=11	3.75 (HP)		21	
15		94	4-7-11 N=18	4.5+ (HP)		16	46-20-26
20		100	9-10-15 N=25	4.5+ (HP)		20	

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

No water observed after drilling

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 01-19-2018 | Boring Completed: 01-19-2018

Drill Rig: Track | Driller: P. Pattison

Project No.: N1175384

BORING LOG NO. WB-16

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2524° Longitude: -84.3944°

Surface Elev.: 862.1 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.5	861.5	**TOPSOIL (6 inches)**
1.5	860.5	**LEAN CLAY**, with silt, trace sand and root hairs, tannish-brown, stiff
		LEAN CLAY (CL), with silt and sand, trace black concretions, brown with light gray striations, hard
7.7	854.5	**LEAN CLAY**, with silt and sand, trace iron concretions, tannish-brown and light gray striations, hard (Residuum)
13.4	848.5	**INTERBEDDED SHALE AND LIMESTONE** Shale: Moderately weathered, very weak, olive-brown
15.0	847	Limestone: Unweathered, strong, light gray **INTERBEDDED SHALE AND LIMESTONE** Shale: Slightly weathered, very weak, olive-brown to gray Limestone: Unweathered, strong, light gray
20.2	842	***Boring Terminated at 20.2 Feet***

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		94	2-2-2 N=4	1.5 (HP)		27	
		100	4-7-10 N=17	4.5+ (HP)		16	30-17-13
		100	5-10-14 N=24	4.5+ (HP)		15	
5		94	7-8-7 N=15	4.25 (HP)		31	
		89	5-7-11 N=18	4.0 (HP)		18	41-21-20
		89	21-11-15 N=26	4.5+ (HP)		8	
10		72	13-15-14 N=29	4.5+ (HP)		14	
		100	32-50/4"	4.5+ (HP)			
15		100	50/5"				
20		100	50/2"				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

No water observed after drilling.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 10-25-2017 | Boring Completed: 10-25-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-18

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2112° Longitude: -84.4457°

Surface Elev.: 575.00 (Ft.)

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT	ATTERBERG LIMITS LL-PL-PI
						100	6-24-23 N=47	2.0 (HP)		7	
						78	6-20-16 N=36	4.0 (HP)		21	27-18-9
						22	6-4-3 N=7	0.5 (HP)		12	
			5			11	2-1-2 N=3	0.50 (HP)		18	
						53	2-4-14 N=18			14	
						44	8-7-11 N=18			16	
			10			53	4-2-4 N=6	1.5 (HP)		15	
			15			89	7-9-8 N=17	3.5 (HP)		14	26-15-11

FILL, lean clay, with gravel, trace brick fragments and cinders, brown and black

6.0 569

POORLY GRADED SAND (SP), with silt and clay, brown trace gray, medium dense

9.0 566

LEAN CLAY (CL), with sand, trace gravel, gray and brown, medium stiff to very stiff (Glacial Till)

16.5 558.5

Boring Terminated at 16.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

No water observed at 2.5 hours after drilling

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 12-05-2017 | Boring Completed: 12-07-2017

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

BORING LOG NO. WB-19

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.1946° Longitude: -84.4528°

Surface Elev.: 597.3 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.5	597	**TOPSOIL (6 inches)**						
		FILL, lean clay, with sand, trace root hairs and cinders, dark gray		100	3-6-6 N=12	4.5+ (HP)	19	
				83	4-4-5 N=9	2.25 (HP)	30	
				89	5-4-4 N=8	1.0 (HP)	28	33-21-12
4.5	593			94	2-2-4 N=6	1.0 (HP)	30	
		LEAN CLAY (CL), with sand, orange-brown with gray mottles, stiff to very stiff	5	83	4-6-9 N=15	3.0 (HP)	25	
				100	9-6-7 N=13	2.5 (HP)	23	
				100	5-5-7 N=12	2.5 (HP)	24	48-20-28
			10					
				72	4-5-6 N=11	3.5 (HP)	24	
15.0	582.5		15					
		LEAN CLAY (CL), with sand, gravel, iron oxide stains and cobbles, gray and orange-brown, hard (Glacial Till)		89	4-4-20 N=24		23	26-17-9
16.5	581	***Boring Terminated at 16.5 Feet***						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

No water observed after drilling.

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 12-03-2017 | Boring Completed: 12-03-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-20

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.1934° Longitude: -84.453°

Surface Elev.: 596.6 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT	ATTERBERG LIMITS LL-PL-PI
LEAN CLAY (CL), trace gravel and iron concretions, gray trace brown, medium stiff to stiff					100	10-13-7 N=20	3.75 (HP)		21	
			▽		100	7-6-6 N=12	1.5 (HP)		25	
					83	3-2-3 N=5	1.0 (HP)		26	45-21-24
		5			100	4-5-6 N=11	2.0 (HP)		20	
					100	4-4-6 N=10	2.75 (HP)		20	48-16-32
					100	4-5-7 N=12	1.75 (HP)		21	
		10			100	4-5-5 N=10	1.75 (HP)		21	
12.5	584									
13.3 **LEAN CLAY (CL)**, with sand, trace iron concretions, reddish-brown, stiff	583.5				100	3-2-9 N=11	1.75 (HP)		21	39-16-23
LEAN CLAY (CL), with sand, gravel and cobbles, brown with gray, hard (Glacial Till)										
15.4	58				100	50/5"			7	
Boring Terminated at 15.4 Feet		15								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling
Water observed at 2' after 1 hour.

▽

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 12-02-2017 | Boring Completed: 12-02-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-22

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.1784° Longitude: -84.4544°

Surface Elev.: 596.8 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.2	596.5	**ASPHALT (3 inches)**
		FILL, silt, with sand, gravel and cinders, some clay, grayish-brown
12.0	585	
		LEAN CLAY (CL), with cobbles and sand, trace gravel, gray, hard (Glacial Till)
21.5	575.5	
		Boring Terminated at 21.5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
			100	4-5-5 N=10	3.75 (HP)		18	
			89	6-8-8 N=16	3.5 (HP)		17	
5			94	8-6-4 N=10	1.75 (HP)		22	
	▽		100	5-8-12 N=20	1.5 (HP)		14	25-15-10
			100	4-4-4 N=8	0.5 (HP)		22	
10			67	2-2-4 N=6	0.5 (HP)		20	
			100	11-12-17 N=29	4.5+ (HP)		12	
15			100	14-28-22 N=50	4.5+ (HP)		11	
	▽							
20			100	11-15-19 N=34	3.75 (HP)		13	26-15-11

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.
Surface capped with asphalt

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed at 17' during drilling*

▽ *Water observed at 7.2' after 1 hour.*

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 12-02-2017 | Boring Completed: 12-02-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-24

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2592° Longitude: -84.3805°

Surface Elev.: 837.1 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.3	837	**TOPSOIL (4 inches)**
0.5	836.5	**AGGREGATE (2 inches)**
		FAT CLAY (CH), with sand and silt, trace small gravel, olive-brown with reddish iron mottles, stiff to very stiff
9.8	827.5	**FAT CLAY**, with silt, tannish-brown with gray and orange-brown striations, hard (Residuum)
15.8	821.5	
16.4	820.5	**INTERBEDDED SHALE AND LIMESTONE** Shale: Slightly weathered, very weak, gray Limestone: Unweathered, strong, light gray
		Boring Terminated at 16.4 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
			78	7-5-5 N=10	3.75 (HP)		19	
			89	4-6-6 N=12	2.75 (HP)		23	
			100	6-7-10 N=17	3.25 (HP)		26	
5			100	4-5-8 N=13	3.0 (HP)		26	60-24-36
			100	4-7-8 N=15	3.25 (HP)		27	
			100	5-6-8 N=14	2.5 (HP)		23	57-21-36
10			100	11-8-12 N=20	4.5+ (HP)		19	
			89	34-30-28 N=58	4.5+ (HP)		15	
15								
	▽		64	16-35-50/5"				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No water observed during drilling

▽ *Water observed at 16.1' after 1 hour.*

Terracon
611 Lunken Park Dr
Cincinnati, OH

Boring Started: 10-24-2017 | Boring Completed: 10-24-2017

Drill Rig: Track | Driller: A. Moore

Project No.: N1175384

BORING LOG NO. WB-17

PROJECT: Central Corridor Pipeline C350

CLIENT: Duke Energy
Cincinnati, OH

SITE: Hamilton County
Cincinnati, Ohio

LOCATION See Exploration Plan

Latitude: 39.2158° Longitude: -84.4438°

Surface Elev.: 561 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (%)	FIELD TEST RESULTS	LABORATORY HP (tsf)	UNCONFINED COMPRESSIVE STRENGTH (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		FILL, lean clay, trace sand, with shale, rock and limestone fragments, gray with brown									
						33	3-5-5 N=10				
						100	3-3-3 N=6				
			5			44	10-9-4 N=13				
						50	4-3-4 N=7				
7.0	554										
		FILL, sandy lean clay, with rock fragments, black to brown with iron concretions, black to brown with iron concretions				100	3-14-14 N=28				
						100	7-6-3 N=9	3.5 (HP)		18	30-17-13
			10								
13.5	547.5			▽							
		SILTY CLAY (CL-ML), with sand, brown, medium stiff to very stiff				27	2-3-5 N=8				
			15								
		-- Rock fragments encountered at 18.5 feet				100	3-5-8 N=13	3.0 (HP)		11	21-13-8
20.0	541		20								
		Boring Terminated at 20 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Water observed at 13.5' during drilling*

No water observed after drilling.

Terracon
611 Lunken Park Dr
Cincinnati, OH

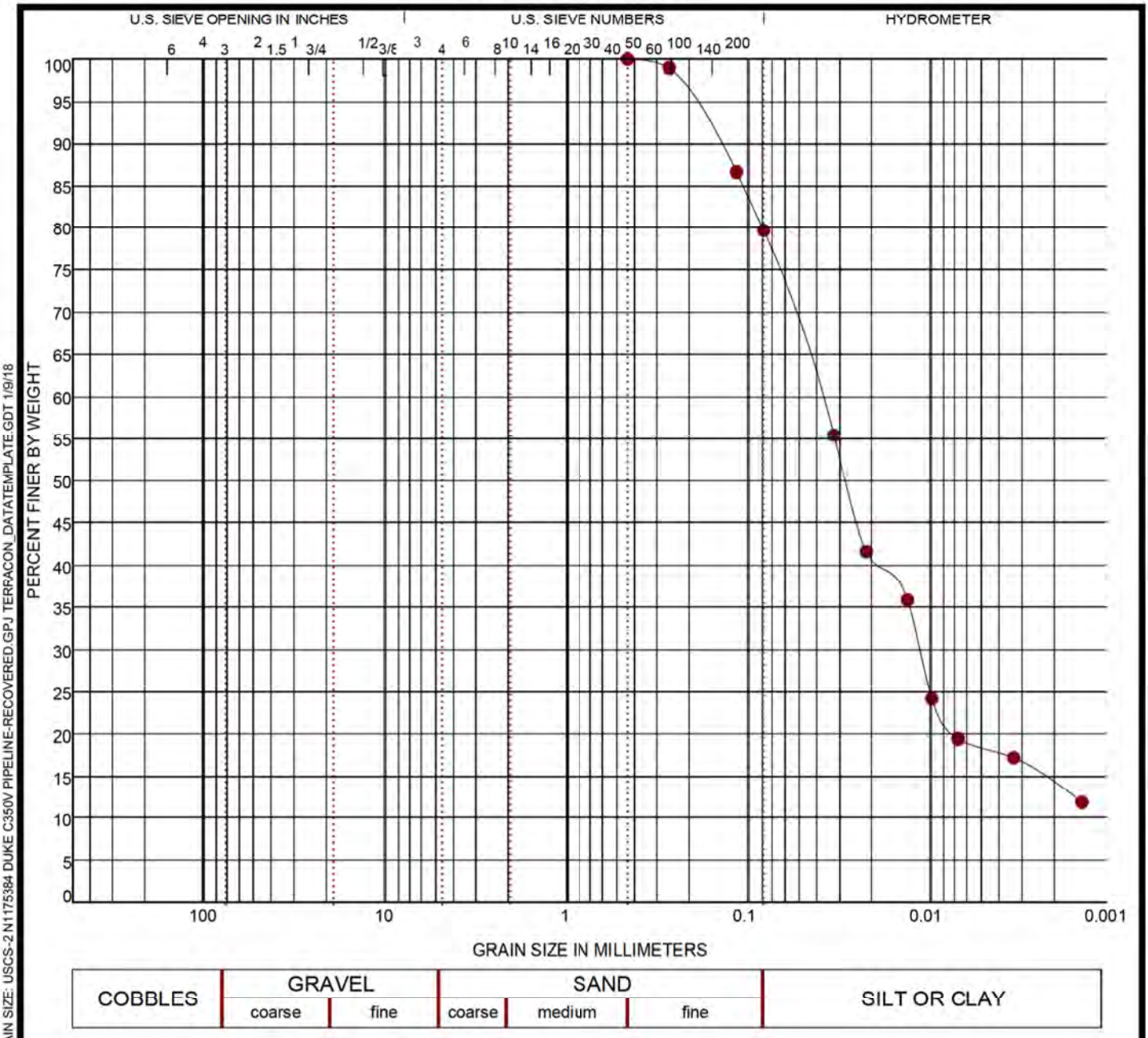
Boring Started: 05-07-2018 | Boring Completed: 05-07-2018

Drill Rig: Track | Driller: R. Mann

Project No.: N1175384

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-1	10 - 11.5	GRAY SILTY CLAY WITH SAND	25					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-1	10 - 11.5	0.425	0.036	0.01		0.0	20.2	60.9		18.9

PROJECT: Duke C350 Pipeline

SITE: Glendale Milford Road
Cincinnati, OH

Terracon
611 Lunken Park Dr
Cincinnati, OH

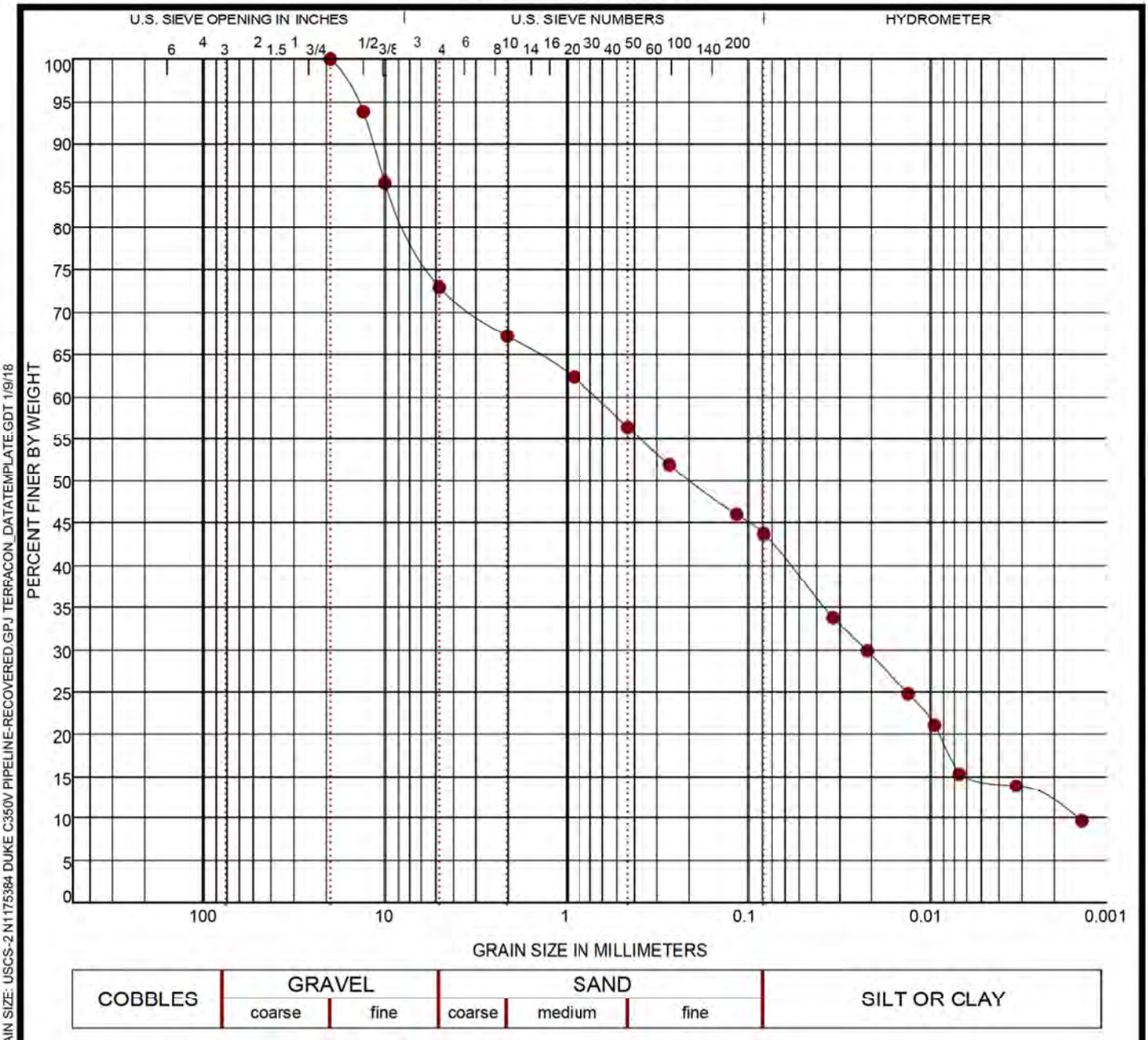
PROJECT NUMBER: N1175384

CLIENT: Duke Energy
Cincinnati, OH

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 N1175384 DUKE C350V PIPELINE-RECOVERED.GPJ TERRACON_DATATEMPLATE.GDT 1/9/18

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-1A	7.5 - 9	BROWN AND GRAY SAND WITH SILTY CLAY AND GRAVEL	17				0.46	478.48

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-1A	7.5 - 9	19	0.641	0.02	0.001	26.9	29.2	28.8		15.1

PROJECT: Duke C350 Pipeline

SITE: Glendale Milford Road
Cincinnati, OH

Terracon
611 Lunken Park Dr
Cincinnati, OH

PROJECT NUMBER: N1175384

CLIENT: Duke Energy
Cincinnati, OH

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 N1175384 DUKE C350V PIPELINE-RECOVERED.GPJ TERRACON_DATATEMPLATE.GDT 1/9/18

GRAIN SIZE DISTRIBUTION

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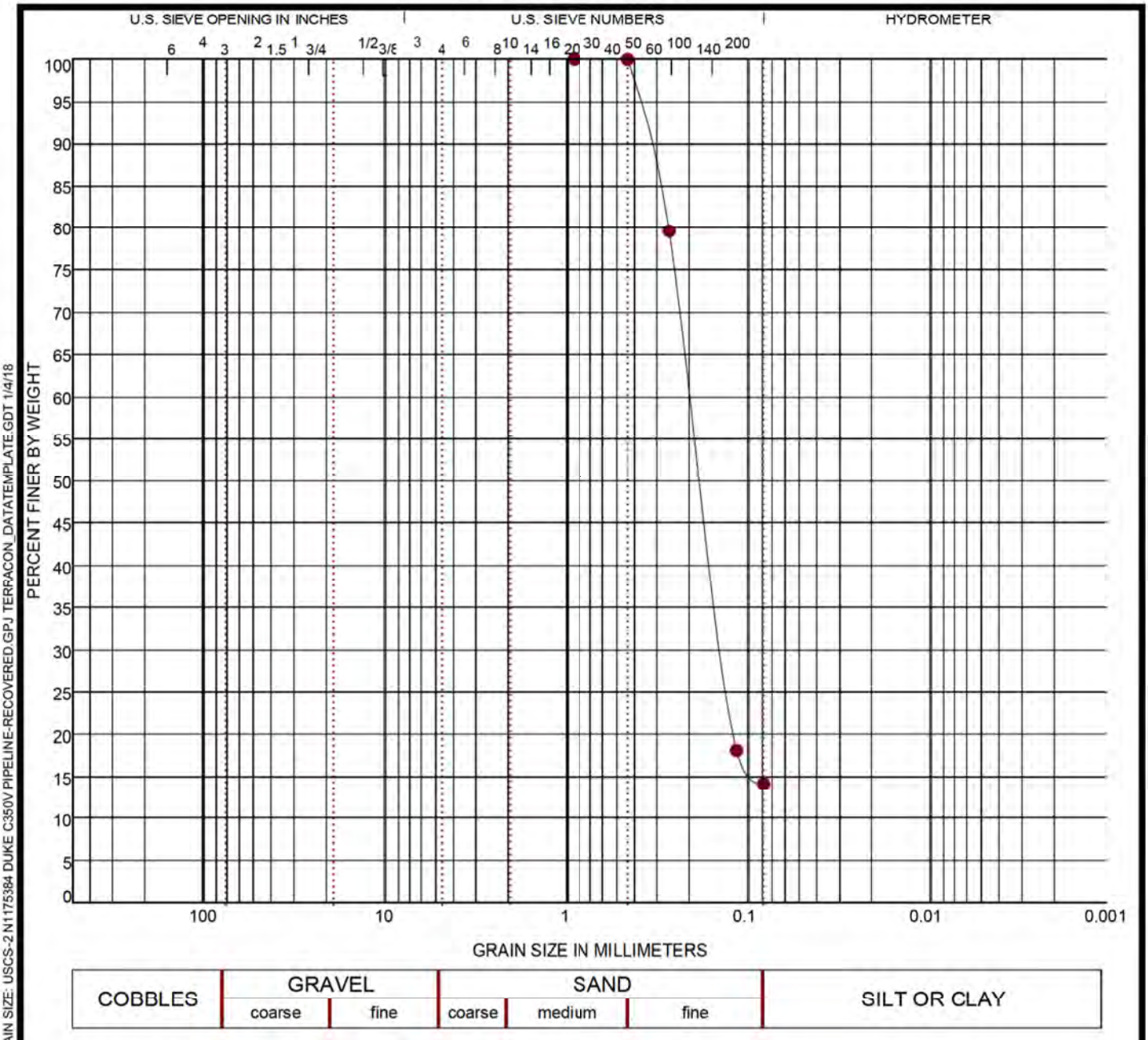

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-2	35 - 36.5	SILTY SAND	22					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-2	35 - 36.5	0.85	0.19	0.125		0.0	85.7		14.3	

PROJECT: Duke C350 Pipeline

SITE: Glendale Milford Road
Cincinnati, OH

Terracon
611 Lunken Park Dr
Cincinnati, OH

PROJECT NUMBER: N1175384

CLIENT: Duke Energy
Cincinnati, OH

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 N1175384 DUKE C350V PIPELINE-RECOVERED.GPJ TERRACON_DATATEMPLATE.GDT 1/4/18

GRAIN SIZE DISTRIBUTION

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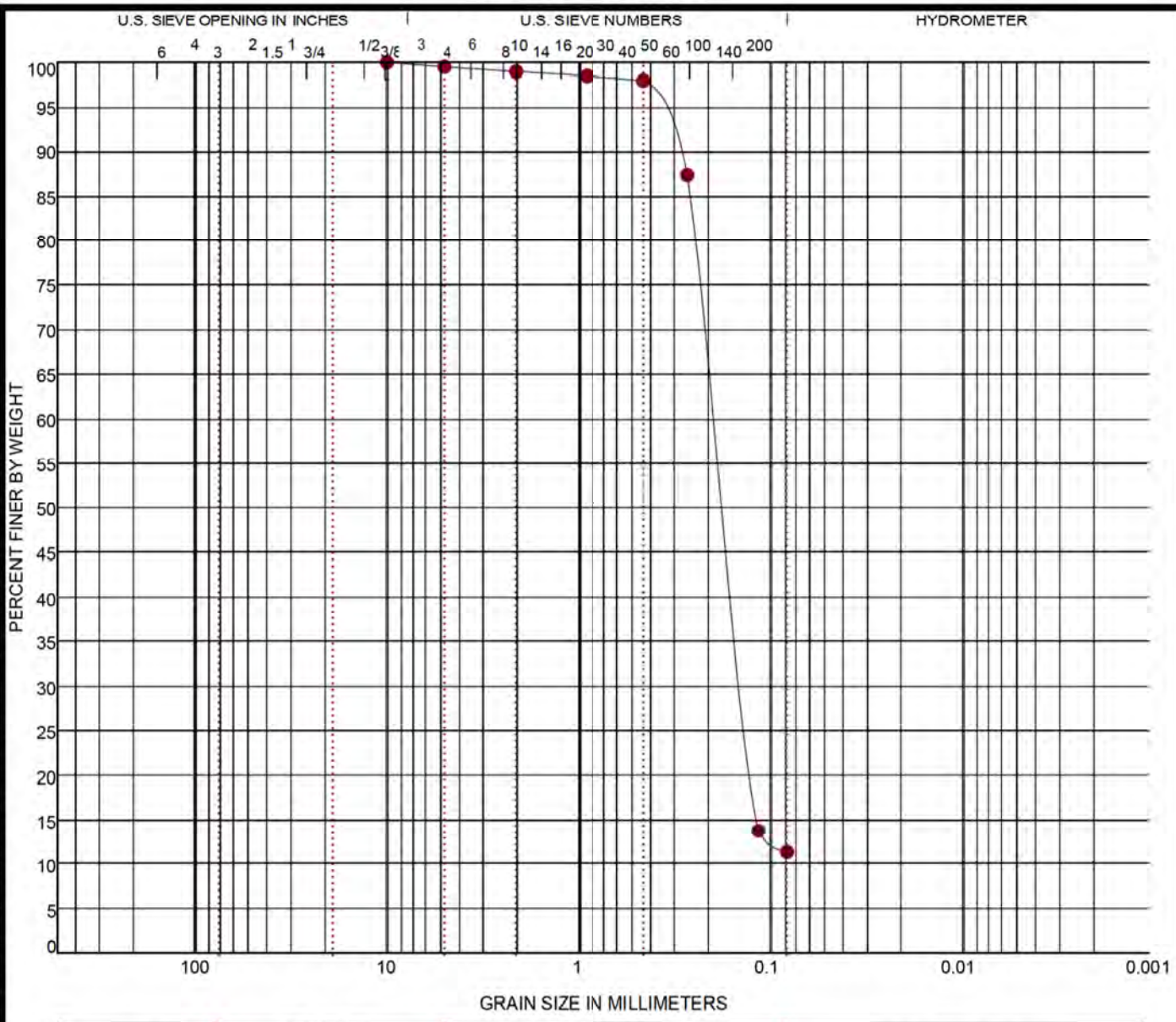

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-2	45 - 46.5	SILTY SAND	21				1.49	2.99

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-2	45 - 46.5	9.5	0.182	0.128		0.5	88.0		11.5	

PROJECT: Duke C350 Pipeline

SITE: Glendale Milford Road
Cincinnati, OH

Terracon
611 Lunken Park Dr
Cincinnati, OH

PROJECT NUMBER: N1175384

CLIENT: Duke Energy
Cincinnati, OH

GRAIN SIZE DISTRIBUTION

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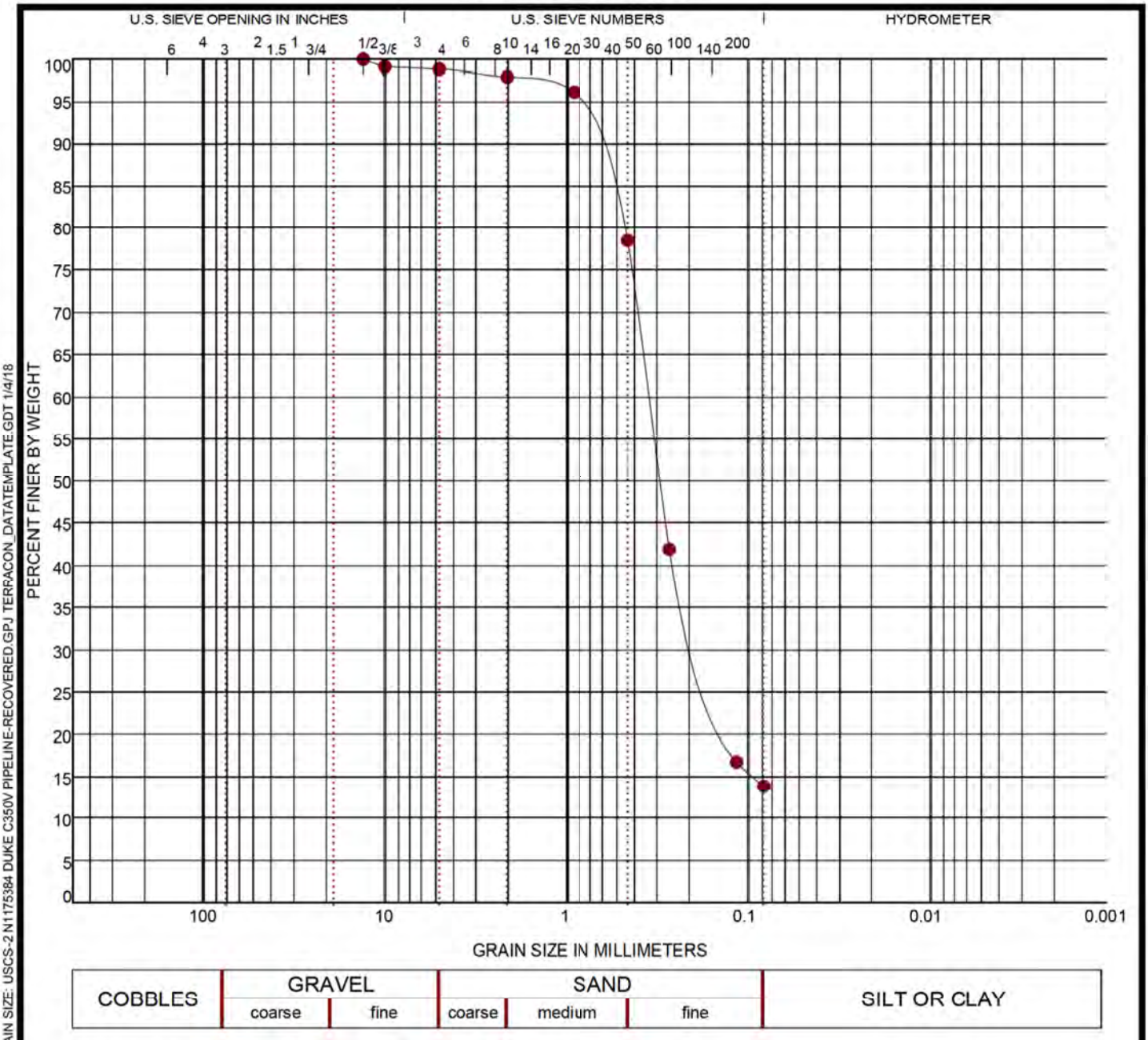


Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-2	80 - 81.5	SILTY SAND	18					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-2	80 - 81.5	12.5	0.324	0.166		1.1	84.9		14.0	

PROJECT: Duke C350 Pipeline

SITE: Glendale Milford Road
Cincinnati, OH

Terracon
611 Lunken Park Dr
Cincinnati, OH

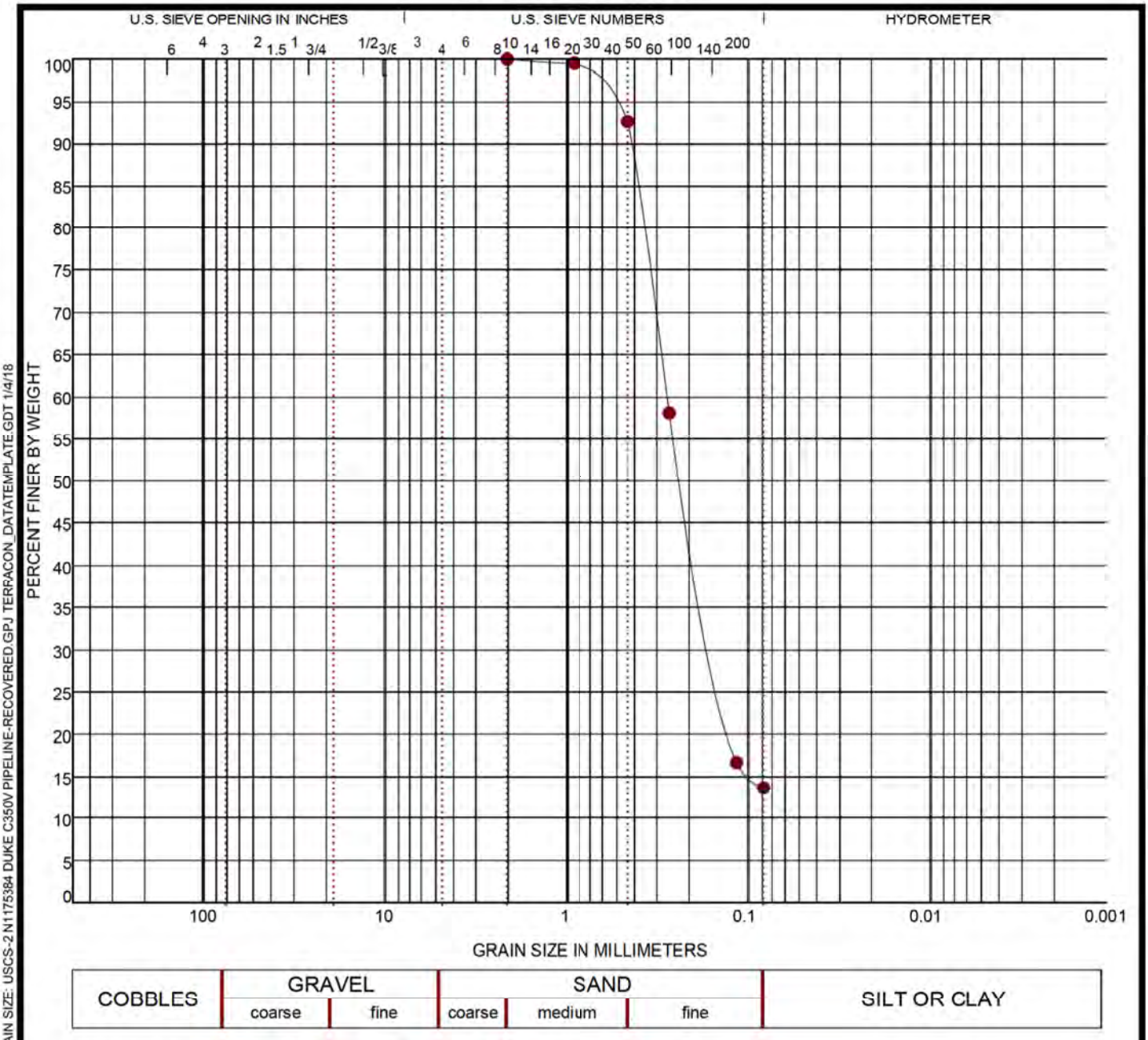
PROJECT NUMBER: N1175384

CLIENT: Duke Energy
Cincinnati, OH

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 N1175384 DUKE C350V PIPELINE-RECOVERED.GPJ TERRACON_DATATEMPLATE.GDT 1/4/18

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-2	95 - 96.5	SILTY SAND	17					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-2	95 - 96.5	2	0.257	0.139		0.0	86.2		13.8	

PROJECT: Duke C350 Pipeline

SITE: Glendale Milford Road
Cincinnati, OH

Terracon
611 Lunken Park Dr
Cincinnati, OH

PROJECT NUMBER: N1175384

CLIENT: Duke Energy
Cincinnati, OH

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 N1175384 DUKE C350V PIPELINE-RECOVERED.GPJ TERRACON_DATATEMPLATE.GDT 1/4/18

GRAIN SIZE DISTRIBUTION

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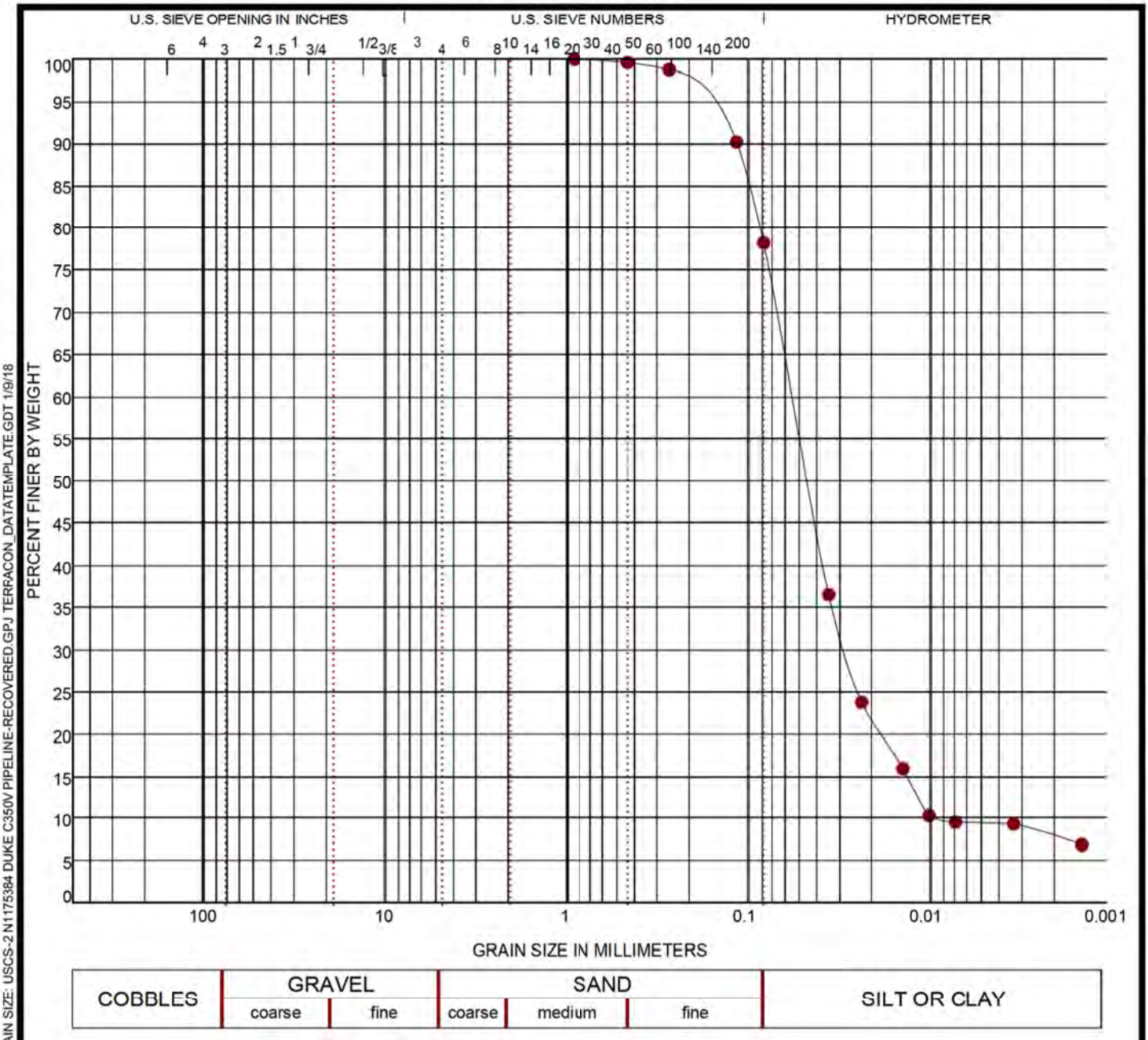

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-2A	35 - 36.5	GRAY SILT WITH SAND	18				1.78	6.99

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-2A	35 - 36.5	0.85	0.052	0.026	0.007	0.0	21.7	68.7		9.6

PROJECT: Duke C350 Pipeline

SITE: Glendale Milford Road
Cincinnati, OH

Terracon
611 Lunken Park Dr
Cincinnati, OH

PROJECT NUMBER: N1175384

CLIENT: Duke Energy
Cincinnati, OH

GRAIN SIZE DISTRIBUTION

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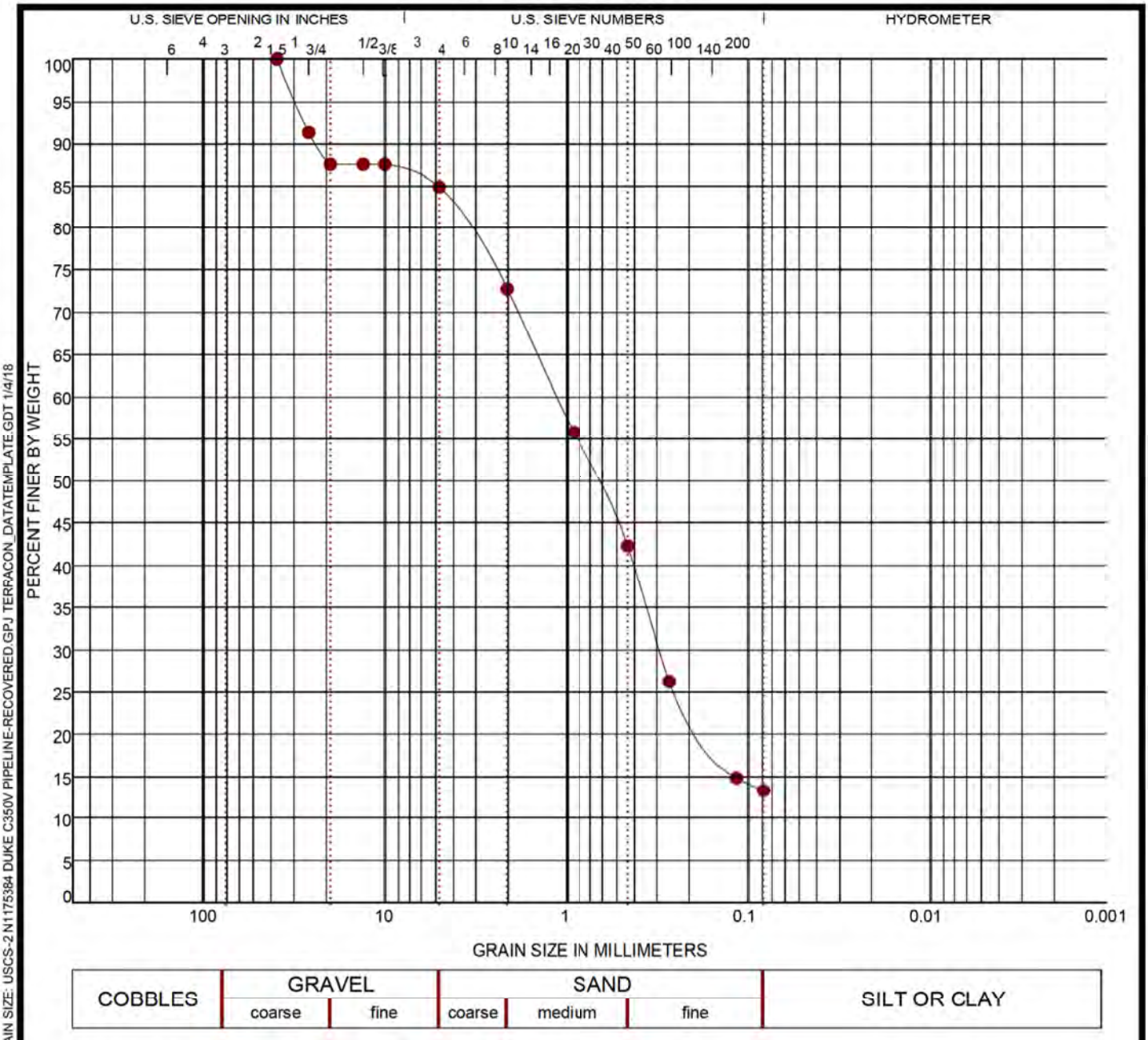

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-2A	40 - 41.5	SILTY SAND WITH GRAVEL	19					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-2A	40 - 41.5	37.5	1.045	0.281		15.0	71.5		13.5	

PROJECT: Duke C350 Pipeline

SITE: Glendale Milford Road
Cincinnati, OH

Terracon
611 Lunken Park Dr
Cincinnati, OH

PROJECT NUMBER: N1175384

CLIENT: Duke Energy
Cincinnati, OH

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 N1175384 DUKE C350V PIPELINE-RECOVERED.GPJ TERRACON_DATATEMPLATE.GDT 1/4/18

GRAIN SIZE DISTRIBUTION

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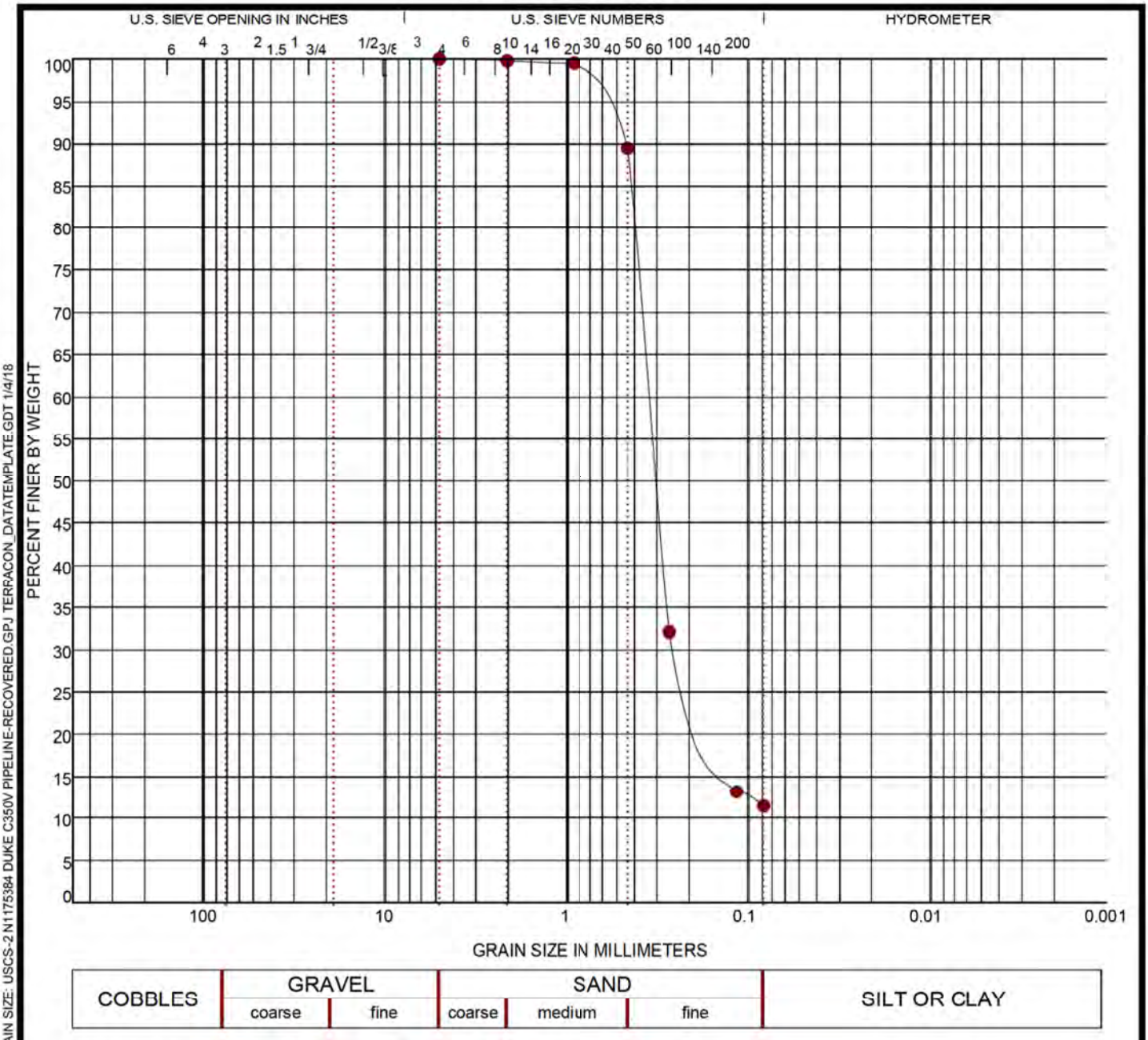


Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-2A	55 - 56.5	SILTY SAND	22				2.92	5.98

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-2A	55 - 56.5	4.75	0.323	0.226		0.0	88.4		11.6	

PROJECT: Duke C350 Pipeline

SITE: Glendale Milford Road
Cincinnati, OH

Terracon
611 Lunken Park Dr
Cincinnati, OH

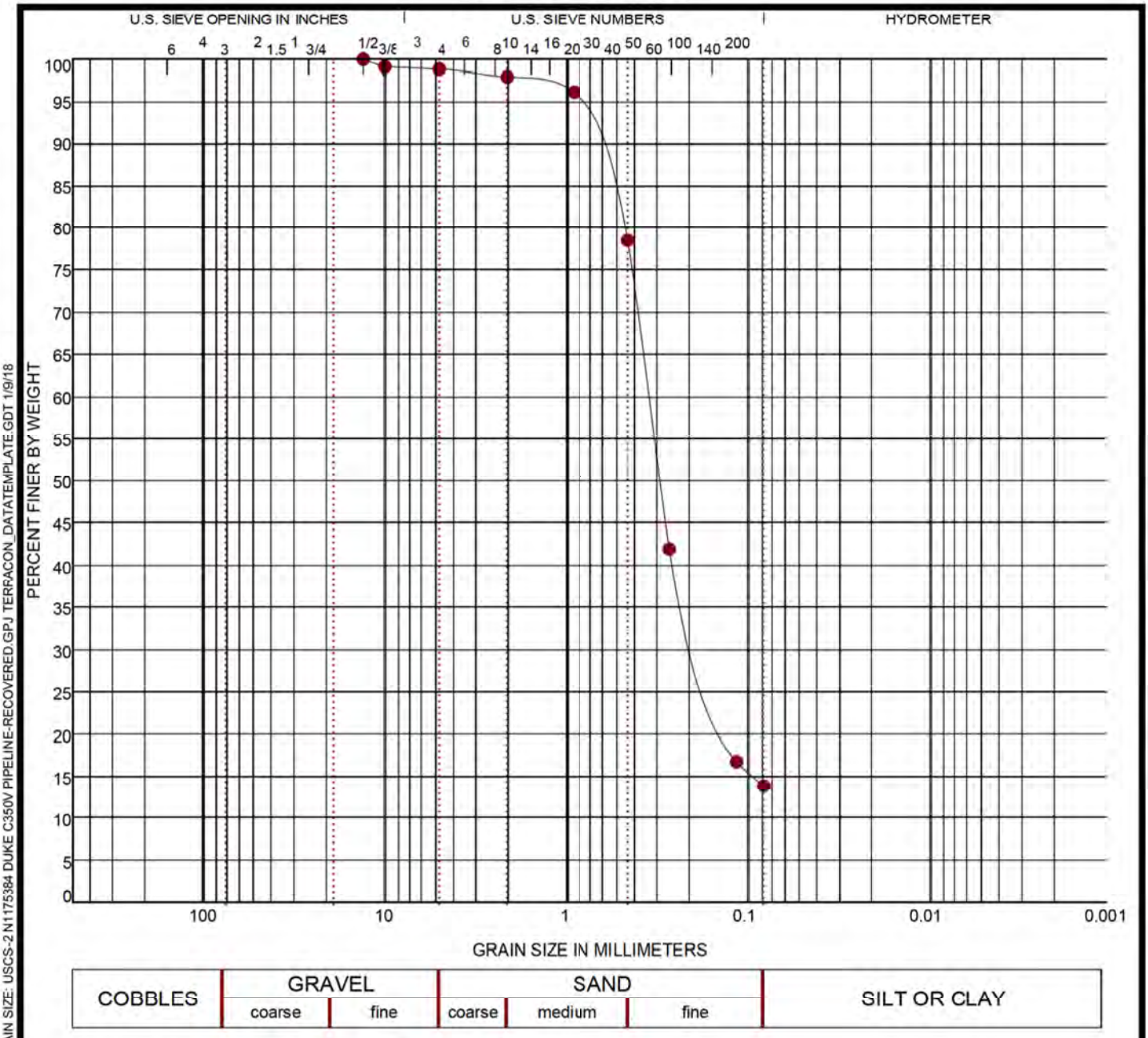
PROJECT NUMBER: N1175384

CLIENT: Duke Energy
Cincinnati, OH

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 N1175384 DUKE C350V PIPELINE-RECOVERED.GPJ TERRACON_DATATEMPLATE.GDT 1/4/18

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-2	80 - 81.5	SILTY SAND	18					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-2	80 - 81.5	12.5	0.324	0.166		1.1	84.9		14.0	

PROJECT: Duke C350 Pipeline

SITE: Glendale Milford Road
Cincinnati, OH

Terracon
611 Lunken Park Dr
Cincinnati, OH

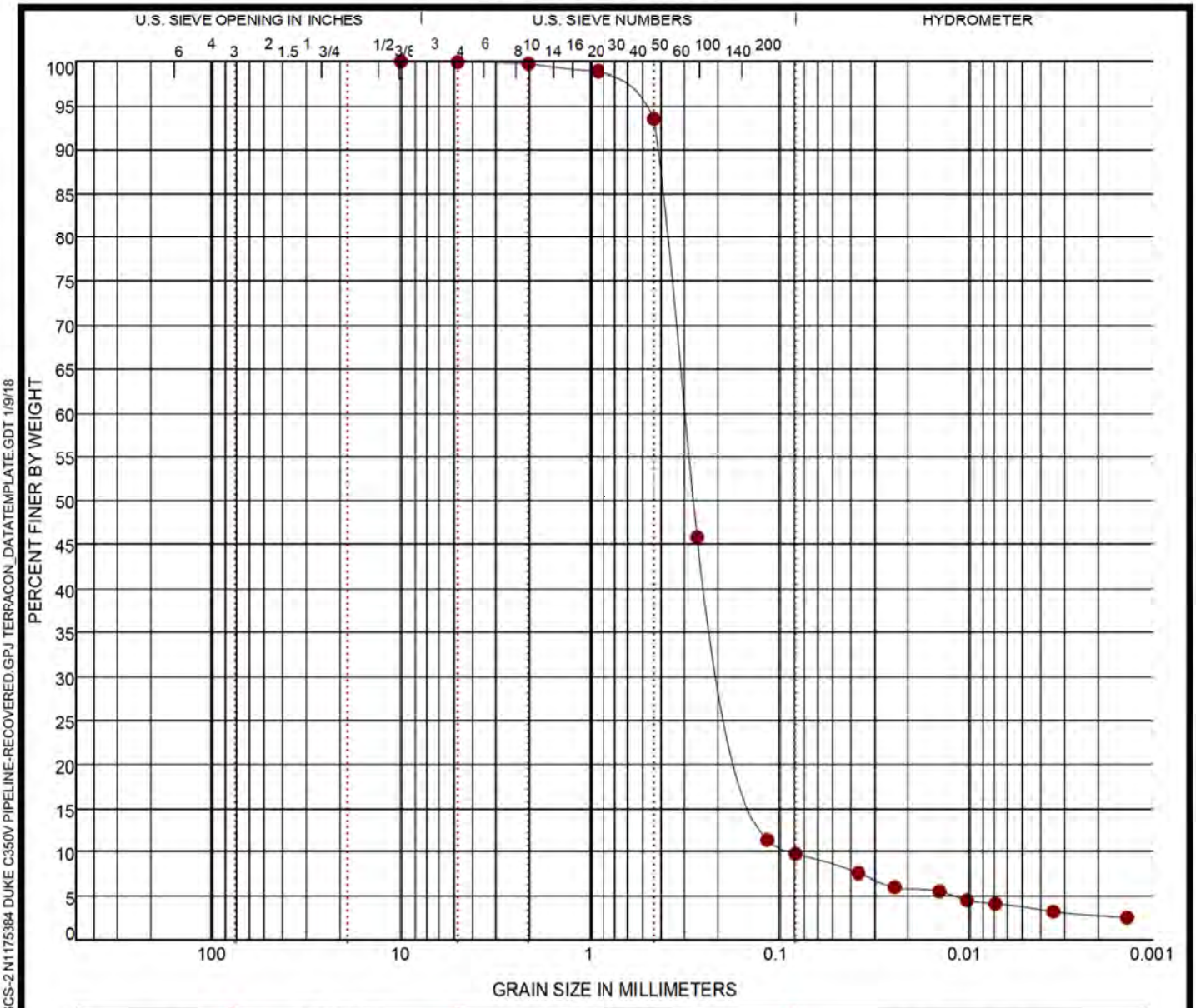
PROJECT NUMBER: N1175384

CLIENT: Duke Energy
Cincinnati, OH

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 N1175384 DUKE C350V PIPELINE-RECOVERED.GPJ TERRACON_DATATEMPLATE.GDT 1/9/18

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-2A	90 - 91.5	SAND	14				1.27	3.84

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-2A	90 - 91.5	9.5	0.292	0.168	0.076	0.1	90.0	5.9		4.0

PROJECT: Duke C350 Pipeline

SITE: Glendale Milford Road
Cincinnati, OH

Terracon
611 Lunken Park Dr
Cincinnati, OH

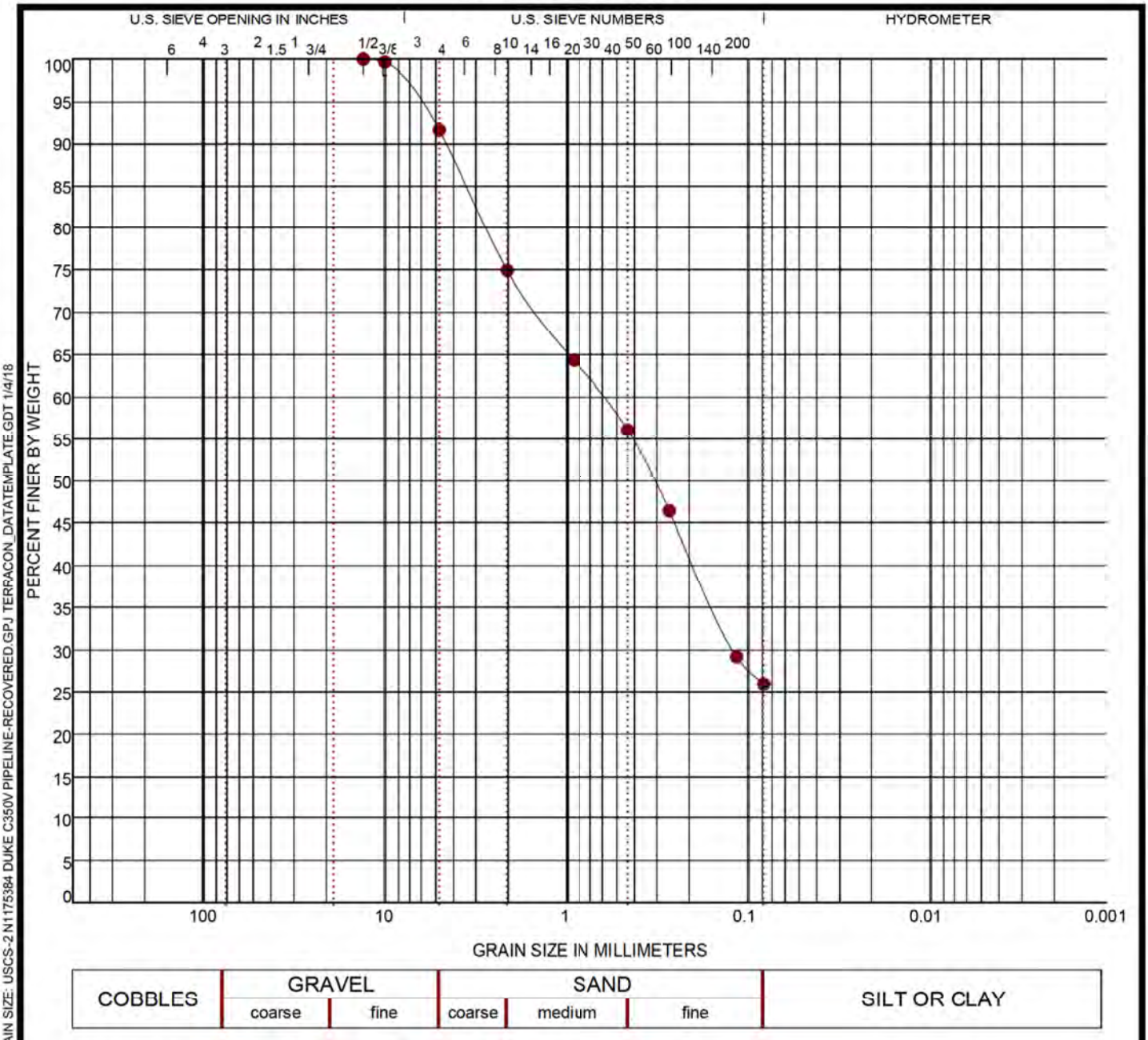
PROJECT NUMBER: N1175384

CLIENT: Duke Energy
Cincinnati, OH

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 N1175384 DUKE C350V PIPELINE-RECOVERED.GPJ TERRACON_DATATEMPLATE.GDT 1/9/18

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-3	40 - 41.5	SILTY SAND	15					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-3	40 - 41.5	12.5	0.586	0.109		8.3	65.6		26.1	

PROJECT: Duke C350 Pipeline

SITE: Glendale Milford Road
Cincinnati, OH

Terracon
611 Lunken Park Dr
Cincinnati, OH

PROJECT NUMBER: N1175384

CLIENT: Duke Energy
Cincinnati, OH

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GRAIN SIZE DISTRIBUTION

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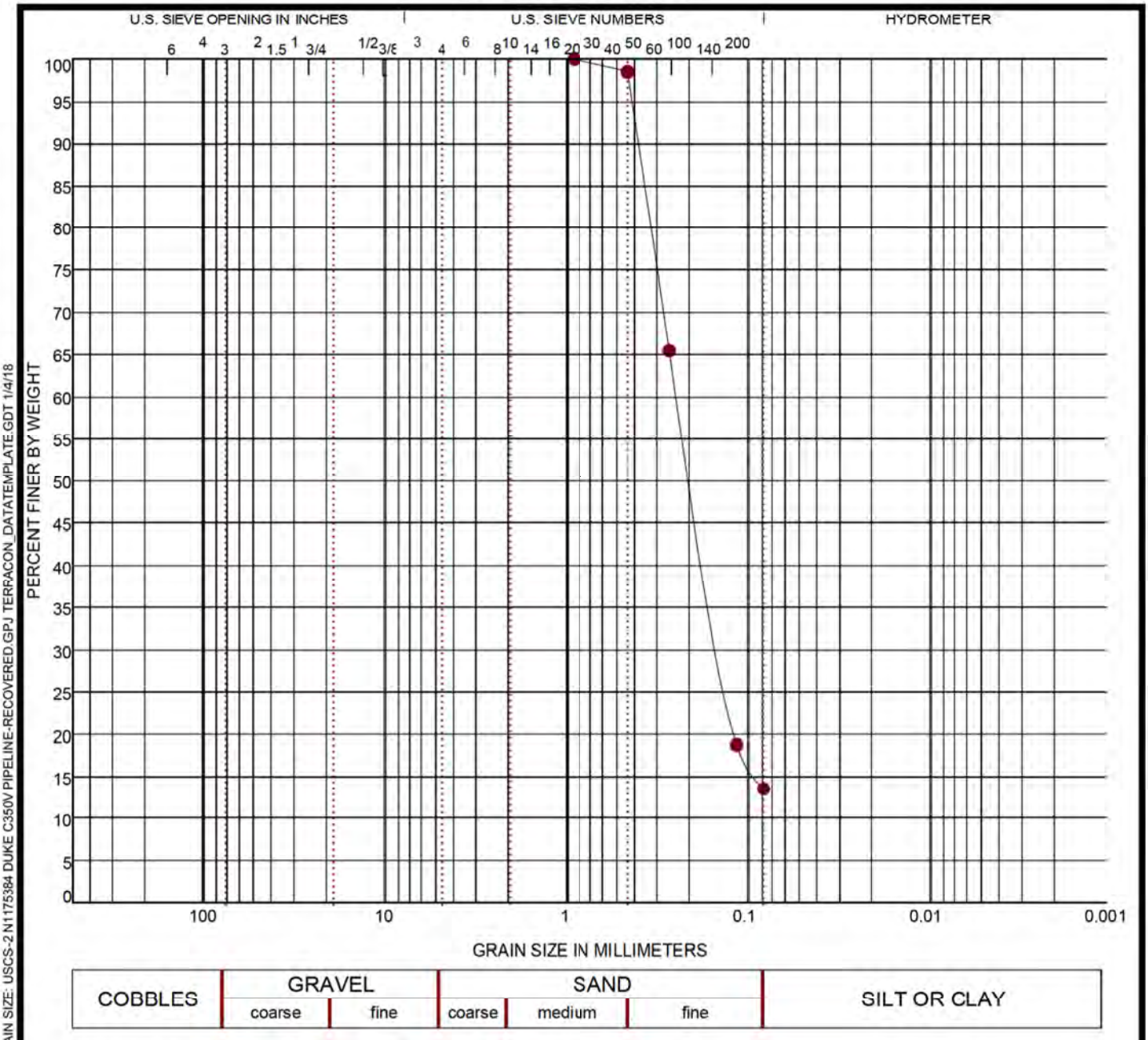

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-3	80 - 81.5	SILTY SAND	21					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-3	80 - 81.5	0.85	0.226	0.13		0.0	86.3		13.7	

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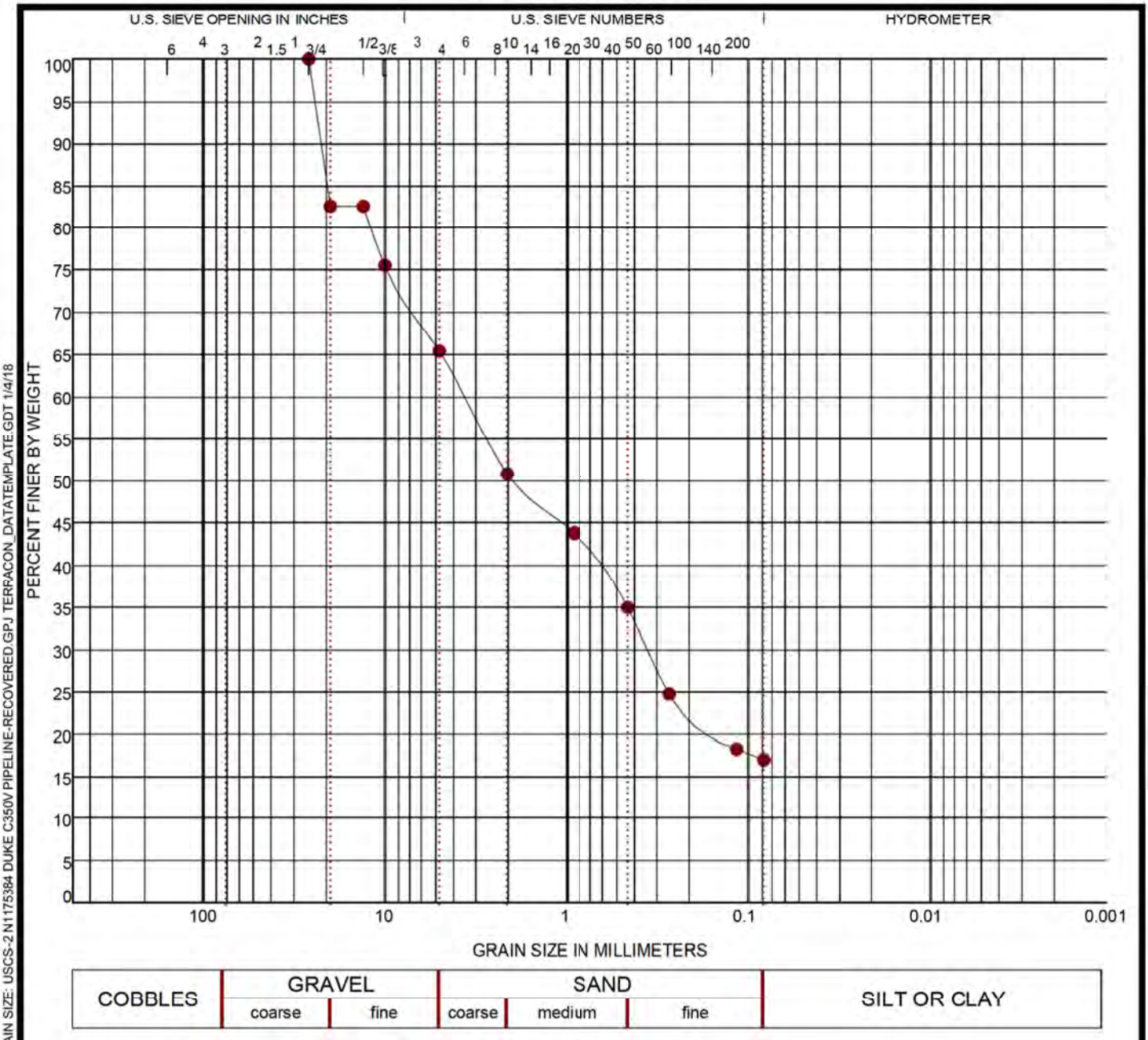

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-3A	25 - 26.5	SILTY SAND WITH GRAVEL	9					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-3A	25 - 26.5	25	3.426	0.326		34.5	48.3		17.2	

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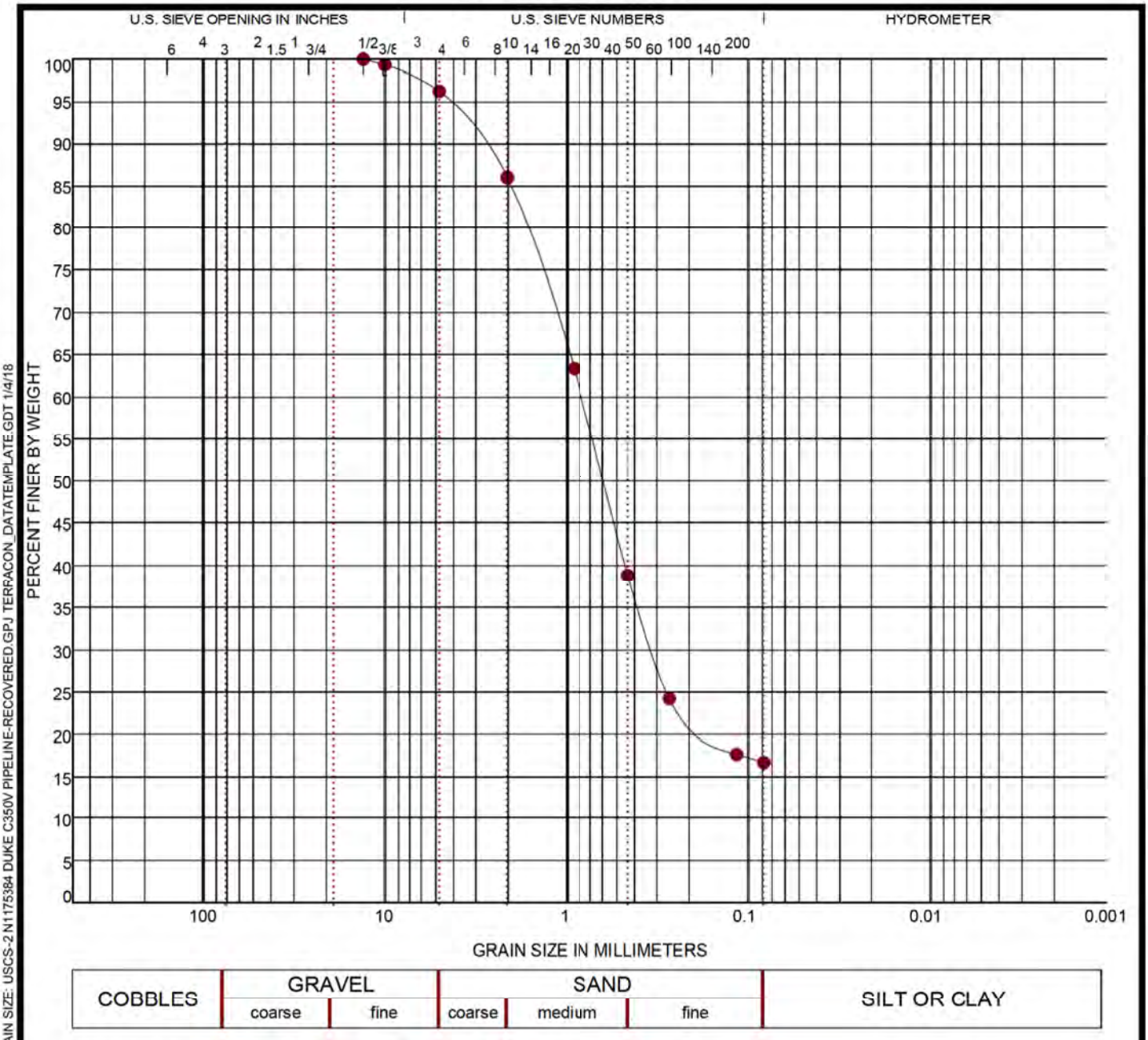

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-3A	45 - 46.5	SILTY SAND	19					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-3A	45 - 46.5	12.5	0.772	0.307		3.7	79.4		16.9	

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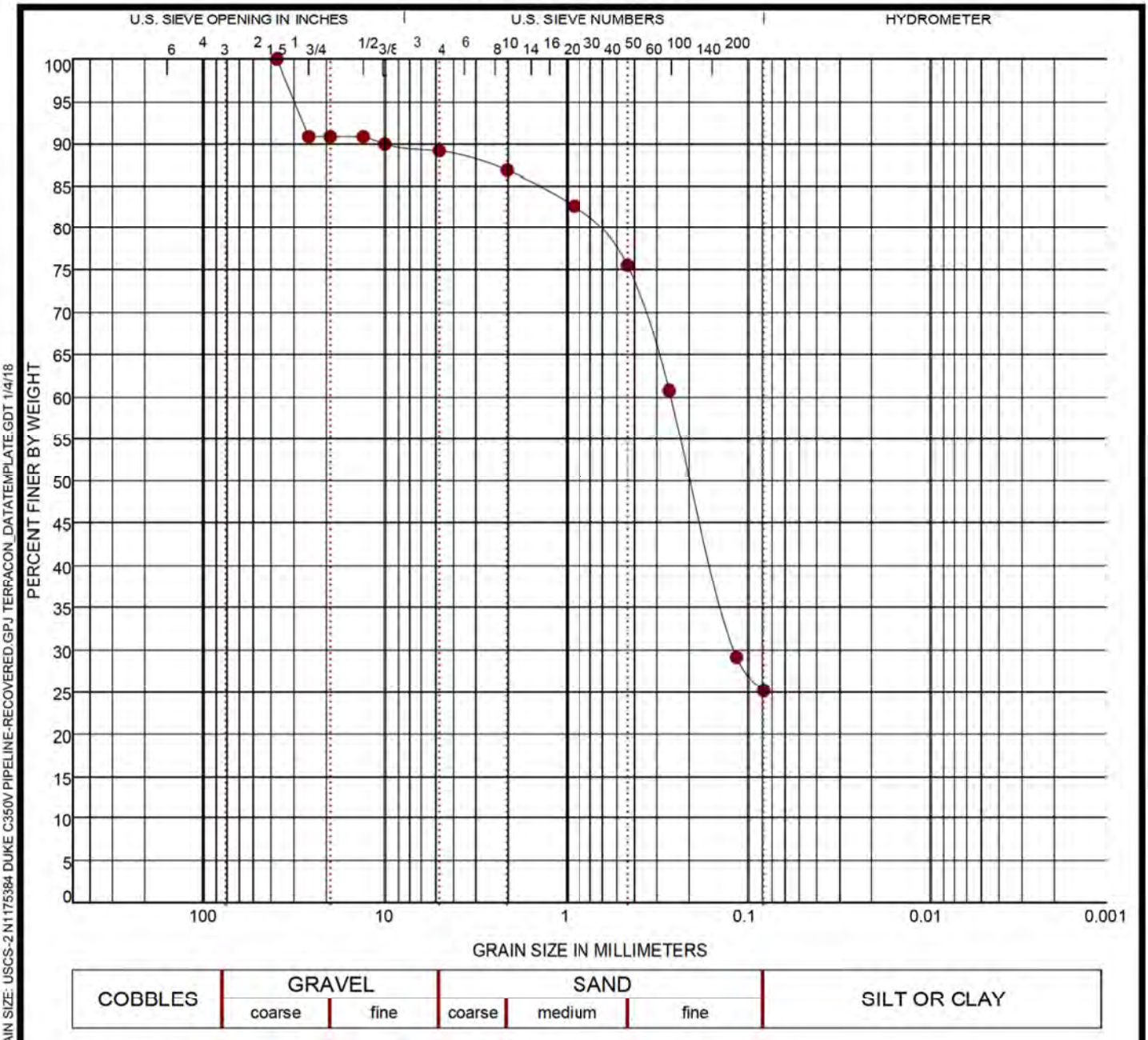

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-4A	15 - 16.5	SILTY SAND WITH GRAVEL	21					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-4A	15 - 16.5	37.5	0.244	0.108		10.8	63.9		25.3	

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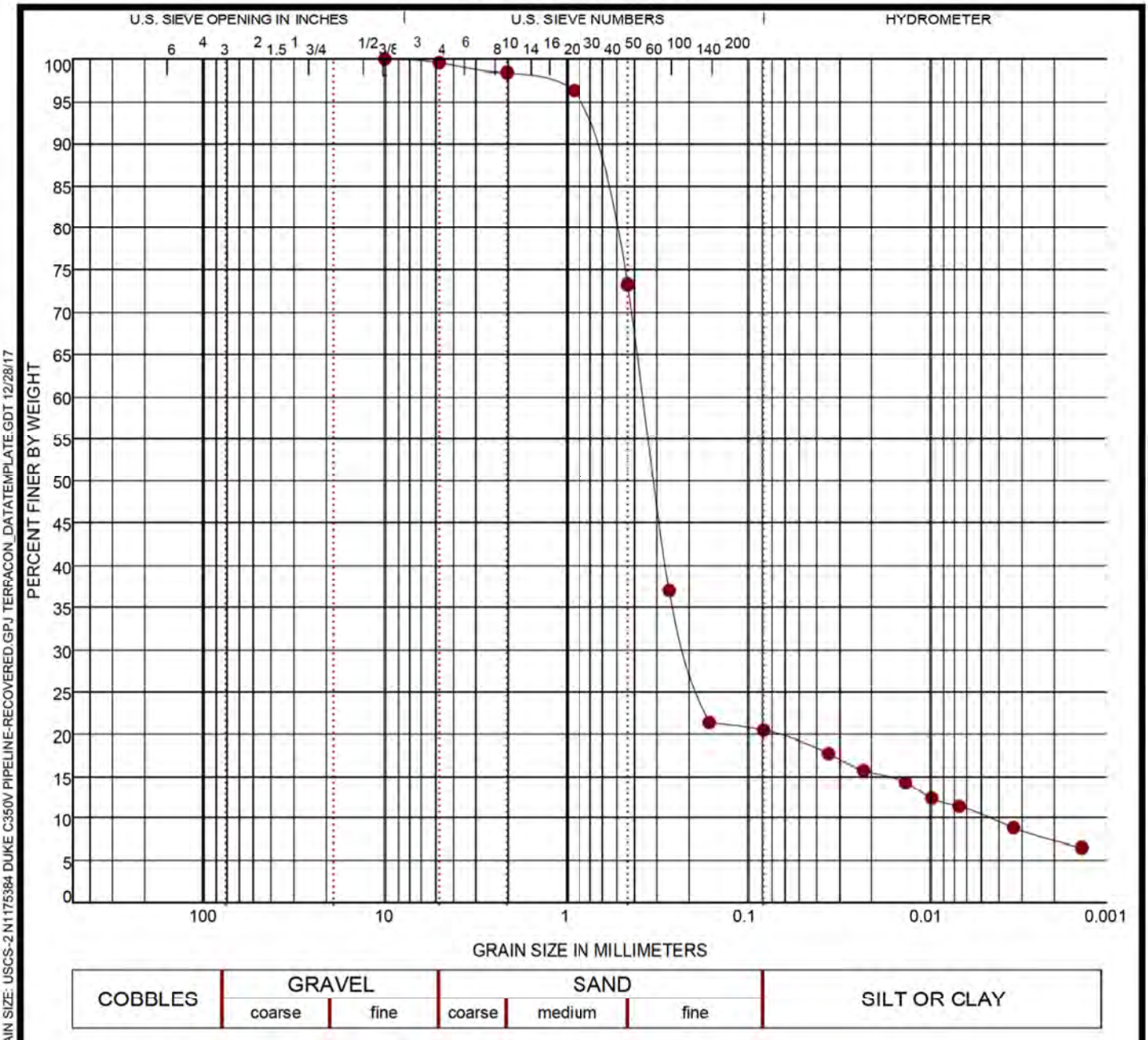

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-7	1.5 - 3	BROWN SAND	15				27.76	86.47

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-7	1.5 - 3	9.5	0.349	0.198	0.004	0.4	78.9	9.9		10.8

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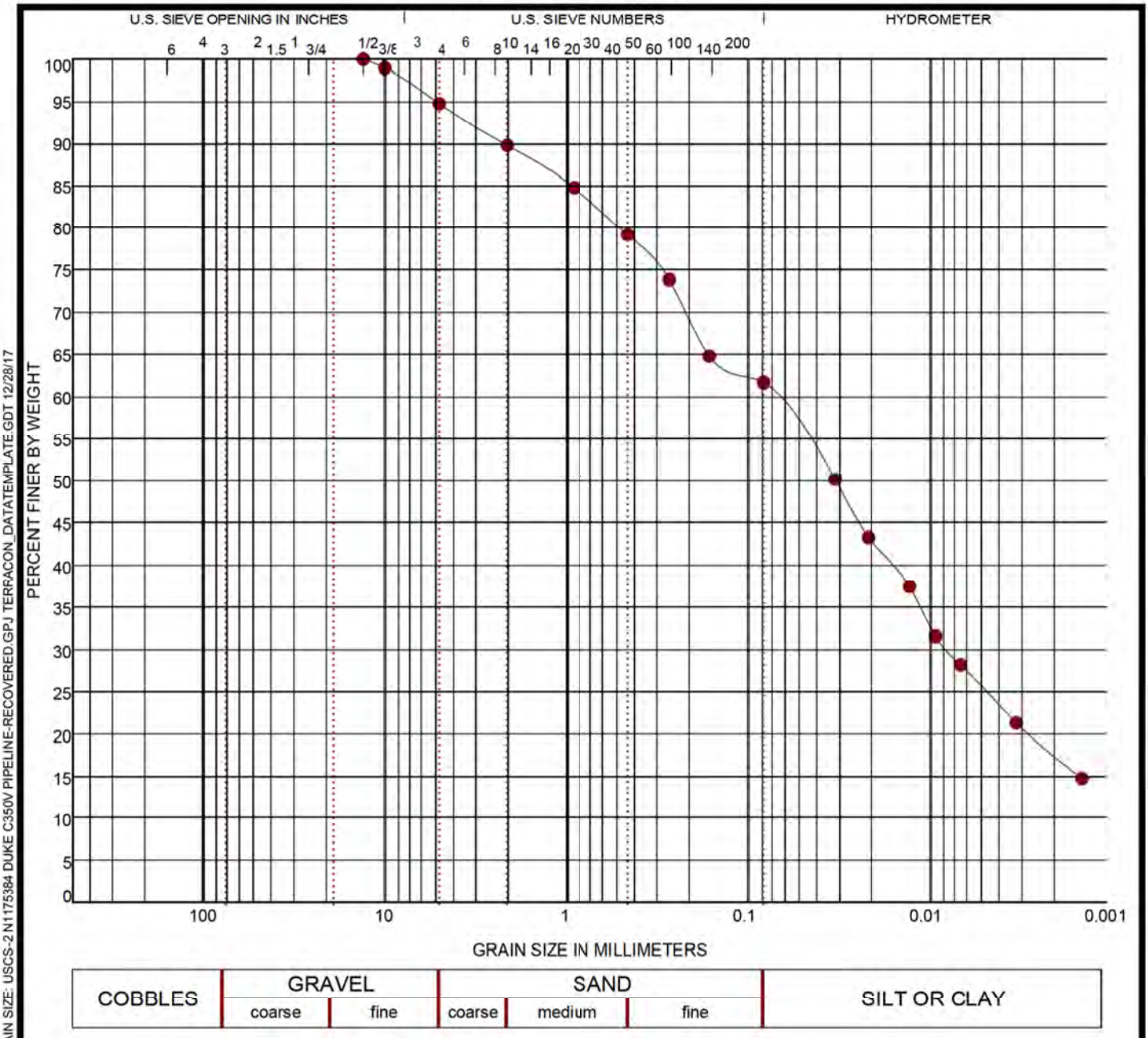

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-7	4.5 - 6	BROWN SANDY CLAY	36					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-7	4.5 - 6	12.5	0.065	0.007		5.2	33.0	35.3		26.4

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GRAIN SIZE DISTRIBUTION

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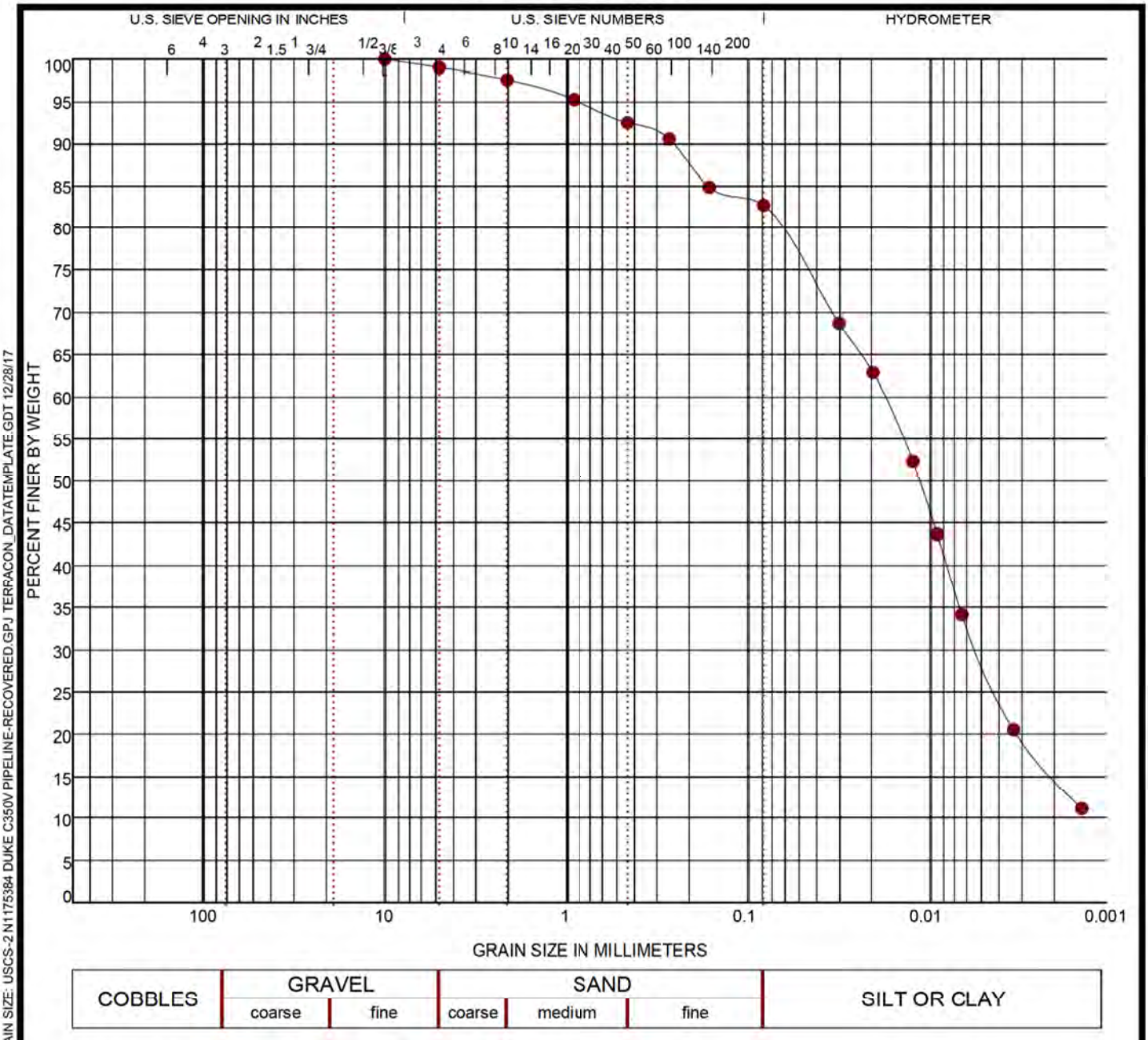

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-8	7.5 - 9	BROWN SILTY CLAY	23					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-8	7.5 - 9	9.5	0.016	0.005		0.9	16.2	52.3		30.5

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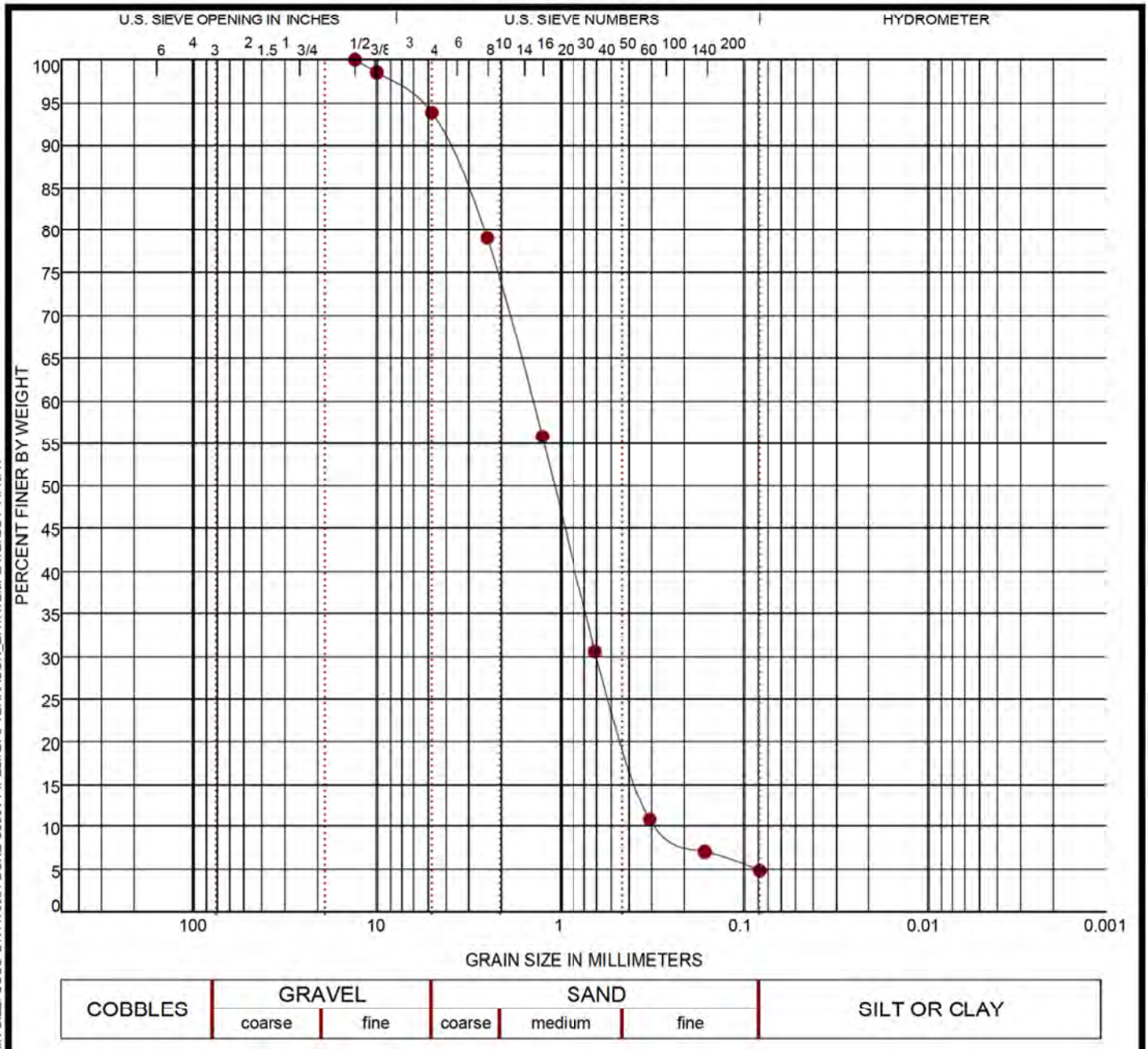

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-10	25 - 26.5	BROWN SAND					1.02	5.32

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-10	25 - 26.5	12.5	1.333	0.584	0.251	6.1	88.8		5.1	

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EXHIBIT: B-1

GRAIN SIZE DISTRIBUTION

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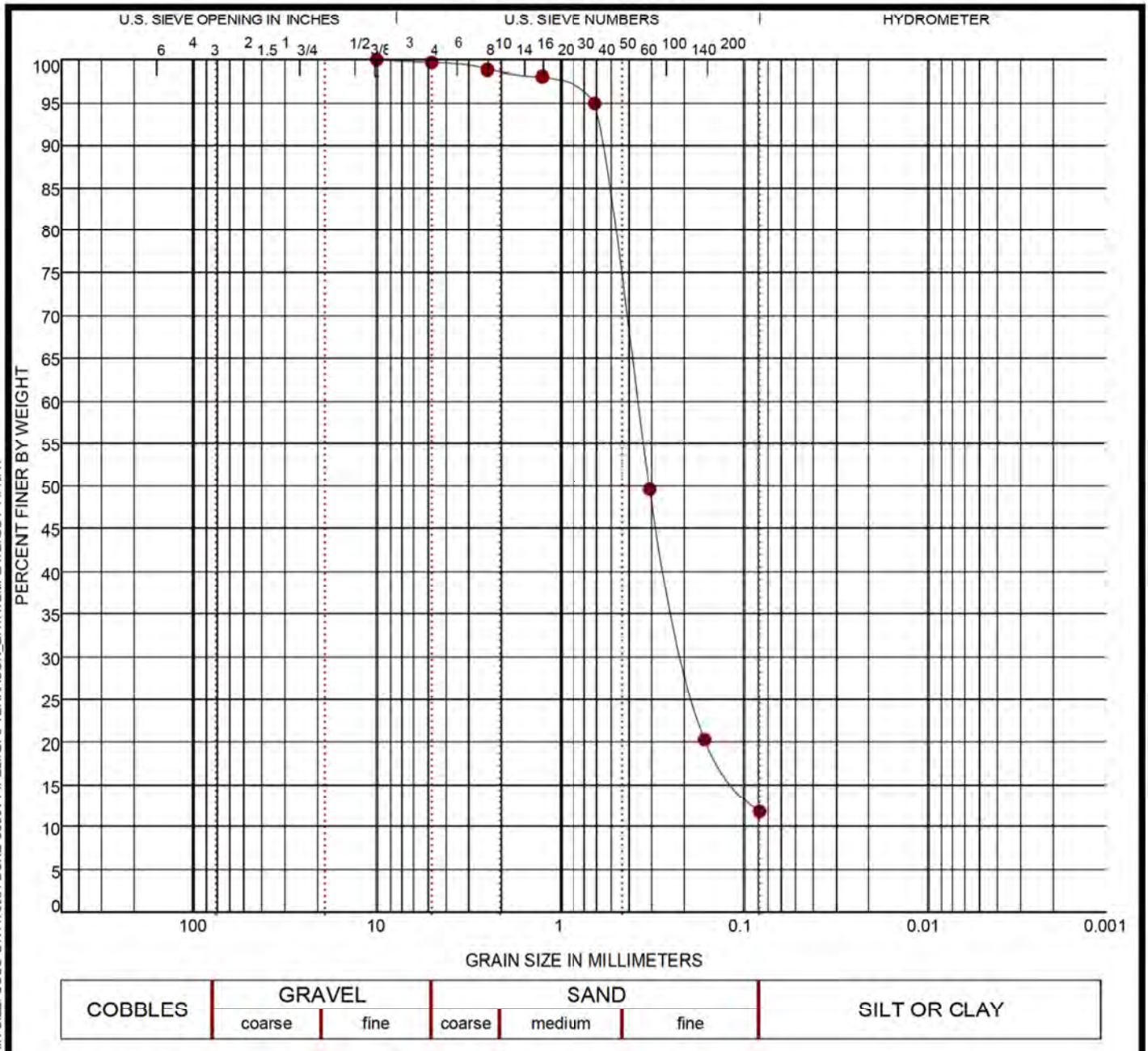

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-10	85 - 86.5	SILTY SAND					1.58	5.50

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-10	85 - 86.5	9.5	0.351	0.188		0.3	87.7		12.0	

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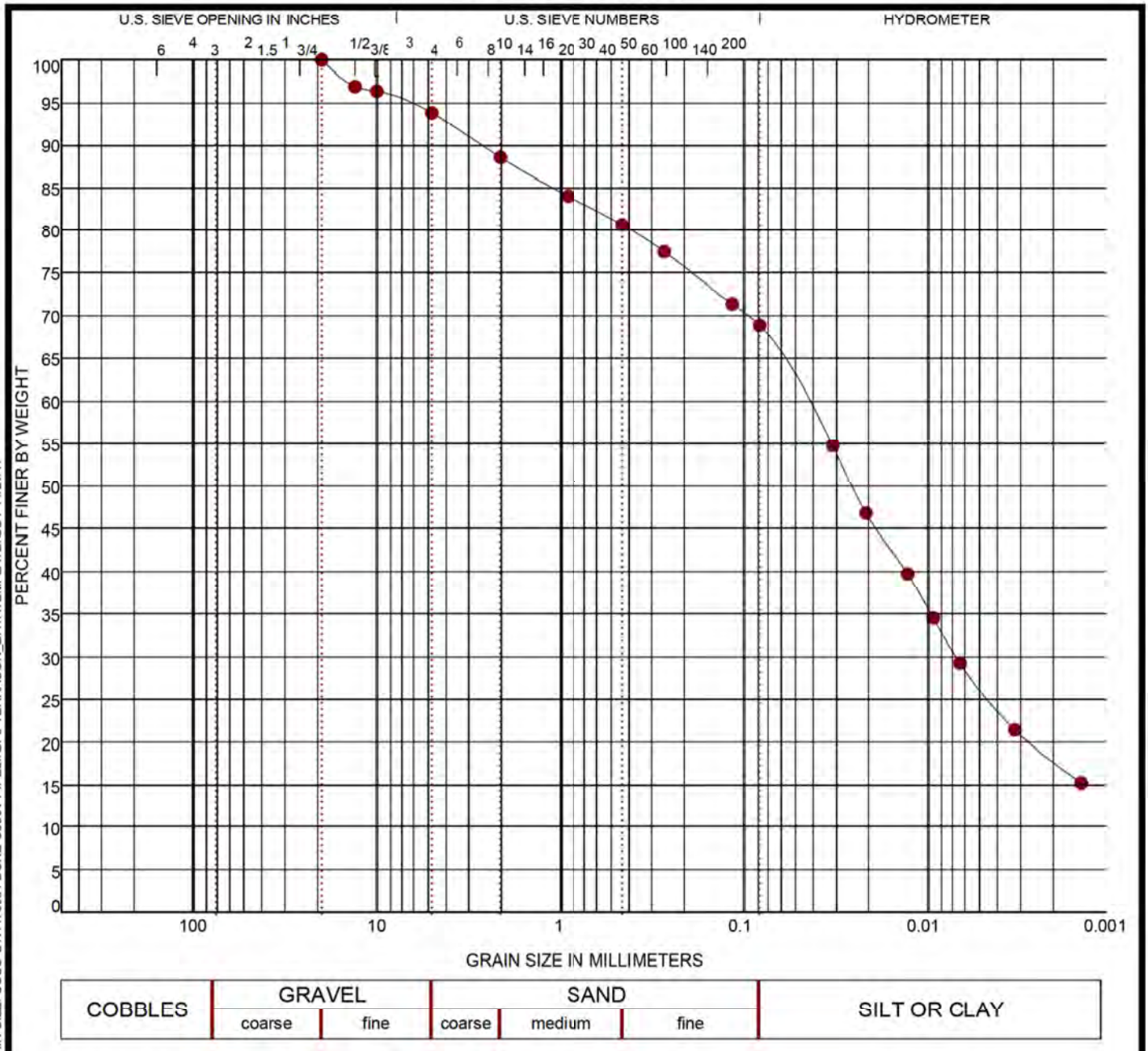

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-12A	15 - 16	SANDY LEAN CLAY (CL)	15	25	14	11		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-12A	15 - 16	19	0.042	0.006		6.1	24.9	41.6		27.3

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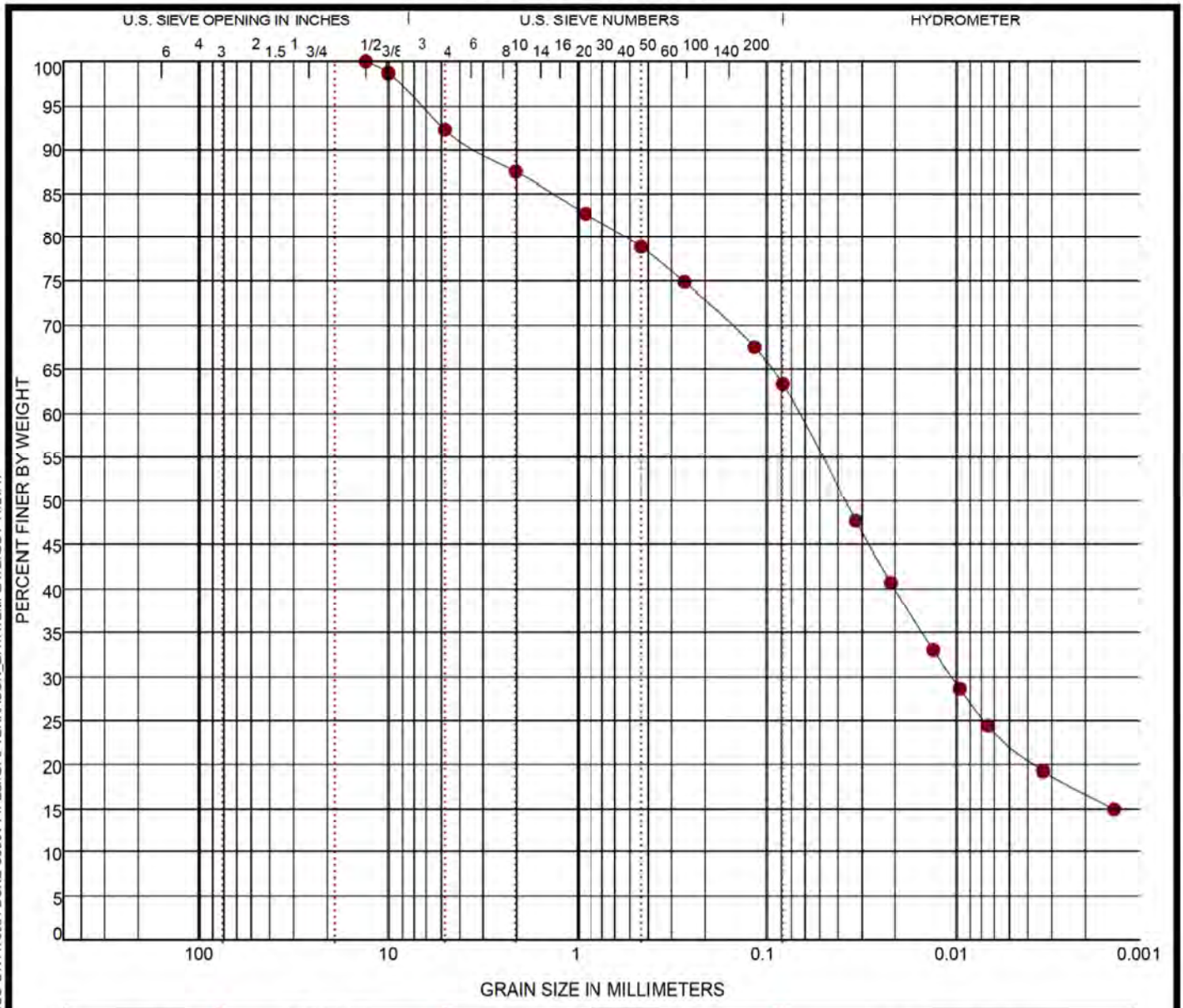

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-12A	35 - 5	SANDY LEAN CLAY (CL)	13	24	13	11		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-12A	35 - 5	12.5	0.062	0.009		7.7	28.9	40.3		23.1

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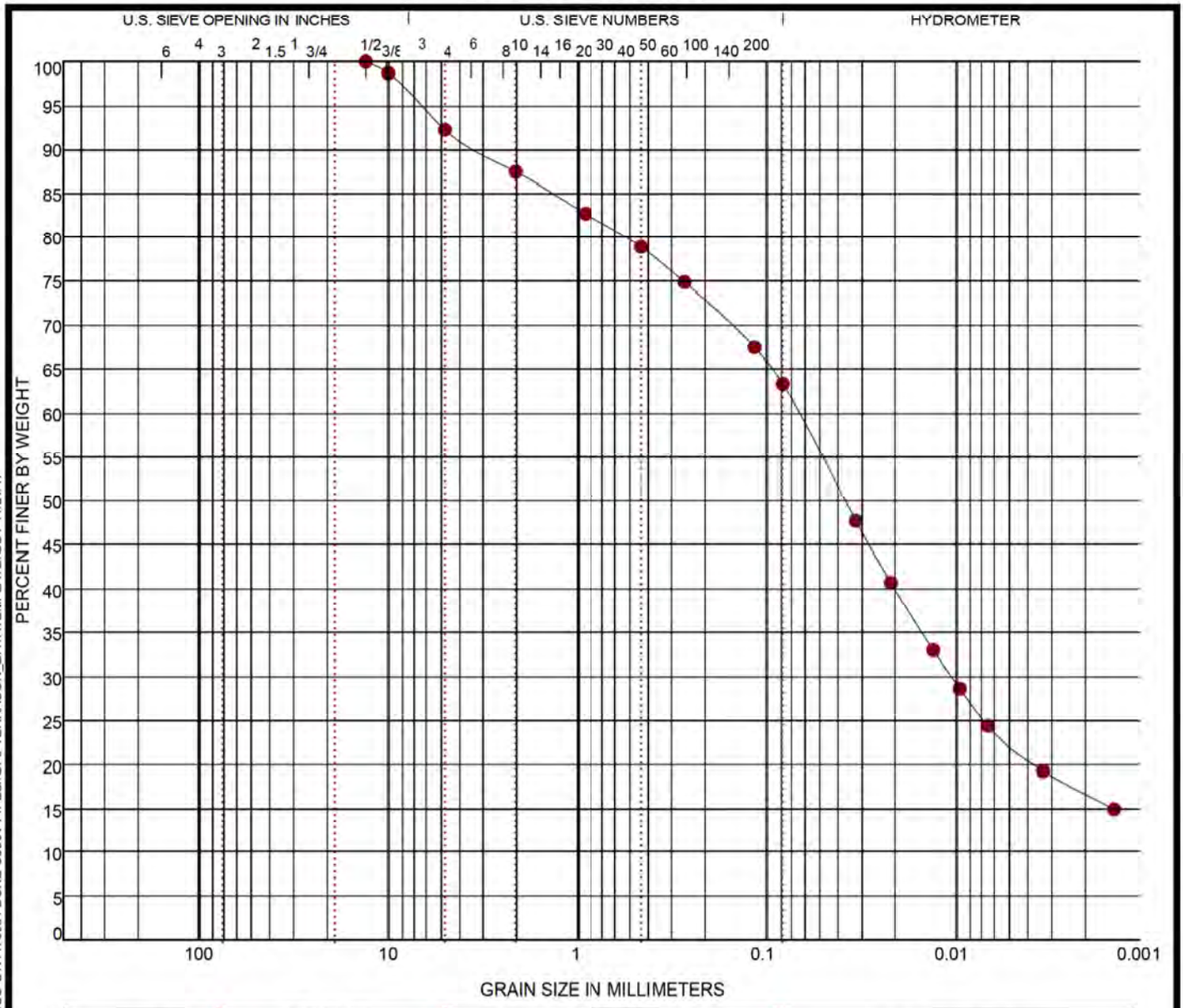

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-12A	35 - 5	SANDY LEAN CLAY (CL)	13	24	13	11		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-12A	35 - 5	12.5	0.062	0.009		7.7	28.9	40.3		23.1

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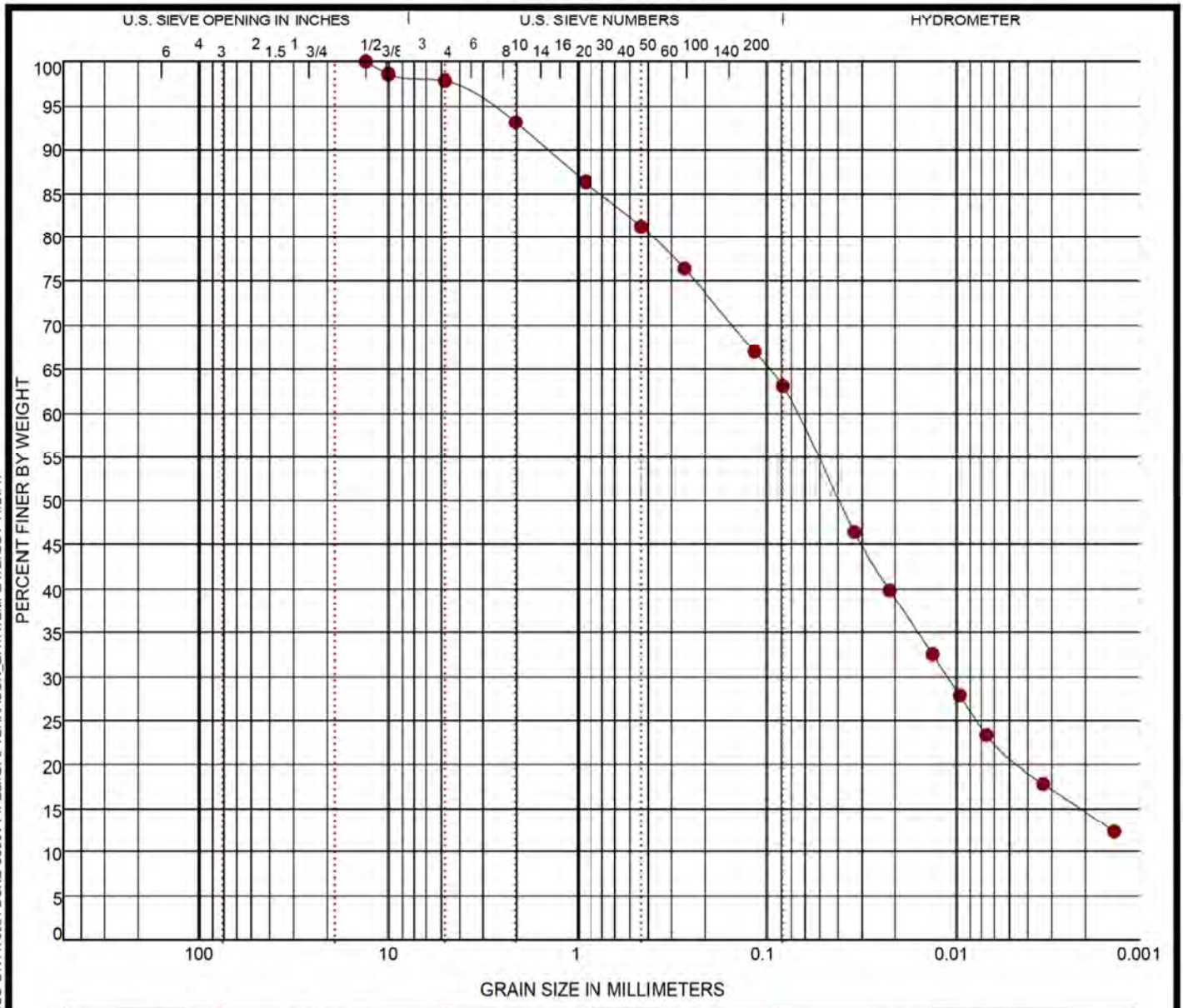

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-12A	55 - 5	SANDY LEAN CLAY (CL)	10	21	12	9		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-12A	55 - 5	12.5	0.064	0.01		2.1	34.8	41.4		21.8

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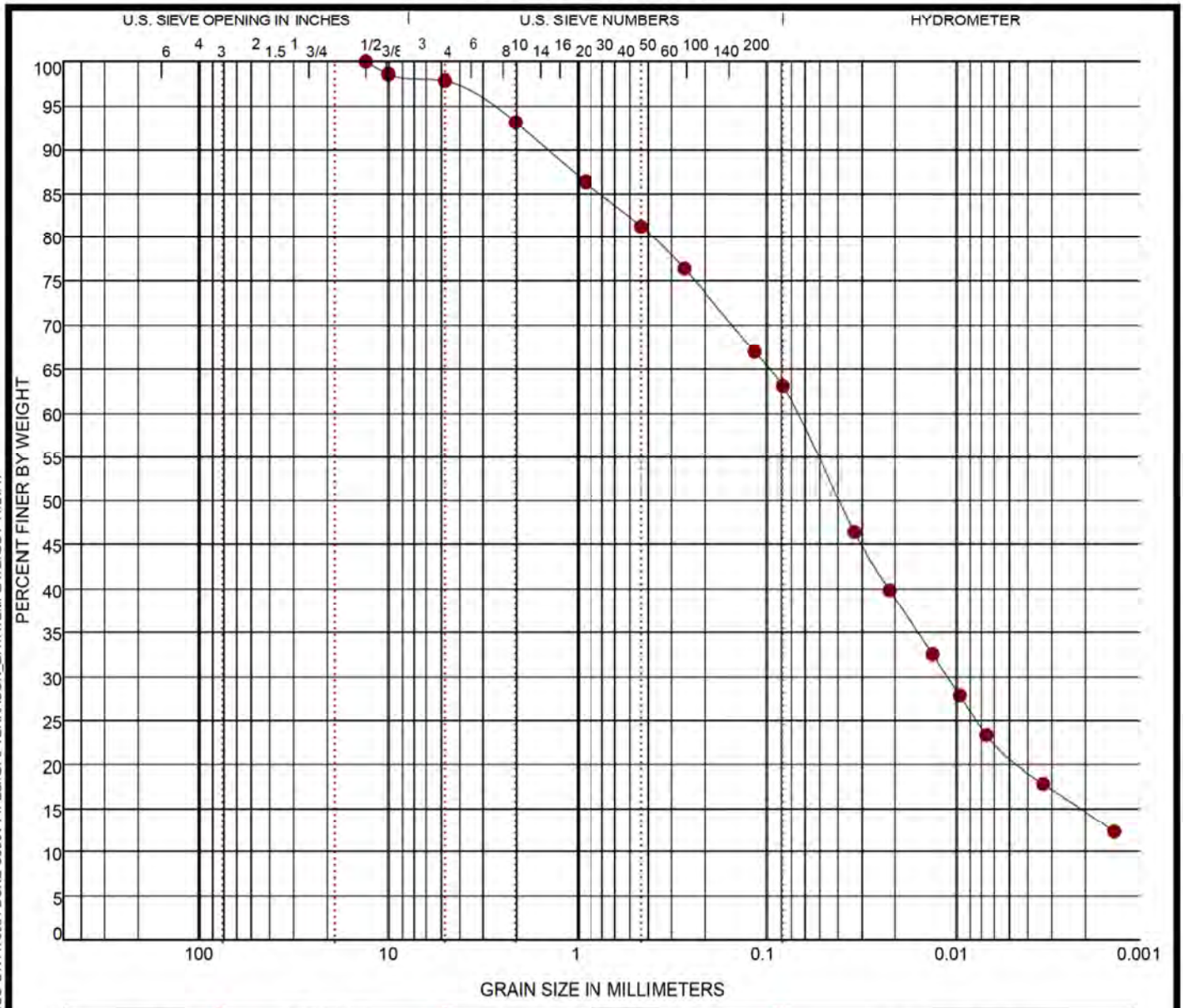

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-12A	55 - 5	SANDY LEAN CLAY (CL)	10	21	12	9		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-12A	55 - 5	12.5	0.064	0.01		2.1	34.8	41.4		21.8

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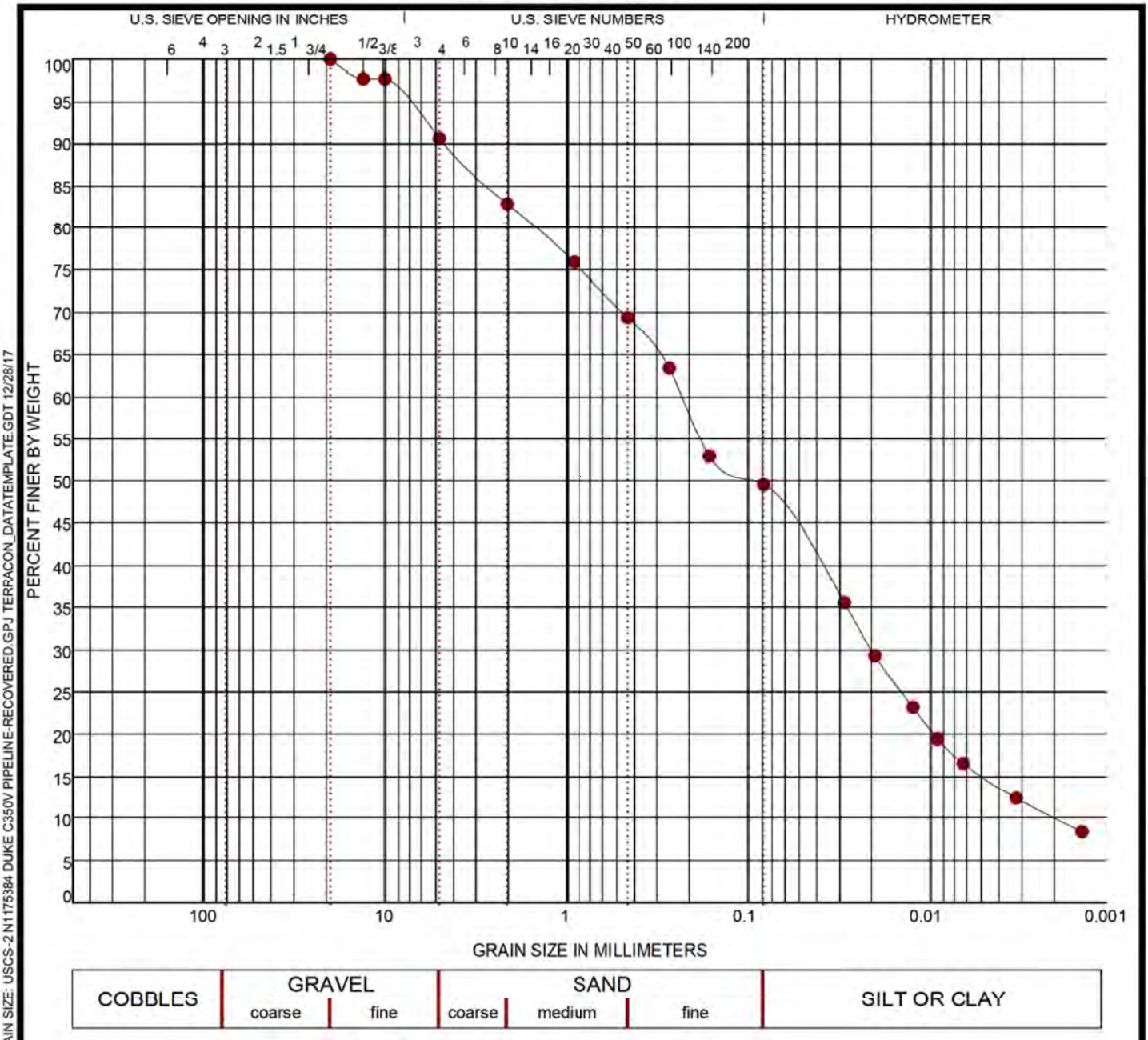

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-13	8.5 - 10	BROWN SILTY SAND	14				0.95	119.91

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-13	8.5 - 10	19	0.211	0.019	0.002	9.3	41.0	33.9		15.7

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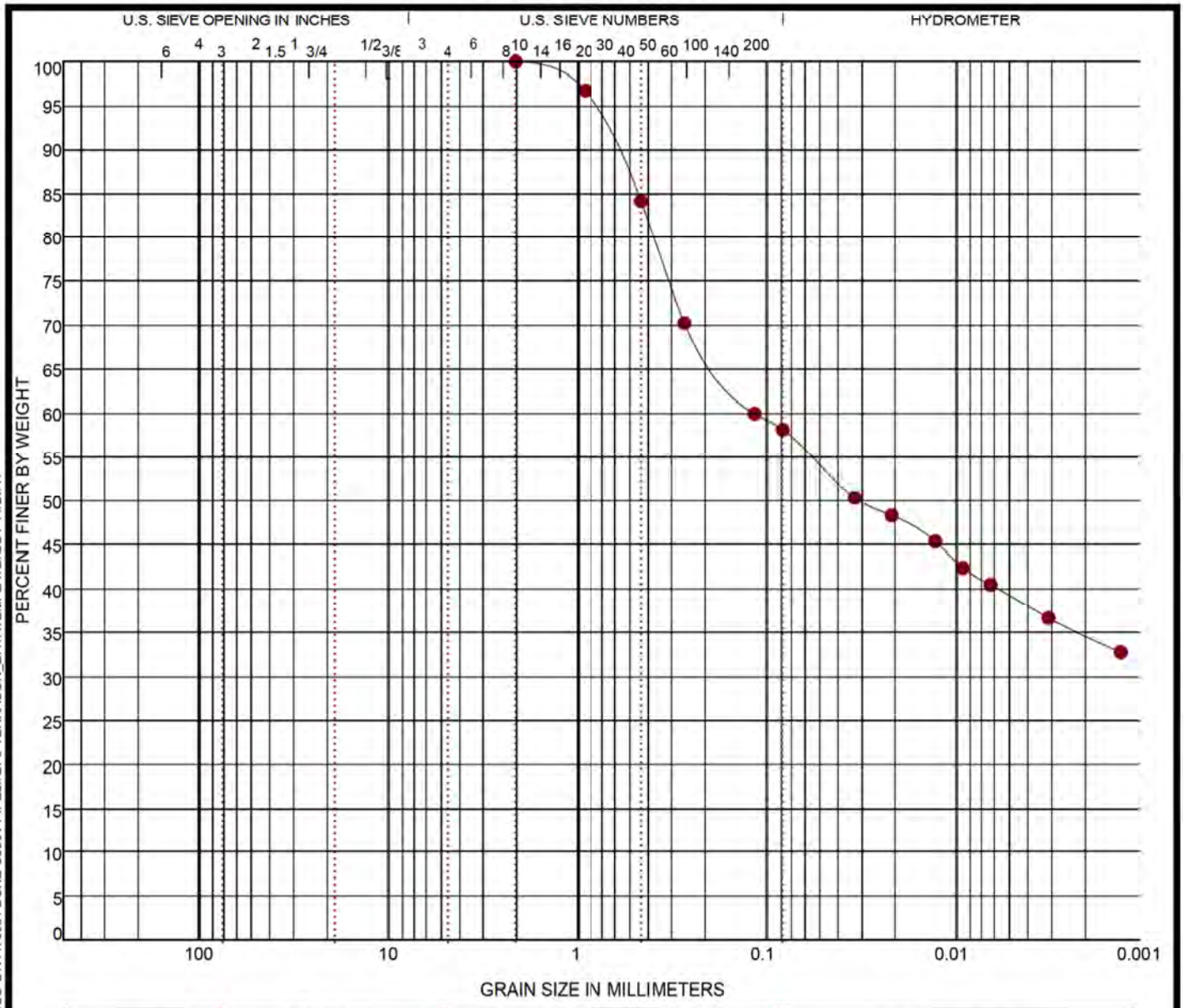

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-14A	20 - 25	BROWN LEAN CLAY (CL)	24	48	19	29		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-14A	20 - 25	2	0.104			0.0	41.7	18.5		39.7

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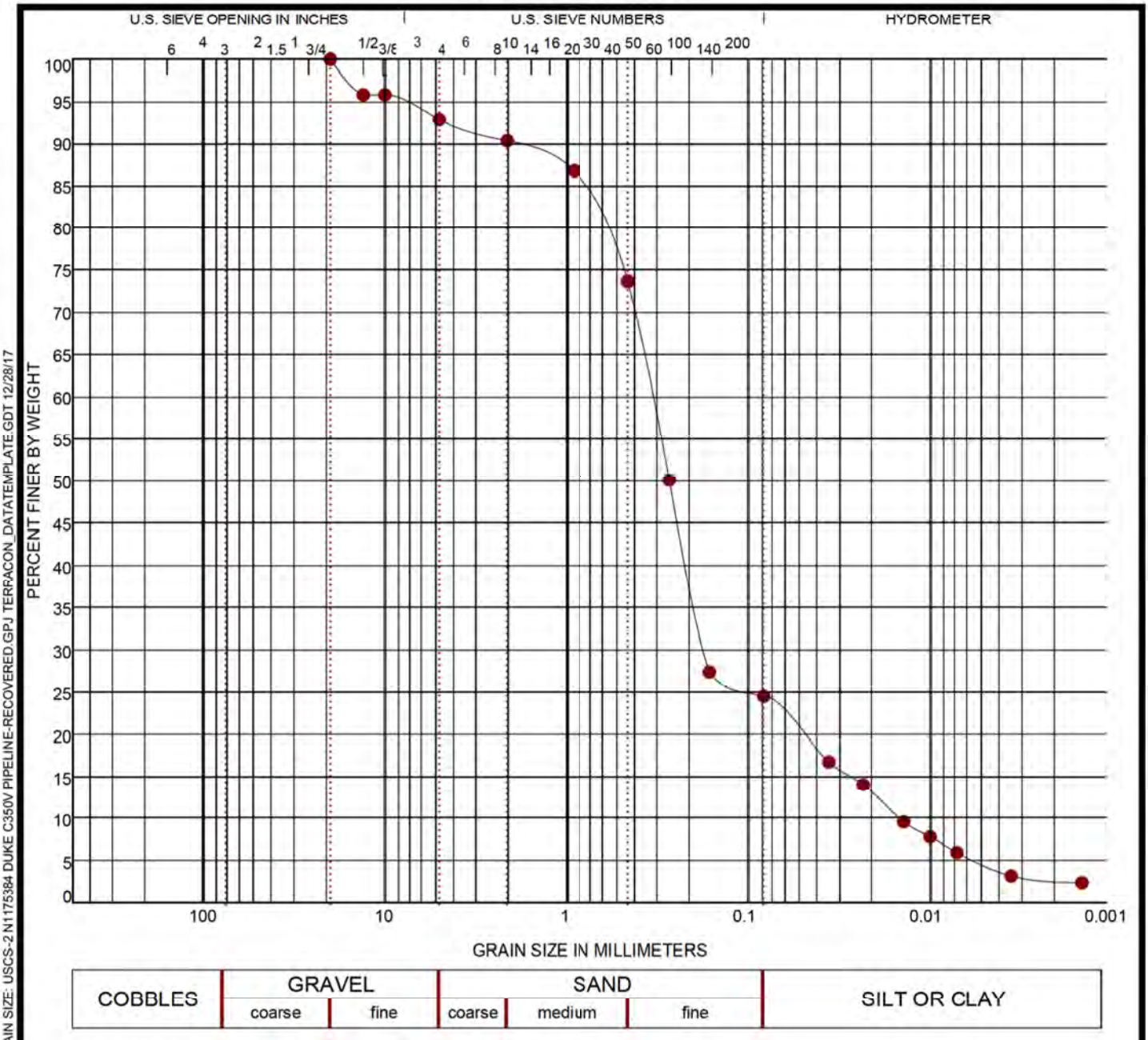

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-18	6 - 7.5	BROWN SAND	14				6.21	24.02

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-18	6 - 7.5	19	0.312	0.159	0.013	7.1	68.3	19.5		5.2

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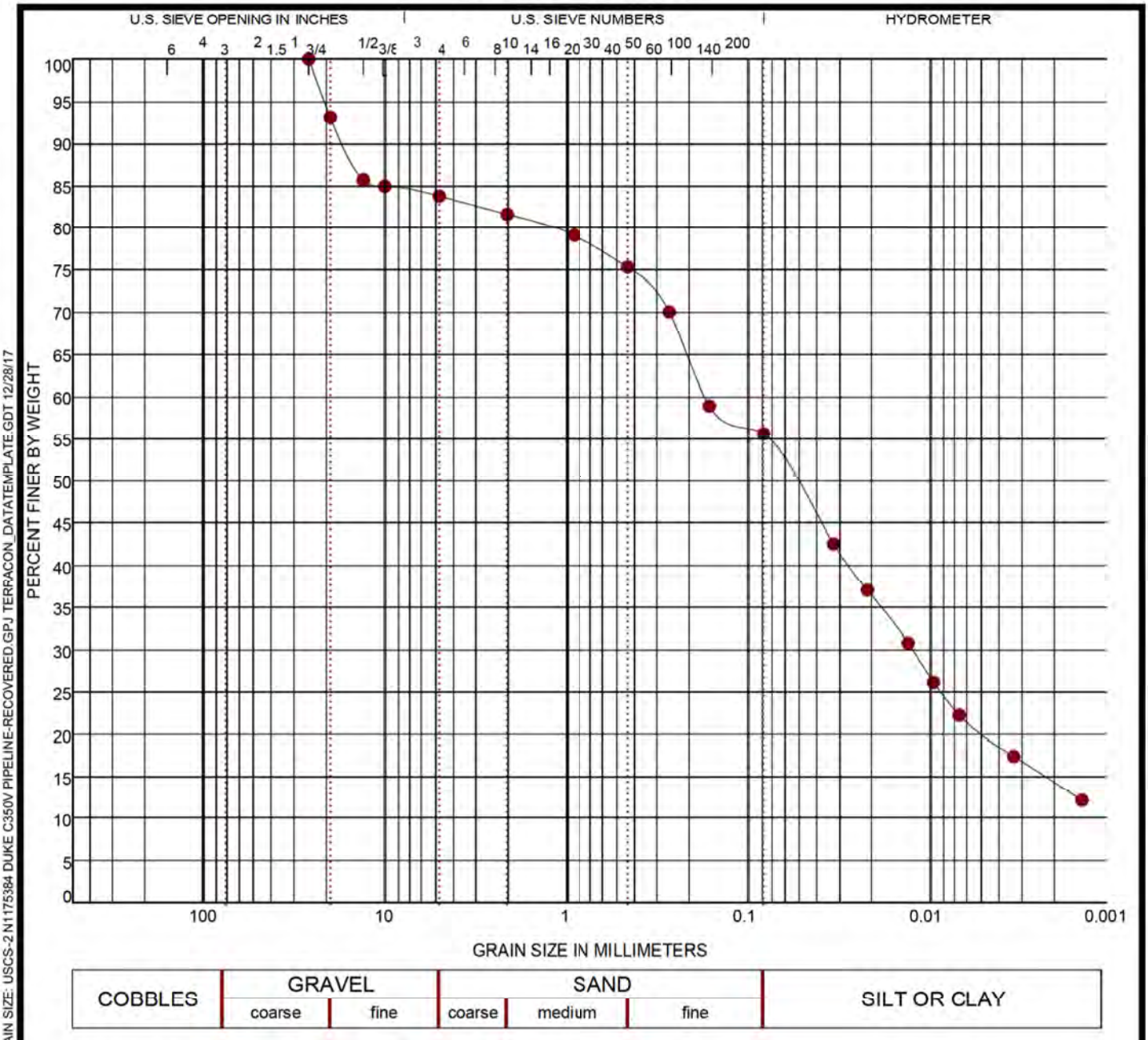

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-22	7 - 8.5	GRAY SILT WITH SAND AND GRAVEL	22					

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-22	7 - 8.5	25	0.157	0.011		16.1	28.2	34.8		20.9

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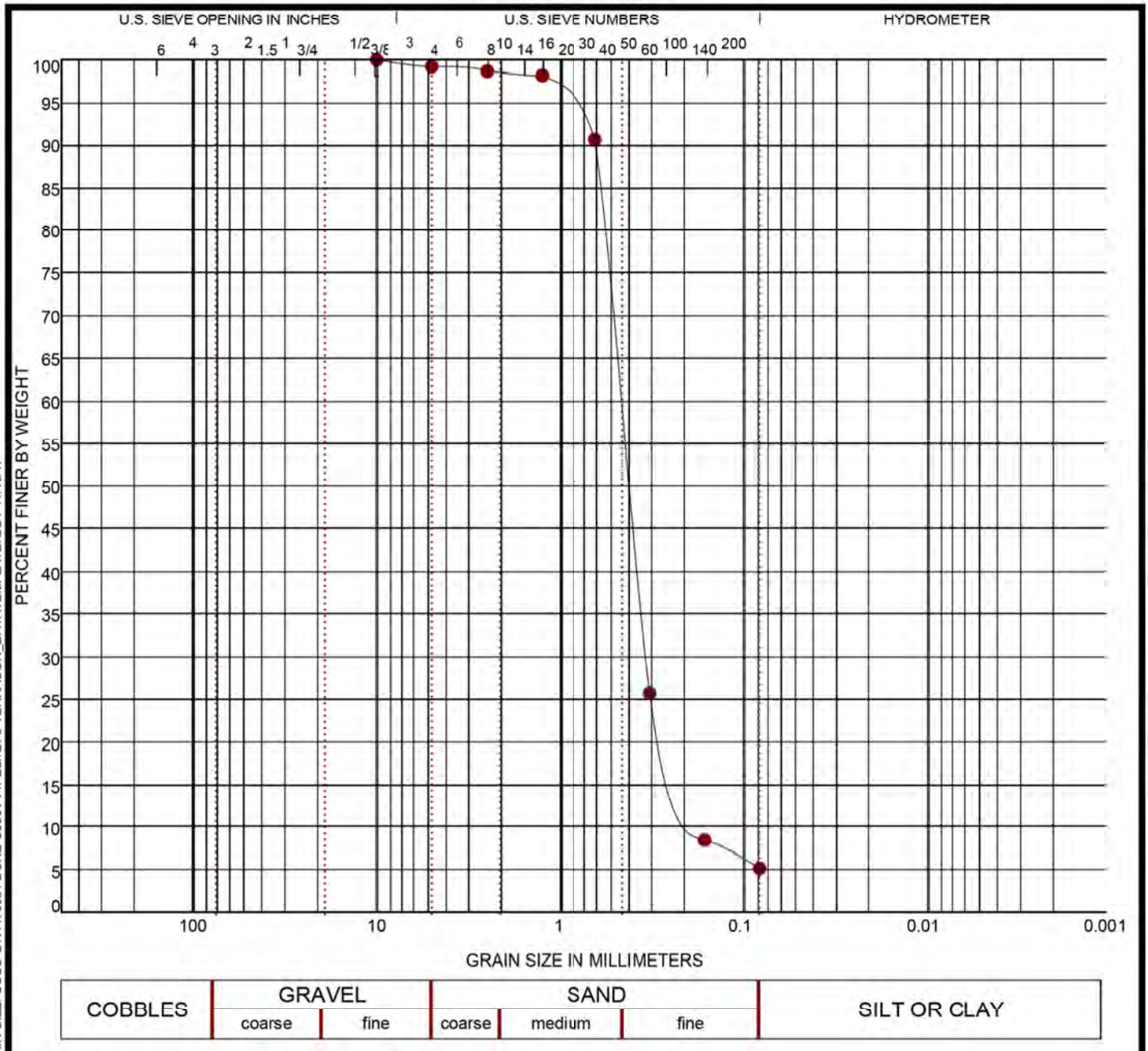

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
WB-11A	15 - 16	BROWN SAND					1.43	2.72

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
WB-11A	15 - 16	9.5	0.432	0.313	0.159	0.8	93.9		5.4	

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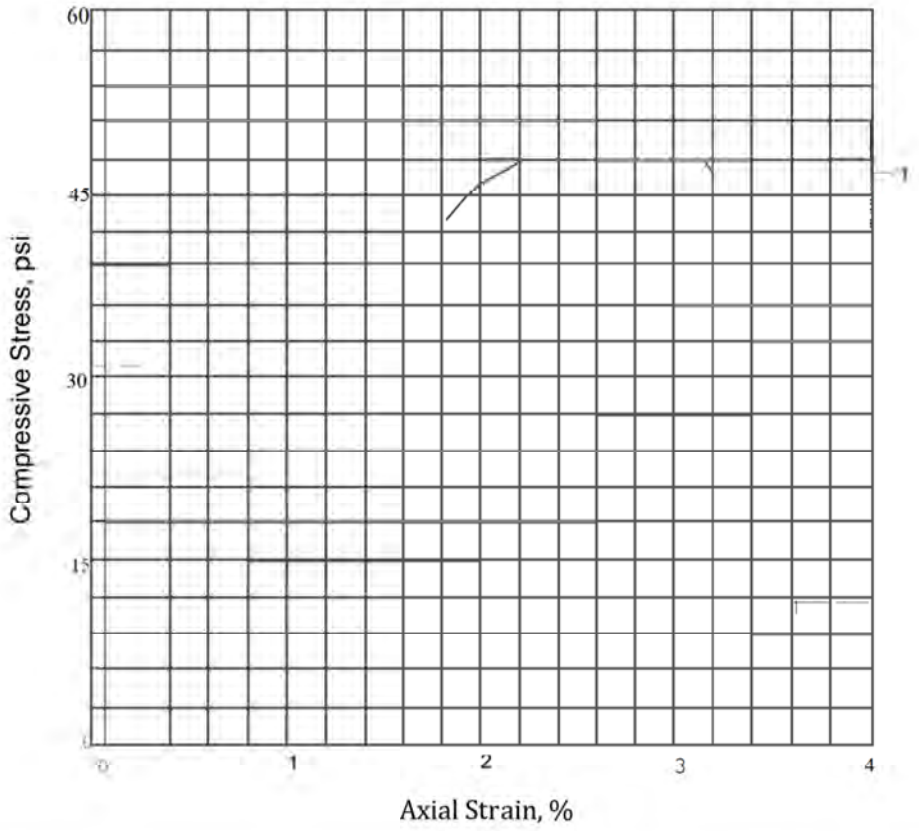
LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 N1175384 DUKE C350V PIPELI.GPJ TERRACON_DATATEMPLATE.GDT 11/15/17

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	52.661			
Undrained shear strength, psi	26.33 1			
Failure strain, %	2.9			
Strain rate, in./min.	0.039			
Water content, %	9.1			
Wet density, pcf	I 51.3			
Dry density, pcf	138.6			
Saturation, %	N/A			
Void ratio	N/A			
Specimen diameter, in.	I .980			
Specimen height, in.	3.950			
Height/diameter ratio	2.00			

Description: CALCAREOUS SHALE

LV = PL = **PI =** Assumed GS= Type: Calcareous Shale

Project No.: N 1165468
Date Sampled: 2- 15— 17

Remarks:

Glient: DUKE ENERGY

Project: DUKE C350 PIPELINE

Source of Sample: BI **Depth:** 41.3-41.8'
Sample Number: 3

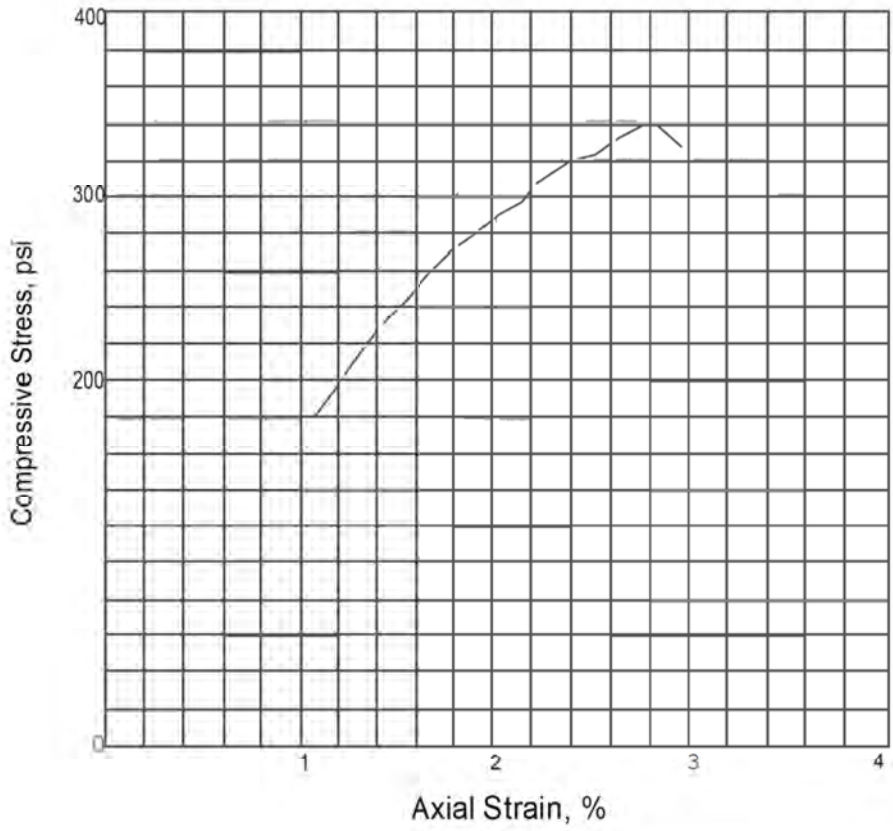
UNCONFINED COMPRESSION TEST

Terracon ,, Inc.
Cincinnati Ohio

Exhibit 1207

Tested By: DR Checked By: GS

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	340.223			
Undrained shear strength, psi	170.111			
Failure strain, %	2.8			
Strain rate, in./min.	0.040			
Water content, %	6.3			
Wet density, pcf	156.6			
Dry density, pcf	147.3			
Saturation, %	N/A			
Void ratio	N/A			
Specimen diameter, in.	1.9J2			
Specimen height, in.	4.0J9			
Height/diameter ratio	2.07			

Description: CALCAREOUS SHALE

LL = | PL = | PI = | **Assumed GS=** Type: Calcareous Shale

Project No.: NI165468
Date Sampled: 2- 1fi-l 7
Remarks:

Client: DTJXE ENERGY

Project: DUKE C350 PIPELINE

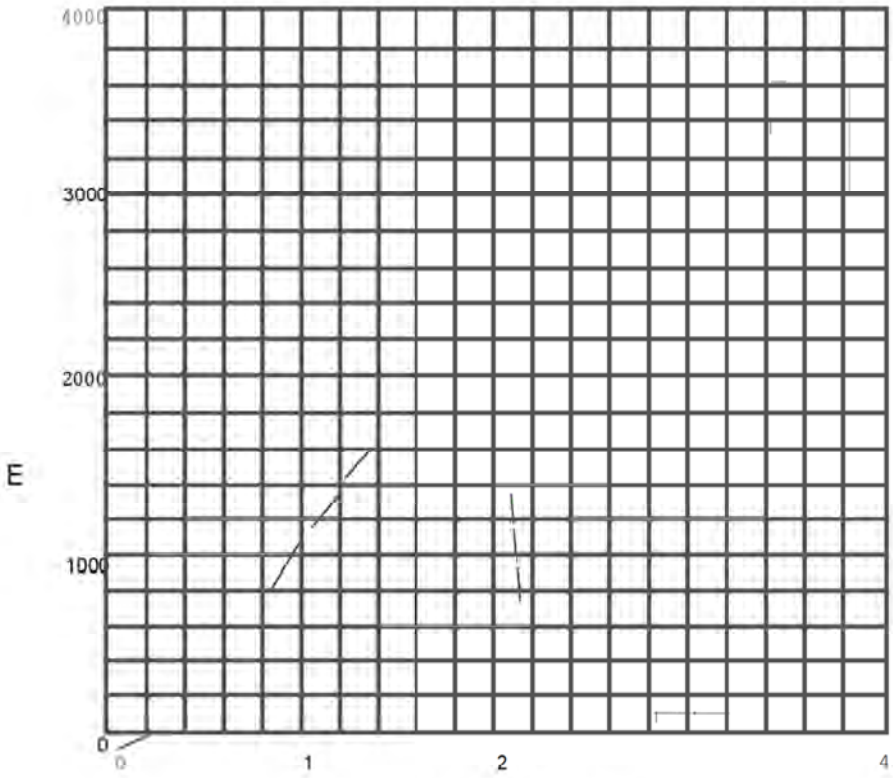
Source of Sample: BJ Depth: 5?.5-58.3'
Sample Number: 6

UNCONFINED COMPRESSION TEST
Terracon, Inc.
Cincinnati Ohio

Exhibit 1208

Tested By: DR **Checked By: GS**

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	2303.985			
Undrained shear strength, psi	1151.992			
Failure strain, %	2.0			
Strain rate, in./min.	0.(140			
Water content, %	3.9			
Wet density, pcf	160.3			
Dry density, pcf	154.2			
Saturation, %	N/A			
Void ratio	N/A			
Specimen diameter, in.	1.983			
Specimen height, in.	4.074			
Height/diameter ratio	2.05			

Description: CALCAREOUS SHALE

LL = PL = **PI =** **Assumed GS=** Type: Calcareous Shale

Project No.: Nll 65468
Date Sampled: 2—I 5—17
Remarks:

Glient: DUKE ENERGY

Project: DUKE C350 PIPELINE

Source of Sample: BI Depth: 77.9-7g,3'
Sample Number: IO

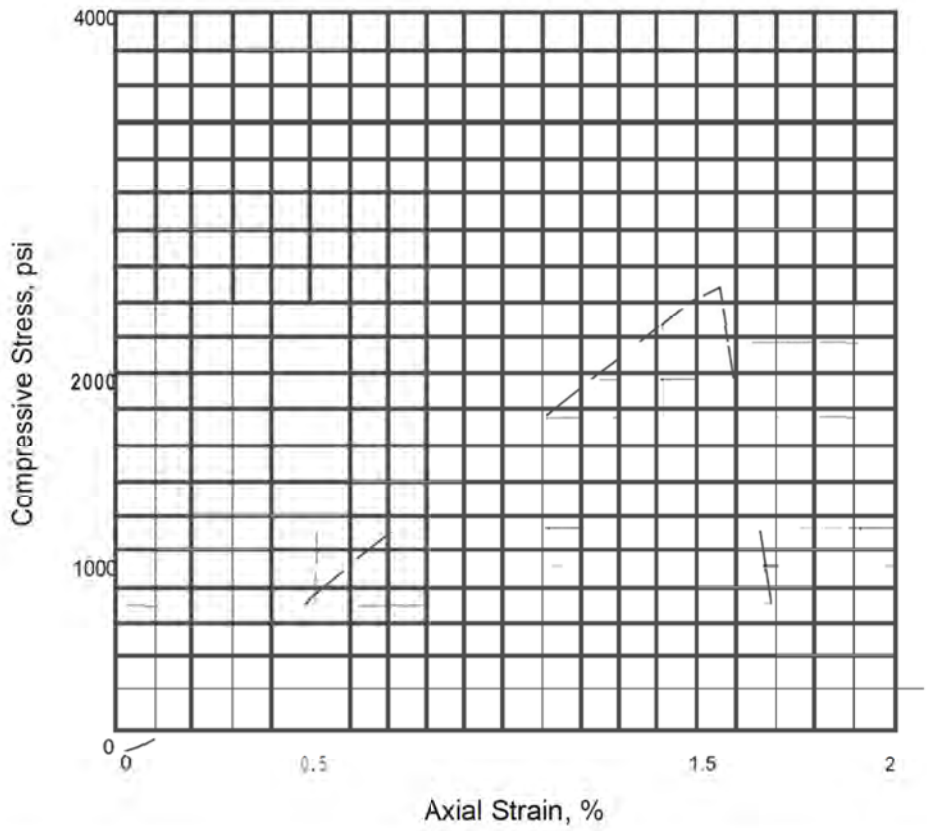
UNCONFINED COMPRESSION TEST

Exhibit 1209

Terracon mc.
Cincinnati Ohio

Tested By: DR Checked By: GS

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	2498.956			
Undrained shear strength, psi	1249.478			
Failure strain, %	1.5			
Strain rate, in./min.	0.040			
Water oontent, *f*	3.5			
Wet density, pcf	159.9			
Dry density, pcf	154.6			
Saturation, %	N/A			
Void ratio	N/A			
Specimen diameter, in.	1.983			
Specimen height, in.	4.075			
Height/diameter ratio	2.05			

Description: CnLCAREOUS SHALE

LL = PL = | PI = | **Assumed GS-**) Type: Cstcareous Shale

Project bio.: N1165468
Date Sampled: 2-I S-t7
Remarks:

Client: DIIKE ENERGY

Project: DUKE C350 PIPELINE

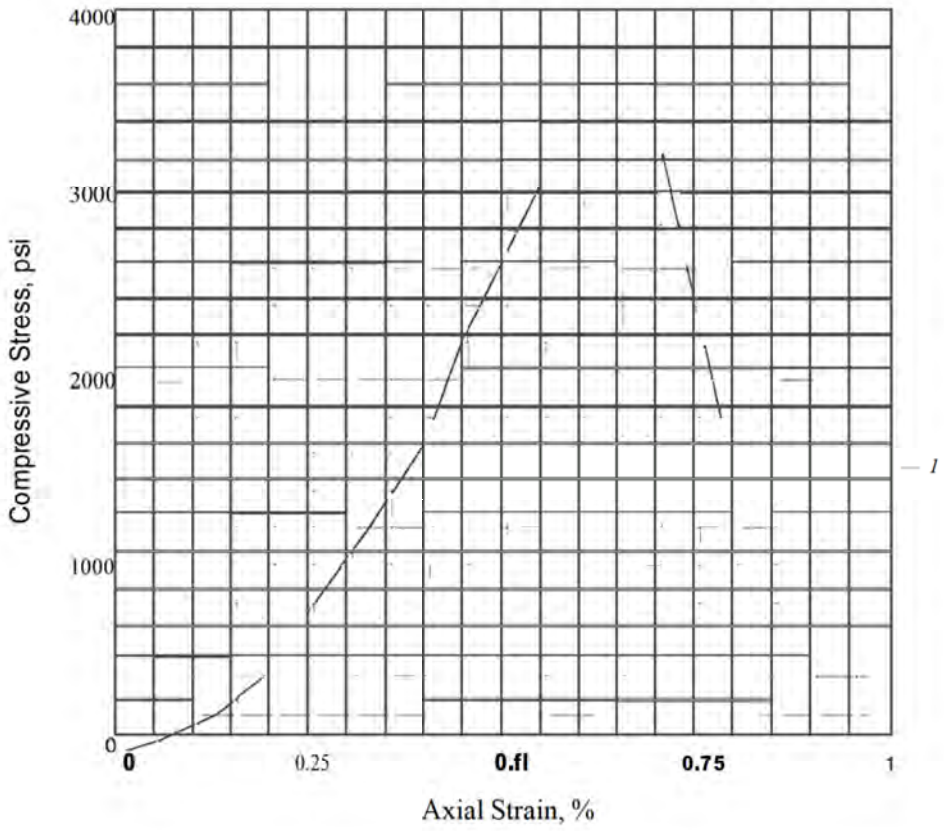
Source of Sample: BI Depth: 84.5-85.0'
Sample Number: 12

UNCONFINED COMPRESSION TEST
Terracon, Inc.
Cincinnati Ohio

Exhibit t2l0

Tested By: DR **Checked By: GS**

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	3847.391			
Undrained shear strength, psi	1923.695			
Failure strain, %	0.7			
Strain rate, in./min.	0.040			
Water content, %	0.8			
Wet density, pcf	166.1			
Dry density, pcf	164.8			
Saturation, %	N/A			
Void ratio	N/A			
Specimen diameter, in.	1.981			
Specimen height, in.	4.048			
Height/diameter ratio	2.04			

Description: LIMESTONE

LV = PL = | PI = Assumed GS= Type: Limestone

Project No.: N1165468
Date Sampled: 2—15—17

Client: DUKE ENERGY

Remarks:

Project: DUKE C350 PIPELINE

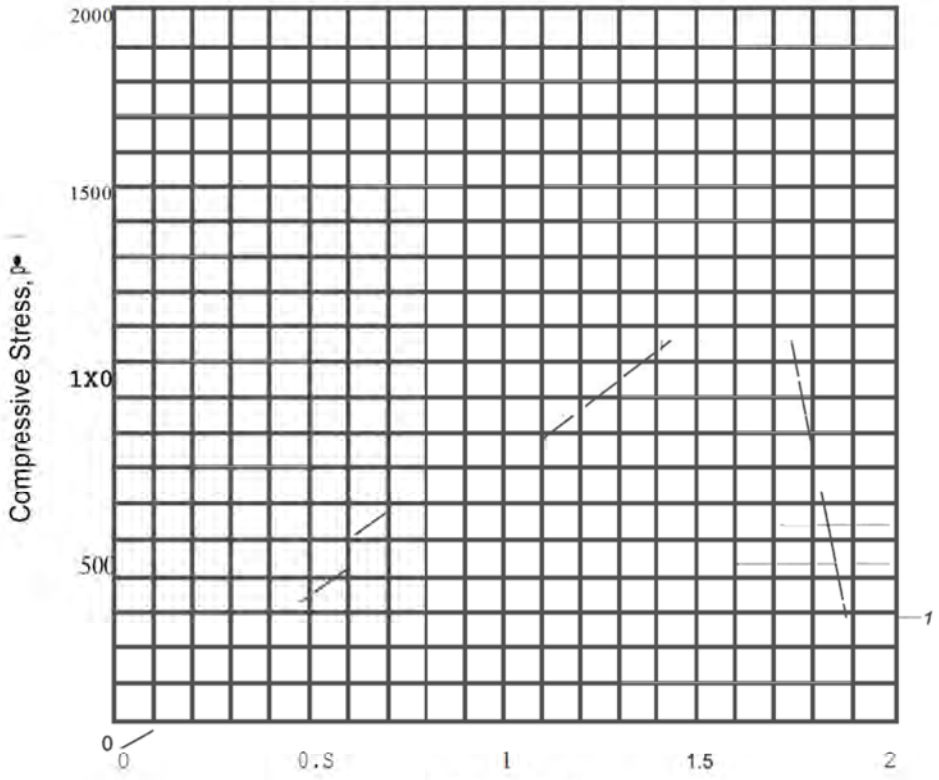
Source of Sample: B2 **Depth:** 55.3-53.7'
Sample Number: 3

UNCONFINED **COMPRESSION** TEST
Terracon Inc.
Cincinnati Ohio

Exhibit 1221

Tested By: DR Checked By: GS

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	1270.861			
Undrained shear strength, psi	635.430			
Failure strain, %	1.7			
Strain rate, in./min.	0.039			
Water content, %	5.0			
Wet density, pcf	160.3			
Dry density, pcf	**152.6**			
Saturation, %	**N/A**			
Void ratio	**N/A**			
Specimen diameter, in.	1.985			
Specimen height, in.	3.993			
Height/diameter ratio	2.01			

Description: CALCAREOUS

LL = PL = | **PI =** **}Assumed GS=**) Type: Calcareous

Project No.: N1165468
Date Sampled: 2-15-17

Client: DUKE ENERGY

Remarks:

Project: DUKE C350 PIPELINE

Source of Sample: B2 **Depth:** 70.8-71.3'
Sample Number: 6

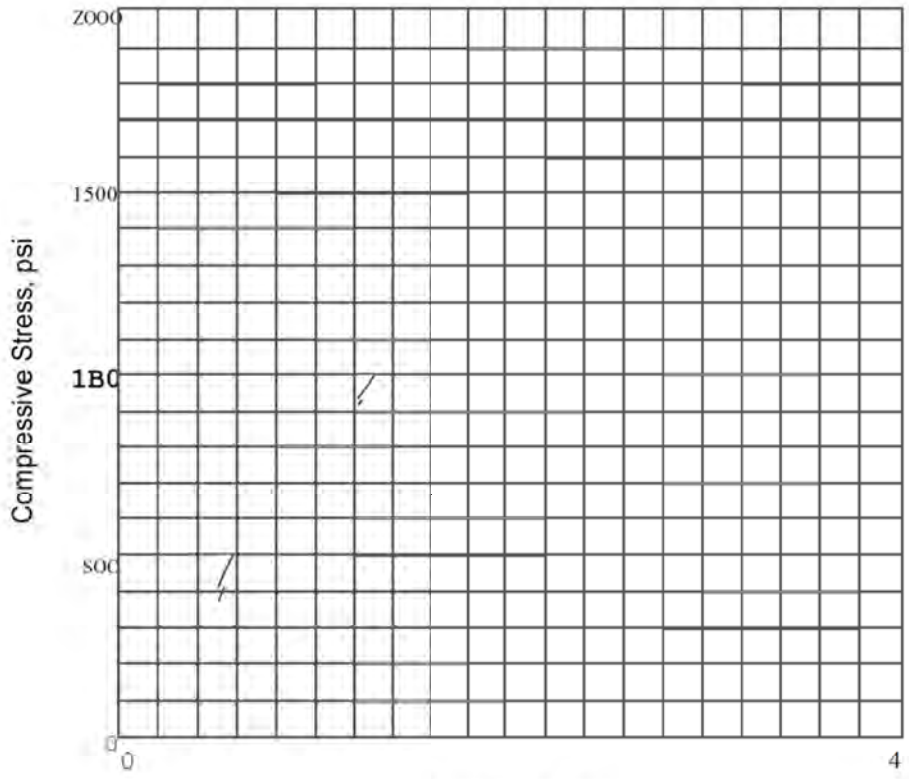
UNCONFINED COMPRESSION TEST

Exhibit t222

Terracon, Inc.
Cincinnati Ohio

Tested By: DR **Checked By: GS**

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	**1461.648**			
Undrained shear strength, psi	730.824			
Failure strain, %	2.0			
Strain rate, in./min.	**0.040**			
Water content, %	3.9			
Wet density, pcf	161.3			
Dry density, pcf	155.2			
Saturation, %	**N/A**			
Void ratio	N/A			
Specimen diameter, in.	1.985			
Specimen height, in.	4.018			
Height/diameter ratio	**2.02**			

Description: CALCAREOUS SHALE

LL = PL = | **PI =**] Assumed GS= Type: Calcareous Shale

Project No.: NI165468
Date Sampled: 2- l6-I?

Client: DUKE ENERGY

Remarks:

Project: DUKE C350 PIPELINE

Source of Sample: B2 **Depth:** 8t.4-8t.8'
Sample Number: 8

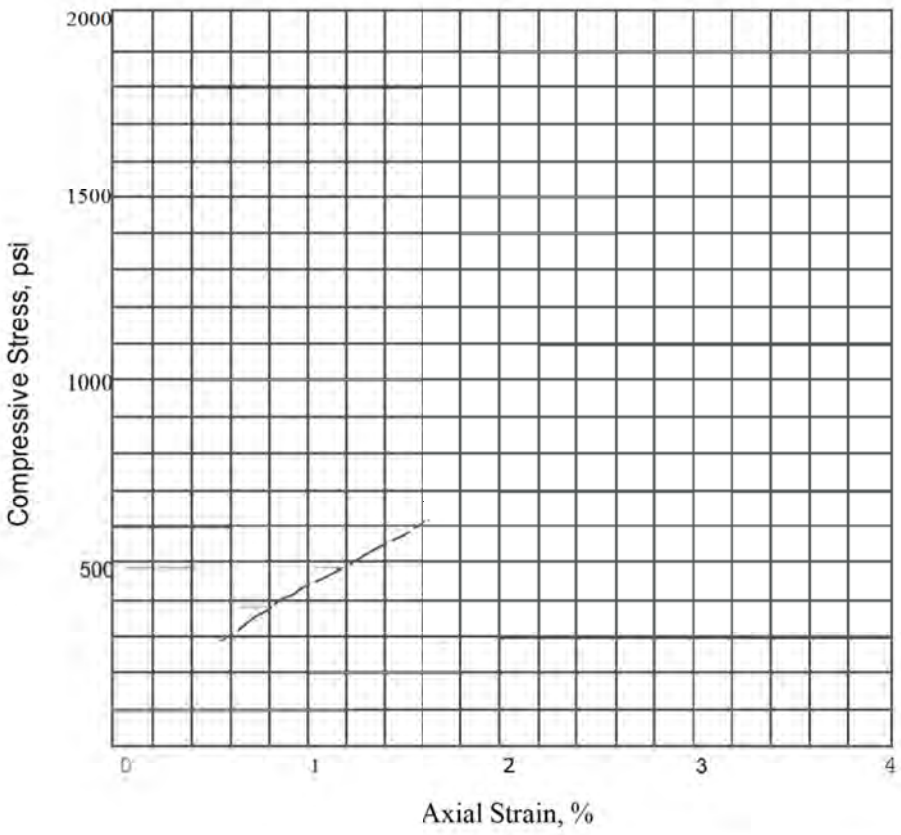
UNCONFINED COMPRESSION TEST

Exhibit 1223

Terracon Inc.
Cincinnati Ohio

Tested By:DR **CheckedBy:GS**

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	1007.913			
Undrained shear strength, psi	503.957			
Failure strain, %	2.7			
Strain rate, in./min.	0.040			
Water content, %	5.2			
Wet density, pcf	159.1			
Dry density, pcf	151.1			
Saturation, %	N/A			
Void ratio	N/A			
Specimen diameter, in.	1.980			
Specimen height, in.	4.017			
Height/diameter ratio	2.03			

Description: CALCAREOUS SHALE

LL - PP = | **PI =** **}Assumed GS=**) Type: Calcareous Shale

Project No.: NI 165468
Date Sampled: 2-16-17
Remarks:

Client: **DUKE ENERGY**

Project: DUKE C350 PIPELINE

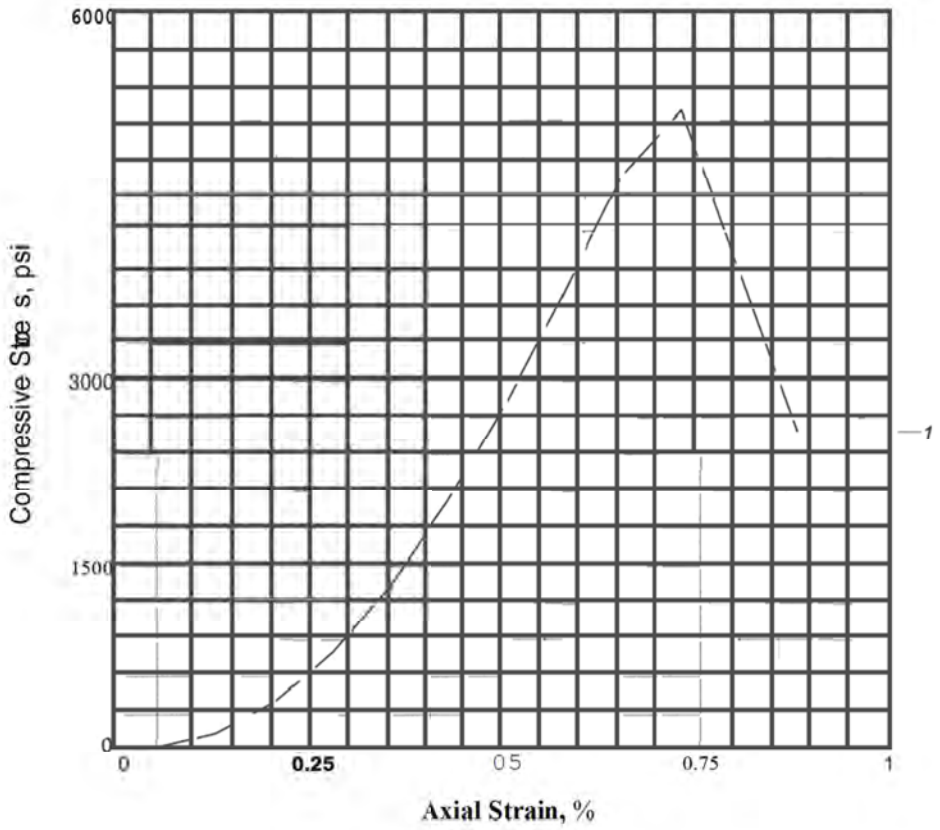
Source of Sample: B2 **Depth: 91.9-92.3'**
Sample Number: t0

UNCONFINED COMPRESSION TEST
Terracon Inc.
Cincinnati Ohio

Exhibit l224

Tested By: DR **Checked By: GS**

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	5182.396			
Undrained shear strength, psi	2591.198			
Failure strain, %	0.7			
Strain rate, in./min.	**0.040**			
Water content, %	0.5			
Wet density, pcl	166.8			
Dry density, pcf	**166.0**			
Saturation, %	N/A			
Void ratio	**N/A**			
Specimen diameter, in.	1.983			
Specimen height, in.	4.009			
Height/diameter ratio	2.02			

Description: LIMESTONE

LL - | PL = | **PI =** **Assumed GS=** Type: Limestone

Project No.: NI 165468
Date Sampled: 2-16- I7

Client: DIIKE **ENERGY**

Remarks:

Project: **D**DUKE C350 PIPELINE

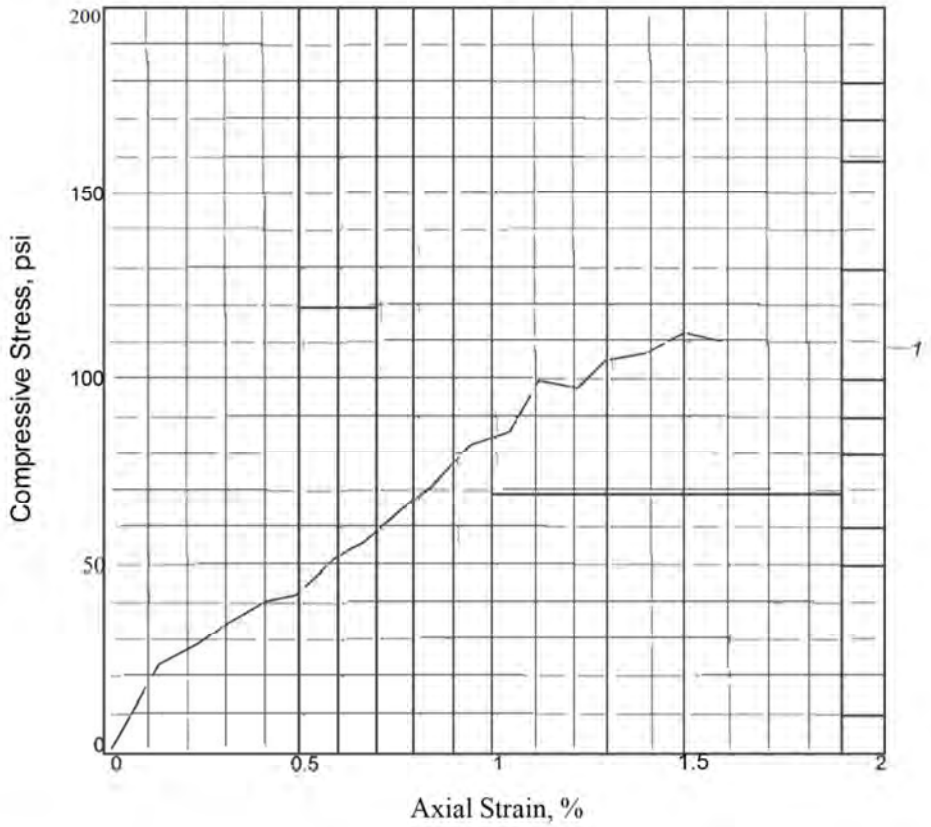
Source of Sample: B2 **Depth:** 98.4-99.t'
Sample Number: I i

UNCONFINED **COMPRESSION TEST**
Terracon , Inc.
Cincinnati Ohio

Exhibit t225

Tested By: DR Checked By: GS

UNCONFINED COMPRESSION TEST



Sample No.	1
Unconfined strength, psi	112.398
Undrained shear strength, psi	56.199
Failure strain, %	1.5
Strain rate, in./min.	N/A
Water content, %	8.4
Wet density, pcf	160.5
Dry density, pcf	148.1
Saturation, %	N/A
Void ratio	N/A
Specimen diameter, in.	1.945
Specimen height, in.	3.965
Height/diameter ratio	2.04

Description: SHALE CLAY

LL = **PL =** | **PI =** Assumed GS= Type: Shale Clay

Project No.: N 7 i 63468
Date Sampled: 2-2 1 -17
Remarks:

Glient: DUKE ENERGY

Project: DUKE C350 PIPELINE

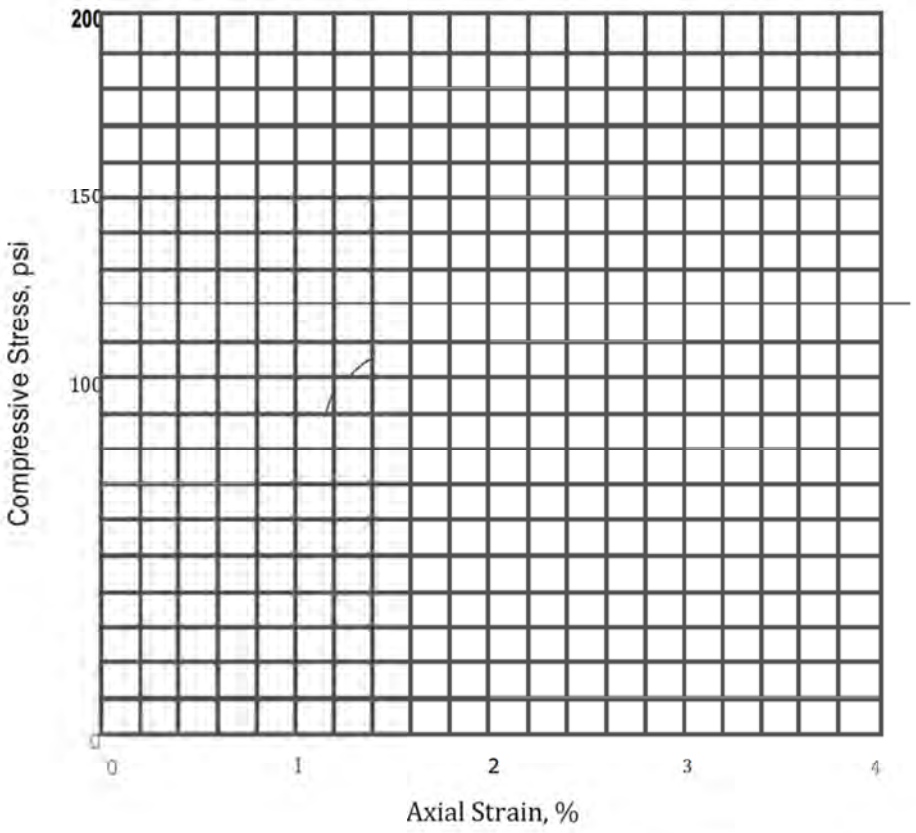
Source of Sample: B3 **Depth:** 88.2-88.7'
Sample Number: I

Exhibit 1543

UNCONFINED **COMPRESSION** TEST
Terracon Inc.
Cincinnati dhio

Tested By: DR **Checked By: GS**

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psi	128.764			
Undrained shear strength, psi	64.382			
Failure strain, %	2.0			
Strain rate, in./min.	**0.039**			
Water content, %	6.5			
Wet density, pcf	153.0			
Dry density, pcf	143.7			
Saturation, %	N/A			
Void ratio	N/A			
Specimen diameter, in.	1.932			
Specimen height, in.	3.945			
Heigh\diameter ratio	**2.04**			

Description: SHALE CLAY

LV =) PL - | **PI =** | **Assumed GS=**] Type: Shale Clay

Project hIo.: N1165468

Date Sampled: 2-21-17

Remarks:

Client: DIJXE ENERGY

Project: DUKE C350 PIPELINE

Source of Sample: B3 Depth: 91.1-91.3'

Sample Number: 2

UNCONFINED COMPRESSION TEST

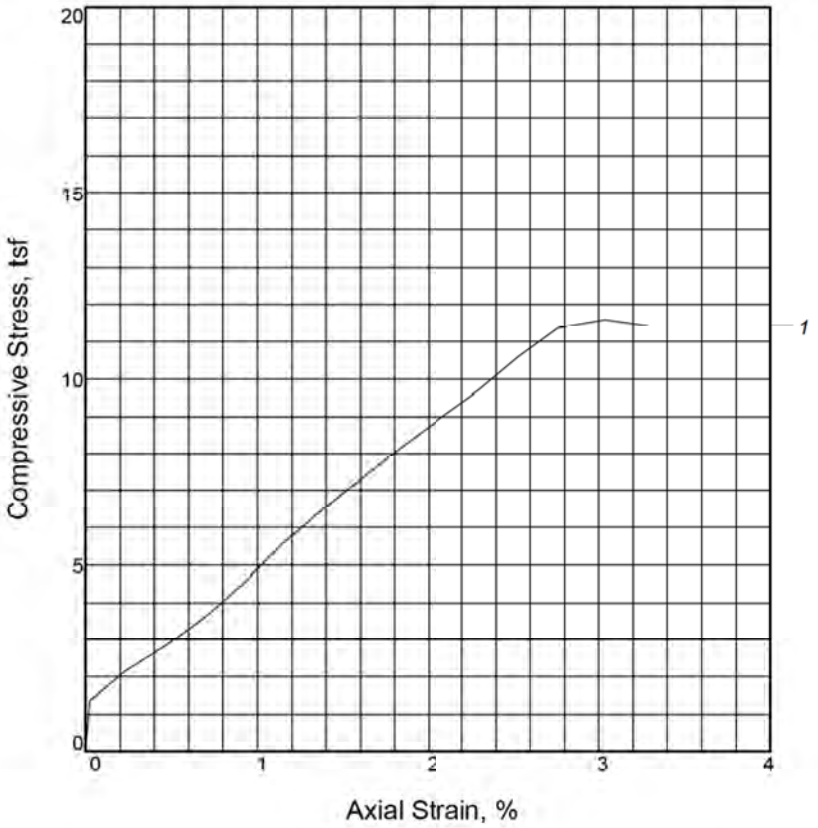
Terracon Inc.

Cincinnati bhio

Exhibit 1544

Tested By: DR Checked By: GS

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, tsf	11.5863			
Undrained shear strength, tsf	5.7931			
Failure strain, %	3.0			
Strain rate, in./min.	0.043			
Water content, %	6.3			
Wet density, pcf	156.5			
Dry density, pcf	147.2			
Saturation, %	N/A			
Void ratio	N/A			
Specimen diameter, in.	1.980			
Specimen height, in.	4.348			
Height/diameter ratio	2.20			

Description: SHALE

LL =	**PL =**	**PI =**	**Assumed GS=**	**Type:** Shale

Project No.: N1175384
Date Sampled: 4-14-20
Remarks:

Client: DUKE ENERGY

Project: CENTRAL CORRIDOR PIPELINE C350

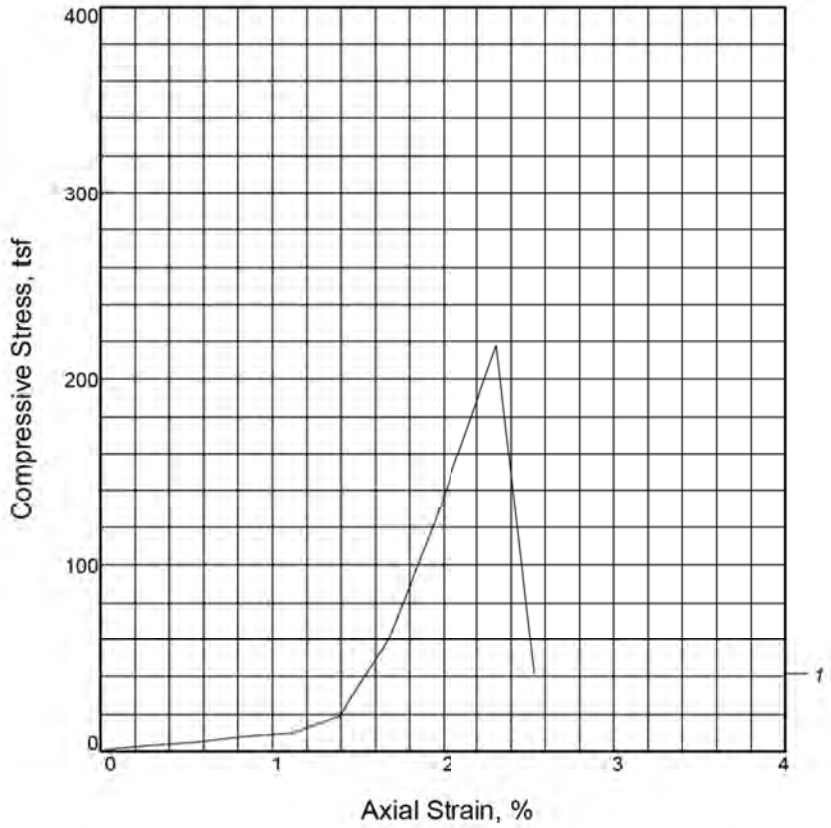
Source of Sample: 20-5 **Depth:** 20-25'
Sample Number: C-2

Exhibit 1875

UNCONFINED COMPRESSION TEST
Terracon, Inc.
Cincinnati, Ohio

Tested By: SF **Checked By:** GS

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, tsf	218.0043			
Undrained shear strength, tsf	109.0021			
Failure strain, %	2.3			
Strain rate, in./min.	0.035			
Water content, %	1.9			
Wet density, pcf	164.0			
Dry density, pcf	161.0			
Saturation, %	N/A			
Void ratio	N/A			
Specimen diameter, in.	1.982			
Specimen height, in.	3.588			
Height/diameter ratio	1.81			

Description: LIMESTONE

LL =	PL =	PI =	Assumed GS=	Type: Limestone

Project No.: N1175384
Date Sampled: 4-14-20
Remarks:

Client: DUKE ENERGY

Project: CENTRAL CORRIDOR PIPELINE C350

Source of Sample: 20-6 **Depth:** 15-20'
Sample Number: C-1

Exhibit 1884

UNCONFINED COMPRESSION TEST
Terracon, Inc.
Cincinnati, Ohio

Tested By: SF **Checked By:** GS

CHEMICAL LABORATORY TEST REPORT

Project Number: N1175384
Service Date: 04/16/20
Report Date: 04/29/20
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client
Duke Energy

Project
Central Corridor Pipeline

Sample Submitted By: Terracon (N1) **Date Received:** 4/13/2020 **Lab No.: 20-0409**

Results of Corrosion Analysis

Lab Number	1898	1899	1900	1901
Sample Number	7	7	7	7
Sample Location	20-4	20-5	20-6	20-7
Sample Depth (ft.)	9.0-10.5	9.0-10.5	9.0-10.5	9.0-10.5
pH Analysis, AWWA 4500 H	8.11	8.06	7.50	7.55
Water Soluble Sulfate (SO4), ASTM C 1580 (percent %)	0.01	0.03	0.02	0.01
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	295	55	48	48
Red-Ox, AWWA 2580, (mV)	+687	+686	+683	+684
Total Salts, AWWA 2540, (mg/kg)	2106	1635	1131	702
Resistivity, ASTM G 57, (ohm-cm)	970	1164	2425	3298

Analyzed By: Trisha Campo

Trisha Campo
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: N1175384
Service Date: 01/10/18
Report Date: 01/19/18
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client
Duke Energy

Project
Duke Energy C350 Pipeline

Sample Submitted By: Terracon (N1) **Date Received:** 1/5/2018 **Lab No.: 18-0043**

Results of Corrosion Analysis

Lab Number	10826 & 10827	10837 & 10838	10846 & 10847	10870 & 10871
Sample Number	S-2 & S-3	S-2 & S-3	S-2 & S-3	S-2 & S-3
Sample Location	WB-1	WB-1A	WB-2	WB-2A
Sample Depth (ft.)	2.5 & 5.0	2.5 & 5.0	2.5 & 5.0	2.5 & 5.0
pH Analysis, AWWA 4500 H	7.14	7.56	7.69	7.31
Water Soluble Sulfate (SO4), ASTM C 1580 (percent %)	0.01	0.01	0.01	0.01
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	35	80	70	60
Red-Ox, AWWA 2580, (mV)	+687	+680	+726	+682
Total Salts, AWWA 2540, (mg/kg)	821	815	222	448
Resistivity, ASTM G 57, (ohm-cm)	5238	3540	3346*	6790

* *WB-2 combined with WB-20*

Analyzed By: Trisha Campo
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: N1175384
Service Date: 01/10/18
Report Date: 01/19/18
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client
Duke Energy

Project
Duke Energy C350 Pipeline

Sample Submitted By: Terracon (N1) **Date Received:** 1/5/2018 **Lab No.: 18-0043**

Results of Corrosion Analysis

Lab Number	10826 & 10827	10837 & 10838	10846 & 10847	10870 & 10871
Sample Number	S-2 & S-3	S-2 & S-3	S-2 & S-3	S-2 & S-3
Sample Location	WB-1	WB-1A	WB-2	WB-2A
Sample Depth (ft.)	2.5 & 5.0	2.5 & 5.0	2.5 & 5.0	2.5 & 5.0
pH Analysis, AWWA 4500 H	7.14	7.56	7.69	7.31
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	133	41	93	98
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	35	80	70	60
Red-Ox, AWWA 2580, (mV)	+687	+680	+726	+682
Total Salts, AWWA 2540, (mg/kg)	821	815	222	448
Resistivity, ASTM G 57, (ohm-cm)	5238	3540	3346*	6790

* *WB-2 combined with WB-20*

Analyzed By: Trisha Campo
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: N1175384
Service Date: 01/10/18
Report Date: 01/19/18
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client
Duke Energy

Project
Duke Energy C350 Pipeline

Sample Submitted By: Terracon (N1) **Date Received:** 1/5/2018 **Lab No.: 18-0043**

Results of Corrosion Analysis

Lab Number	10892	10934 & 10935	10634 & 10635	9168 & 9169
Sample Number	S-1	S-4 & S-5	S-3 & S-4	S-4 & S-5
Sample Location	WB-3	WB-5	WB-7	WB-9
Sample Depth (ft.)	0	4.5 & 6.0	3.0 & 4.5	4.5 & 5.0
pH Analysis, AWWA 4500 H	7.84	7.82	7.22	7.39
Water Soluble Sulfate (SO4), ASTM C 1580 (percent %)	0.02	0.01	0.01	0.09
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	98	50	72	65
Red-Ox, AWWA 2580, (mV)	+677	+675	+699	+711
Total Salts, AWWA 2540, (mg/kg)	1103	694	179	2285
Resistivity, ASTM G 57, (ohm-cm)	1891*	2231**	4462***	2377****

* *WB-3 combined with WB-18*
** *WB-5 combined with WB-11*
*** *WB-7 combined with WB-16*
**** *WB-9 calculated reciprocal of Total Salts*

Analyzed By: Trisha Campo
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: N1175384
Service Date: 01/10/18
Report Date: 01/19/18
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client
Duke Energy

Project
Duke Energy C350 Pipeline

Sample Submitted By: Terracon (N1) **Date Received:** 1/5/2018 **Lab No.: 18-0043**

Results of Corrosion Analysis

Lab Number	10892	10934 & 10935	10634 & 10635	9168 & 9169
Sample Number	S-1	S-4 & S-5	S-3 & S-4	S-4 & S-5
Sample Location	WB-3	WB-5	WB-7	WB-9
Sample Depth (ft.)	0	4.5 & 6.0	3.0 & 4.5	4.5 & 5.0
pH Analysis, AWWA 4500 H	7.84	7.82	7.22	7.39
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	168	76	55	932
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	98	50	72	65
Red-Ox, AWWA 2580, (mV)	+677	+675	+699	+711
Total Salts, AWWA 2540, (mg/kg)	1103	694	179	2285
Resistivity, ASTM G 57, (ohm-cm)	1891*	2231**	4462***	2377****

* *WB-3 combined with WB-18*
** *WB-5 combined with WB-11*
*** *WB-7 combined with WB-16*
**** *WB-9 calculated reciprocal of Total Salts*

Analyzed By: Trisha Campo
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: N1175384
Service Date: 01/10/18
Report Date: 01/19/18
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client
Duke Energy

Project
Duke Energy C350 Pipeline

Sample Submitted By: Terracon (N1) **Date Received:** 1/5/2018 **Lab No.: 18-0043**

Results of Corrosion Analysis

Lab Number	9153 & 9154	9185 & 9186	9194 & 9195	10659 & 10660
Sample Number	S-2 & S-3	S-3 & S-4	S-3 & S-4	S-3 & S-4
Sample Location	WB-11	WB-14	WB-16	WB-18
Sample Depth (ft.)	2.5 & 5.0	4.0 & 5.5	3.0 & 4.5	3.0 & 4.5
pH Analysis, AWWA 4500 H	8.14	7.83	7.73	7.08
Water Soluble Sulfate (SO4), ASTM C 1580 (percent %)	0.01	0.01	0.01	0.01
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	145	77	52	62
Red-Ox, AWWA 2580, (mV)	+669	+715	+732	+686
Total Salts, AWWA 2540, (mg/kg)	659	223	157	1016
Resistivity, ASTM G 57, (ohm-cm)	2231*	7372	4462**	1891***

* *WB-11 combined with WB-5*
** *WB-16 combined with WB-7*
*** *WB-18 combined with WB-3*

Analyzed By: Trisha Campo
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: N1175384
Service Date: 01/10/18
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Project
Duke Energy C350 Pipeline

Sample Submitted By: Terracon (N1) **Date Received:** 1/5/2018 **Lab No.: 18-0043**

Results of Corrosion Analysis

Lab Number	9153 & 9154	9185 & 9186	9194 & 9195	10659 & 10660
Sample Number	S-2 & S-3	S-3 & S-4	S-3 & S-4	S-3 & S-4
Sample Location	WB-11	WB-14	WB-16	WB-18
Sample Depth (ft.)	2.5 & 5.0	4.0 & 5.5	3.0 & 4.5	3.0 & 4.5
pH Analysis, AWWA 4500 H	8.14	7.83	7.73	7.08
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	121	47	66	128
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	145	77	52	62
Red-Ox, AWWA 2580, (mV)	+669	+715	+732	+686
Total Salts, AWWA 2540, (mg/kg)	659	223	157	1016
Resistivity, ASTM G 57, (ohm-cm)	2231*	7372	4462**	1891***

* *WB-11 combined with WB-5*
** *WB-16 combined with WB-7*
*** *WB-18 combined with WB-3*

Analyzed By: Trisha Campo
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: N1175384
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Client
Duke Energy

Project
Duke Energy C350 Pipeline

Sample Submitted By: Terracon (N1) **Date Received:** 1/5/2018 **Lab No.: 18-0043**

Results of Corrosion Analysis

Lab Number	10677 & 10678	10685 & 10686	9202 & 9203	4 & 5
Sample Number	S-4 & S-5	S-3 & S-4	S-4 & S-5	S-1
Sample Location	WB-20	WB-22	WB-24	4.5-7.5
Sample Depth (ft.)	4.5 & 6.0	4.0 & 5.5	4.5 & 6.0	
pH Analysis, AWWA 4500 H	7.40	7.07	7.20	8.02
Water Soluble Sulfate (SO4), ASTM C 1580 (percent %)	0.01	0.01	0.01	50
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	75	58	68	857
Red-Ox, AWWA 2580, (mV)	+700	+700	+702	+714
Total Salts, AWWA 2540, (mg/kg)	221	749	709	125
Resistivity, ASTM G 57, (ohm-cm)	3346*	1552**	1552**	1649

* *WB-20 combined with WB-2*
** *WB-22 combined with WB-24*

Analyzed By: Trisha Campo
Chemist

CHEMICAL LABORATORY TEST REPORT

Project Number: N1175384
Service Date: 01/10/18
Report Date: 01/19/18
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client
Duke Energy

Project
Duke Energy C350 Pipeline

Sample Submitted By: Terracon (N1) **Date Received:** 1/5/2018 **Lab No.: 18-0043**

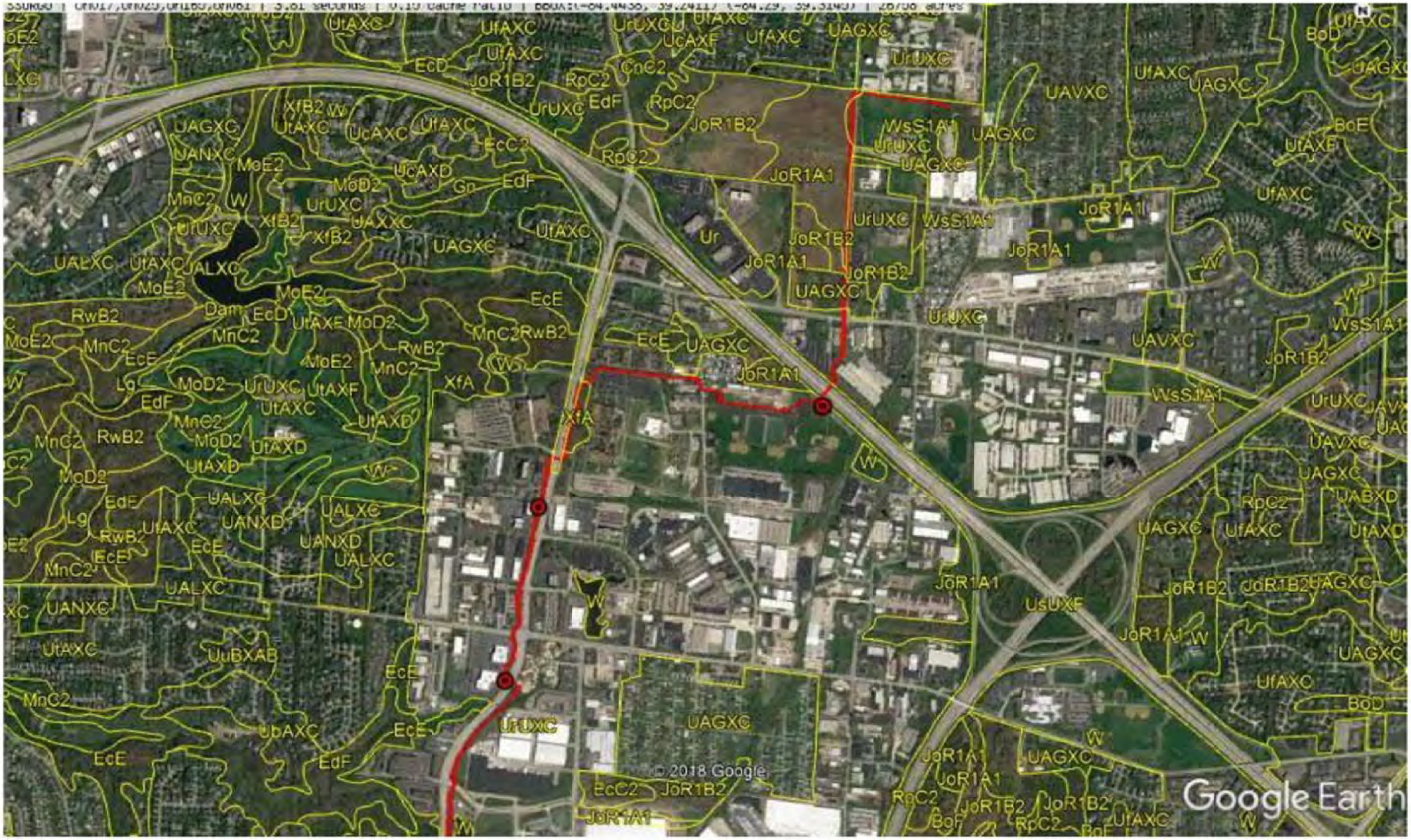
Results of Corrosion Analysis

Lab Number	10677 & 10678	10685 & 10686	9202 & 9203
Sample Number	S-4 & S-5	S-3 & S-4	S-4 & S-5
Sample Location	WB-20	WB-22	WB-24
Sample Depth (ft.)	4.5 & 6.0	4.0 & 5.5	4.5 & 6.0
pH Analysis, AWWA 4500 H	7.40	7.07	7.20
Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	121	47	117
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	75	58	68
Red-Ox, AWWA 2580, (mV)	+700	+700	+702
Total Salts, AWWA 2540, (mg/kg)	221	749	709
Resistivity, ASTM G 57, (ohm-cm)	3346*	1552**	1552**

* *WB-20 combined with WB-2*
** *WB-22 combined with WB-24*

Analyzed By: Trisha Campo
Chemist

USDA SOIL SURVEY



Source: Google Earth Pro

Project Manager: CMD	Project No. N1175384	Terracon Consulting Engineers & Scientists	USDA Soil Survey	Exhibit
Drawn by: MPH	Scale: NOT TO SCALE	611 Lunken Park Drive, Cincinnati, Ohio 45226	Duke Energy	
Checked by:	File Name: SoilMapA	PH. (513) 321-5816 FAX. (513) 321-0294	C350-Central Corridor Pipeline	
Approved by:	Date: 5/24/2018		Hamilton County, Ohio	

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Source: Google Earth Pro

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: CMD	Project No. N1175384
Drawn by: MPH	Scale: NOT TO SCALE
Checked by:	File Name: SoilMapB
Approved by:	Date: 5/24/2018

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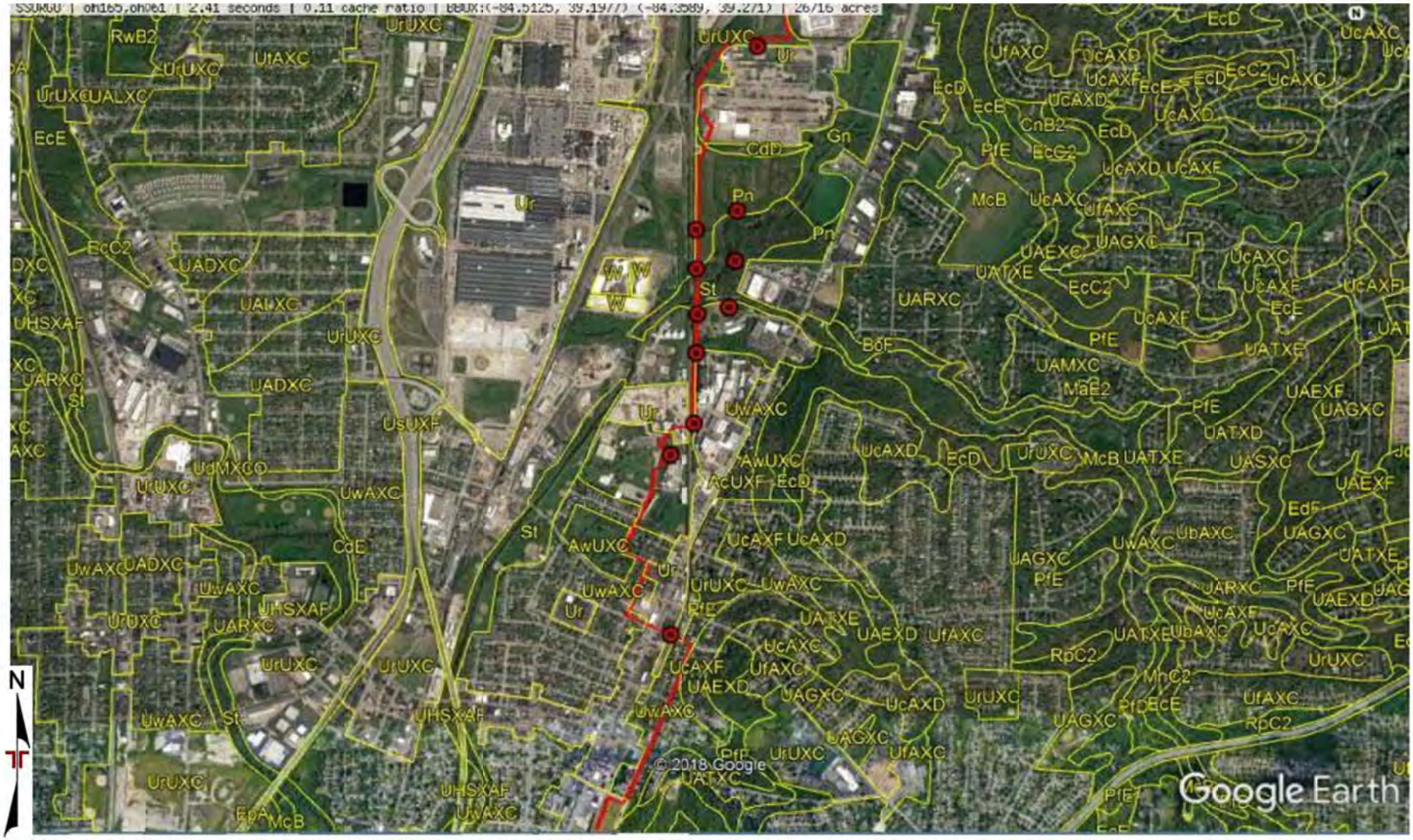
USDA Soil Survey

Duke Energy

C350-Central Corridor Pipeline

Hamilton County, Ohio

Exhibit



Source: Google Earth Pro

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: CMD	Project No. N1175384
Drawn by: MPH	Scale: NOT TO SCALE
Checked by:	File Name: SoilMapC
Approved by:	Date: 5/24/2018

Terracon
Consulting Engineers & Scientists
611 Lunken Park Drive Cincinnati, Ohio 45226
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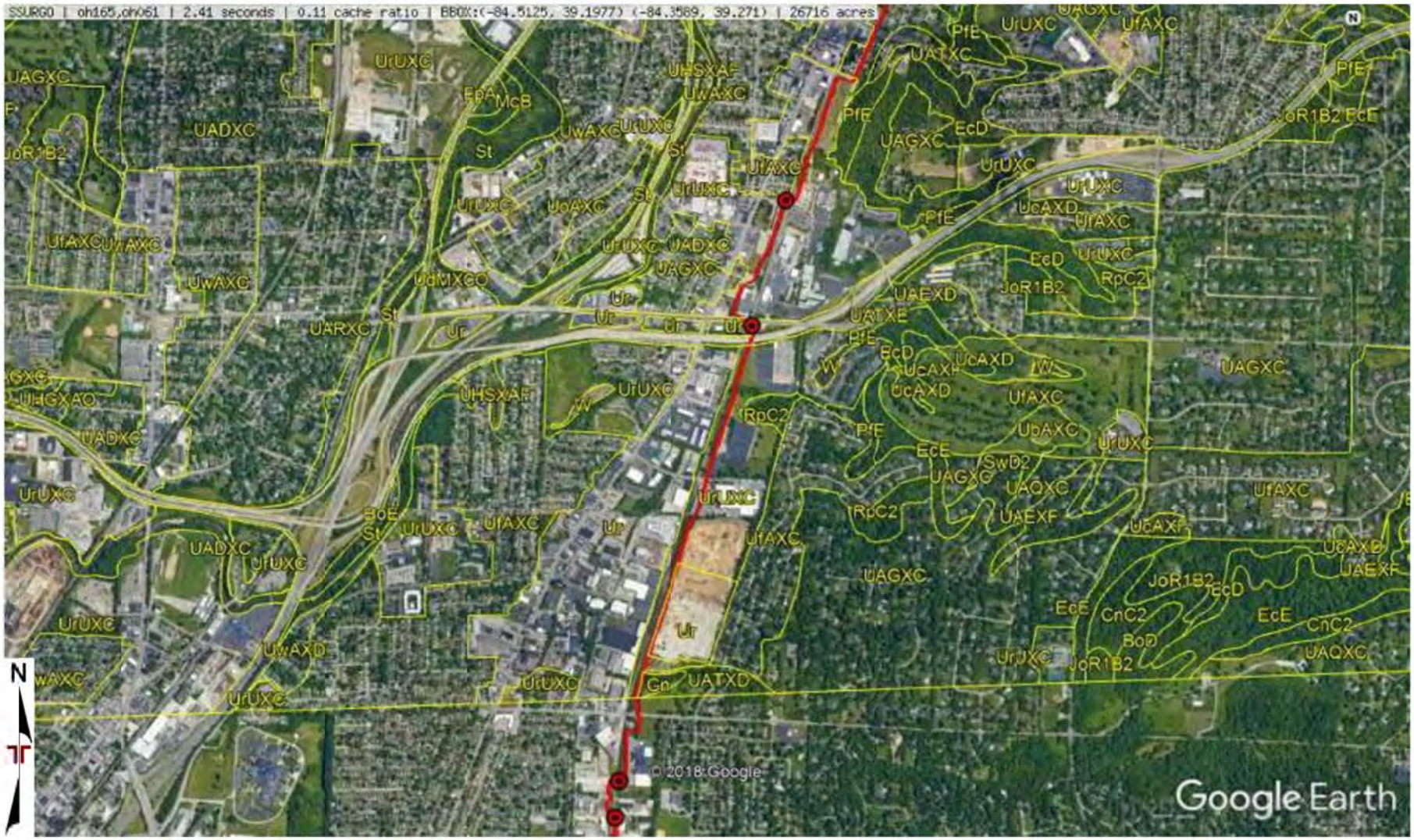
USDA Soil Survey

Duke Energy
C350-Central Corridor Pipeline
Hamilton County, Ohio

Exhibit



Source: Google Earth Pro

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: CMD	Project No. N1175384
Drawn by: MPH	Scale: NOT TO SCALE
Checked by:	File Name: SoilMapD
Approved by:	Date: 5/24/2018

Terracon
Consulting Engineers & Scientists
611 Lunken Park Drive Cincinnati, Ohio 45226
PH. (513) 321-5816 FAX. (513) 321-0294

USDA Soil Survey

Duke Energy
C350-Central Corridor Pipeline
Hamilton County, Ohio

Exhibit

Source: Google Earth Pro

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: CMD	Project No. N1175384
Drawn by: MPH	Scale: NOT TO SCALE
Checked by:	File Name: SoilMapE
Approved by:	Date: 5/24/2018

Terracon
Consulting Engineers & Scientists
611 Lunken Park Drive Cincinnati, Ohio 45226
PH. (513) 321-5816 FAX. (513) 321-0294

USDA Soil Survey

Duke Energy
C350-Central Corridor Pipeline
Hamilton County, Ohio

Exhibit

SUPPORTING INFORMATION

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Central Corridor Pipeline C350 ■ Cincinnati, Ohio

6/22/2018 ■ Terracon Project No. N1175384

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
Standard Penetration Test	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (tsf)	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12
GRAIN SIZE TERMINOLOGY		**PLASTICITY DESCRIPTION**	
Major Component of Sample	Particle Size	Term	Plasticity Index
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

UNIFIED SOIL CLASSIFICATION SYSTEM

C350 Central Corridor Pipeline Expansion ■ Cincinnati, Hamilton County, Ohio

June 22, 2018 ■ Terracon Project No. N1175384

Terracon GeoReport

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc$ or $Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay [K, L, M, N] / Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay [K, L, M, P] / Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

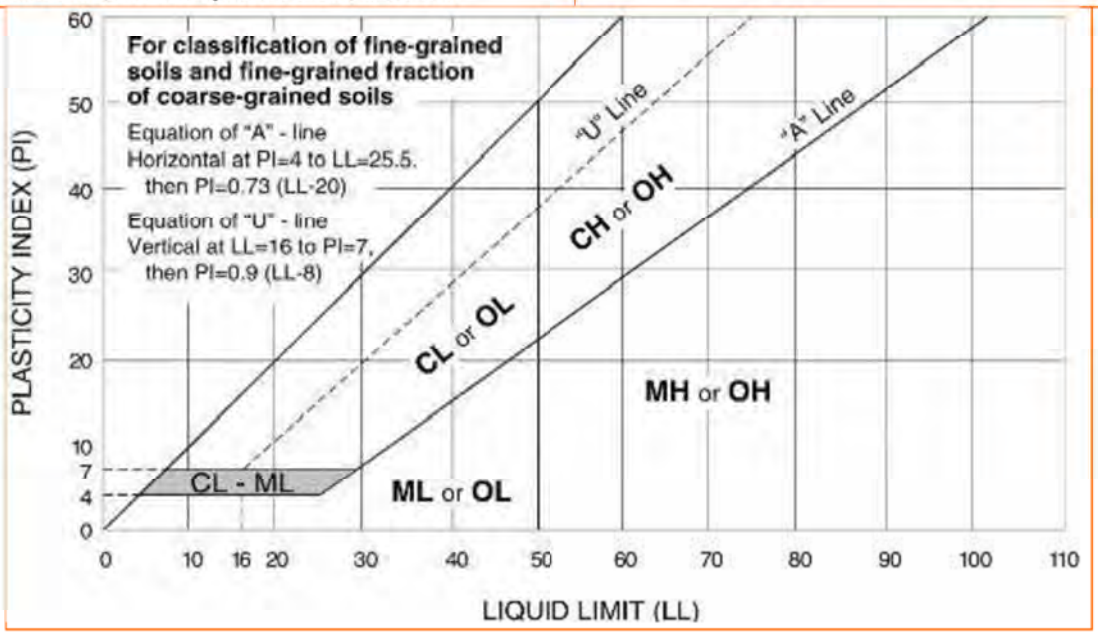
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



DESCRIPTION OF ROCK PROPERTIES

C350 Central Corridor Pipeline Expansion ■ Cincinnati, Hamilton County, Ohio

June 22, 2018 ■ Terracon Project No. N1175384

Terracon GeoReport

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi (MPa)**
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	**Medium**	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	**Thick**	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	**Massive**	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009 Technical Manual for Design and Construction of Road Tunnels – Civil Elements

PHOTOGRAPHS OF SITE CONDITIONS

Photo 1: WB-1 Before

Photo 2: WB-1 After

Photo 3: WB-1A Before

Photo 4: WB-1A After

Photo 5: WB-2 Before

Photo 6: WB-2 After

Photo 7: WB-2A Before

Photo 8: WB-2A After

Photo 9: WB-3 Before

Photo 10: WB-3 After

Photo 11: WB-3A Before

Photo 12: WB-3A After

Photo 13: WB-4 Before

Photo 14: WB-4 After

Photo 15: WB-5 Before

Photo 16: WB-5 After

Photo 17: WB-7 Before

Photo 18: WB-7 After

Photo 19: WB-8 Before

Photo 20: WB-8 After

Photo 21: WB-9 Before

Photo 22: WB-9 After

Photo 23: WB-10 Before

Photo 24: WB-10 After

Photo 25: WB-11 Before

Photo 26: WB-11 After

Photo 27: WB-12 Before

Photo 28: WB-12 After

Photo 29: WB-13 Before

Photo 30: WB-13 After

Photo 31: WB-14 Before

Photo 32: WB-14 After

Photo 33: WB-15 Before

Photo 34: WB-15 After

Photo 35: WB-16 Before

Photo 36: WB-16 After

Photo 37: WB-18 Before

Photo 38: WB-18 After

Photo 39: WB-19 Before

Photo 40: WB-19 After

Photo 41: WB-20 Before

Photo 42: WB-20 After

Photo 43: WB-22 Before

Photo 44: WB-22 After

Photo 45: WB-24 Before

Photo 46: WB-24 After

Photo 47: E-101 Before

Photo 48: E-101 After

Photo 49: E-102 Before

Photo 50: E-102 After

Photo 51: E-103 Before

Photo 52: E-103 After

Photo 53: E-104 Before

Photo 54: E-104 After

Photo 55: E-105 Before

Photo 56: E-105 After

Photo 57: E-106 Before

Photo 58: E-106 After

Photo 59: E-107 Before

Photo 60: E-107 After

Photo 61: E-108 Before

Photo 62: E-108 After

Photo 63: E-109 Before

Photo 64: E-109 After

Photo 65: E-110 Before

Photo 66: E-110 After

Photo 67: E-111 Before

Photo 68: E-111 After

Photo 69: E-114 Before

Photo 70: E-114 After