SITE INFORMATION FOR BIDDERS REPORT

MEDARD RESERVOIR TOE DRAIN REPLACEMENT

B&V PROJECT NO. 410374

PREPARED FOR

Southwest Florida Water Management District (SWFWMD)

5 NOVEMBER 2021

Written by:	**Abhijeet Chordia**	**<u>November 5, 2021</u>** **Date**
Professional Engineer:	**Suppakit Chomtid, Ph.D., P.E.**	**<u>November 5, 2021</u>** **Date**
	License No.	
Approved by:	**Jeffrey A. Beriswill, P.E.**	**<u>November 5, 2021</u>** **Date**

`

Table of Contents

List of Tables

List of Figures

List of Appendices

1.0 INTRODUCTION

Black & Veatch was retained by the Southwest Florida Water Management District (SWFWMD) under Task Work Assignment (TWA) 21TW0003649 to evaluate the existing seepage and stability conditions and to determine alternative design solutions to mitigate elevated piezometric water elevations (PWE's) at the downstream toe of the Edward Medard Reservoir in the vicinity of the southwest embankment between Station (STA.) 11+00 through STA. 15+50 and STA. 16+00 through STA. 20+00. (See **Figure 1**).

Black & Veatch presents this Site Information for Bidders Report in general accordance with Task Order 21TW0003742. The purpose of the report is to provide potential construction contractors with information relating to the project description, site history, site investigations, subsurface conditions, and estimated soil engineering properties. Further information relating to the construction scope of work and details is provided on the draft construction drawings provided under separate cover.

1.1 Project Information

Based on the results of the Site Investigation and Design Evaluation Report, completed under TWA No. 21TW0003649, the SWFWMD has determined that the existing toe drain system on the northside and southside of spillway will be replaced in order to increase the toe drain efficiency. Existing toe drain system comprises of 6-inch to 12-inch perforated clay and PVC pipes connected at various manholes.

Proposed construction items to improve the toe drain efficiency for the southwest embankment of Medard Reservoir include:

- <u>Replacement Toe Drain system on northside of the spillway:</u> A 12-inch HDPE perforated pipe connecting MH-6 to MH-2. This proposed pipe will tie-in with existing toe drain at MH-6 (coming from MH-8). At MH-2, the proposed toe drain pipe will connect to the existing 12-inch perforated PVC pipe flowing to the north drain outlet.
- <u>Replacement Toe Drain system on southside of the spillway:</u> A 12-inch HDPE perforated pipe connecting MH-9 to MH-1 and from MH-1 to the south drain outlet. This proposed pipe will replace the existing toe drain system on the southside of the spillway entirely.
- <u>West Drainage Ditch:</u> The existing toe swale/ ditch to the west of the toe approximately between STA. 16+50 and STA. 19+50 will be regraded, and a filter blanket of No. 57 stone over non-woven geotextile will be installed.
- <u>Pressure Relief Wells:</u> In order to control the excessive porewater pressures within he foundation soils use of pressure relief well is recommended. Pressure relief well be spaced at approximately 20 feet apart. Relief wells will consist of a 4-inch diameter (SCH. 40 PVC) pipe with 0.01-inch slot surrounded by sand filter (FDOT Filter Sand) and sealed with bentonite at top. Water from the relief wells will be collected in the proposed 12-inch gravity fed perforated HDPE pipe discussed above. Pipe bedding fill will include #57 stone wrapped in a filter sand blanket.

1.2 Site Description

The Edward Medard Park & Reservoir (Park & Reservoir) is in east-central Hillsborough County, Florida, 15 miles east of Tampa. The Park & Reservoir lies south of State Highway 60 in portions of Sections 25, and 36 of Township 29 South, Range 21 East and Section 30, Township 29 South, Range 22 East, and is bordered on the west by Turkey Creek Road. The property encompasses 1,287 acres and can be divided into 2 components: Medard Park and Medard Reservoir. Land uses surrounding the Park & Reservoir include agriculture, old mined lands, and rural residential areas.

Most of the lands comprising the Park & Reservoir were donated to SWFWMD by the American Cyanamid Company (ACC) in 1969. Approximate of 1,160 acres of site were mined for phosphate ore between 1963 and 1969 by ACC, who had approached SWFWMD to propose the future land donation prior to initiating mining operations on the current reservoir site. SWFWMD determined that the proposal was consistent with water management plans for the Alafia River Basin and agreed to cooperatively develop the reservoir for flood control, water conservation, and public recreation.

Originally the Park & Reservoir site was called Pleasant Grove Park and Reservoir, although some historic documents list the name of the Park & Reservoir site as Lake Sucarnoochee. The Park & Reservoir site was renamed in 1977 in honor of a District governing board member, Mr. Edward Medard, who was instrumental in initiating the project (SWFWMD, 1991).

The Reservoir portion (Medard Reservoir) encompasses approximately 770 acres of phosphate mined land and consists of 4 major components:

- Reservoir
- Earthen Embankment
- Principal Spillway
- Emergency Spillway

The earthen dam that impounds the Little Alafia River is approximately 6,000 feet in length. The embankment extends along the western and southern sides of reservoir. The principal spillway is located at the southwestern corner of the reservoir whereas the emergency spillway is along the north portion of the embankment.

The dam was constructed in 1970 to elevation (EL.) 67.5 ft. NGVD[1]. Based on the Pleasant Grove Reservoir Alafia Basin - Plan and Details by Gee & Jenson Consulting Engineers, Inc. in 1970, the original ground surface elevation in the vicinity of the principal spillway ranged from EL. 40 ft. to EL 43 ft. The original ground surface to the west and northwest of the principal spillway ranged from EL. 40 ft. to EL. 50 ft. whereas the original ground surface to the southeast and east of the principal spillway ranged from EL. 40 ft. to EL. 70 ft. The principal spillway was constructed approximately 100 - 150 feet southeast of the original stream bed of the Little Alafia River, which was at approximate EL. 40 ft.

The original embankment cross section consisted of an earthen embankment with a crest width of 15 feet and slope of 4 horizontal to 1 vertical (4H:1V) downstream and 2H:1V upstream. The initial design crest elevation was set at EL. 67.5 ft. The initial design also included a toe drain system that consisted of perforated Orangeburg pipe. The original drain system also had a series of drain pipes that paralleled the original toe and were connected to an open toe ditch using 4-inch diameter lateral pipes placed about 20 feet apart. This drain system was located between the current dam STA. 12+00 to STA. 15+50 and STA. 14+00 to STA. 22+00 south concrete head wall and from north concrete head wall extending to STA. STA 24+00.

---

[1] All elevations in this report are referenced to the National Geodetic Vertical Datum of 1929 (NGVD-1929) unless otherwise stated.

In 1973, the underdrain system was modified and expanded. The original toe ditch was modified and replaced with new 8 to 12-inch diameter pipes. The new drain pipes were encased in a gravel fill. The original 4-inch diameter Orangeburg drain pipes were connected to the new drain using solid lateral pipes. This drain was installed between STA. 12+00 to the south concrete headwall and the north concrete headwall to STA 22+00. The spillway underdrain pipes (20 to 30-feet long) were installed and connected to the new toe drain system.

In 1976, the reservoir was emptied due to an undermining condition in the vicinity of principal spillway, the existing metal outfall pipes and principal spillway structure were replaced with a concrete structure and outfall pipes. The new structure has a concrete outfall and two rows of pressure relief drains near its concrete headwall. The pressure relief drains were designed to collect excessive seepage along the new concrete outfall and discharge through the principal spillway concrete headwall.

The construction work also included an emergency spillway improvement, a modified embankment crest to EL. 70.0 ft. and an installed parallel toe drain (about 40 to 50 feet upslope of the 1973 toe drain).

The upstream slope was protected with sand-cement riprap from EL 55.0 ft to EL 66.5 ft and grassed on the upper potion to the crest elevation. The downstream slope was grassed along the entire slope.

The new toe drain system was installed in 1976 and consisted of a 6-inch PVC perforated pipe that was connected to the 1973 toe drain at MH-2 just north of the north concrete headwall. The new toe drain was installed from STA. 16+80 through STA. 28+40. The new toe drain was built with several vertical relief wells between STA. 17+00 and STA. 22+00. These vertical relief well were installed to elevations ranging from 30 to 40 ft.

In 2009, the reservoir was drained for the upstream slope modification. The upstream slope was armored with articulating concrete block revetment system underlain by nonwoven geotextile and topped with a layer of gravel between STA. 3+40 and STA. 36+80.

2.0 SITE INVESTIGATIONS

2.1 Hillsborough County Soil Survey

Soils data from the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) Soil Survey of Hillsborough County, Florida, were reviewed as a part of this project. The mapped soil unit in the immediate vicinity of the Medard Reservoir earthen embankment STA. 11+00 and STA. 20+00 was identified as 6 primary mapping unit. The mapped soil units within the project area are presented in **Table 1**.

Table 1: Summary of Hillsborough County Soils Survey

Map Unit Symbol	Map Unit Name	USDA Seasonal High Groundwater Table Depth (feet)	Location of Map Unit Relating to Earthen Embankment
43	Quartzipsamments, nearly level	0.0 – 5.0	Footprint of Embankment & Along Downstream Toe (STA. 16+00 and STA. 19+00)
46	St. Johns fine sand	0.0 – 1.0	Along Downstream Toe (STA. 13+00 and STA. 15+50)
53	Tavares-Millhopper complex, 0 to 5 percent slopes	3.5 – 6.0	Along Downstream Toe (STA. 11+00 and STA. 13+00)
60	Winder fine sand, frequently flooded	0.0 – 5.0	Along Downstream Toe (STA. 13+00 and STA. 15+50)
61	Zolfo fine sand, 0 to 2 percent slopes	1.5 – 3.5	Along Downstream Toe (East of STA. 11+00)
99	Water	Flooded	Reservoir Area

Based on the historical aerial photography and soil survey information in the vicinity of STA. 11+00 and STA. 20+00, it is Black & Veatch's opinion that the USDA-NRCS soil units within the footprint of earthen embankment between STA 16+00 and STA. 19+00 of the Medard Reservoir consist of Quartzipsamments (map unit 43)**.** This is a nearly level, sandy soil resulting from phosphate mining operations. The Quartzipsamments are manmade accumulations of sand as a by-product of phosphate mining operations and are placed hydraulically.

The minor component of Quartzipsamments is Haplaquents, clayey. The Haplaquents were also produced from phosphate mining operations. These soils contain about 88 percent clay, 8 percent silt and 4 percent sand and are commonly termed, "waste phosphatic clay." It is typical to encounter Haplaquents, clayey interbed and/or interface with Quartzipsamments.

Borders between mapping units on the USDA-NRCS Soil Survey Maps are approximate and the transition between soil types may be very gradual. Areas of dissimilar soils can occur within a mapped unit. However, the soil survey provides a good basis for an initial evaluation of shallow soil conditions in the area and can provide an indication of changes that may have occurred due to excavation, mining, filling, and other activities at the site. Please refer to the Hillsborough County Soil Survey provided in **Appendix A** for detailed descriptions of the soil units and their approximate locations within the project site.

2.2 Geophysical Investigation

To develop a better understanding of the physical conditions of the foundation soils along the downstream slope between STA. 16+00 and STA. 22+00 and in the vicinity of the principal spillway, a geophysical investigation was conducted using electrical resistivity imaging (ERI) on July 8, 9, and 12, 2021. The ERI Survey was performed by GeoView, Inc. (GeoView) on behalf of Black & Veatch as a part of this study. The ERI survey was conducted using the Advanced Geosciences, Inc. Sting R8 automatic electrode resistivity system. Five ERI transects were performed using up to 112 electrodes with a spacing of 7.5 ft. The ERI data was analyzed using EarthImager 2D, a computer inversion program, which provides two-dimensional vertical cross-sectional resistivity model (pseudo-section) of the subsurface. As part of the ERI analysis, the modeling results were corrected for changes in elevation along each of the transects. The purpose of the ERI Survey was to help characterize near-surface geological conditions and to identify subsurface features that may be associated with internal erosion and/or paleo-karst activity. GeoView's final geophysical investigation report is included in **Appendix B**.

2.3 CPT Soundings

Ten Cone Penetration Test (CPT) soundings with pore pressure measurements (CPT-1 through CPT-10) were performed along the downstream slope and downstream toe of the earthen embankment between STA. 11+00 and STA. 20+00. Pore pressure dissipation tests were completed at three of the CPT sounding locations. The tests were performed at an approximate offset of 2 - 3 feet of CPT-1, CPT-2 and CPT-5. The CPT soundings were conducted to a maximum depth of 51 feet below ground surface (bgs) to provide a rapid determination of soil strength and relative density/consistency. The CPT soundings were performed between September 22 and September 23, 2021 by Amdrill, Inc. (Amdrill) with oversight by a Black & Veatch representative. The testing was performed in general accordance to ASTM D 5778. Locations of the CPT soundings are presented on **Figure 2**. The summary of CPT soundings is presented in **Table 2**. Coordinates of the borings were collected during the field investigation using hand-held GPS system. The existing ground elevations were estimated based on Hillsborough County Map Viewer.

Table 2: Survey Summary of CPT Soundings

Boring ID	Northing (ft)	Easting (ft)	Approx. Ground Elevation (ft NGVD-29)	Termination Depth(ft)
CPT-1/1A	1300218.9	601428.5	44.0	23.5
CPT-2/2A	1300104.3	601483.6	42.0	32.5
CPT-3	1299937.4	601482.0	39.0	30.0
CPT-4	1299944.8	601612.2	42.0	45.5
CPT-5/5A	1299821.1	601730.9	46.5	42.0
CPT-6	1299999.4	601558.7	41.0	26.0
CPT-7	1300086.8	601470.0	40.0	29.0

Boring ID	Northing (ft)	Easting (ft)	Approx. Ground Elevation (ft NGVD-29)	Termination Depth(ft)
CPT-8/8A	1300188.6	601500.5	50.0	27.5
CPT-9	1300182.1	601485.9	48.0	57.0
CPT-10	1299999.4	601558.7	61.0	47.0

Note that the northing and easting coordinates along with the ground elevations are approximate

The CPT is used to determine the geotechnical engineering properties of soils and delineating soil stratigraphy. It is a quasi-static penetration test, meaning that the cone is pushed at a slow rate rather than driven with a hammer or rotary drilling. In the CPT, a 1.4-inch diameter piezocone was continuously pushed and the relevant subsurface data was recorded at 2-cm intervals. Cone tip resistance, pore water pressure on the shaft between the cone and the friction sleeve, and sleeve friction were continuously recorded during each push. The “tip resistance” is the force required to push the tip of the cone and the “sleeve friction” is the force required to push the outer sleeve of the cone assembly through the soil. The “friction ratio” is the ratio between sleeve friction and tip resistance, measured as a percentage. Soil type and soil properties can be inferred from these measurements. The CPT sounding profiles are provided in **Appendix C**.

2.4 SPT Borings

Four SPT borings were completed by Amdrill with oversight by a Black & Veatch representative on September 29 and September 30, 2021. The borings were advanced along the downstream slope and downstream toe of the earthen embankment between STA. 11+00 and STA. 20+00. A summary of the SPT borings is presented in **Table 3** and the boring locations are shown on **Figure 2**. Coordinates and ground surface elevations of the borings were collected during the field investigation using a hand-held GPS device. The existing ground elevation were estimated based on Hillsborough County GIS Map Viewer.

Table 3: Summary of SPT Borings

Boring ID	Northing (ft)	Easting (ft)	Approx. Ground Elevation (ft)	Termination Depth(ft)
B-1	1299656.5	601870.2	56	38.9
B-2	1300101.3	601485.5	42	39.4
B-3	1300209.8	601424.0	42	38.5
B-4	1300215.7	601376.2	42	40.0

Note that the northing and easting coordinates along with the ground elevations are approximate.

The SPT borings were advanced to depths up to 40 feet bgs. The SPT borings were drilled using a compact track-mounted drill rig, with a safety hammer. The borings were drilled using mud rotary methods, and soil samples were obtained at various intervals in general accordance with ASTM D 1586. Groundwater measurements were made during the drilling in each soil boring. The borings were sealed to the ground surface with cement-bentonite grout upon their completion.

The borings were logged in the field using typical logging procedures adapted for this project by the project team in order to have consistent descriptions of subsurface strata in accordance with the Unified Soil Classification System (USCS). Final boring logs were prepared by Black & Veatch based on a professional geotechnical engineer's review of the field boring logs, split spoon samples, soil index properties and laboratory test results. Detailed boring logs are provided in **Appendix C**.

2.5 Laboratory Testing

Representative samples from the borings were selected by Black & Veatch based on a professional geotechnical engineer's review of soil samples and field boring logs for index property tests. A limited soil laboratory program including moisture content (ASTM D2216), percent passing #200 sieve (ASTM D1140) and Atterberg limits (ASTM D4318) were performed by Atlas Technical Consultant LLC (Atlas). Detailed laboratory test results are included in **Appendix C**. A summary of the laboratory test results is provided in **Table 4**.

Table 4: Summary of Laboratory Test Results

Boring ID	Sample Depth (ft)	Moisture Content (%)	% Finer #200 Sieve	Atterberg Limits (%)		
				LL	PL	PI
B-1	2.0 – 4.0	15.2	18.8	-	-	-
B-1	6.0 – 8.0	31.3	65.3	76	18	58
B-1	12.0 – 14.0	57.2	85.6	-	-	-
B-1	18.0 – 20.0	21.7	17.0	-	-	-
B-2	0.0 – 2.0	13.6	12.5	-	-	-
B-2	10.0 – 12.0	28.3	23.8	-	-	-
B-2	14.0 – 16.0	38.3	30.3	-	-	-
B-2	16.0 – 18.0	39.9	20.9	86	44	42
B-2	18.0 – 20.0	45.0	13.5	-	-	-
B-3	2.0 – 4.0	20.4	10.5	-	-	-
B-3	4.0 – 6.0	19.5	2.2	-	-	-
B-3	16.0 – 18.0	51.9	38.6	140	62	78
B-4	2.0 – 4.0	16.7	19.9	-	-	-
B-4	8.0 – 10.0	23.1	23.7	-	-	-
B-4	14.0 – 16.0	28.2	13.9	-	-	-

LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, NP: Non-Plastic

2.6 Mechanical Auger Borings

In order to determine the type of filter sand required for the project, Black & Veatch sub-contracted Tierra, Inc. to perform five mechanical auger borings to obtain bulk samples of base soils. Boring location plan, boring logs and laboratory test results for these mechanical auger borings are presented in **Appendix D**.

3.0 SUBSURFACE CONDITIONS

3.1 Area Geology

The Medard Reservoir is located near the eastern boundary of Hillsborough County and the western boundary of Polk County, just south of the town of Plant City, Florida. Hillsborough County is located in the Land O' Lakes Plain (Plain), a geomorphic feature that occurs from southwestern Hernando County, southward to Pinellas and Hillsborough Counties. The occurrence of karst features within the Plain varies from abundant and closely spaced to scattered. An overburden of undifferentiated Quaternary siliciclastic sediments and Quaternary Beach Ridge and Dune features cover much of the karst Plain with the area varying from poorly drained to well drained soils, with many springs present. (Green et. al, 2012) The northern half of the Plain is underlain by the Lower Oligocene Suwannee Limestone or the Upper Eocene Ocala Limestone where the Arcadia Formation and Suwannee Limestone are missing due to erosion. The Upper Oligocene to Lower Miocene Tampa Member of the Arcadia Formation, Hawthorn Group is present farther south and overlays the older Oligocene Suwannee.

The surficial sediments in the project site consist of Undifferentiated Quaternary/Tertiary aged sediments and dunes of the Cypresshead Formation, ranging in thickness from 0 to 50 feet. Beneath the surficial sediments lie the phosphatic sands, clays, and carbonates of the Hawthorn Group, Peace River Formation, including the Bone Valley Member which are Miocene/Pliocene in age. Beneath the Peace River Formation lie the limestones, dolomites, phosphatic and clayey limestones of the Hawthorne Group, Arcadia Formation, Tampa Member, and Suwannee Limestone, which are Miocene/Oligocene in age. These limestones and dolomitic limestones are up to more than 350 feet in thickness. The underlying Eocene age carbonate rocks are the Ocala Limestone and Avon Park Formation, consisting of limestone and dolomitic limestone. The Ocala and Avon Park limestones and dolomitic limestones begin approximately at -350 feet elevation (NGVD) and are in excess of 600 feet in thickness (USGS, 2021).

Western Polk County is located in the Polk Upland, a geologic feature that occurs within the majority of Polk County, and is bounded by the Gulf Coastal Lowlands to the west, the Western Valley to the north, the DeSoto Plain to the south, and the Lake Wales Ridge to the east (Campbell, 1986). The Polk Upland is characterized by surface and near-surface sediments consisting of quartz sand, clay, phosphorite, limestone, and dolomite, ranging in age from late Eocene to Holocene. The first recognizable lithostratigraphic unit occurring below these near-surface sediments is the Hawthorn Group, Arcadia Formation, Tampa Member, of the Miocene/Oligocene age. The Tampa Member can reach thicknesses of up to 50 feet, and is composed of limestone with subordinate dolostone, sand, and clay. Underlying the Hawthorn Group, Arcadia Formation, Tampa Member is the Suwannee Limestone of the Oligocene age. The Suwannee Limestone can reach thicknesses up to 150 feet, and is characterized by being white, cream, or tan, variably textures, fossiliferous, poorly to well indurated and variably recrystallized, with localized dolomitized or silicified zones. The Suwannee Limestone rests on top of the Ocala Group, which consists of three limestone formations, which in ascending order are the Inglis, Williston, and Crystal River formations. The limestone formations of the Ocala Group reach thicknesses up to 150 feet, and primarily consist of white, to cream, to dark brown, granular to chalky, fossiliferous, poorly to well indurated limestone and dolomite, and is known for its very high permeability (USGS, 2021). The regional geology of both Hillsborough County and Polk County in the general vicinity of the Edward Medard Reservoir is presented below in **Table 5**.

Table 5: Generalized Stratigraphic Units of Hillsborough and Polk Counties

Geologic Age	Stratigraphic Unit	General Lithologic Character
Holocene (Recent)	Holocene Sediments	Quartz sands, carbonate sands and muds, and organics.
Pleistocene/ Holocene	Undifferentiated Sediments	Fine to coarse sands with silts, clay, and marl.
Pleistocene/ Pliocene	Reworked Cypresshead Sediments	Fine to coarse grained quartz sands with gravel and clay.
	Shelly Sediments	Fossiliferous quartz sands and carbonates.
	Dunes	Fine to medium grained quartz sand.
Pliocene	Cypresshead Formation	Very fine to very coarse grained clean to clayey sands.
Miocene/ Pliocene	Hawthorn Group, Peace River Formation, Bone Valley Member	Phosphate grains in a mixture of quartz sand, silt, and clay.
	Hawthorn Group, Peace River Formation	Interbedded phosphatic sands, clays, and carbonates.
Miocene/ Oligocene	Hawthorn Group, Arcadia Formation, Tampa Member	Limestone with subordinate dolostone, sand, and clay.
Oligocene	Suwannee Limestone	Fossiliferous, vuggy to moldic limestone with finely to coarsely crystalline dolostone.
Eocene	Ocala and Avon Park Limestone	Porous, marine limestone, soft, granular to chalky, highly fossiliferous.

3.2 Subsurface Conditions

The subsurface conditions underlying the southwestern earthen embankment of Medard Reservoir between STA. 11+00 and STA. 22+00 were characterized using the in-situ data collected from the ERI Survey and the geotechnical investigation (CPTU Soundings and SPT Borings). The pertinent subsurface conditions underlying the southwestern earthen embankment are presented in Sections 3.2.1 and Section 3.2.2.

3.2.1 Subsurface Conditions – ERI Survey

Three ERI Survey transects (ERI Transect 1 through ERI Transect 3) were performed along the downstream slope of the southwestern earthen embankment between STA. 14+00 and STA. 22+00. The other two ERI Survey transects (ERI Transect 4 and REI Transect 5) were conducted along the north and south sides of the concrete conduit of the principal spillway at an approximate offset distance of 65 feet and 75 feet, respectively. The pertinent information of the ERI Survey are provided below:

- The ERI Transects indicate the presence of high to moderate resistivity (red to green colors on ERI transects) near surface soils to a depth range of 5 to -5 ft. This high to moderate resistivity layer is likely associated with a surficial layer of sandy to silty sediments.
- The surficial sandy to silty layer is underlain by an approximately 20 to 45 ft- thick low-resistivity layer (blue color) which extends to an estimated elevation range of -25 to -40 ft. This low resistivity layer is most likely the clayey sediments associated with the upper member of the Hawthorne Group.
- The upper member of the Hawthorne Group is underlain by a moderate resistivity layer (green), which is underlain by a high resistivity layer in orange to red. Based on the regional geology, this moderate resistivity layer is most likely associated with the weathered limestones of the Tampa Limestone member of the Hawthorne Group. The underlying high-resistivity layer is most likely associated with the more competent limestones of the lower Hawthorne Formation.
- Four ERI anomalies were identified at the project site proximate to the principal spillway area.
- The ERI anomaly GV-1 is observed on both ERI Transects 1 and 4. The anomaly is characterized by the discontinuous or increasing depth of the clayey sediments (upper member of the Hawthorne Group).
- The ERI anomalies GV-2 and GV-3 are associated with the occurrence of high resistivity zones located with the upper member of the Hawthorne Group. These anomalies may be associated with areas of pocket of sandy soils within the clay layer. Alternatively, these anomalies could be associated with naturally occurring (non-karst related) depositional or erosional processes within the Hawthorne Group.
- The ERI anomaly GV-4 is characterized by a localized thinning of the clay layer and associated occurrence of the suspected limestone layer at a more-shallow depth. This anomaly may be associated with discontinuous shallow limestone layer within the Hawthorne Group.

Given the above information, the subsurface conditions underlying the southwestern earthen embankment of Medard Reservoir between STA. 14+00 and STA. 22+00 were characterized based on the resistivity characters and background information of area geology. The subsurface conditions based on the ERI Survey are presented in **Table 6**.

Table 6: Subsurface Conditions based on ERI Survey

~ EL. (ft)	Upper Portion of Downstream Slope (based on ERI Transect 1)							
	STA. 22+00 – STA. 20+00		STA. 20+00 – STA. 16+50		STA. 16+50 – STA. 15+50 (Principal Spillway)		STA. 15+50 – STA. 14+00	
	Materials	Perm. Character	Materials	Perm. Character	Materials	Perm. Character	Materials	Perm. Character
60.0 - 55.0	Sandy to Silty sediments	Moderate to High	Sandy to Silty sediments	Moderate to High	Sandy to Silty sediments	Moderate to High	Sandy to Silty sediments	Moderate to High
55.0 - 50.0	Sandy to Silty sediments	High	Sandy to Silty sediments	High	Silty to Clayey sediments	Moderate to Low	Sandy to Silty sediments	High
50.0 - 45.0	Sandy to Silty sediments	High	Sandy to Silty sediments	High	Sandy to Silty sediments	Moderate to Low	Sandy to Silty sediments	High
45.0 - 40.0	Sandy to Silty sediments	High	Sandy to Silty sediments	High	Sandy to Silty sediments	Moderate to Low	Sandy to Silty sediments	High
40.0 - 35.0	Sandy to Silty sediments	High	Sandy to Silty sediments	High	Interference with Underground Structure		Sandy to Silty sediments	High
35.0 - 30.0	Sandy to Silty sediments	High	Sandy to Silty sediments	High			Sandy to Silty sediments	High
30.0 - 25.0	Sandy to Silty sediments	High	Sandy to Silty sediments	High			Sandy to Silty sediments	High
< 25.0	Calcareous Clay/Weathered Limestone with lenses of Sand	Low to High	Calcareous Clay/Weathered Limestone with lenses of Sand	Low to High			Calcareous Clay/Weathered Limestone with lenses of Sand	Low to High

Table 6 *(continued)*

~ EL. (ft)	Middle Portion of Downstream Slope (based on ERI Transect 2)							
	STA. 22+00 – STA. 20+00		STA. 20+00 – STA. 16+50		STA. 16+50 – STA. 15+50 (Principal Spillway)		STA. 15+50 – STA. 14+00	
	Materials	Perm. Character	Materials	Perm. Character	Materials	Perm. Character	Materials	Perm. Character
60.0 - 55.0	-	-	-	-	-	-	-	-
55.0 - 50.0	-	-	-	-	-	-	-	-
50.0 - 45.0	Sandy to Silty sediments	Moderate to High	Sandy to Silty sediments	Moderate to High	Sandy to Silty sediments	Moderate to High	Sandy to Silty sediments	Moderate to High
45.0 - 40.0	Sandy to Silty sediments	High	Sandy to Silty sediments	Moderate to High	Sandy to Silty sediments	Moderate to Low	Sandy to Silty sediments	High
40.0 - 35.0	Sandy to Silty sediments	High	Sandy to Silty sediments	High			Sandy to Silty sediments	High
35.0 - 30.0	Sandy to Silty sediments	High	Sandy to Silty sediments	High			Sandy to Silty sediments	High
30.0 - 25.0	Sandy to Silty sediments	High	Sandy to Silty sediments	High	Interference with Underground Structure		Sandy to Silty sediments	High
< 25.0	Calcareous Clay/Weathered Limestone with lenses of Sand	Low to High	Calcareous Clay/Weathered Limestone with lenses of Sand	Low to High			Calcareous Clay/Weathered Limestone with lenses of Sand	Low to High

Table 6 *(continued)*

~ EL. (ft)	Lower Portion of Downstream Slope (based on ERI Transect)							
	STA. 22+00 – STA. 20+00		STA. 20+00 – STA. 16+50		STA. 16+50 – STA. 15+50 (Principal Spillway)		STA. 15+50 – STA. 14+00	
	Materials	Perm. Character	Materials	Perm. Character	Materials	Perm. Character	Materials	Perm. Character
60.0 - 55.0	-	-	-	-	-	-	-	-
55.0 - 50.0	-	-	-	-	-	-	-	-
50.0 - 45.0	-	-	-	-	-	-	-	-
45.0 - 40.0	Sandy to Silty sediments	Moderate to High	Sandy to Silty sediments	Moderate to High	Sandy to Silty sediments	Moderate to High	-	-
40.0 - 35.0	Silty to Clayey sediments	Low to Moderate	Sandy to Silty sediments	High	Interference with Underground Structure		-	-
35.0 - 30.0	Silty to Clayey sediments	Low to Moderate	Sandy to Silty sediments	High			-	-
30.0 - 25.0	Calcareous Clay/Weathered Limestone with lenses of Sand	Low to High	Sandy to Silty sediments	Moderate to High			-	-
< 25.0			Calcareous Clay/Weathered Limestone with lenses of Sand	Low to High			-	-

3.2.2 Subsurface Conditions – CPTU Soundings & SPT Borings

CPTU soundings (CPT-1 through CPT-10) and SPT borings (B-1 through B-4) performed along the downstream slope of the southwestern earthen embankment in the vicinity of between STA 11+00 and STA. 22+00 to determine the foundation soil conditions.

3.2.2.1 Pertinent Information from CPTU Soundings

Results for the CPT-1, CPT-2, CPT-3, CPT-6 and CPT-8 typically indicate the materials beneath the ground surface are mixed layers of sand, silty sand, sandy silt and gravelly sand with lenses of clayey silt to silty clay underlain by clayey sediments (upper member of the Hawthorne Group).

CPT-4 was conducted on the south side of headwall of the principal spillway concrete outfall structure near the ERI anomaly GV-3. CPT-4 indicates the mixed layers of sand, silty sand and sandy silt with lenses of clayey silt to silty clay from ground surface elevation (EL. 42 ft) extending to a depth of 18.5 ft. below ground surface, bgs (EL. 23.5 ft) and subsequently underlain by the hard clay (upper member of the Hawthorne Group) extending to a depth of 29 feet bgs (EL. 13 ft). A 5-ft thick of very loose/very soft materials is encountered below the hard clay. A medium dense to very dense sand is indicated below a very loose/very soft materials to a sounding termination depth of 45.5 ft bgs (EL. -3.5 ft).

The foundation soils conditions encountered within CPT-4 are in accordance with the results of the ERI survey. The very loose/very soft zone (anomaly GV-3) can be attributed an area of pocket of very loose sandy and/or very soft clay.

CPT-5 was conducted along the downstream toe in the vicinity of Monitoring Well (MW) 3 at approximate STA. 14+00. CPT-5 indicates the mixed layers of sand, silty sand, sandy silt and gravelly sand with lenses of clayey silt to silty clay from ground surface elevation (EL. 46.5 ft) extending to a depth of 15.5 ft bgs (EL. 31 ft) and subsequently underlain by the stiff to very stiff clay extending to a depth of 18 ft bgs (EL. 28.5 ft).

Below the stiff to very stiff clay in CPT-5, the mixed layers of sand, silty sand, sandy silt and gravelly sand with lenses of clayey silt to silty clay are encountered to a depth of 34.5 ft. bgs (EL. 12.0 ft; expected top of upper member of the Hawthorne Group). The hard clay, upper member of the Hawthorne Group, extends to a sounding termination depth of 42 ft. bgs (EL 4.5 ft).

CPT-7 was conducted along the downstream toe in the vicinity of MW-H (PZ-8) at approximate STA. 18+50. CPT-7 indicates the mixed layers of sand, silty sand, sandy silt and gravelly sand with lenses of clayey silt to silty clay from ground surface elevation (EL. 40 ft) extending to a depth of 15.0 ft. below ground surface, bgs (EL. 25.0 ft) and subsequently underlain by the hard clay (upper member of the Hawthorne Group) extending to a depth of 23 feet bgs (EL. 17 ft). The mixed layers of very loose to very dense sands are indicated below the hard clay materials to a sounding termination depth of 29.0 ft (EL. 11.0 ft).

CPT-9 was conducted in the vicinity of MW-I (PZ-9) behind the headwall of the principal spillway concrete outfall structure at approximate STA. 16+25. CPT-9 indicates a layer of sandy silt to clayey silt from ground surface elevation (EL. 48.0 ft) extending to a depth of 6.0 ft. below ground surface, bgs (EL. 42.0 ft) and subsequently underlain by the stiff to very hard clay with lenses of sand to silty sand/sandy silt materials extending to a depth of 42.5 ft. bgs (EL. 5.5 ft). Below the stiff to very hard clay in CPT-9, the layer of firm sand to sand silty is encountered to a sounding termination depth of 57.0 ft. bgs (EL. -9.0 ft).

CPT-10 was conducted on the upper portion of the downstream slope within ERI anomaly GV-1. CPT-10 indicates the mixed layers of sand, silty sand, sandy silt and gravelly sand from ground surface (EL. 61 ft) to 36.5 ft bgs (EL. 24.5 ft) and subsequently underlain by the hard clay (upper member of the Hawthorne Group) with a lens of fine-grained materials extending to a depth of 45.5 feet bgs (EL. 15.5 ft). Below the hard clay layer, the layer of firm sand is encountered to a sounding termination depth of 47.0 ft. bgs (EL. 14.0 ft).

Based on the above results, the subsurface profiles at the CPTU soundings are in accordance with the results of the ERI survey. No evidence of the revealing and/or migration of soils were encountered within soundings. The CPTU sounding profiles are provided in **Appendix C**.

3.2.2.2 Pertinent Information from SPT Soundings

Results for SPT borings B-1 through B-4 generally indicate the subsurface materials are mixed layers of sand with varying fines contents (SP, SP-SC, SC) underlain by weathered limestone fragments.

Boring B-1 was drilled in the vicinity of monitoring well PZ-10. Lenses of firm to stiff fat clays were encountered between 4 feet to 16 feet bgs, interbedded within clayey sand layers.

In borings B-2, B-3 and B-4 generally; fine-grained sands with traces of silt, were encountered below surficial soils and the thickness of this layer varying between 4 feet to 10 feet. This sand layer was underlain by clayey sand with phosphate granules. Weathered limestone fragments (slightly cemented to cemented) were encountered below the clayey sand stratum. Loss of circulation of the drilling fluid was encountered in borings B-2 and B-3 at 37.5 feet bgs and 28.5 feet bgs respectively.

3.2.2.3 Stratigraphy

The subsurface soil conditions encountered in the CPT Soundings and SPT borings are provided on the boring logs in **Appendix C**. The CPT sounding/SPT boring logs represent our interpretation of the subsurface geotechnical conditions based on the field soil boring logs and visual examination of the samples by a geotechnical engineer and empirical equations. The lines designating the interface between various strata on the CPT sounding/SPT boring logs represent the approximate interface location; the actual transition between strata may be gradual.

In general, the borings encountered nine typical soil strata at the study area:

Compacted Embankment Fill

As a part of this scope of work, soil borings were not performed along the crest of the southwest embankment. Therefore, we referred to previous borings performed by other consultants. Soils below the crest and spreading across the upstream and downstream slopes consisted of embankment fill. These soils primarily consisted of sands with varying fines contents (SP, SM, SP-SM, SP-SC and SC). The relative density of this stratum varied between medium dense to dense. This stratum was encountered to a depth of 10 to 18 feet below the existing grade along the crest of the embankment.

Silty Sand

Surficial soils along the toe of the embankment consist primarily of silty sands. This stratum approximately extends up to a depth of 1 to 4 feet below the existing ground surface. The relative density of this stratum varies between very loose to loose and the soils were generally observed to be moist to wet.

Sand, Gravelly Sand

This soil stratum consists of sand and gravelly sands with relatively high permeability and was encountered in the vicinity of stations 14+00, 17+00 and 19+00. This stratum was encountered below the embankment fill along the crest of slope. The thickness of this stratum varies at each as-built cross section and generally thins out near the toe of slope. The relative density of this stratum was generally medium dense with few exceptions in the CPT soundings.

Sand, Sand with Silt, Sand with Clay - 1

This soil stratum was encountered as a thin lens below the surficial soils along the toe in the vicinity of STA. 19+00. Soil stratum generally consists of sands with less than 12% fines. The thickness of this stratum varies between 1 to 3 feet. The relative density of this stratum varies between very loose to loose.

Sandy Silt

This stratum was encountered at each as-built cross section. Near STA. 14+00, this stratum was interbedded between sand and gravelly sand soil stratum. The sandy silt stratum was encountered below the surficial silty sands and sand with silt and clay between STA. 17+00 and STA. 19+00 and was generally underlain by sand and gravelly sand stratum. Relative density of this stratum varies between firm to stiff soils.

Silt Matrix

The sand and gravelly sand layer was generally underlain by a matrix of low to high elastic silts (ML, MH) with occasional occurrence of highly plastic clays. This stratum consists of stiff clayey silts to silty clays with very low permeability. The thickness of this stratum varies along each cross section between 2 to 15 feet.

Clay Matrix

Clay matrix was encountered below the silt matrix strum and consists of over consolidated sandy to silty clays at each as-built cross section. Thickness of this stratum varies between 5 to 15 feet whereas the relative density varies between stiff to hard soils with few exceptions of soft to firm clays in the CPT soundings CPT-1 and CPT-6.

Sand, Sand with Silt, Sand with Clay - 2

The clay matrix was underlain by a soil stratum consisting of sands with less than 12% fines near STA. 19+00. The thickness of this stratum is estimated between 5 to 20 feet, and the relative density varies from medium dense to dense.

Limestone

The Clay Matrix and Sand, Sand with Silt, Sand with Clay - 2 soil strata were underlain by weathered limestone. This stratum is generally composed of hard limestone. Limestone fragments recovered were generally angular with their size approximately ranging from 1/8” to 2”, with light gray to gray clayey sand infill in rock mass fractures. This stratum was not identified in the vicinity of STA. 14+00 as it was not encountered in boring B-1 or CPT-5.

3.3 Groundwater Conditions

Groundwater was observed in the SPT borings at depths ranging from 2.5 to 4 feet bgs along the downstream toe between STA. 16+00 and STA. 20+00 during the geotechnical investigation. No groundwater was encountered in boring B-1 located in the vicinity of MH-K (PZ-10). These groundwater measurements were made during drilling without allowing time for stabilization of the groundwater level in the borings. As a result, the actual groundwater levels may vary from the levels reported on the boring logs. The groundwater levels at the project site are artificially controlled through a network of toe drains. Fluctuations in groundwater levels at the site should be anticipated throughout the year in response to changes in the frequency and intensity of rainfall, and changes in the water levels within the reservoir at and adjacent to the project site. Further variations in the groundwater level should be expected along the downstream toe between STA. 16+00 and STA. 20+00 due to the local influence of an adjacent wetland area.

4.0 DESIGN ENGINEERING PROPERTIES OF FOUNDATION SOILS

Design engineering properties for the foundation soils underlying the southwestern earthen embankment were developed based on an evaluation of the seepage model calibration and geotechnical site exploration data (CPT Soundings and SPT Borings).

The estimated engineering parameters presented herein are generally conservative and representative of each stratigraphic unit, taking into consideration the inherent variability within the component soils. Where appropriate, the design analyses incorporated sensitivity evaluations using the expected range in variations in selected engineering properties.

4.1 Design Hydraulic Properties

The design hydraulic properties of each foundation soil layer were selected based on the PWE results from the seepage model calibration results. The selected design hydraulic properties of each foundation soil layer are provided in **Table 7**.

Table 7: Design Hydraulic Properties

Soil Stratum	Design Hydraulic Properties		
	Horizontal Hydraulic Conductivity (k_h, ft/s)	Vertical Hydraulic Conductivity (k_v, ft/s)	k_h/k_v
Compacted Embankment Fill	3.3E-05	3.3E-05	1
Silty Sand	6.4E-04	6.4E-04	1
Sand, Gravelly Sand	3.0E-03 to 6.0E-03	3.0E-03 to 6.0E-03	1
Sand, Sand with Silt, Sand with Clay - 1	5.5E-04	5.5E-04	1
Sandy Silt	7.5E-05	7.5E-05	1
Sand, Sand with Silt, Sand with Clay - 2	2.8E-04	2.8E-04	1
Silt Matrix	8.6E-07	4.3E-07	0.5
Clay Matrix	2.4E-04	1.2E-04	0.5
Limestone	2.3E-03	2.3E-03	1

4.2 Design Strength Properties

The relevant strength properties of the foundation soils were selected based upon CPT soundings and SPT borings performed during this study. The design strength properties for the foundation soils are summarized in **Table 8**.

Table 8: Design Strength Properties

Soil Stratum	Soil Parameters				
	Average SPT N-Values (blows per foot)	Total Unit Weight, γ_{total} (pcf)	Submerged Unit Weight, γ_{sub} (pcf)	Friction Angle, ϕ' (degrees)	Cohesion, c (psf)
Compacted Embankment Fill	22.2	120	57.6	32.0	25
Silty Sand	6.6	116	53.8	26.0	-
Sand, Gravelly Sand	28.9	123	60.7	32.0	-
Sand, Sand with Silt, Sand with Clay - 1	7.4	115	52.5	26.0	-
Sandy Silt	14.0	117	54.2	30.0	-
Sand, Sand with Silt, Sand with Clay - 2	17.9	121	58.3	30.0	-
Silt Matrix	26.3	112	49.8	32.0	-
Clay Matrix	22.2	120	57.6	32.0	-
Limestone	50+	130	67.6	45.0	-

5.0 REPORT LIMITATIONS

Our evaluation of foundation design and construction conditions has been based on our understanding of the site, the available project information, our previous experience relevant to the project site, our assumptions and the data obtained during our field exploration as described herein. The general subsurface conditions used were based on interpolation of the subsurface data at our borings. The design recommendations in this report have been developed on the basis of the previously described project characteristics and subsurface conditions. If project criteria or locations change, we must be permitted to determine if our recommendations are still applicable or if they must be modified. The findings of such a review will be presented in a supplemental report.

Regardless of the thoroughness of a subsurface exploration, there is the possibility that conditions will differ from those at the boring location, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. Therefore, experienced geotechnical engineers must observe earthwork and foundation construction to assess if the conditions anticipated in design actually exist.

Our professional services have been performed, our findings derived, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. This company is not responsible for the conclusions, opinions or recommendations of others based on these data.

6.0 REFERENCES

- Bay Area Environmental Services, Inc., (2021), "Medard Reservoir Toe Drain Video Inspection between MH-2 and MH-6".
- BCI Engineers & Scientists, Inc. (BCI - now Wood), (2001), "Report of Geotechnical Exploration and Dam Evaluation Medard Reservoir".
- BCI Engineers & Scientists, Inc. (BCI - now Wood), (2003), "Piezometer Installation and Geotechnical Analysis of Seepage and Stability for Edward Medard Dam & Reservoir.
- Black & Veatch, (2021), "Quarterly Data Report for Edward Medard Reservoir (2nd Quarter Report)".
- Black & Veatch, (2021), "Quarterly Data Report for Edward Medard Reservoir (3rd Quarter Report)".
- Gee & Jenson Consulting Engineers, Inc., (1970), "Pleasant Grove Reservoir Alafia Basin – Plan and Details".
- Greiner Engineering Sciences, Inc., (1977), "Structural Modifications to The Pleasant Grove Dam".
- Kisinger, Campo & Associates, Corp. (KCA), (2002), "Drainage Detail Sheet".
- Kisinger, Campo & Associates, Corp. (KCA), (2002), "Medard Reservoir Toe Drain and Relief Drain Video Inspection".
- Kisinger, Campo & Associates, Corp. (KCA), (2009), "Inspection of Seepage at Medard".
- Lambe, William T. and Whitman Robert V., (1969), "Soil Mechanics" John Wiley and Son's, New York, NY.
- Naval Facilities Engineering Command (NAVFAC), (1982), "Soil Mechanics," NAVAFAC-DM7, Design Manual 7.1.
- Professional Service Industries, Inc. (PSI), (1998), "Geotechnical Services Report – Edward Medard Reservoir".
- Southwest Florida Water Management District (SWFWMD), (1998), "Well Locations and Cross Section – Limited Topographic Survey".
- U.S. Army Corps of Engineers (USACE), (1992), "Engineering and Design – Design, Construction, and Maintenance of Relief Wells," ER-1110-2-1914.
- U.S. Army Corps of Engineers (USACE), (1993), "Engineering and Design – Seepage Analysis and Control Dam," EM-1110-2-1901.
- U.S. Army Corps of Engineers (USACE), (2003), "Engineering and Design – Slope Stability," EM-1110-2-1902.

FIGURES

Graphic presentation of Medard Structure Baseline Recovery
July 13, 2021
Section 36, Township 29 South, Range 21 East,
Hillsborough County, Florida

Date: 8/23/2021

STATION	Northing	Easting	Description
STA 0+00	1299563.073	603044.128	FCM W/DISK "SWFWMD"
STA 10+15.12	1299550.301	602029.223	FIRC 5/8" "REF. LB 7560
STA 24+19.11	1300693.948	601215.040	FIIRC 5/8" "REF. LB 7560
STA 34+50	1301725.142	601205.796	FND BRIDGE SPIKE (NO ID)

Notes:
1. This is not a survey.
2. Current imagery of 2020.
3. Graphic presentation is based on the District GIS basemap.
4. Work order 20-002
5. Intended plot size 11" x 17".
6. Baselines heron is based on the following documents:
Drawing No. 11-100-526.pdf
Pages from MEDARD AS-BUILT.pdf
7. The Set Nail and Disk points have the station stamped on the disk.

Legend

- Found Iron Rod and Cap "Ref LB 7560"
- Found Bridge Spike (No ID)
- Found Concrete Monument "SWFWMD"
- Set Nail and Disk "SWFWMD"
- Survey Base Line
- Secondary Roads
- Section/Township/Range

BLACK & VEATCH
EMPLOYEE-OWNED

DRAWN BY: A. CHORDIA
CHECKED BY: S. CHOMTID
PROJECT NO. : 410374

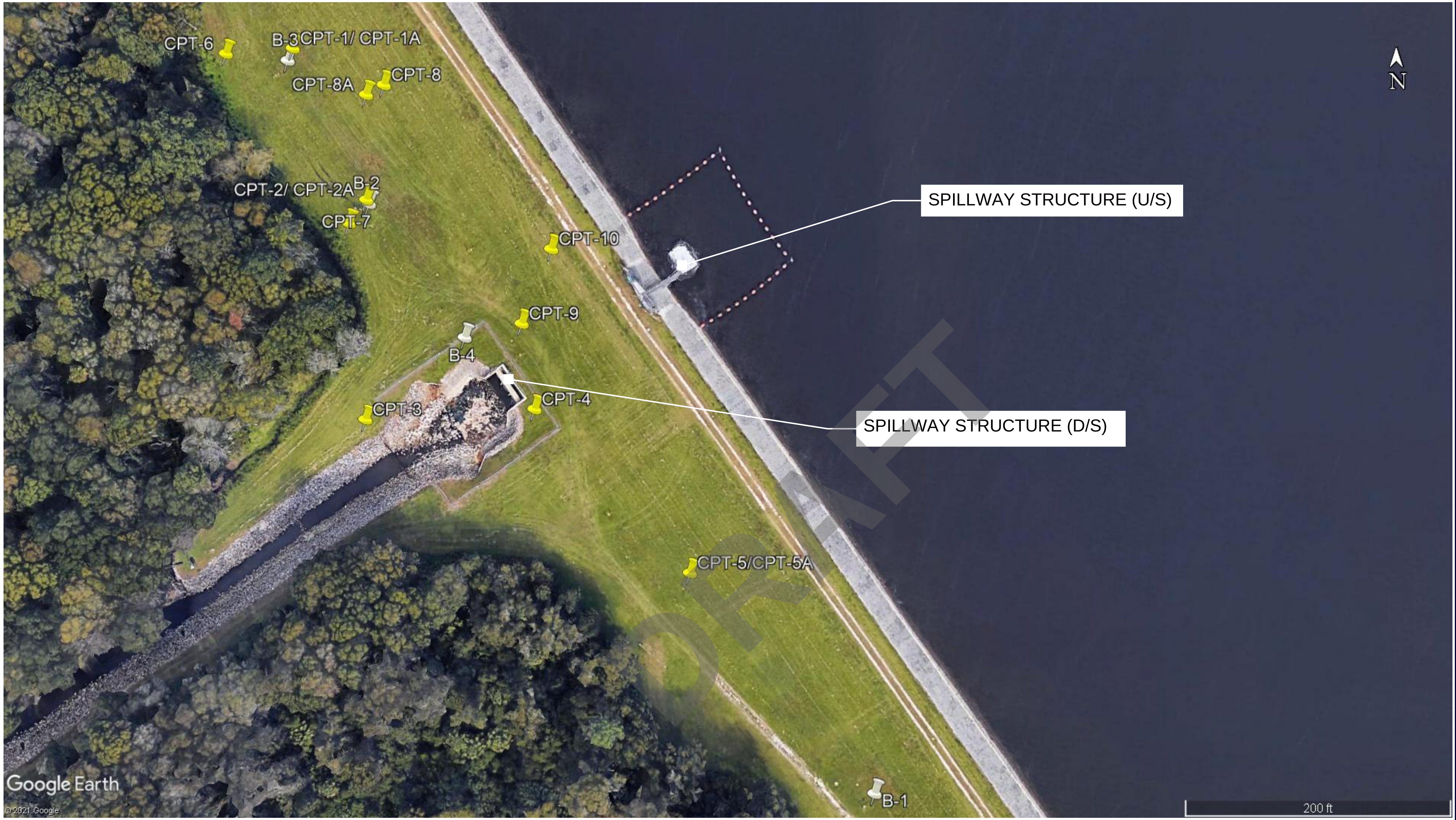
FIGURE NUMBER : 1

CLIENT: SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

PROJECT NAME: MEDARD RESERVOIR SEEPAGE EVALUATION & TOE DRAIN DESIGN

FIGURE TITLE: SITE LOCATION PLAN

SITE LOCATION: PLANT CITY, FLORIDA



SOURCE: GOOGLE EARTH PRO IMAGERY DATE: 01/18/2021.

LEGEND:

- SPT BORINGS (B-X)
- CPT BORINGS (CPT-X)

BLACK & VEATCH
EMPLOYEE-OWNED

CLIENT: SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

PROJECT NAME: SEEPAGE EVULATION & TOE DRAIN DESIGN (MEDARD RESERVOIR)

FIGURE TITLE: BORING LOCATION PLAN

SITE LOCATION: PLANT CITY, FLORIDA

DRAWN BY: A. CHORDIA

CHECKED BY: S. CHOMTID

DATE: 11/01/2021

PROJECT NO. : 410374

FIGURE NUMBER : 2

Appendix A. Hillsborough County Soil Survey

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Hillsborough County, Florida

August 17, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

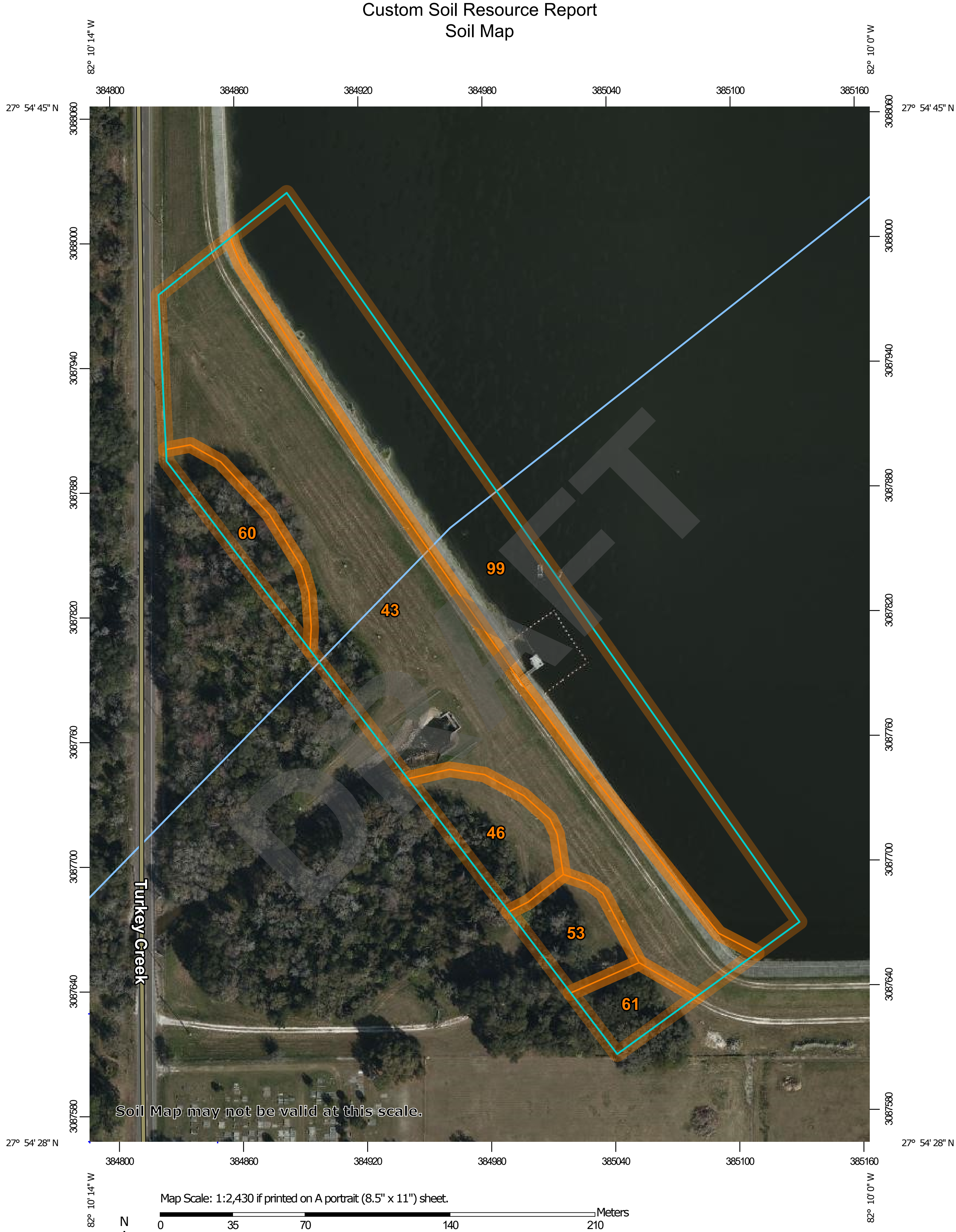
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:2,430 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Hillsborough County, Florida
Survey Area Data: Version 20, Jun 8, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jan 31, 2019—Feb 16, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
43	Quartzipsamments, nearly level	5.6	47.1%
46	St. Johns fine sand	0.7	5.6%
53	Tavares-Millhopper complex, 0 to 5 percent slopes	0.5	4.1%
60	Winder fine sand, frequently flooded	0.5	4.5%
61	Zolfo fine sand, 0 to 2 percent slopes	0.3	2.8%
99	Water	4.3	36.0%
Totals for Area of Interest		**12.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Hillsborough County, Florida

43—Quartzipsamments, nearly level

Map Unit Setting

National map unit symbol: 1j72w
Elevation: 0 to 200 feet
Mean annual precipitation: 48 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 324 to 354 days
Farmland classification: Not prime farmland

Map Unit Composition

Quartzipsamments, nearly level, and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Quartzipsamments, Nearly Level

Setting

Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

C - 0 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Forage suitability group: Forage suitability group not assigned (G155XB999FL)
Other vegetative classification: Forage suitability group not assigned (G155XB999FL)
Hydric soil rating: No

Minor Components

Haplaquents, clayey

Percent of map unit: 5 percent

Landform: Depressions on marine terraces
Landform position (three-dimensional): Interfluve, dip, talf
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Other vegetative classification: Forage suitability group not assigned (G155XB999FL)
Hydric soil rating: Yes

46—St. Johns fine sand

Map Unit Setting

National map unit symbol: 1j72z
Elevation: 10 to 150 feet
Mean annual precipitation: 48 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 324 to 354 days
Farmland classification: Farmland of unique importance

Map Unit Composition

St. johns and similar soils: 87 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of St. Johns

Setting

Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 12 inches: fine sand
E - 12 to 29 inches: fine sand
Bh - 29 to 46 inches: fine sand
C - 46 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0

Available water supply, 0 to 60 inches: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Minor Components

Basinger

Percent of map unit: 7 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Floridana

Percent of map unit: 6 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Hydric soil rating: Yes

53—Tavares-Millhopper complex, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2w4gz
Elevation: 20 to 150 feet
Mean annual precipitation: 45 to 53 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Tavares and similar soils: 63 percent
Millhopper and similar soils: 32 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tavares

Setting

Landform: Ridges on marine terraces, flats on marine terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve, rise
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Eolian or sandy marine deposits

Typical profile

A - 0 to 6 inches: fine sand
C - 6 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 42 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Forage suitability group: Sandy soils on rises, knolls, and ridges of mesic uplands (G154XB121FL)
Other vegetative classification: Sandy soils on rises, knolls, and ridges of mesic uplands (G154XB121FL)
Hydric soil rating: No

Description of Millhopper

Setting

Landform: Knolls on marine terraces, rises on marine terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 6 inches: fine sand
E - 6 to 64 inches: fine sand
Bt - 64 to 76 inches: sandy loam
Btg - 76 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 1.98 in/hr)
Depth to water table: About 42 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Forage suitability group: Sandy soils on rises, knolls, and ridges of mesic uplands (G154XB121FL)
Other vegetative classification: Sandy soils on rises, knolls, and ridges of mesic uplands (G154XB121FL)
Hydric soil rating: No

Minor Components

Candler

Percent of map unit: 3 percent
Landform: Ridges on marine terraces, knolls on marine terraces
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Other vegetative classification: Sandy soils on ridges and dunes of xeric uplands (G154XB111FL)
Hydric soil rating: No

Astatula

Percent of map unit: 2 percent
Landform: Ridges on marine terraces, hills on marine terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Interfluve, side slope, tread
Down-slope shape: Convex, linear
Across-slope shape: Convex
Other vegetative classification: Sandy soils on ridges and dunes of xeric uplands (G154XB111FL), Longleaf Pine-Turkey Oak Hills (R154XY002FL)
Hydric soil rating: No

60—Winder fine sand, frequently flooded

Map Unit Setting

National map unit symbol: 1j73f

Elevation: 0 to 200 feet
Mean annual precipitation: 48 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 324 to 354 days
Farmland classification: Not prime farmland

Map Unit Composition

Winder, frequently flooded, and similar soils: 88 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Winder, Frequently Flooded

Setting

Landform: Flood plains on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear, concave
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 14 inches: fine sand
B/E - 14 to 18 inches: sandy clay loam
Btg - 18 to 34 inches: sandy clay loam
Cg - 34 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: NoneFrequent
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C/D
Forage suitability group: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G155XB345FL)
Other vegetative classification: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G155XB345FL)
Hydric soil rating: Yes

Minor Components

Samsula

Percent of map unit: 4 percent
Landform: Depressions on marine terraces

Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Organic soils in depressions and on flood plains (G155XB645FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Basinger

Percent of map unit: 4 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Chobee, frequently flooded

Percent of map unit: 4 percent
Landform: Flood plains on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G155XB345FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

61—Zolfo fine sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2w0q1
Elevation: 30 to 160 feet
Mean annual precipitation: 44 to 56 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Zolfo and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Zolfo

Setting

Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread, rise

Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 59 inches: fine sand
Bh - 59 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A
Forage suitability group: Sandy soils on rises and knolls of mesic uplands (G155XB131FL)
Other vegetative classification: Sandy soils on rises and knolls of mesic uplands (G155XB131FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Minor Components

Myakka

Percent of map unit: 5 percent
Landform: Drainageways on flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Millhopper

Percent of map unit: 4 percent
Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread, rise, talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Sandy soils on rises, knolls, and ridges of mesic uplands (G155XB121FL)
Hydric soil rating: No

Tavares

Percent of map unit: 4 percent
Landform: Rises on marine terraces, knolls on marine terraces, flatwoods on marine terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Side slope, interfluve, tread, rise
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Other vegetative classification: Sandy soils on rises, knolls, and ridges of mesic uplands (G155XB121FL), Longleaf Pine-Turkey Oak Hills (R155XY002FL), Sand Pine Scrub (R155XY001FL)
Hydric soil rating: No

Malabar

Percent of map unit: 2 percent
Landform: — error in exists on —
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: R155XY011FL - Slough
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

99—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Interpretive groups

Land capability classification (irrigated): None specified
Forage suitability group: Forage suitability group not assigned (G155XB999FL)
Other vegetative classification: Forage suitability group not assigned (G155XB999FL)
Hydric soil rating: Unranked

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Appendix B. Final Geophysical Investigation Report by Geoview, Inc.

FINAL REPORT
GEOPHYSICAL INVESTIGATION
TOE DRAIN & SEEPAGE EVALUATION FOR
EDWARD MEDARD RESERVOIR
PLANT CITY, FLORIDA

Prepared for Southwest Florida Water Management District
Brooksville, FL

Prepared by GeoView, Inc.
St. Petersburg, FL

July 16, 2021

Robin Bailey
Structure Operation Project Manager
Southwest Florida Water Management District
2379 Broad Street
Brooksville, Florida 34604

Subject: Transmittal of Final Report for Geophysical Investigation
Toe Drain & Seepage Evaluation for Edward Medard Reservoir – Plant City, Florida
GeoView Project Number 33497

GeoView, Inc. (GeoView) is pleased to submit the final report that summarizes and presents the results of the geophysical investigation conducted at the Toe Drain and Seepage Evaluation for Edward Medard Reservoir. Electrical resistivity was used to evaluate near-surface geological conditions. GeoView appreciates the opportunity to have assisted you on this project. If you have any questions or comments about the report, please contact us.

GEOVIEW, INC.

Michael J. Wightman, P.G.
Principal Geophysicist, President
Florida Professional Geologist
Number 1423

Steve Scruggs, P.G.
Senior Geophysicist
Florida Professional Geologist
Number 2470

A Geophysical Services Company

4610 Central Avenue
St. Petersburg, FL 33711

Tel.: (727) 209-2334
Fax: (727) 328-2477

1.0 Introduction

A geophysical investigation was conducted along the berm in the southwestern portion of the Edward Medard Reservoir located at 6140 Turkey Creek Road in Plant City, Florida. The investigation was conducted on July 8, 9, and 12, 2021.

The objective of this investigation was to help determine the location of any shallow voids or areas of downward raveling soils in the area associated with a toe drain along the base of the berm. It is suspected that any such shallow geological features might be associated with sinkhole (karst) activity. The location of the study area is provided on Figure 1 (Appendix 1).

Based on the regional geological setting the project site is underlain by a surficial layer of sandy to silty sediments. This surficial layer is underlain by the clayey sediments of the Hawthorne Group. The Tampa Limestone (typically a weathered limestone) is the base member of the Hawthorne Group and is underlain by Ocala Limestone which is usually more competent than the overlying Tampa Limestone.

2.0 Description of Geophysical Investigation

The geophysical investigation was completed using electrical resistivity imaging (ERI). The ERI survey was conducted using the Advanced Geosciences, Inc. Sting R8 automatic electrode resistivity system. Five ERI transects were performed using up to 112 electrodes with an "a spacing" of 7.5 ft. A dipole-dipole combined with an inverse Schlumberger electrode configuration was used with a maximum "n value" of six. The ERI data was analyzed using EarthImager 2D, a computer inversion program, which provides two-dimensional vertical cross-sectional resistivity model (pseudo-section) of the subsurface. As part of the ERI analysis the modeling results were corrected for changes in elevation along each of the transects.

The positions of the geophysical transect lines were recorded using a Trimble Geo-7x Global Positioning System (GPS). A Wide Area Augmentation System (WAAS) was used to augment GPS with additional signals for increasing the reliability, integrity, accuracy, and availability of the GPS signal. By using WAAS, an accuracy of less than 1 ft in the horizontal dimension was achieved. Vertical elevations were also collected along each of the ERI transect lines. These vertical elevations have an accuracy of 1 to 2 ft.

A description of the ERI method and the methods employed for geotechnical characterization studies is provided in Appendix A2.2. A discussion of the modeling process used to create the ERI results is provided in Appendix A2.2.1.

3.0 Identification of Possible Sinkhole Features Using ERI Method

Sinkhole features are typically characterized by one of the following conditions on the ERI profile:

1. The occurrence of highly resistive material that extends to depth in a columnar fashion towards the top of the limestone. Such a feature may indicate the presence of a sand-filled depression or raveling zone.
2. The localized presence of low-resistivity material extending below the interpreted depth to the top of limestone. Such a feature may indicate the presence of a clay-filled void or fracture with the limestone or the presence of highly weathered limestone rock.
3. Any significant localized increase in the depth to limestone. Such a feature may indicate the presence of an in-filled depression (paleo-sink).

When comparing the results of the ERI method, the following considerations should be given. The ERI method, for example, describes the transition from clay to limestone as a transition, rather than a discrete depth. This transition is due to several factors including: a) The vertical density of the resistivity data decreasing with depth and b) The possibility that the upper portion of the limestone is weathered which would create a physical transition zone in terms of resistivity between the clay and competent (non-weathered) limestone and c) The limitations in the modeling process.

4.0 Survey Results

<u>4.1 Discussion of ERI Survey Results</u>

Results from the ERI survey are shown on Figure 1 and the individual data profiles are presented in Appendix 1. The ERI transects are of excellent quality (a discussion of the criteria used to determine the quality of an ERI inversion model is provided in Appendix A2.2.1). References made to the elevations of the various ERI layers are above mean sea level (msl) and are based on GPS results. These elevations are considered accurate to 1 to 2 ft.

In general, analysis of the ERI transects indicate the presence of high to moderate resistivity near-surface soil materials to a depth range of 5 to -5 msl (represented in red to green on the ERI transects). This high to moderate resistivity layer is likely associated with a surficial layer of sandy to silty sediments. The surficial high to moderate resistivity layer is underlain by an approximately 20 to

45-ft thick low-resistivity layer (represented in blue) which extends to an estimated depth range of -25 to -40 ft msl. This low resistivity layer is most likely the clayey sediments associated with the upper member of the Hawthorne Group. The suspected clayey sediments are underlain by a moderate resistivity layer (green) which is underlain by a high resistivity layer in orange to red. Based on the regional geology, this moderate resistivity layer is most likely associated with the weathered limestones of the Tampa Limestone member of the Hawthorne Group. The underlying high-resistivity layer is most likely associated with the more competent limestones of the Ocala Formation.

4.2 Discussion of ERI Anomalies

Four ERI anomalies were identified at the project site proximate to the discharge area. These anomalies were characterized by apparent lateral discontinuities or irregularities within the clayey sediments of the Hawthorne Group. These anomalies are shown as ERI Anomalies GV-1 through GV-4 on Figure 1. These anomaly areas are shown on each of the modeled results for each of the ERI transects (Appendix 1).

The ERI anomaly associated with GV-1 is observed on both ERI Transects 1 and 4. The anomaly is characterized by the suspected clay layer either being discontinuous or increasing in depth. The ERI anomalies associated with GV-2 and GV-3 are associated with the occurrence of high resistivity zones within the suspected clay layer. These anomalies may be associated with areas of sandy soils within the clay layer as would be associated with a potential ravel zone. Alternatively, these anomalies could be associated with naturally occurring (non-karst related) depositional or erosional processes within the Hawthorne Group. The ERI anomaly associated with GV-4 is characterized by a localized thinning of the low-resistivity clay layer and associated occurrence of the suspected limestone layer at a more-shallow depth. This anomaly may be associated with discontinuous shallow limestone layer within the Hawthorne Group.

The drainage culvert did interfere with the ERI results on ERI Transects 1 and 2. This interference was characterized by a low-resistivity zone that extended from near the land surface towards the bottom of the ERI models. This area of interference is shown on modeled results for ERI Transects 1 and 2.

It is noted that all the identified ERI anomalies are proximate to the discharge culvert and therefore may be suspect due to possible interference. As the ERI method is dependent on the measurement of generated electrical fields transmitted through the ground, sources of cultural interference (i.e., foundations, utilities, etc.) can distort this measured electrical field resulting in an invalid data model in these affected areas. However, with the excellent data quality and the lack of similar responses in the data sets on Transects 2 and 3 in corresponding locations, it is unlikely that the anomalies are a result of suspect interference in the data.

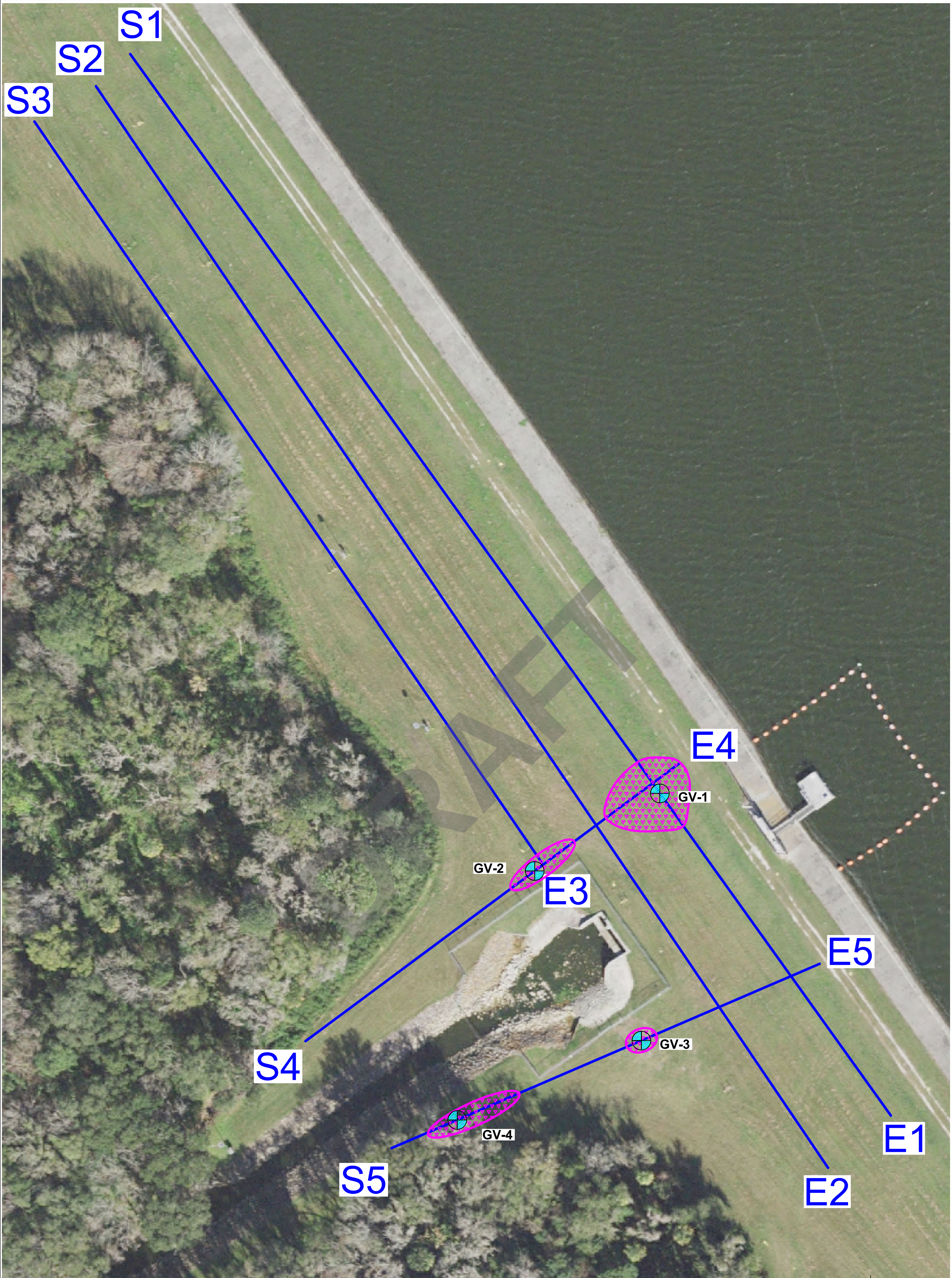
It is not possible, based on the geophysical results to determine whether these identified anomalies are associated with sinkhole conditions or a discontinuity in the suspected clay unit (low resistivity layer) that may affect the structural integrity of the berm. It is recommended that the anomalies be tested using appropriate geotechnical test methods. Table 1 provides the coordinates for the apparent centers for each ERI anomaly. These coordinates were developed using a Trimble GEO-7x global positioning system (GPS) with 1 to 2 ft accuracy.

Table 1 – Recommended Boring Coordinates*

Boring	Northing	Easting	Latitude	Longitude
GV-1	1300063.98	601627.90	27.9101168°	-082.1688729°
GV-2	1300014.11	601547.19	27.9099793°	-082.1691226°
GV-3	1299905.14	601615.60	27.9096798°	-082.1689103°
GV-4	1299853.59	601497.32	27.9095376°	-082.1692763°

* US State Plane, Florida West 0101, NAD83 (Conus), Feet

APPENDIX 1
FIGURE AND ERI TRANSECTS



GOOGLE EARTH AERIAL 2020

EXPLANATION

S1 E1 ERI TRANSECT LINES WITH START & END POINTS

GV-1 ERI ANOMALY & DESIGNATION

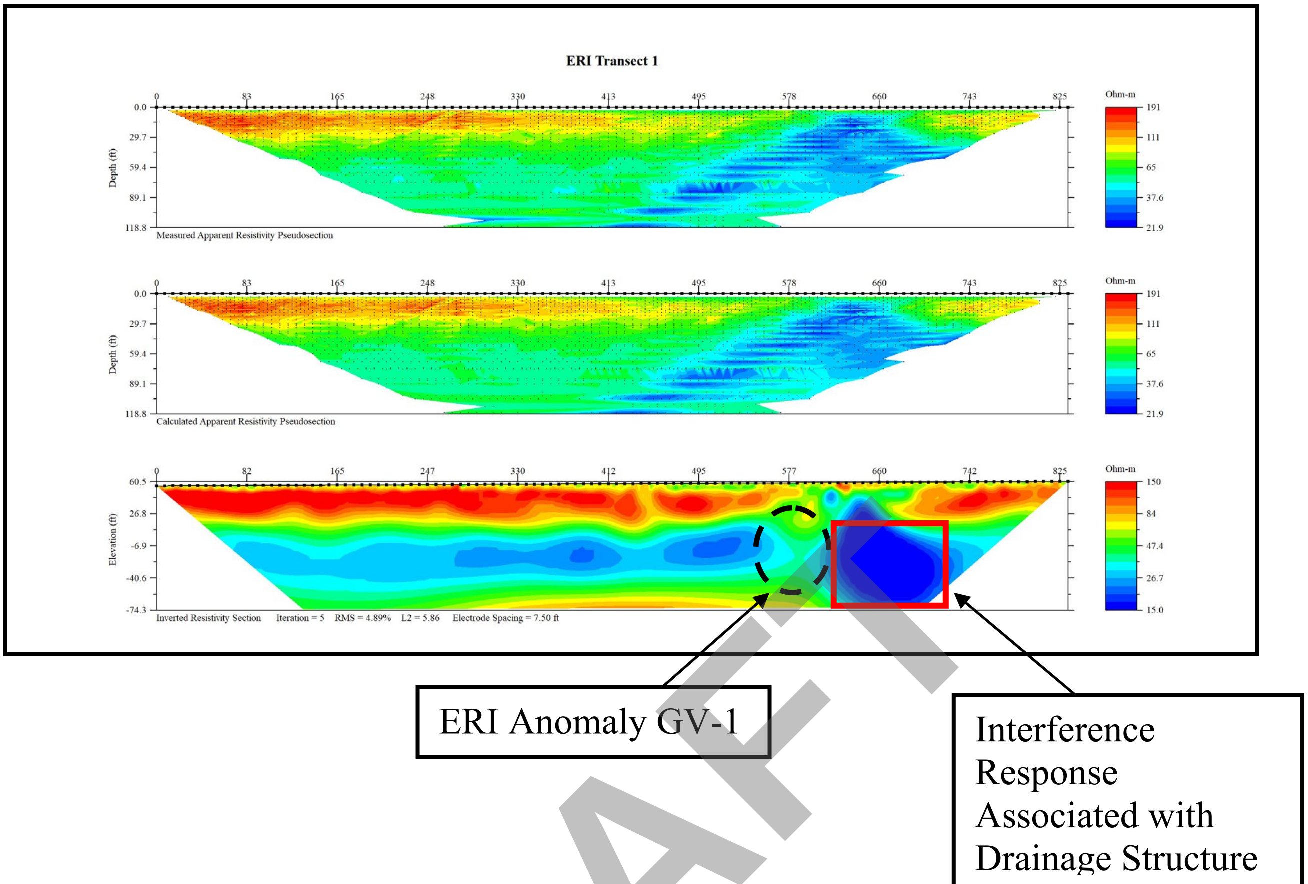
RECOMMENDED BORING

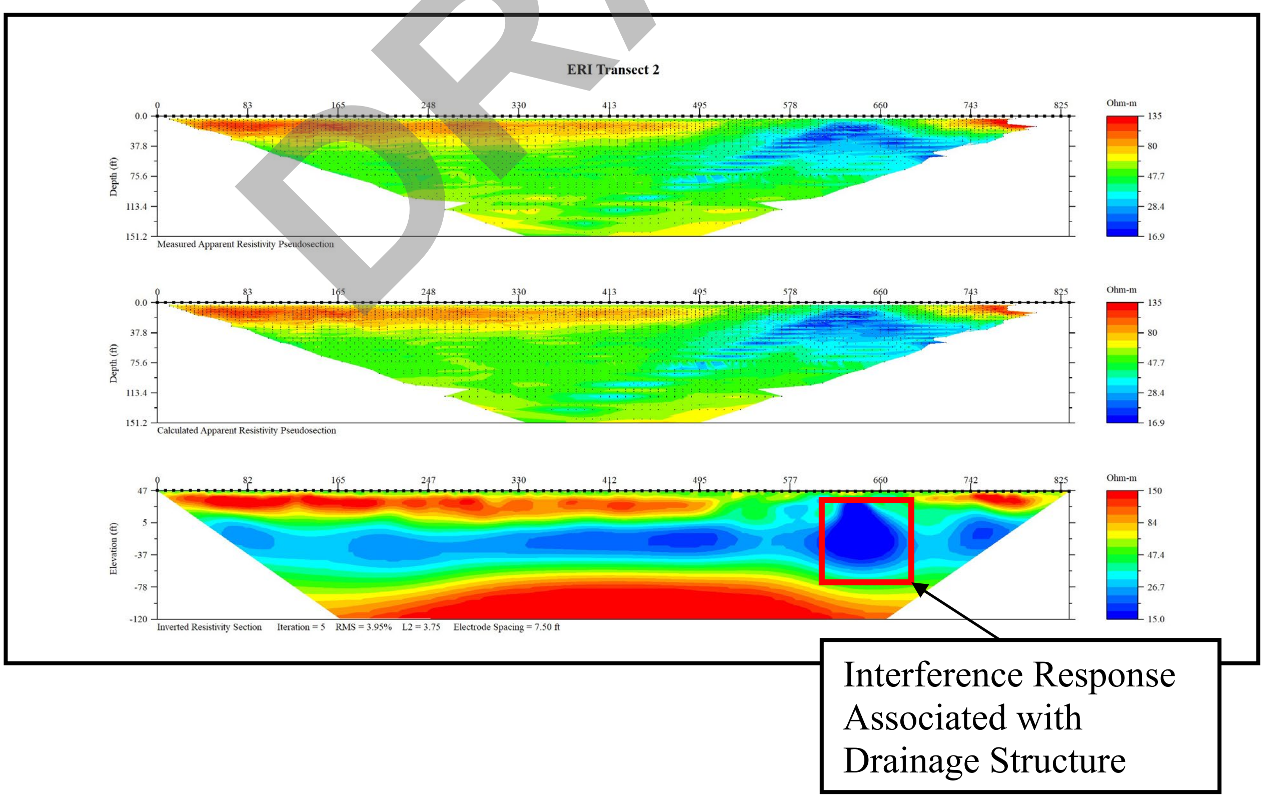
N

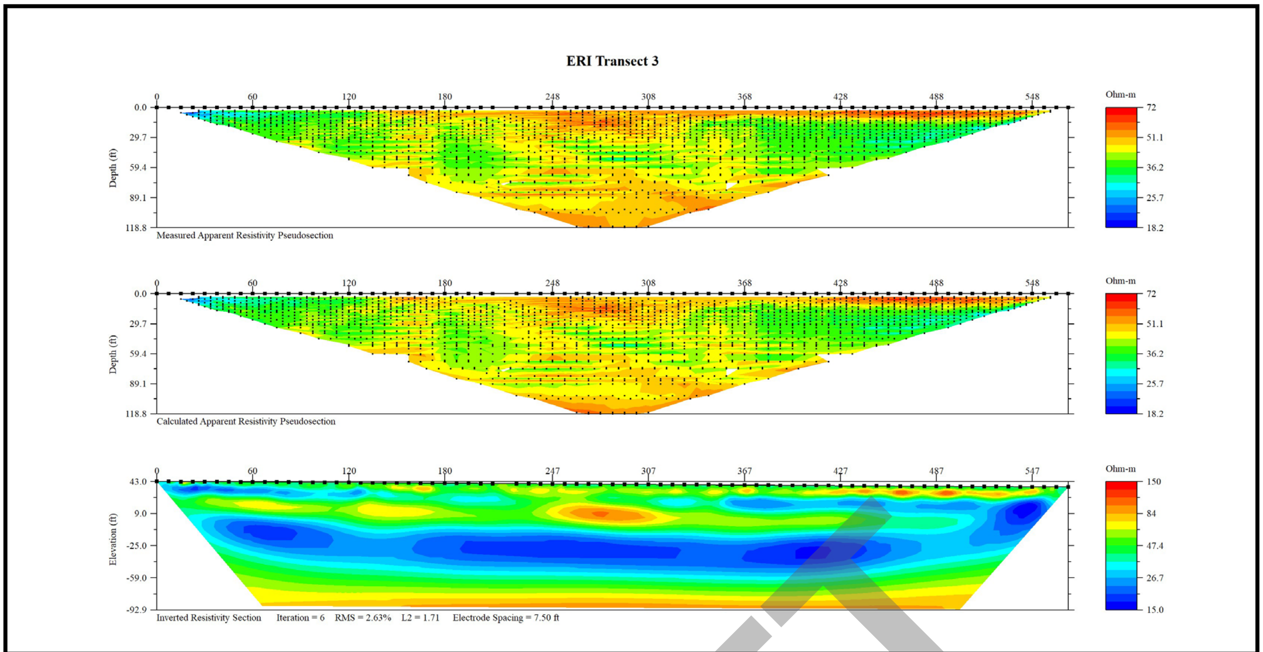
0 60'

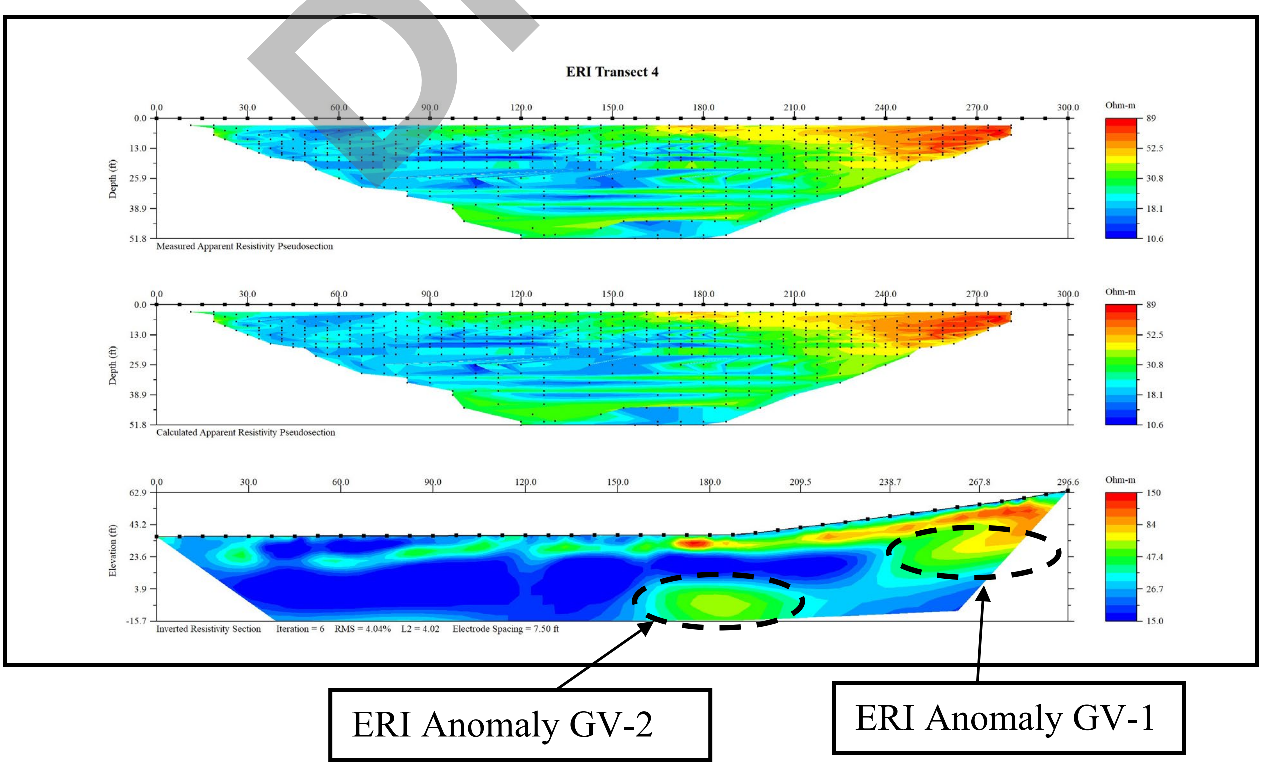
SCALE: 1"=60' APPROXIMATE

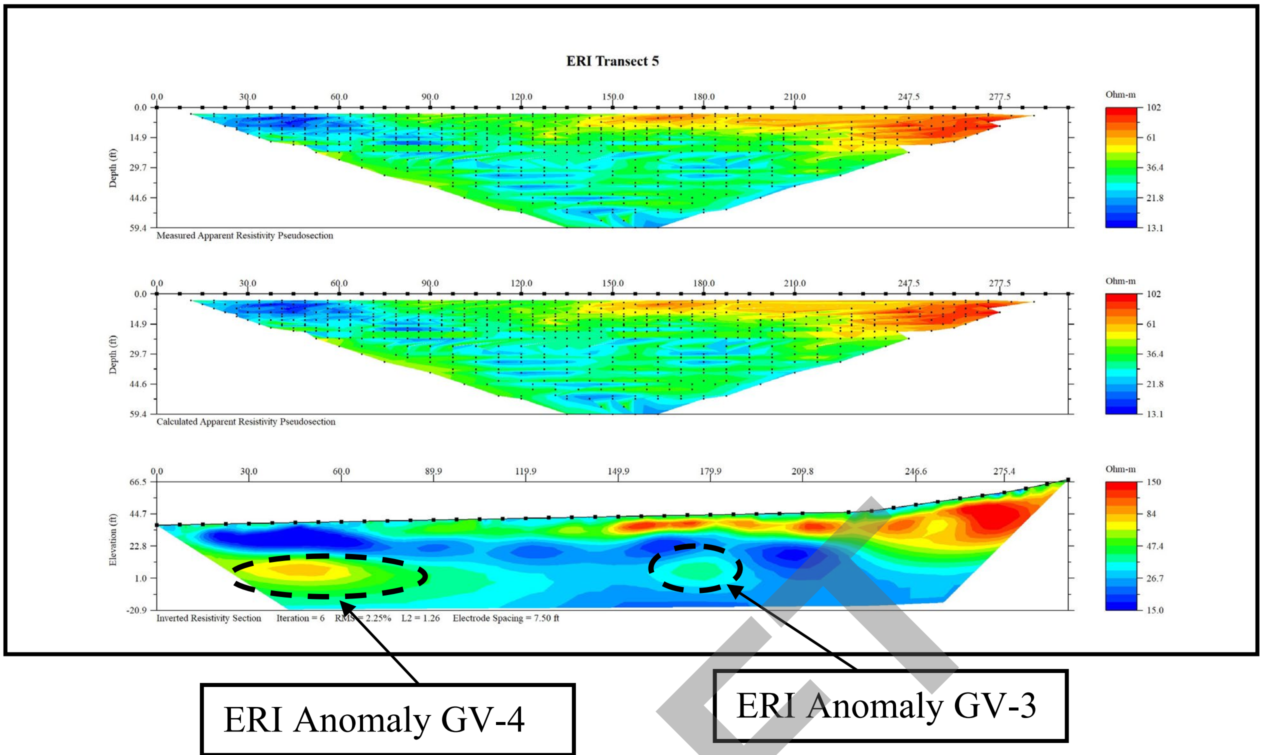
GeoView	FIGURE 1 SITE MAP SHOWING RESULTS OF GEOPHYSICAL INVESTIGATION	TOE DRAIN & SEEPAGE EVALUATION FOR EDWARD MEDARD RESERVOIR SITE PLANT CITY, FLORIDA
		BLACK & VEATCH TAMPA, FLORIDA — PROJECT: 33497 DATE: 07/15/21


ERI Transect 1
Measured Apparent Resistivity Pseudosection
Calculated Apparent Resistivity Pseudosection
Inverted Resistivity Section Iteration = 5 RMS = 4.89% L2 = 5.86 Electrode Spacing = 7.50 ft
Depth (ft)
Elevation (ft)
Ohm-m
ERI Anomaly GV-1
Interference Response Associated with Drainage Structure


ERI Transect 2
Measured Apparent Resistivity Pseudosection
Calculated Apparent Resistivity Pseudosection
Inverted Resistivity Section Iteration = 5 RMS = 3.95% L2 = 3.75 Electrode Spacing = 7.50 ft
Depth (ft)
Elevation (ft)
Ohm-m
Interference Response Associated with Drainage Structure


ERI Transect 3
Measured Apparent Resistivity Pseudosection
Calculated Apparent Resistivity Pseudosection
Inverted Resistivity Section Iteration = 6 RMS = 2.63% L2 = 1.71 Electrode Spacing = 7.50 ft
Depth (ft)
Elevation (ft)
Ohm-m


ERI Transect 4
Measured Apparent Resistivity Pseudosection
Calculated Apparent Resistivity Pseudosection
Inverted Resistivity Section Iteration = 6 RMS = 4.04% L2 = 4.02 Electrode Spacing = 7.50 ft
Depth (ft)
Elevation (ft)
Ohm-m
ERI Anomaly GV-2
ERI Anomaly GV-1


ERI Transect 5
Depth (ft)
0.0
14.9
29.7
44.6
59.4
0.0 30.0 60.0 90.0 120.0 150.0 180.0 210.0 247.5 277.5
Measured Apparent Resistivity Pseudosection
Ohm-m
102
61
36.4
21.8
13.1
Calculated Apparent Resistivity Pseudosection
Elevation (ft)
66.5
44.7
22.8
1.0
-20.9
0.0 30.0 60.0 89.9 119.9 149.9 179.9 209.8 246.6 275.4
Ohm-m
150
84
47.4
26.7
15.0
Inverted Resistivity Section Iteration = 6 RMS = 2.25% L2 = 1.26 Electrode Spacing = 7.50 ft
ERI Anomaly GV-4
ERI Anomaly GV-3

APPENDIX 2
DESCRIPTION OF GEOPHYSICAL METHODS, SURVEY METHODOLOGIES AND LIMITATIONS

A2.1 On Site Measurements

The positions of the geophysical transect lines were recorded using a Trimble Geo-7x Global Positioning System (GPS). These GPS systems typically have an accuracy of 1 to 2 ft.

A2.2 Electrical Resistivity

Electrical resistivity surveying is a geophysical method in which an electrical current is injected into the earth; the subsequent response (potential) is measured at the ground surface to determine the resistance of the underlying earth materials. The resistivity survey is conducted by applying electrical current into the earth from two implanted electrodes (current electrodes C_1 and C_2) and measuring the associated potential between a second set of implanted electrodes (potential electrodes P_1 and P_2). Field readings are in volts. Field readings are then converted to resistivity values using Ohm's Law and a geometric correction factor for the spacing and configuration of the electrodes. The calculated resistivity values are known as "apparent" resistivity values. The values are referred to as "apparent" because the calculations for the values assume that the volume of earth material being measured is electrically homogeneous. Such field conditions are rarely present.

Resistivity of earth materials is controlled by several properties including composition, water content, pore fluid resistivity and effective permeability. For this study the properties that had the primary control on measured resistivity values are composition and effective permeability. The general geological setting of this project area is clay overlain by limestone.

For this study a dipole-dipole combined with an inverse Schlumberger resistivity array configuration was used. The dipole-dipole array is different that most other resistivity arrays in that the electrode and current electrodes are kept together using a constant spacing value referred to as an "a spacing". The current and potential electrode sets are moved away from each other using multiples of the "a spacing" value. The number of multiples is referred to as the "n value". For example, an array with an "a spacing" of 5 ft and a "n value" of 6 would have the current and potential electrode sets spaced 30 ft apart with a separation between the two electrodes in the set of 5 ft. By sampling at varying "n values", greater depth measurements can be achieved. Inverse Schlumberger data is collected with the current set of electrodes being kept with a fixed separation (L spacing) and the potential electrodes a minimum distance of 5L from the inner current electrodes. Dipole-dipole resistivity data is usually presented in a two-dimensional pseudo-section format. Inverse Schlumberger data is usually presented as a vertical profile of resistivity distribution below the center point between the two current electrodes. The dipole-dipole and inverse Schlumberger data is combined and presented as either a contour of the individual data points (using the calculated apparent resistivity values) or as a geological model using least squares analysis. Such least squares analysis was used for this study using the computer software program (EarthImager 2D) developed for the equipment manufacturer. Apparent resistivity values are calculated using the following formula for a dipole-dipole configuration: $\gamma_a=\pi(b^3/a^2-b)\nabla V/I$:

Where:

$\gamma_a=$	apparent resistivity
$\pi=$	3.14
a=	"a spacing"
b=	"a spacing" x "n value"
$\nabla V=$	voltage between the two potential electrodes
I=	current (in amps)

For a Schlumberger configuration the apparent resistivity is calculated using: $\gamma_a=\pi([s^2-a^2]/4)\nabla V/aI$:

Where:

$\gamma_a=$	apparent resistivity
$\pi=$	3.14
a=	spacing between the inner set of electrodes"
s=	distance between the outer electrode and nearest inner electrode
$\nabla V=$	voltage between the two potential electrodes
I=	current (in amps)

A2.2.1 Inversion Modeling of ERI Data

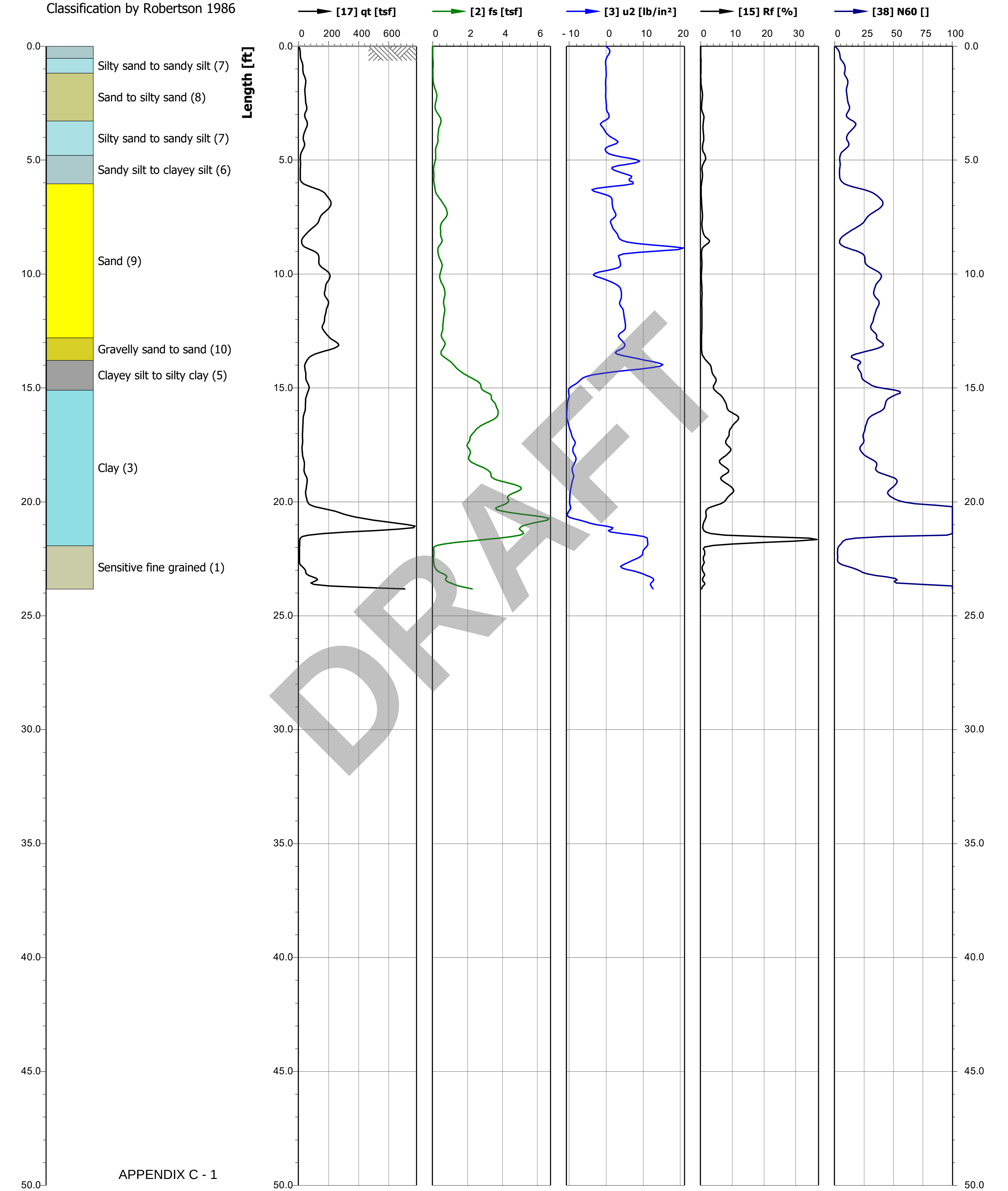
The objective for inversion modeling of resistivity data is to create a description of the actual distribution of earth material resistivity based on the subsurface geology that closely matches the resistivity values that are measured by the instrumentation. This modeling is done through the use of EarthImager™, a proprietary computer program developed by the equipment manufacturer. When evaluating the validity of the inversion model several factors need to be considered. The RMS, or root mean square error, expresses the quality of fit between the actual and modeled resistivity values for the given set of points in the model. The lower the RMS error the higher the quality of fit between the actual and modeled data sets. In general, inversion models with an RMS error of less than 5 to 10 percent are acceptable. The size of the RMS error is dependent upon the number of bad data points within a data set and the magnitude of how bad the data points are. As part of the modeling process bad data points are typically removed, which decreases the RMS error and improves (with limitations) the quality of the model. The quality of fit between the actual and modeled resistivity values is also expressed as the L-2 norm. When the modeled and actual data sets have converged, the L-2 norm reduces to unity (1.0 or smaller).

However, as the number of data points is reduced, the validity of the inversion model is diminished. Accordingly, when interpreting a particular area of an inversion model the number of data points used to create that portion of the model must be taken into consideration. If very few points are within a particular area of the model, then the modeled solution in that area should be considered suspect and possibly rejected.

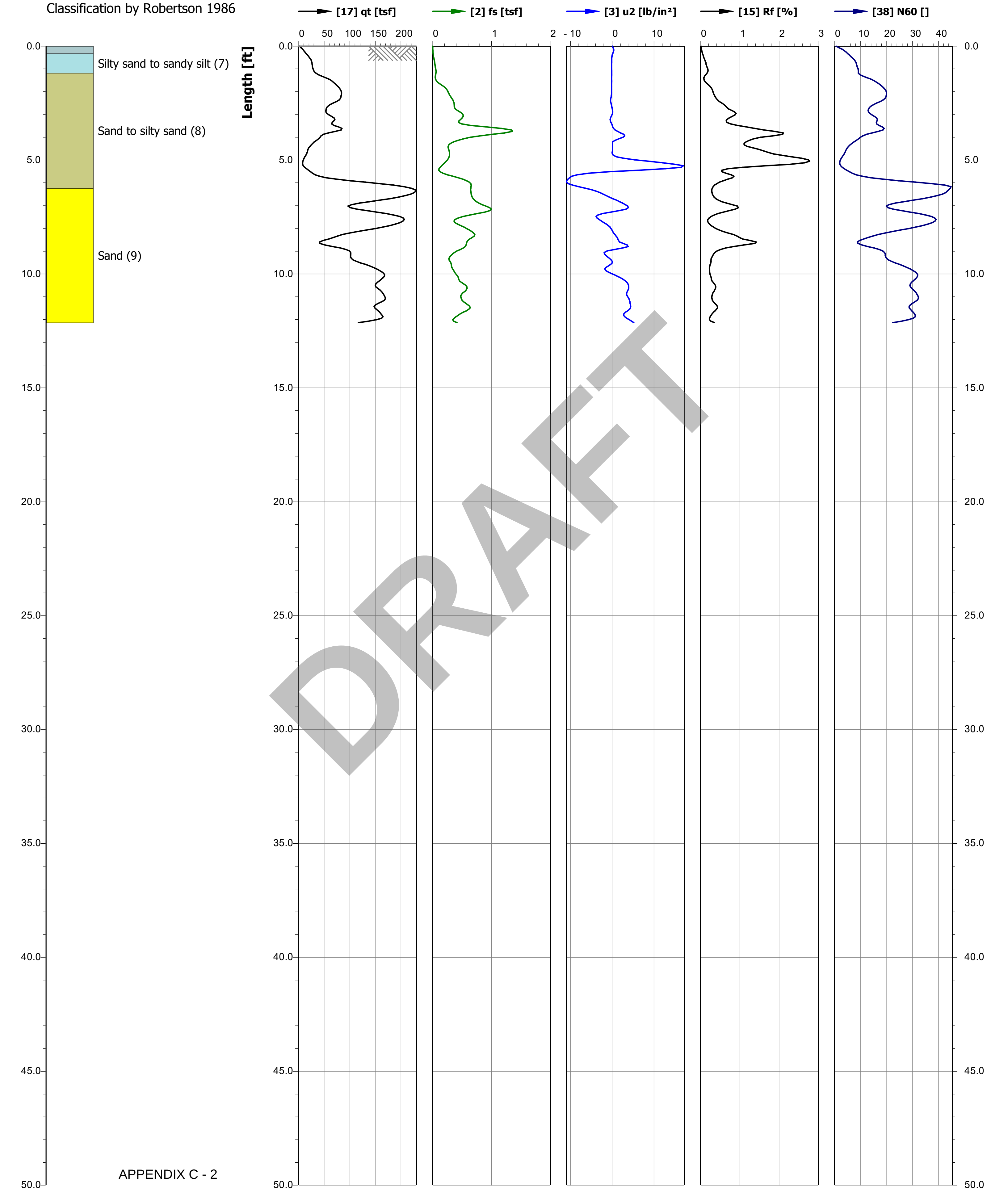
The entire ERI transect should be considered suspect if a model has a high RMS error and a large number of removed data points. It is likely that sources of interference have affected the field readings and rendered the modeled solution invalid. Such sources of interference can include buried metallic underground utilities, reinforced concrete slabs, septic leach fields or electrical grounding systems. Accordingly, all efforts need to be made in the field to locate, to the degree possible, the ERI transect lines away from such features. The locations of such features also need to be mapped in the field so their potential effects can be considered when interpreting the modeled results.

Appendix C. CPT Sounding Profiles, SPT Boring Logs and Laboratory Test Results

BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 44'	Test no: CPT-1
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/22/2021	Standard / class: /
	Area factor a/b: 0.850 / 0.000	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	

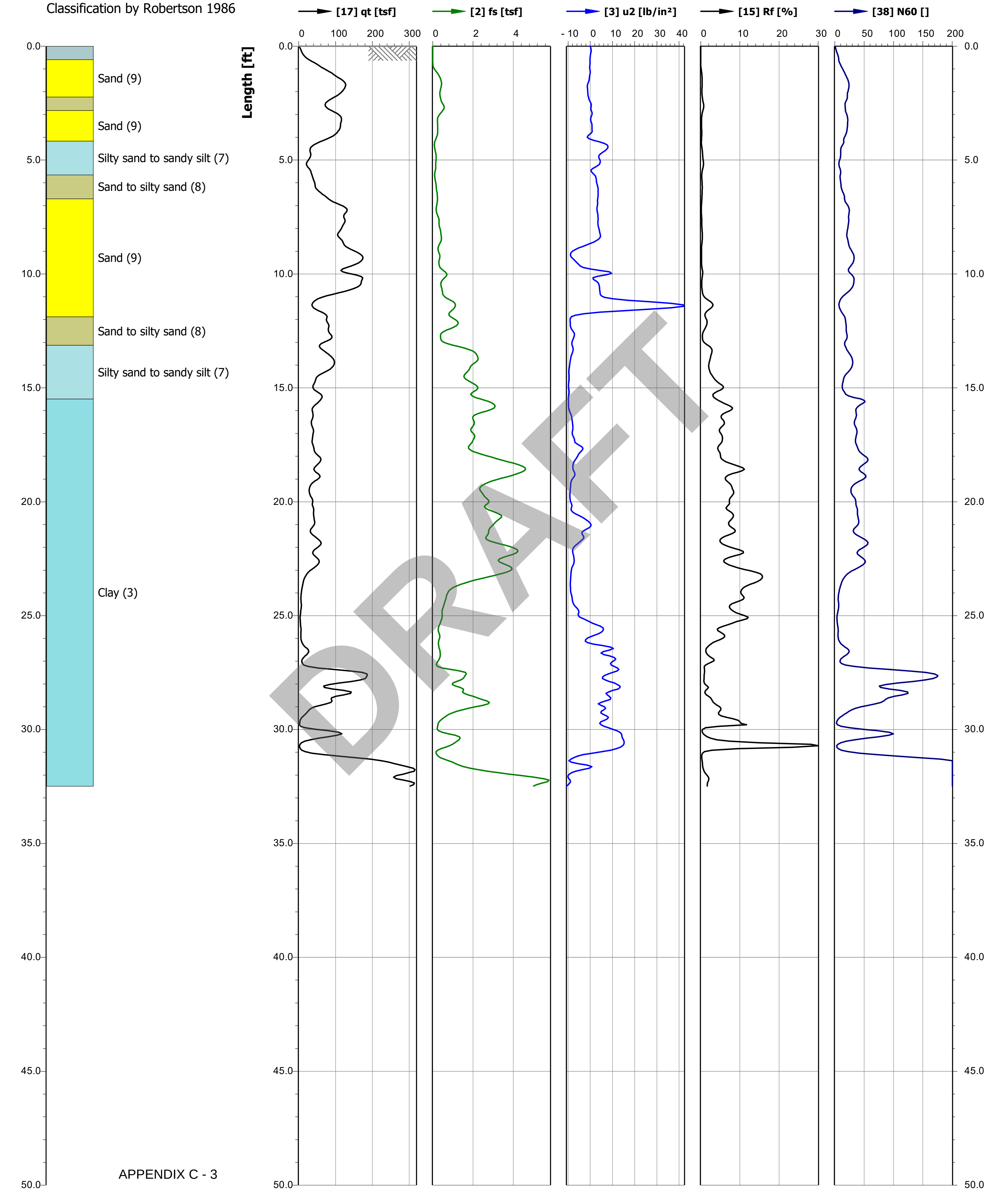


BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 44'	Test no: CPT-1A
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/22/2021	Standard / class: /
	Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	

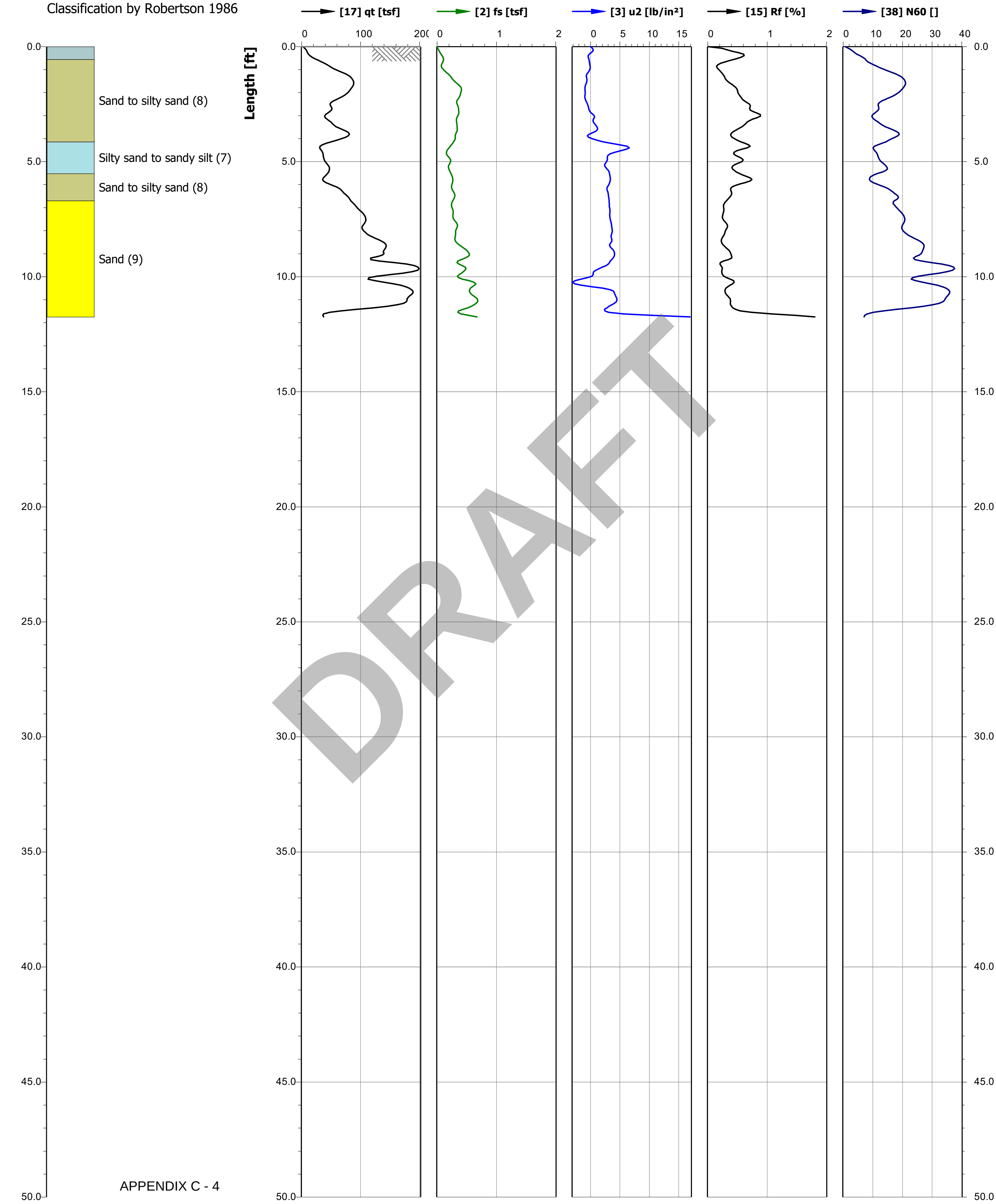


APPENDIX C - 2

BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 42'	Test no: CPT-2
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/22/2021	Standard / class: /
	Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	

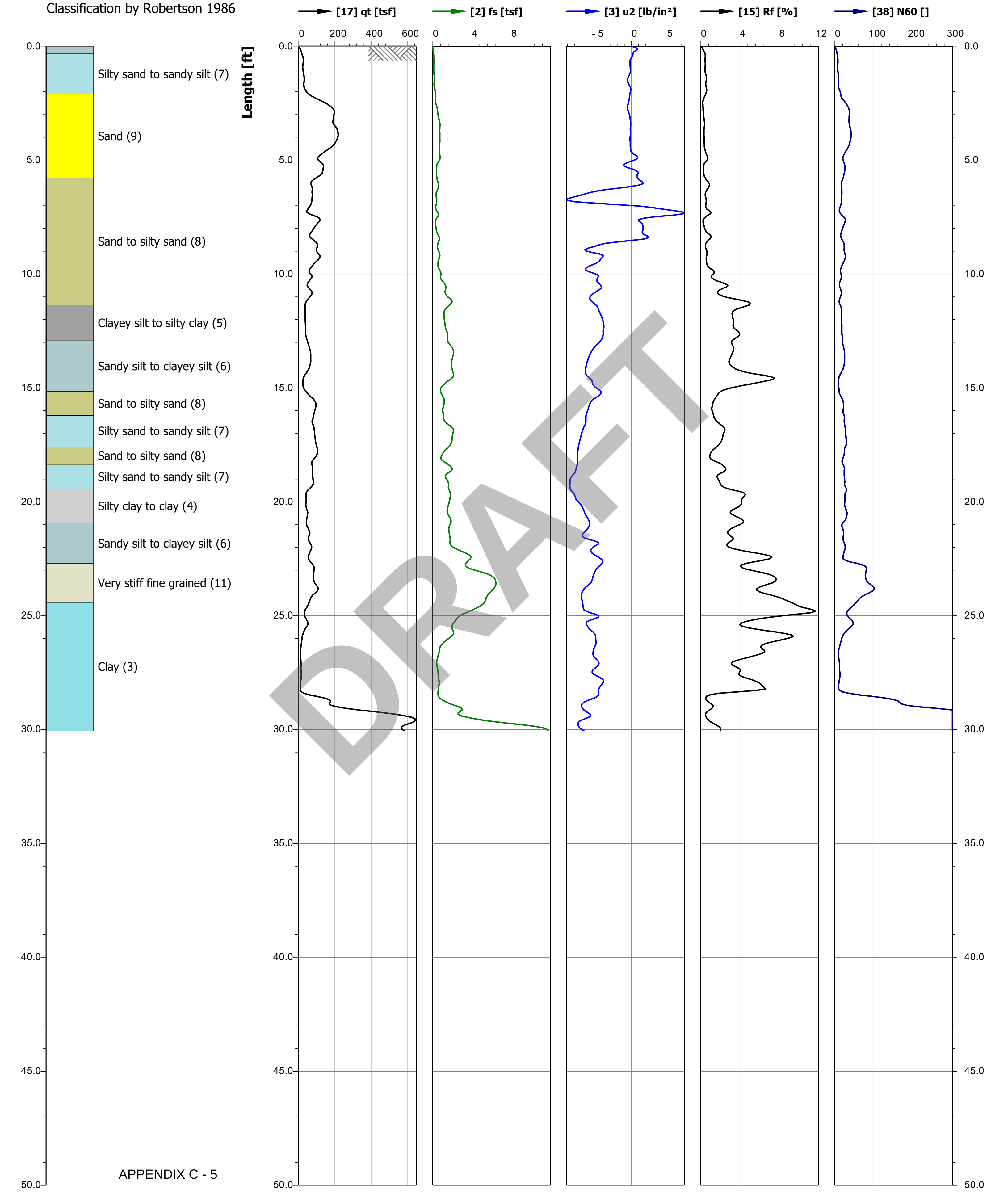


BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 42'	Test no: CPT-2A
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/22/2021	Standard / class: /
	Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	



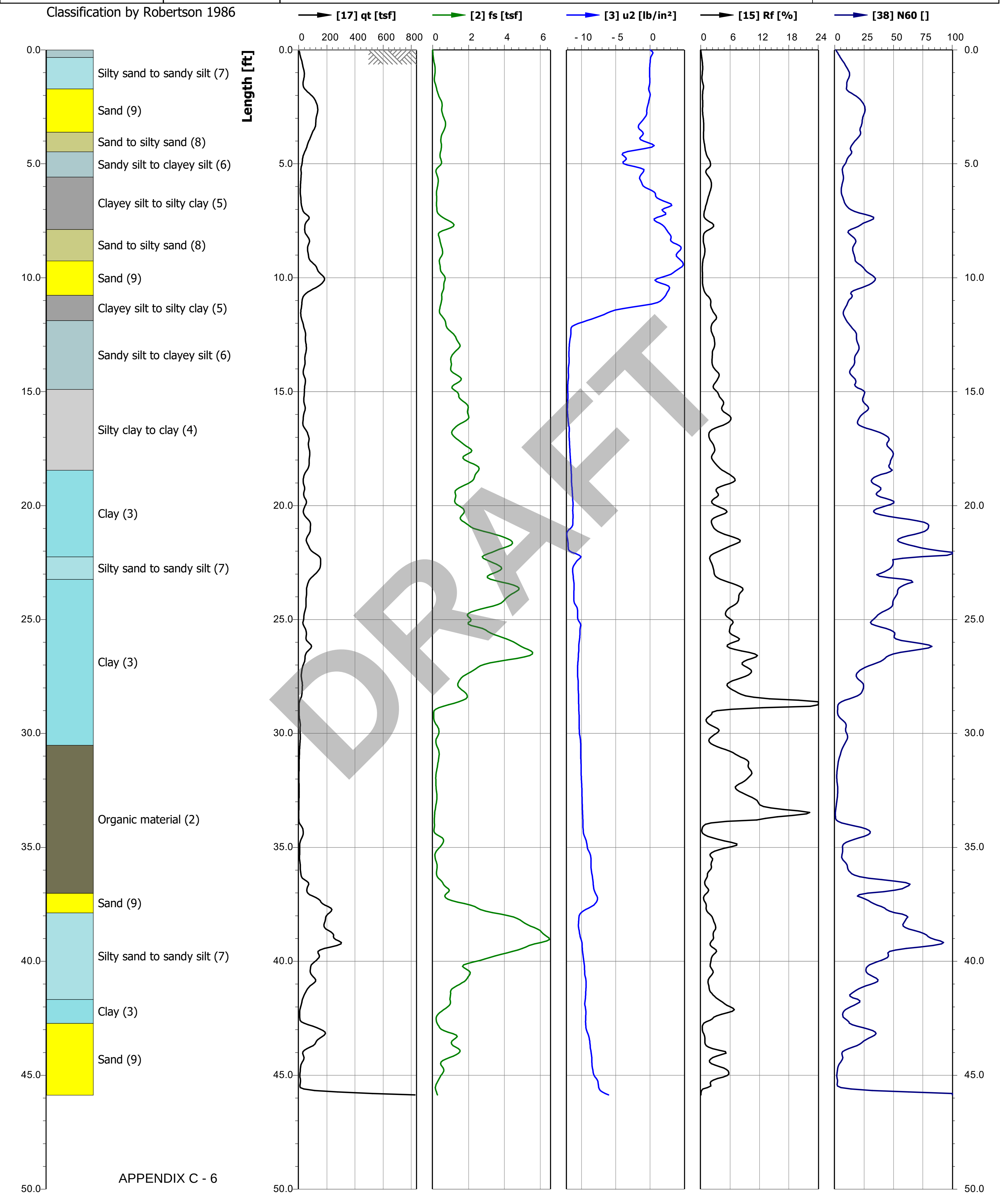
APPENDIX C - 4

BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 39'	Test no: CPT-3
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/22/2021	Standard / class: /
	Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	

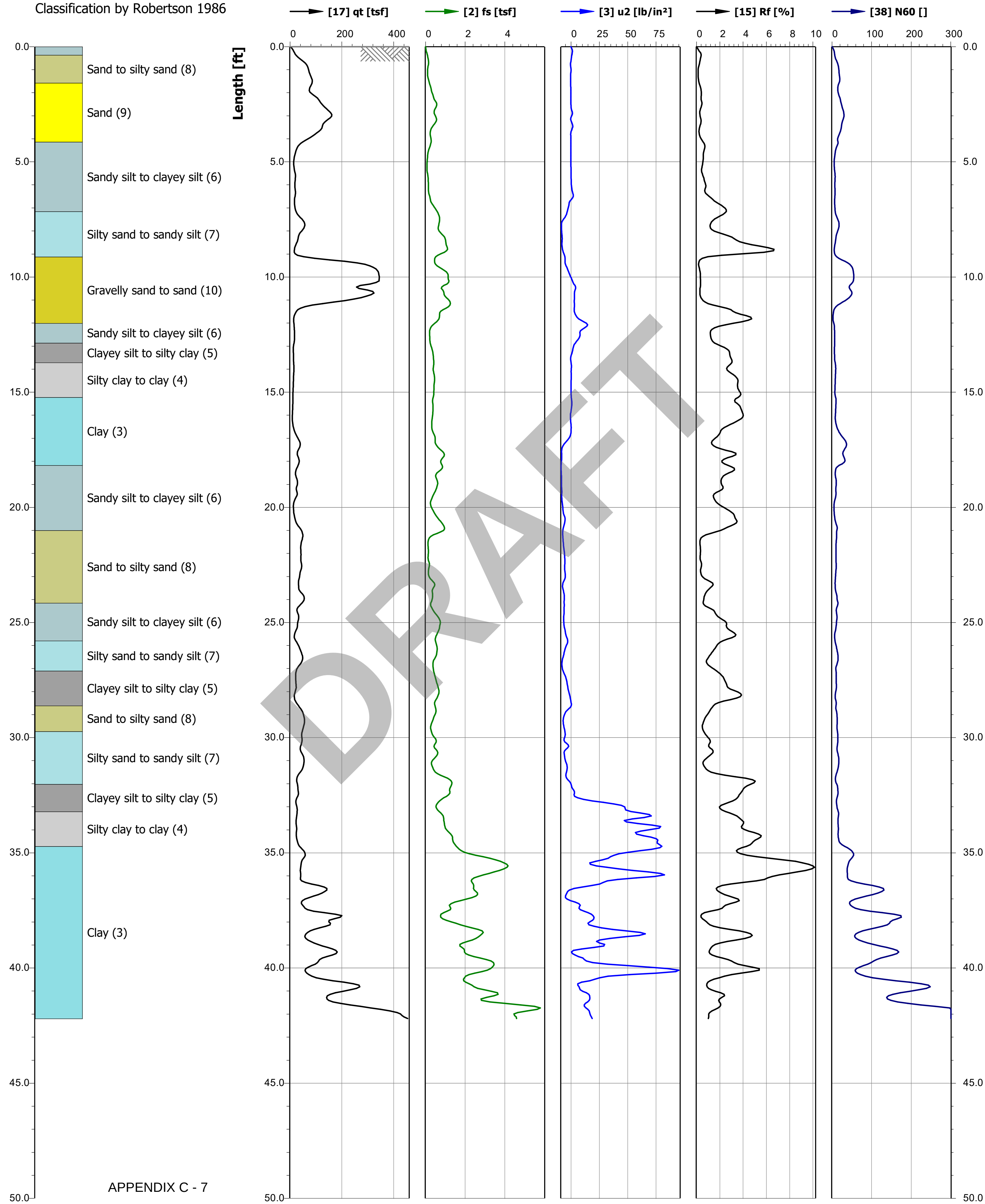


APPENDIX C - 5

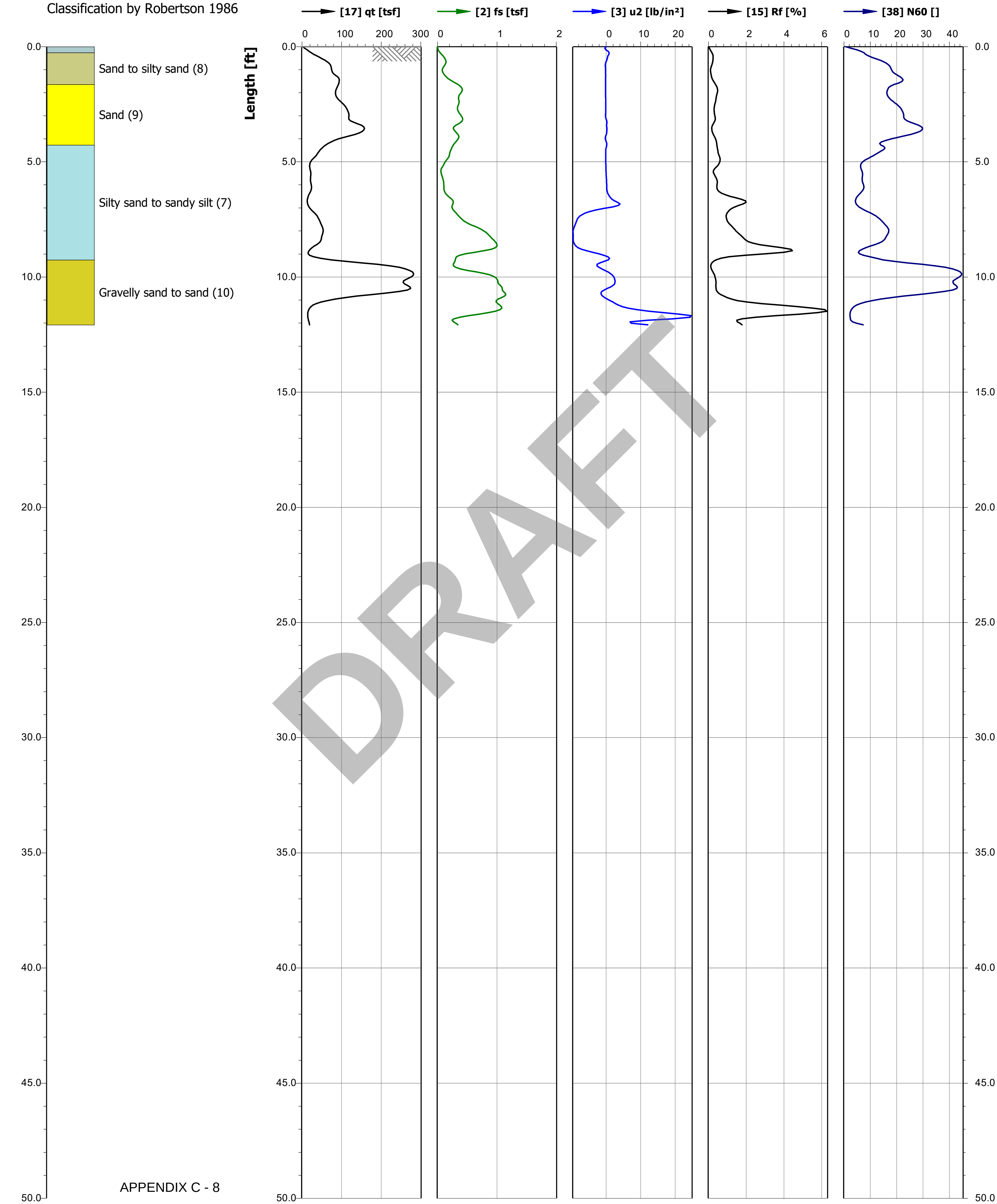
BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 42'	Test no: CPT-4
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/23/2021	Standard / class: /
	Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	



BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 46.5'	Test no: CPT-5
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/23/2021	Standard / class: /
	Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	

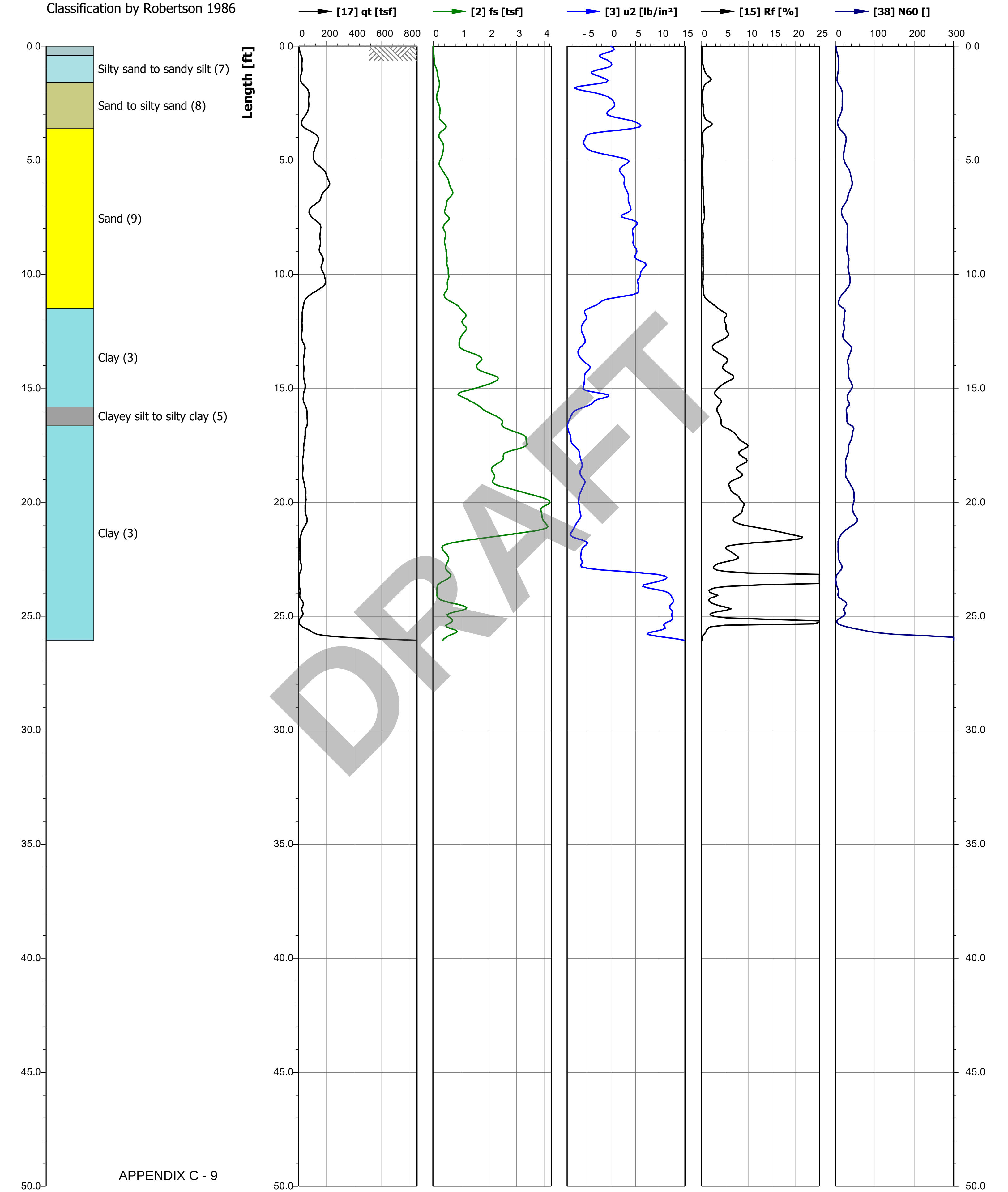


BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 47'	Test no: CPT-5A
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/23/2021	Standard / class: /
	Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	

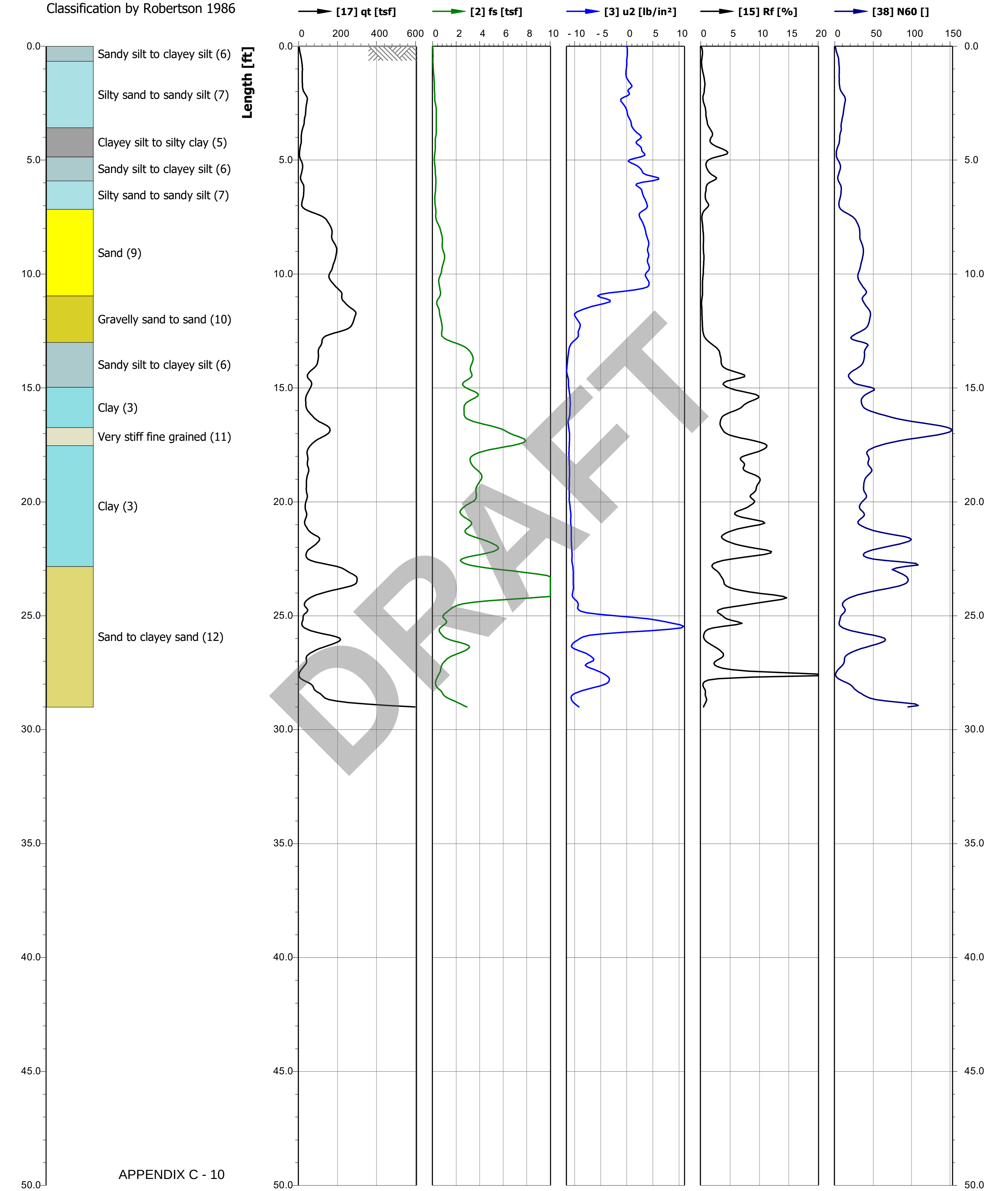


BLACK & VEATCH

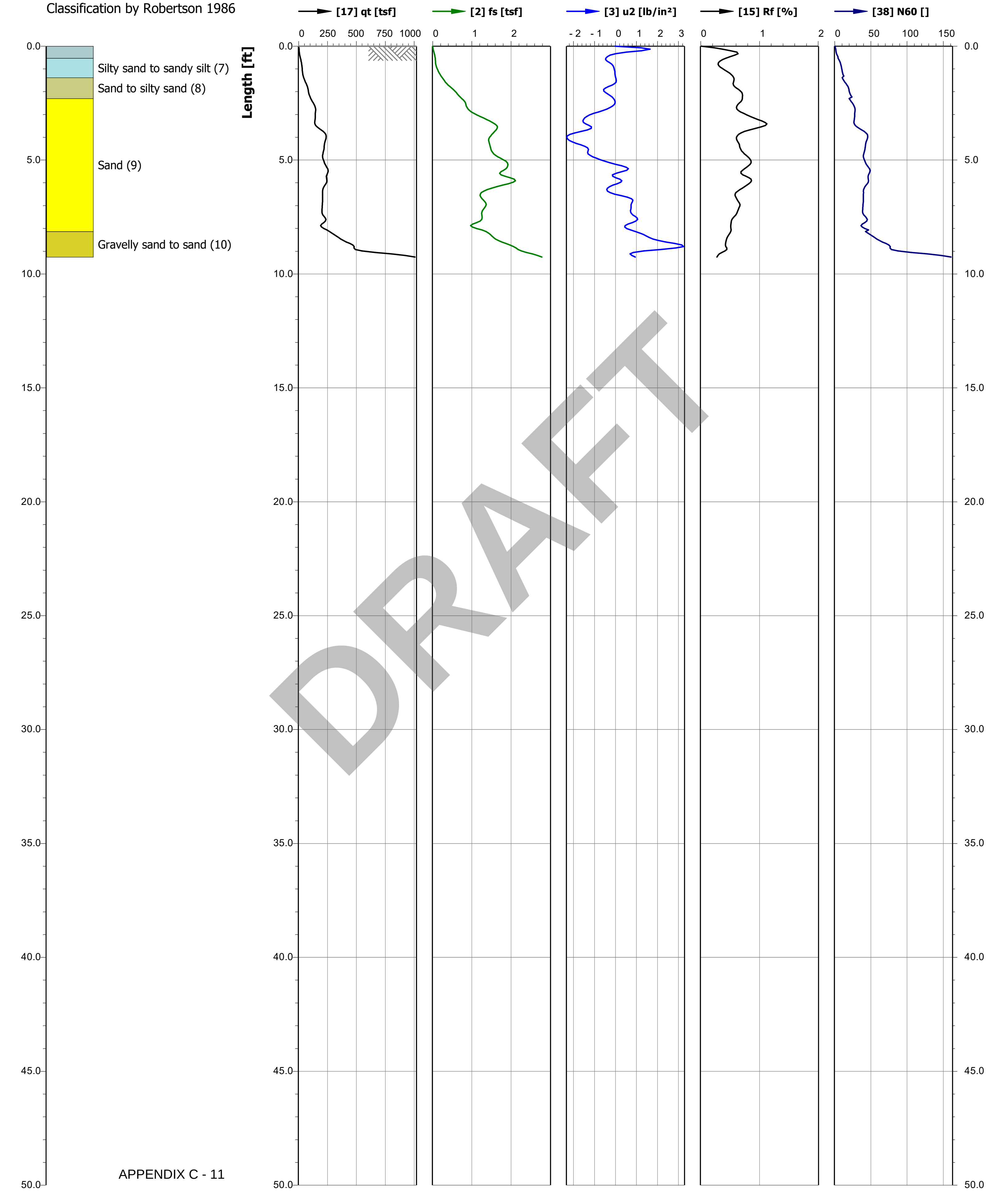
Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 41'	Test no: CPT-6
Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/22/2021	Standard / class: /
Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	



BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 40'	Test no: CPT-7
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/22/2021	Standard / class: /
	Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	

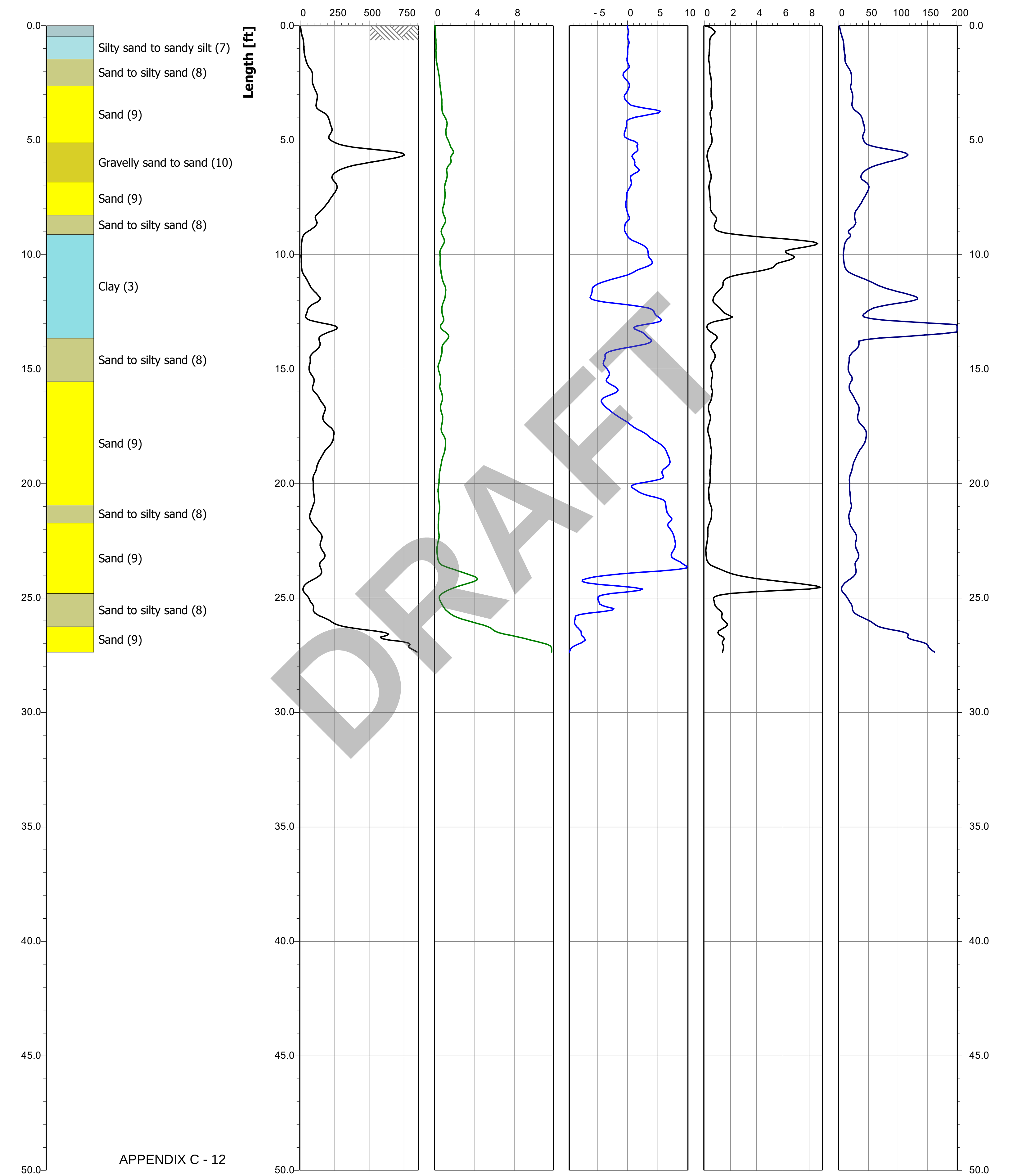


BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 54'	Test no: CPT-8
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/23/2021	Standard / class: /
	Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	

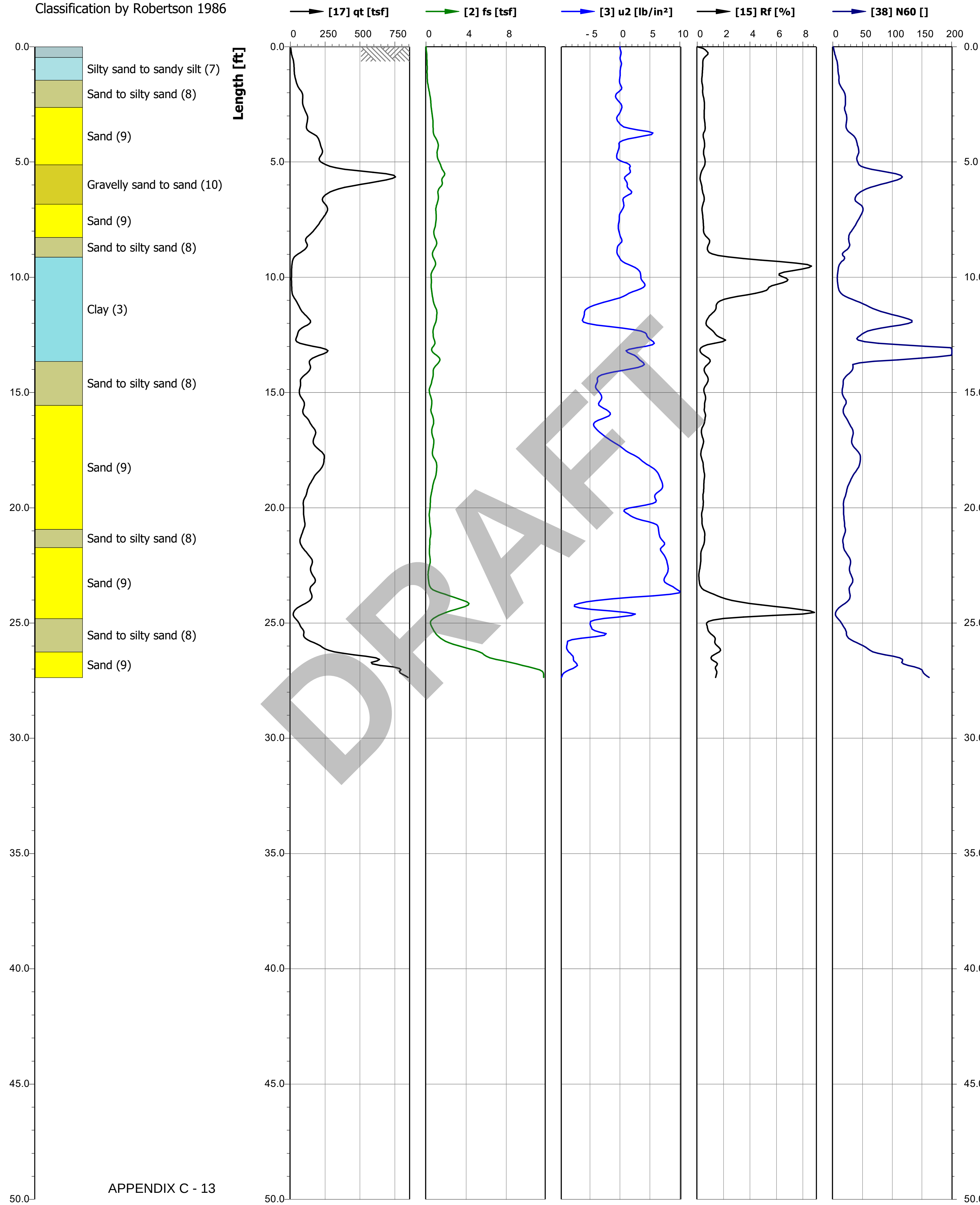


BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 50'	Test no: CPT-8A
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/23/2021	Standard / class: /
	Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	

Classification by Robertson 1986

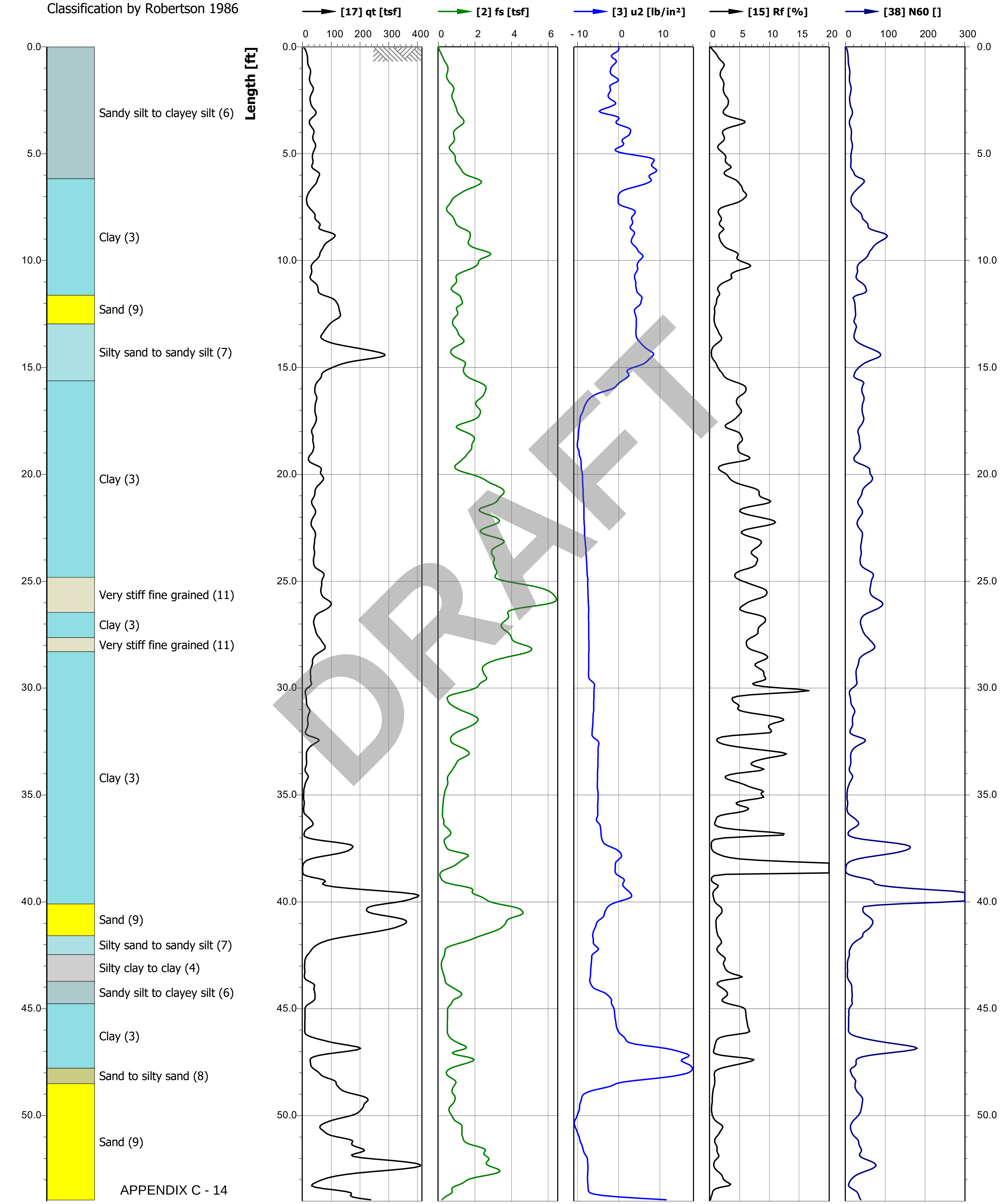


BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 50'	Test no: CPT-8A
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/23/2021	Standard / class: /
	Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	

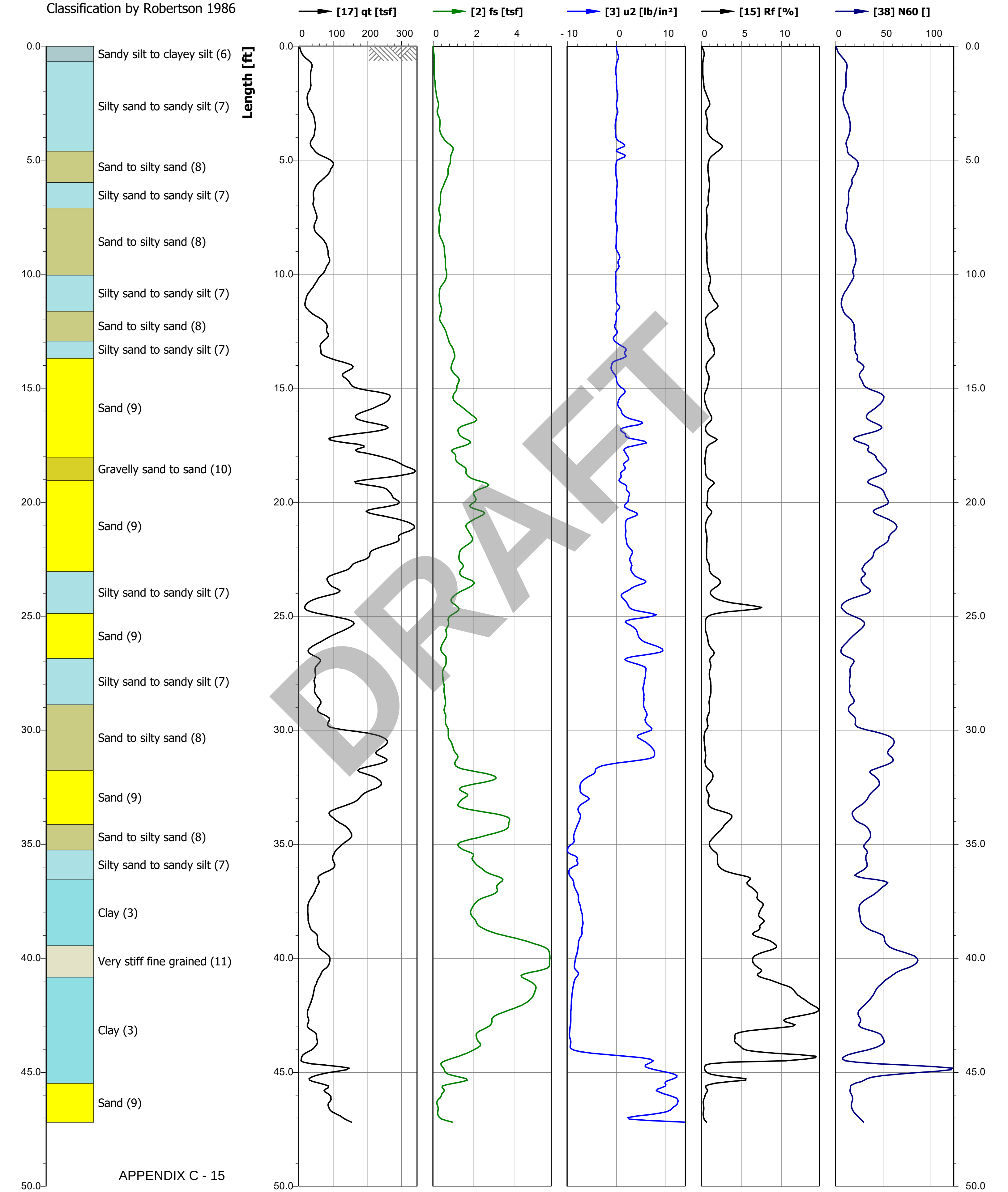


APPENDIX C - 13

BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 48'	Test no: CPT-9
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/23/2021	Standard / class: /
	Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:67
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	



BLACK & VEATCH	Cone no: 5436	Location: Plant City, FL	Position:	Ground level: 61'	Test no: CPT-10
	Tip/sleeve area [cm²]: 10 / 150	Project ID: 403619	Client: SWFWMD	Date: 7/23/2021	Standard / class: /
	Area factor a/b: 0.847 / 0.002	Project: Medard Reservoir		Page: 1/1	Scale: 1:62
	Pore pressure: U2	CPT Sounding performed by AMDRILL, INC.		Coordinate system:	



BORING NUMBER B-1

BLACK & VEATCH
Building a world of difference.

CLIENT SWFWMD
PROJECT NAME Medard Reservoir-Seepage Eval. & Toe Drain Design
PROJECT NUMBER 403619
PROJECT LOCATION Plant City, FL
DATE STARTED 7/28/21 **COMPLETED** 7/29/21
GROUND ELEVATION 56 ft **HOLE SIZE** 4
DRILLING CONTRACTOR AmDrill, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Standard Penetration / Mud Rotary
AT TIME OF DRILLING ---
LOGGED BY AC **CHECKED BY** MC
AT END OF DRILLING ---
NOTES N1299656.5, E601870.2
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0	AU 1		SC		(SC) Light gray to gray, fine-grained Clayey SAND, trace silt and organics.
	AU 2				gray
4.0					52.0
5	AU 3		CH		(CH) Bluish gray, Sandy Fat CLAY with trace organics and orangish brown sand.
6.0					50.0
	SS 4	0-3-5-8 (8)	CH		(CH) Firm, bluish gray, Sandy Fat CLAY with trace organics and orangish brown sand.
8.0					48.0
	SS 5	10-15-13-11 (28)	SP-SC		(SP-SC) Medium Dense, light gray to bluish gray, fine-grained quartz, poorly graded SAND with Clay, trace silt. Drilling mud introduced at 10 feet below ground surface.
10.0					46.0
10	SS 6	3-3-6-7 (9)	CH		(CH) Stiff, bluish gray, Fat CLAY with black phosphate granules, few orange rock fragments and trace sand.
	SS 7	3-4-6-7 (10)			trace rock fragments
15	SS 8	2-4-6-7 (10)			
16.0					40.0
	SS 9	4-6-6-7 (12)	SC		(SC) Medium Dense, light gray to light orange, fine-grained Clayey SAND with black phosphate granules.
18.0					38.0
	SS 10	6-3-4-4 (7)	SC		(SC) Loose, light gray to light orange, fine-grained Clayey SAND with black phosphate granules.
20					
23.5					32.5
25	SS 11	2-3-4 (7)	SP		(SP) Loose to Medium Dense, orangish brown to light brown, fine-grained quartz, poorly graded SAND with trace silt.
30	SS 12	3-5-12 (17)			no recovery in the split spoon, probably due to the catcher falling down. The stratum is assumed to be the same as above except realtive density is medium dense.

DRAFT

(Continued Next Page)

CLIENT SWFWMD

PROJECT NAME Medard Reservoir-Seepage Eval. & Toe Drain Design

PROJECT NUMBER 403619

PROJECT LOCATION Plant City, FL

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30			SP		(SP) Loose to Medium Dense, orangish brown to light brown, fine-grained quartz, poorly graded SAND with trace silt. *(continued)*
				33.5	22.5
35	SS 13	19-33-50/1"	SP		(SP) Very Dense, light orange to orange, fine to medium grained quartz, cemented, poorly graded SAND. Rock fragments where recovered in the split spoon and when crushed between fingers and thumb, the fragments break into sand.
	SS 14	50/5"		38.9	17.1

All elevations in this report are approximate and referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29)

Bottom of borehole at 38.9 feet.

BLACK & VEATCH
Building a world of difference.

BORING NUMBER B-2

CLIENT SWFWMD
PROJECT NAME Medard Reservoir-Seepage Eval. & Toe Drain Design
PROJECT NUMBER 403619
PROJECT LOCATION Plant City, FL
DATE STARTED 7/29/21 **COMPLETED** 7/30/21
GROUND ELEVATION 42 ft **HOLE SIZE** 4
DRILLING CONTRACTOR AmDrill, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Standard Penetration / Mud Rotary
▽ **AT TIME OF DRILLING** 2.50 ft / Elev 39.50 ft
LOGGED BY AC **CHECKED BY** MC
AT END OF DRILLING ---
NOTES N1300101.34, E601485.5
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0	SS 1	5-6-8-9 (14)	SC	1.5	(SC) Medium Dense, light brown to brown, fine-grained fine-grained Clayey SAND with trace silt and organics.	40.5
	SS 2	6-5-7-7 (12)	SP	4.0	(SP) Medium Dense, light orange, fine-grained quartz, poorly graded SAND with trace silt, moist to ▽ wet. Drilling mud introduced at 4 feet below ground surface. gray, trace rock fragments, wet	38.0
5	SS 3	2-1-4-5 (5)	SP	6.0	(SP) Loose, light to dark brown, fine to medium grained quartz, poorly graded SAND with trace silt and black phosphate granules.	36.0
	SS 4	5-6-12-13 (18)	SP		(SP) Medium Dense, light gray to gray, fine to medium grained quartz, poorly graded SAND with trace silt and black phosphate granules.	
10	SS 5	4-9-12-14 (21)		10.0		32.0
	SS 6	6-5-6-8 (11)	SC		(SC) Medium Dense, bluish gray, fine grained Clayey SAND with black phosphate granules.	
	SS 7	5-6-10-10 (16)			bluish gray to light gray	
15	SS 8	4-4-7-7 (11)				
	SS 9	5-7-10-11 (17)				
20	SS 10	4-5-11-17 (16)			bluish gray	
25	SS 11	9-10-13 (23)			slightly cemented	
				28.5		13.5
30	SS 12	7-16-9 (25)			Off-white to very pale brown, LIMESTONE, cemented.	

(Continued Next Page)

BLACK & VEATCH
Building a world of difference.

BORING NUMBER B-2

CLIENT SWFWMD

PROJECT NAME Medard Reservoir-Seepage Eval. & Toe Drain Design

PROJECT NUMBER 403619

PROJECT LOCATION Plant City, FL

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
30					Off-white to very pale brown, LIMESTONE, cemented. *(continued)*	
	SS 13	9-4-2 (6)			slightly cemented	
35						
	SS 14	50/5"			Loss of circulation at 37 feet. Cemented, few fragments up to 1/2-inch in size with recovered.	
	SS 15	5-50/5"		39.4		2.6

All elevations in this report are approximate and referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29)

Bottom of borehole at 39.4 feet.

BLACK & VEATCH
Building a world of difference.

BORING NUMBER B-3

CLIENT SWFWMD
PROJECT NAME Medard Reservoir-Seepage Eval. & Toe Drain Design
PROJECT NUMBER 403619
PROJECT LOCATION Plant City, FL
DATE STARTED 7/30/21 **COMPLETED** 7/30/21
GROUND ELEVATION 42 ft **HOLE SIZE** 4
DRILLING CONTRACTOR AmDrill, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Standard Penetration / Mud Rotary
AT TIME OF DRILLING 4.00 ft / Elev 38.00 ft
LOGGED BY AC **CHECKED BY** MC
AT END OF DRILLING ---
NOTES N1300209.8, E601423.95
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0	SS 1	4-4-6-8 (10)	SP-SC		(SP-SC) Loose, gray to dark gray, fine-grained quartz, poorly graded SAND with Clay, trace roots and silt.	
	SS 2	6-3-2-3 (5)			light brown to orangish brown	
4.0 ▽						38.0
5	SS 3	1-2-1-4 (3)	SP		(SP) Very Loose, light to dark brown, fine-grained quartz, poorly graded SAND with trace silt. Drilling mud introduced at 4 feet below ground surface.	
6.0						36.0
	SS 4	2-5-12-13 (17)	SP		(SP) Medium Dense, light gray to gray, fine-grained quartz, poorly graded SAND with trace silt.	
	SS 5	6-10-18-17 (28)			with trace black phosphate granules	
10	SS 6	5-6-15-17 (21)			light gray to gray, light brown with trace black phosphate granules	
12.0						30.0
	SS 7	5-11-28-22 (39)	SP		(SP) Dense, light gray to gray, fine-grained quartz, poorly graded SAND with black phosphate granules and trace rock fragments.	
14.0						28.0
15	SS 8	6-7-7-11 (14)	SC		(SC) Medium Dense, bluish gray, fine grained Clayey SAND with black phosphate granules.	
	SS 9	2-4-8-12 (12)				
	SS 10	5-8-12-13 (20)				
19.5						22.5
20					Pale brown, off-white LIMESTONE, cemented.	
25	SS 11	50/5"			pale brown, few fragments up to 1/4-inch in size were recovered	
30	SS 12	4-2-4 (6)			Loss of circulation at 28.5 feet. Very pale brown, off-white, few fragments up to 3/4-inch in size were recovered.	

(Continued Next Page)

CLIENT SWFWMD **PROJECT NAME** Medard Reservoir-Seepage Eval. & Toe Drain Design

PROJECT NUMBER 403619 **PROJECT LOCATION** Plant City, FL

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30					Pale brown, off-white LIMESTONE, cemented. *(continued)*
	SS 13	10-50/4"			few fragments up to 1 1/2-inch in size were recovered.
35					
				38.5	3.5

After 3 hammer blows, apparent artesian zone was encountered and split spoon was not advanced further.
All elevations in this report are approximate and referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29)

Bottom of borehole at 38.5 feet.

BLACK & VEATCH Building a world of difference.

BORING NUMBER B-4

CLIENT SWFWMD
PROJECT NAME Medard Reservoir-Seepage Eval. & Toe Drain Design
PROJECT NUMBER 403619
PROJECT LOCATION Plant City, FL
DATE STARTED 7/30/21 **COMPLETED** 7/30/21
GROUND ELEVATION 42 ft **HOLE SIZE** 4
DRILLING CONTRACTOR AmDrill, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Standard Penetration / Mud Rotary
▽ **AT TIME OF DRILLING** 4.00 ft / Elev 38.00 ft
LOGGED BY AC **CHECKED BY** MC
AT END OF DRILLING ---
NOTES N1299999.4, E601558.7
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0	SS 1	4-3-6-7 (9)	SP		(SP) Very Loose, light gray, fine-grained quartz, poorly graded SAND with trace roots and silt.	
1.0						41.0
	SS 2	4-4-6-17 (10)	SC		(SC) Loose, gray to dark gray, fine-grained Clayey SAND with trace roots and silt. Drilling mud introduced at 4 feet below ground surface.	
4.0 ▽						38.0
5	SS 3	1-1-4-9 (5)	SP		(SP) Loose, gray to light brown, fine-grained quartz, poorly graded SAND with trace silt.	
6.0						36.0
	SS 4	8-12-17-18 (29)	SP		(SP) Medium Dense, light gray, fine to medium grained quartz, poorly graded SAND with trace silt and orange rock fragments.	
8.0						34.0
10	SS 5	9-10-7-6 (17)	SC		(SC) Medium Dense, bluish gray, fine grained Clayey SAND with black phosphate granules.	
	SS 6	5-6-9-10 (15)				
	SS 7	7-6-7-12 (13)				
15	SS 8	7-7-9-12 (16)				
	SS 9	4-5-9-12 (14)				
17.5						24.5
20	SS 10	5-5-7-9 (12)			Very pale brown, off-white LIMESTONE, cemented with light brown sand.	
23.5						18.5
25	SS 11	6-5-10 (15)	SC		(SC) Medium Dense, bluish gray to gray, fine grained Clayey SAND with black phosphate granules and trace gray gravel like rock fragments.	
28.5						13.5
30	SS 12	3-5-13 (18)			Very pale brown, off-white LIMESTONE, cemented. Few fragments up to 1/2-inch in size were recovered.	

(Continued Next Page)

BLACK & VEATCH
Building a world of difference.

BORING NUMBER B-4

CLIENT SWFWMD
PROJECT NAME Medard Reservoir-Seepage Eval. & Toe Drain Design
PROJECT NUMBER 403619
PROJECT LOCATION Plant City, FL

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
30					Very pale brown, off-white LIMESTONE, cemented. Few fragments up to 1/2-inch in size were recovered. *(continued)*
	SS 13	14-20-18 (38)			pale brown to off-white
35					
40	SS 14	4-19-9 (28)			40.0 2.0

All elevations in this report are approximate and referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29)

Bottom of borehole at 40.0 feet.

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.		**Lab No.**	09922
Project Name :	Medard Reservoir Seepage Evaluation & Toe Drain Design	**Date Received :**	8/3/2021
Client :	Abhijeet Chordia	**Date Tested :**	8/4/2021
Soil Description :	Dark gray sand w/ trace of clay pieces	**USCS :**	SC
Sample Location :	B1		
Sample Depth :	2' - 4'		

Wet Weight (gr)	204.6	**Natural Moisture Content**	**15.20%**
Dry Weight (gr)	177.6	**-200**	**18.75%**
Tare Weight (gr)			
Water (gr)	27.0		
Weight after Wash (gr)	144.3		
Weight Loss (gr)	33.3		

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants, LLC
5602 Thompson Center Court, Suite 405, Tampa, FL 33634
Tel: 813-889-8960, Fax: 813-889-8754

Date: 8/5/2021 **Lab #** 9937

Project: Medard Reservoir Seepage Evaluation **Client:** Abhijeet Chordia

Technician: CK **Sampled From:** B1 6' - 8'

Atterberg Limits

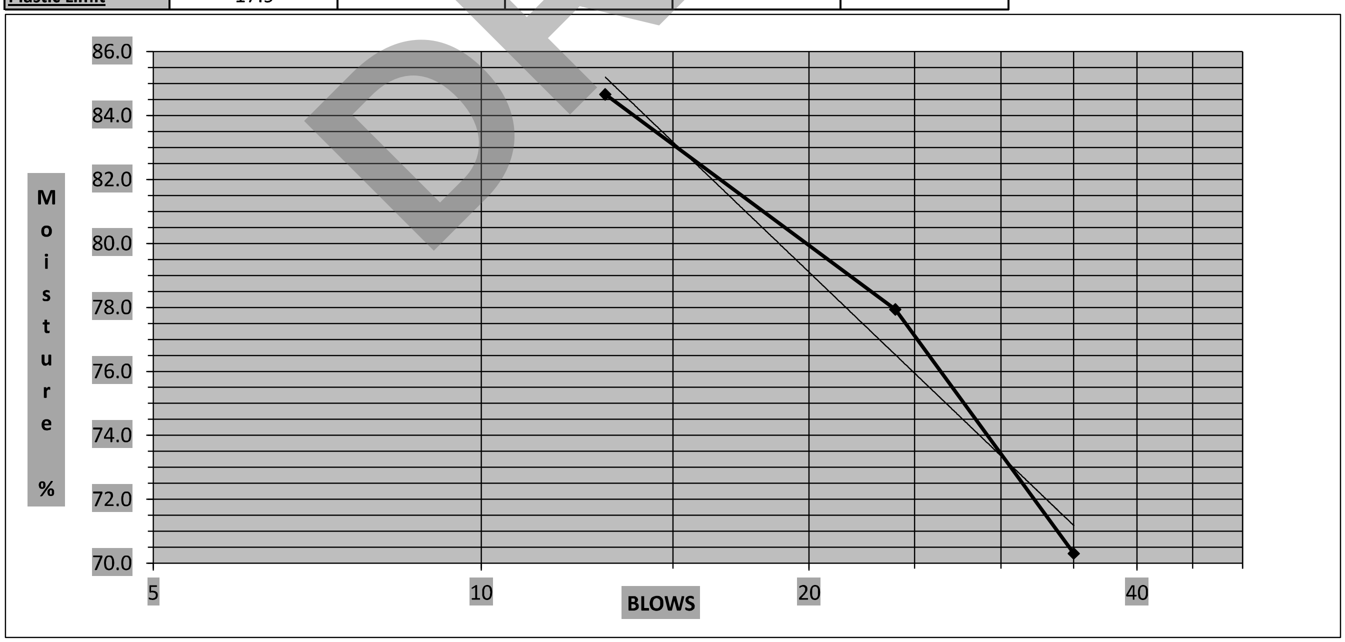
USCS:	CH

Liquid Limit

Run #	1	2	3	4	5	Liquid Limit
Tare #	C7	C3	C4			76
Tare + Wet Soil	34.6	31.79	35.56			
Tare + Dry Soil	27.19	25.15	26.95			
Water (gr)	7.41	6.64	8.61			
Tare (gr)	16.65	16.63	16.78			
Dry Soil	10.54	8.52	10.17			
Moisture %	70.3	77.9	84.7			
Number of Blows	35	24	13			

Plastic Limit

Run #	1	2	3	4	5	Plastic Limit	Plastic Index
Tare #	4					17.9	58.1
Tare + Wet Soil	16.88						
Tare + Dry Soil	16.42						
Water (gr)	0.46						
Tare (gr)	13.85						
Dry Soil	2.57						
Moisture %	17.9						
Plastic Limit	17.9						



DRAFT

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants, LLC
5602 Thompson Center Court, Suite 405, Tampa, FL 33634
Tel: 813-889-8960, Fax: 813-889-8754

Date:	8/5/2021	**Lab #**	9938
Project:	Medard Reservoir Seepage Evaluation	**Client:**	Abhijeet Chordia
Technician:	CK	**Sampled From:**	B2 16' - 18'

Atterberg Limits

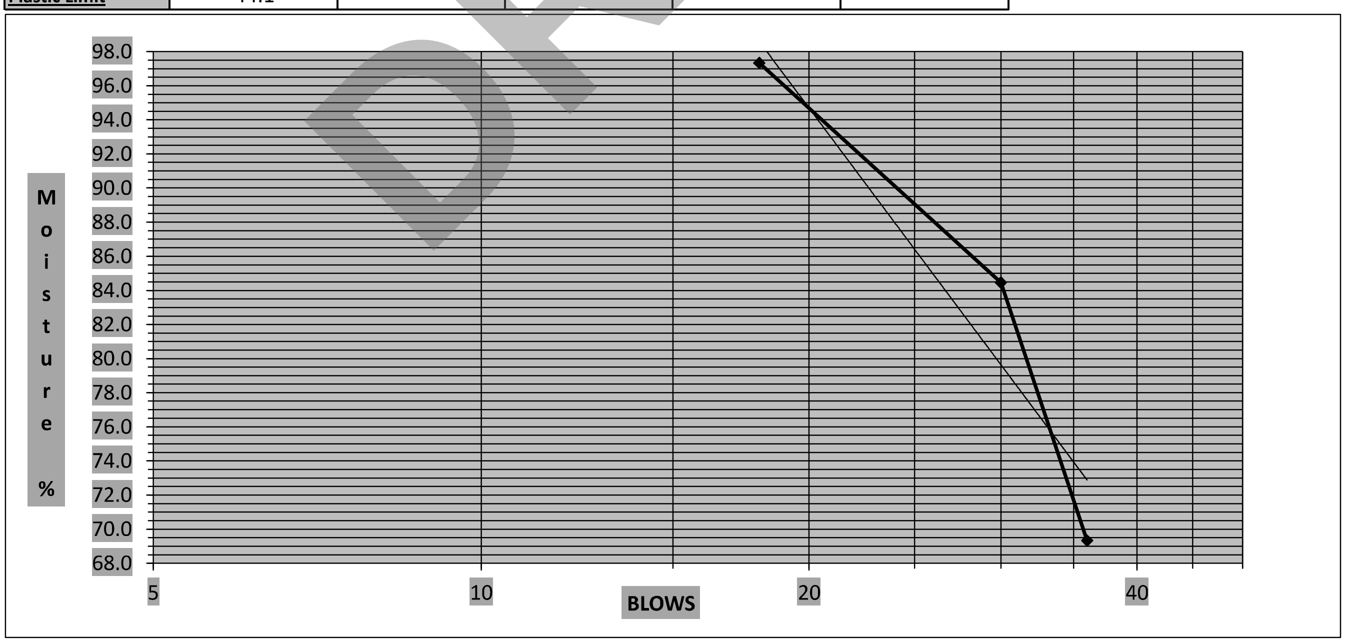
USCS:	MH

Liquid Limit

Run #	1	2	3	4	5	Liquid Limit
Tare #	6	1	C2			86.5
Tare + Wet Soil	28.66	25.3	28.8			
Tare + Dry Soil	22.58	20.03	22.96			
Water (gr)	6.08	5.27	5.84			
Tare (gr)	13.81	13.79	16.96			
Dry Soil	8.77	6.24	6			
Moisture %	69.3	84.5	97.3			
Number of Blows	36	30	18			

Plastic Limit

Run #	1	2	3	4	5	Plastic Limit	Plastic Index
Tare #	2					44.1	42.4
Tare + Wet Soil	16.8						
Tare + Dry Soil	15.9						
Water (gr)	0.9						
Tare (gr)	13.86						
Dry Soil	2.04						
Moisture %	44.1						
Plastic Limit	44.1						



Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants, LLC
5602 Thompson Center Court, Suite 405, Tampa, FL 33634
Tel: 813-889-8960, Fax: 813-889-8754

Date:	8/5/2021	**Lab #**	9939
Project:	Medard Reservoir Seepage Evaluation	**Client:**	Abhijeet Chordia
Technician:	CK	**Sampled From:**	B3 16' - 18'

Atterberg Limits

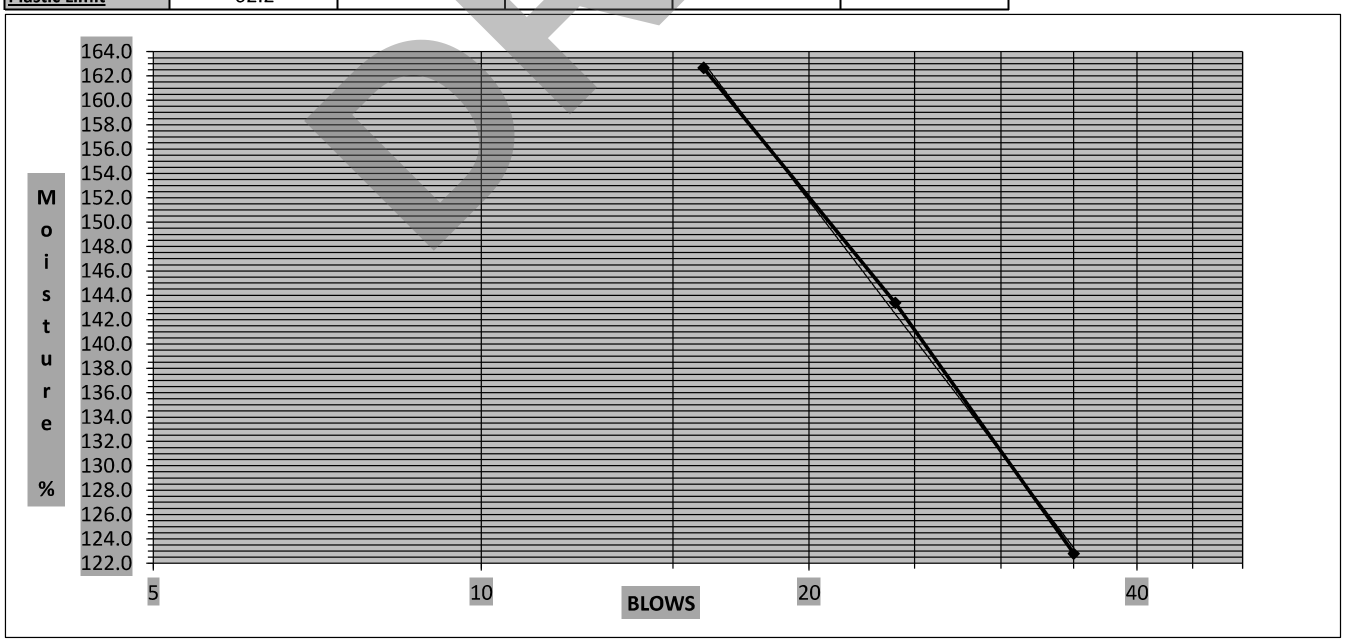
USCS:	MH

Liquid Limit

Run #	1	2	3	4	5	Liquid Limit
Tare #	3	C5	8			140.5
Tare + Wet Soil	27.15	27.37	26.35			
Tare + Dry Soil	19.82	20.99	18.64			
Water (gr)	7.33	6.38	7.71			
Tare (gr)	13.85	16.54	13.9			
Dry Soil	5.97	4.45	4.74			
Moisture %	122.8	143.4	162.7			
Number of Blows	35	24	16			

Plastic Limit

Run #	1	2	3	4	5	Plastic Limit	Plastic Index
Tare #	C6					62.2	78.3
Tare + Wet Soil	19.2						
Tare + Dry Soil	18.18						
Water (gr)	1.02						
Tare (gr)	16.54						
Dry Soil	1.64						
Moisture %	62.2						
Plastic Limit	62.2						



Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.		**Lab No.**	09923
Project Name :	Medard Reservoir Seepage Evaluation & Toe Drain Design	**Date Received :**	8/3/2021
Client :	Abhijeet Chordia	**Date Tested :**	8/4/2021
Soil Description :	Gray sandy clay w/ trace of roots	**USCS :**	CH
Sample Location :	B1		
Sample Depth :	6' - 8'		

Wet Weight (gr)	141.1	**Natural Moisture Content**	**31.26%**
Dry Weight (gr)	107.5	**-200**	**65.30%**
Tare Weight (gr)			
Water (gr)	33.6		
Weight after Wash (gr)	37.3		
Weight Loss (gr)	70.2		

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Ed Zisman

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.

Project Name : Medard Reservoir Seepage Evaluation & Toe Drain Design

Client : Abhijeet Chordia

Soil Description : Light gray sandy clay w/ fine root veins

Sample Location : B1

Sample Depth : 12' - 14'

Lab No. 09924

Date Received : 8/3/2021

Date Tested : 8/4/2021

USCS : CH

Wet Weight (gr)	152.6	**Natural Moisture Content**	**57.16%**
Dry Weight (gr)	97.1	**-200**	**85.58%**
Tare Weight (gr)			
Water (gr)	55.5		
Weight after Wash (gr)	14.0		
Weight Loss (gr)	83.1		

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.		**Lab No.**	09925
Project Name :	Medard Reservoir Seepage Evaluation & Toe Drain Design	**Date Received :**	8/3/2021
Client :	Abhijeet Chordia	**Date Tested :**	8/4/2021
Soil Description :	Light gray clayey sand	**USCS :**	SC
Sample Location :	B1		
Sample Depth :	18' - 20'		

Wet Weight (gr)	225.8	**Natural Moisture Content**	**21.73%**
Dry Weight (gr)	185.5	**-200**	**17.04%**
Tare Weight (gr)			
Water (gr)	40.3		
Weight after Wash (gr)	153.9		
Weight Loss (gr)	31.6		

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.

Lab No. 09926

Project Name : Medard Reservoir Seepage Evaluation & Toe Drain Design

Date Received : 8/3/2021

Client : Abhijeet Chordia

Date Tested : 8/4/2021

Soil Description : Gray sand w/ clay pieces and white sand

USCS : SP-SC

Sample Location : B2

Sample Depth : 0' - 2'

Wet Weight (gr)	230.3	**Natural Moisture Content**	**13.56%**
Dry Weight (gr)	202.8	**-200**	**12.48%**
Tare Weight (gr)			
Water (gr)	27.5		
Weight after Wash (gr)	177.5		
Weight Loss (gr)	25.3		

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Ed Zisman

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.		**Lab No.**	09927
Project Name :	Medard Reservoir Seepage Evaluation & Toe Drain Design	**Date Received :**	8/3/2021
Client :	Abhijeet Chordia	**Date Tested :**	8/4/2021
Soil Description :	Greenish gray clayey sand	**USCS :**	SC
Sample Location :	B2		
Sample Depth :	10' - 12'		

Wet Weight (gr)	227.5	**Natural Moisture Content**	**28.31%**
Dry Weight (gr)	177.3	**-200**	**23.75%**
Tare Weight (gr)			
Water (gr)	50.2		
Weight after Wash (gr)	135.2		
Weight Loss (gr)	42.1		

DRAFT

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Ed Zisman

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.		**Lab No.**	09928
Project Name :	Medard Reservoir Seepage Evaluation & Toe Drain Design	**Date Received :**	8/3/2021
Client :	Abhijeet Chordia	**Date Tested :**	8/4/2021
Soil Description :	Greenish gray clayey sand	**USCS :**	SC
Sample Location :	B2		
Sample Depth :	14' - 16'		

Wet Weight (gr)	234.5	**Natural Moisture Content**	**38.27%**
Dry Weight (gr)	169.6	**-200**	**30.25%**
Tare Weight (gr)			
Water (gr)	64.9		
Weight after Wash (gr)	118.3		
Weight Loss (gr)	51.3		

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Ed Zisman

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.		**Lab No.**	09929
Project Name :	Medard Reservoir Seepage Evaluation & Toe Drain Design	**Date Received :**	8/3/2021
Client :	Abhijeet Chordia	**Date Tested :**	8/4/2021
Soil Description :	Greenish gray clayey sand	**USCS :**	SC
Sample Location :	B2		
Sample Depth :	16' - 18'		

Wet Weight (gr)	99.6	**Natural Moisture Content**	**39.89%**
Dry Weight (gr)	71.2	**-200**	**20.93%**
Tare Weight (gr)			
Water (gr)	28.4		
Weight after Wash (gr)	56.3		
Weight Loss (gr)	14.9		

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Ed Zisman

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.		**Lab No.**	09930
Project Name :	Medard Reservoir Seepage Evaluation & Toe Drain Design	**Date Received :**	8/3/2021
Client :	Abhijeet Chordia	**Date Tested :**	8/4/2021
Soil Description :	Greenish gray clayey sand	**USCS :**	SC
Sample Location :	B2		
Sample Depth :	18' - 20'		

Wet Weight (gr)	158.2	**Natural Moisture Content**	**45.00%**
Dry Weight (gr)	109.1	**-200**	**13.47%**
Tare Weight (gr)			
Water (gr)	49.1		
Weight after Wash (gr)	94.4		
Weight Loss (gr)	14.7		

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Ed Zisman

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.		**Lab No.**	09931
Project Name :	Medard Reservoir Seepage Evaluation & Toe Drain Design	**Date Received :**	8/3/2021
Client :	Abhijeet Chordia	**Date Tested :**	8/4/2021
Soil Description :	Dark gray clayey sand w/ white sand	**USCS :**	SP-SC
Sample Location :	B3		
Sample Depth :	2' - 4'		

Wet Weight (gr)	174.7	**Natural Moisture Content**	**20.40%**
Dry Weight (gr)	145.1	**-200**	**10.54%**
Tare Weight (gr)			
Water (gr)	29.6		
Weight after Wash (gr)	129.8		
Weight Loss (gr)	15.3		

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Ed Zisman

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.		**Lab No.**	09932
Project Name :	Medard Reservoir Seepage Evaluation & Toe Drain Design	**Date Received :**	8/3/2021
Client :	Abhijeet Chordia	**Date Tested :**	8/4/2021
Soil Description :	Grayish brown sand	**USCS :**	SP
Sample Location :	B3		
Sample Depth :	4' - 6'		

Wet Weight (gr)	249.0	**Natural Moisture Content**	**19.48%**
Dry Weight (gr)	208.4	**-200**	**2.21%**
Tare Weight (gr)			
Water (gr)	40.6		
Weight after Wash (gr)	203.8		
Weight Loss (gr)	4.6		

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.		**Lab No.**	09933
Project Name :	Medard Reservoir Seepage Evaluation & Toe Drain Design	**Date Received :**	8/3/2021
Client :	Abhijeet Chordia	**Date Tested :**	8/4/2021
Soil Description :	Gray clayey sand	**USCS :**	SC
Sample Location :	B3		
Sample Depth :	16' - 18'		

Wet Weight (gr)	108.3	**Natural Moisture Content**	**51.89%**
Dry Weight (gr)	71.3	**-200**	**38.57%**
Tare Weight (gr)			
Water (gr)	37.0		
Weight after Wash (gr)	43.8		
Weight Loss (gr)	27.5		

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Ed Zisman

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.		**Lab No.**	09934
Project Name :	Medard Reservoir Seepage Evaluation & Toe Drain Design	**Date Received :**	8/3/2021
Client :	Abhijeet Chordia	**Date Tested :**	8/4/2021
Soil Description :	Dark grayish brown clayey sand w/ trace of lime rock	**USCS :**	SC
Sample Location :	B4		
Sample Depth :	2' - 4'		

Wet Weight (gr)	170.7	**Natural Moisture Content**	**16.68%**
Dry Weight (gr)	146.3	**-200**	**19.89%**
Tare Weight (gr)			
Water (gr)	24.4		
Weight after Wash (gr)	117.2		
Weight Loss (gr)	29.1		

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.

Project Name : Medard Reservoir Seepage Evaluation & Toe Drain Design

Client : Abhijeet Chordia

Soil Description : Greenish gray clayey sand

Sample Location : B4

Sample Depth : 8' - 10'

Lab No. 09935

Date Received : 8/3/2021

Date Tested : 8/4/2021

USCS : SC

Wet Weight (gr)	124.8	**Natural Moisture Content**	**23.08%**
Dry Weight (gr)	101.4	**-200**	**23.67%**
Tare Weight (gr)			
Water (gr)	23.4		
Weight after Wash (gr)	77.4		
Weight Loss (gr)	24.0		

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Atlas Technical Consultants LLC
5602 Thompson Center Court, Suite 405
Tel:813-889-8960| Fax:813-889-8754

NMC % / -200 Wash

Project No.		**Lab No.**	09936
Project Name :	Medard Reservoir Seepage Evaluation & Toe Drain Design	**Date Received :**	8/3/2021
Client :	Abhijeet Chordia	**Date Tested :**	8/4/2021
Soil Description :	Greenish gray clayey sand	**USCS :**	SC
Sample Location :	B4		
Sample Depth :	14' - 16'		

Wet Weight (gr)	224.3	**Natural Moisture Content**	**28.17%**
Dry Weight (gr)	175.0	**-200**	**13.94%**
Tare Weight (gr)			
Water (gr)	49.3		
Weight after Wash (gr)	150.6		
Weight Loss (gr)	24.4		

DRAFT

Respectfully Submitted,
Atlas Technical Consultants LLC
COA #7783

Ed Zisman

Edward Zisman, P.E., P.G.
Geotechnical Department Manager
FL P.E. License No. 53451

Appendix D. Geotechnical and Laboratory Services Report by Tierra Inc.

TIERRA

October 15, 2021

Black & Veatch Corporation
3405 W. Dr. Martin Luther King Jr. Blvd., Suite 125
Tampa, FL 33607

Attn: Mr. Abhijeet Chordia, M.Sc., P.E.
Geotechnical Engineer – Water Business

RE: **Geotechnical Field and Laboratory Services**
Medard Reservoir – Toe Drain Design
Hillsborough County, Florida
Black & Veatch Project No. 410374
Tierra Project No.: 6511-21-328

Mr. Chordia:

Tierra, Inc. (Tierra) has completed the geotechnical field and laboratory services for the referenced project. Attached with this letter are the following:

- Boring Location Plan
- Soil Profiles
- Laboratory Test Results

We appreciate the opportunity to offer our services and look forward to working with you on this project. Please do not hesitate to contact our office with any questions regarding this letter or attachments.

Respectfully Submitted,

TIERRA, INC.

Joseph R. Antinori, P.E.
Geotechnical Engineer

7351 Temple Terrace Highway • Tampa, FL 33637
Phone (813) 989-1354 • Fax (813) 989-1355

BORING LOCATION PLAN

0 100'

PLAN SCALE

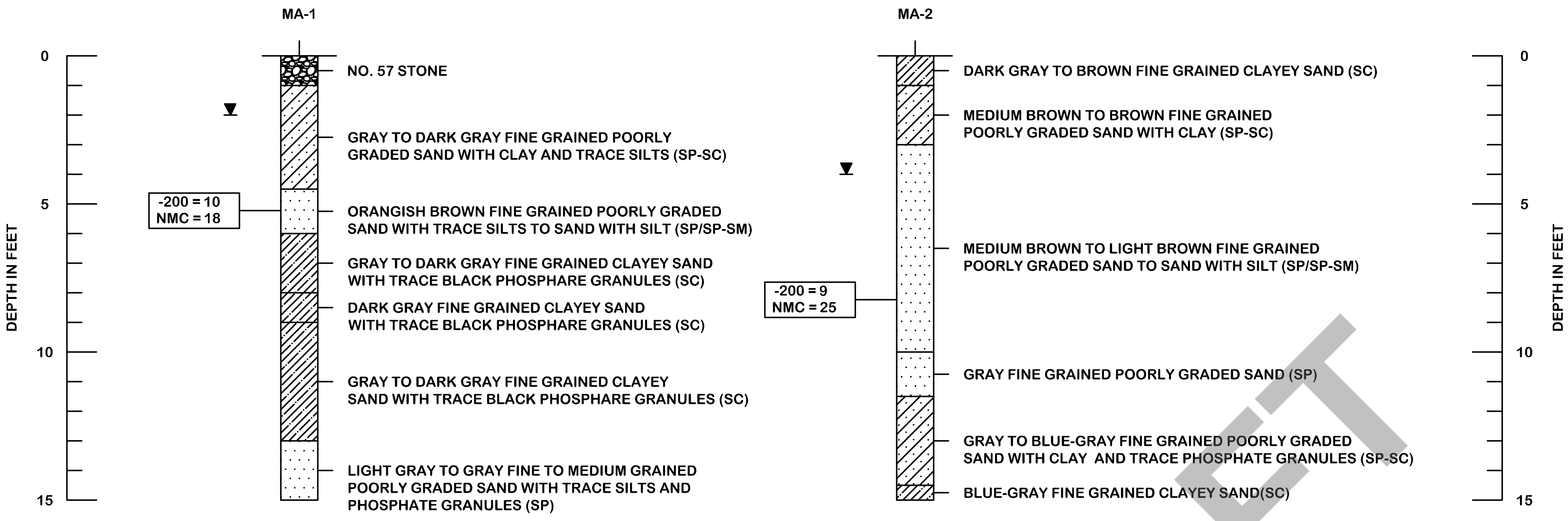
N

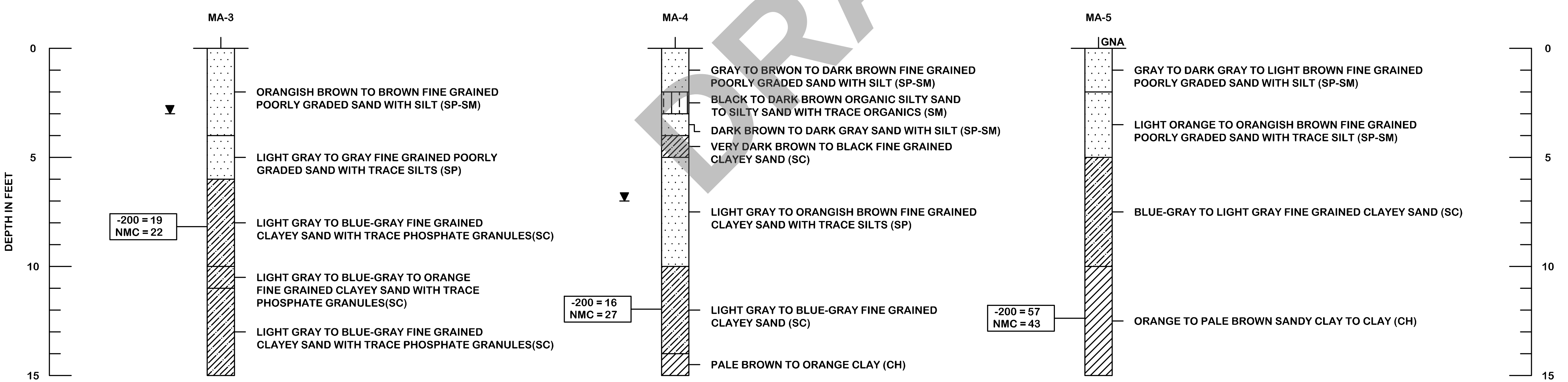
LEGEND

APPROXIMATE LOCATION OF AUGER BORING

DRAWN BY: SW CHECKED BY: JRA	APPROVED BY: JRA DATE: OCT 2021	ENGINEER OF RECORD: JOSEPH R. ANTINORI, P.E. FLORIDA LICENSE NO.: 73176	TIERRA 7351 Temple Terrace Highway Tampa, Florida 33637 Phone: 813-989-1354 Fax: 813-989-1355	SCALE: NOTED	PROJECT NUMBER: 6511-21-328	GEOTECHNICAL ENGINEERING SERVICES EDWARD MEDARD - RESERVOIR DAM HILLSBOROUGH COUNTY, FLORIDA	SHEET 1

SOIL PROFILES





LEGEND

SAND TO SAND WITH SILT (SP/SP-SM)
CLAYEY SAND (SC)
SILTY SAND (SM)
SANDY CLAY TO CLAY (CH)
SAND WITH CLAY (SP-SC)
NO. 57 STONE

▼	GROUNDWATER LEVEL ENCOUNTERED DURING INVESTIGATION
SP	UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2488) GROUP SYMBOL AS DETERMINED BY VISUAL REVIEW COMPLETED BY REPRESENTATIVE OF BLACK & VEATCH AND LABORATORY TESTING COMPLETED BY TIERRA, INC. ON SELECTED SAMPLES FOR CONFIRMATION OF VISUAL REVIEW
-200	PERCENT PASSING #200 SIEVE
NMC	NATURAL MOISTURE CONTENT (%)
GNA	GROUNDWATER NOT APPARENT

DRAWN BY: SW CHECKED BY: JRA	APPROVED BY: JRA DATE: OCT 2021	ENGINEER OF RECORD: JOSEPH R. ANTINORI, P.E. FLORIDA LICENSE NO.: 73176	TIERRA 7351 Temple Terrace Highway Tampa, Florida 33637 Phone: 813-989-1354 Fax: 813-989-1355	SCALE: NOTED	PROJECT NUMBER: 6511-21-328	GEOTECHNICAL ENGINEERING SERVICES EDWARD MEDARD - RESERVOIR DAM HILLSBOROUGH COUNTY, FLORIDA	SHEET 2

Tierra, Inc.

Geotechnical Laboratory Services
Edward Medard Park
Hillsborough County, Florida
Tierra Project No. 6511-21-328

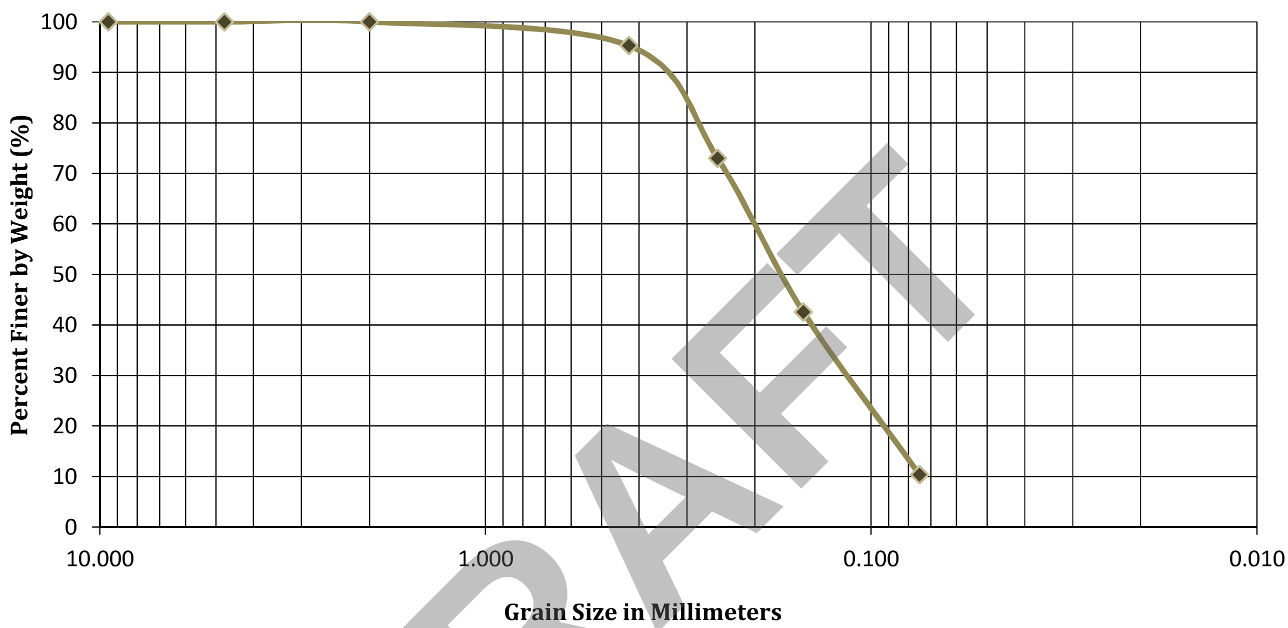
Boring Name	Depth (ft)	Sieve Analyses - % Passing					Moisture Content
		#10	#40	#60	#100	#200	
MA-1	4.5 - 6.0	100	95	73	43	10	18
MA-2	3.0 - 10.0	100	96	74	32	9	25
MA-3	6.0 - 10.0	100	91	55	30	19	22
MA-4	10.0 - 14.0	100	98	83	44	16	27
MA-5	10.0 - 15.0	100	94	84	72	57	43

Grain Size Distribution Report
Edward Medard - Reservoir Dam
Hillsborough County, Florida

Tierra Project No.: 6511-21-328

Station	Offset	Sample No.	Depth (ft)
---	---	MA-1	4.5-6.0

Grain Size Distribution Curve



Material Description	Classification	
	USCS	AASHTO
	SP-SM	---

Sieve Number	Diameter (mm)	Percent Finer by Weight (%)	Coefficients			
3/4"	19.000	100	D_{10}	0.075		
3/8"	9.500	100	D_{15}	0.082	D_{30}	0.114
4	4.750	100	D_{50}	0.170	D_{60}	0.201
10	2.000	100	D_{85}	0.333	D_{90}	0.375
40	0.425	95.3	D_{95}	0.422		
60	0.250	73				
100	0.150	42.6	C_U	2.679	C_C	0.868
200	0.075	10.4				

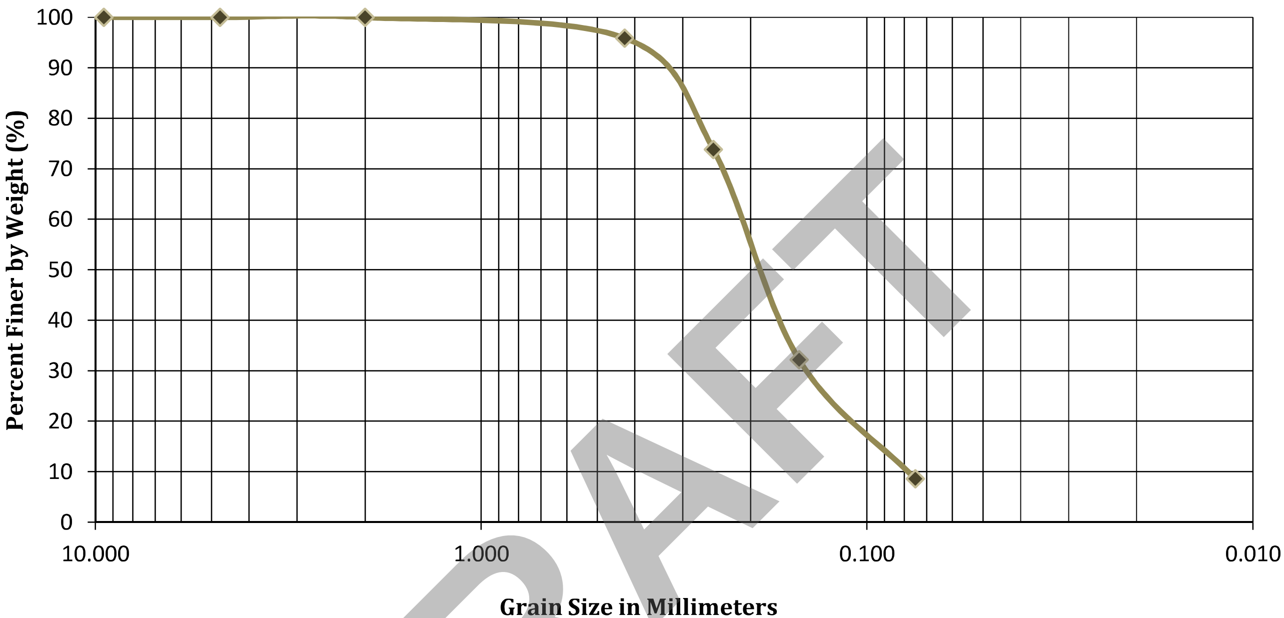
TIERRA
GEOTECHNICAL • MATERIALS
ENVIRONMENTAL • ENGINEERING

Grain Size Distribution Report
Edward Medard - Reservoir Dam
Hillsborough County, Florida

Tierra Project No.: 6511-21-328

Station	Offset	Sample No.	Depth (ft)
---	---	MA-2	3.0-10.0

Grain Size Distribution Curve



Material Description	Classification	
	USCS	AASHTO
	SP-SM	---

Sieve Number	Diameter (mm)	Percent Finer by Weight (%)	Coefficients			
3/4"	19.000	100	D_{10}	0.078		
3/8"	9.500	100	D_{15}	0.093	D_{30}	0.141
4	4.750	100	D_{50}	0.187	D_{60}	0.211
10	2.000	100	D_{85}	0.327	D_{90}	0.369
40	0.425	95.9	D_{95}	0.416		
60	0.250	73.8				
100	0.150	32.2	C_U	2.700	C_C	1.199
200	0.075	8.6				

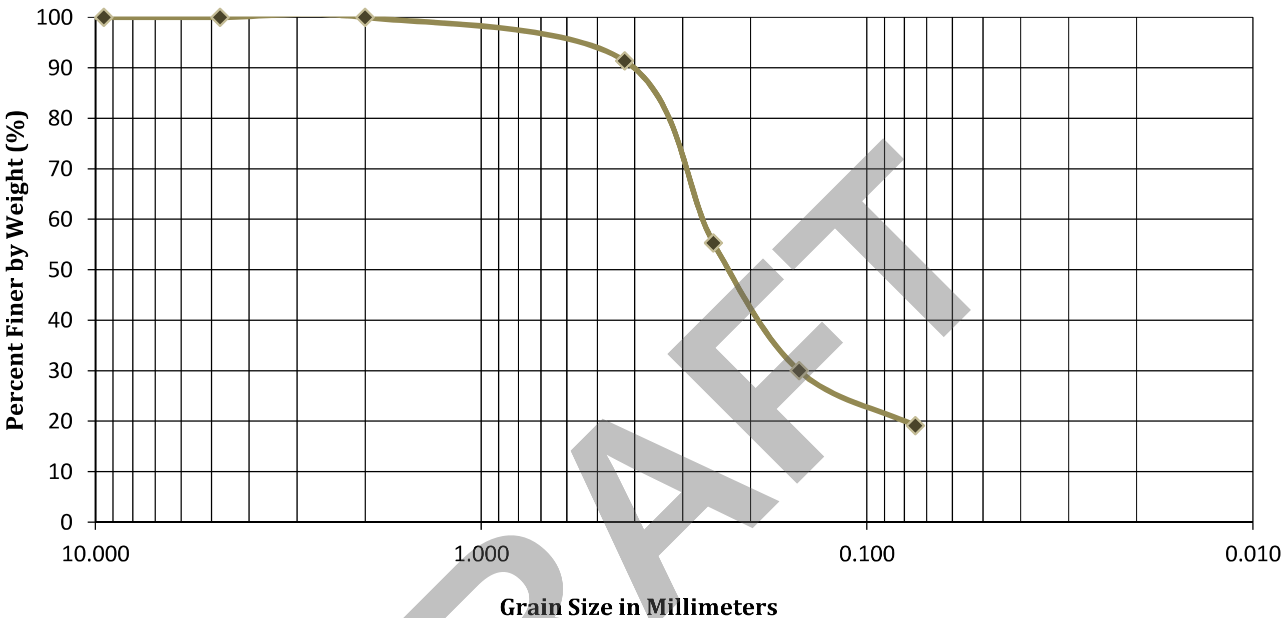
TIERRA
GEOTECHNICAL • MATERIALS
ENVIRONMENTAL • ENGINEERING

Grain Size Distribution Report
Edward Medard - Reservoir Dam
Hillsborough County, Florida

Tierra Project No.: 6511-21-328

Station	Offset	Sample No.	Depth (ft)
---	---	MA-3	6.0-10.0

Grain Size Distribution Curve



Material Description	Classification USCS	Classification AASHTO
	SC	---

Sieve Number	Diameter (mm)	Percent Finer by Weight (%)
3/4"	19.000	100
3/8"	9.500	100
4	4.750	100
10	2.000	100
40	0.425	91.4
60	0.250	55.3
100	0.150	30.0
200	0.075	19.1

Coefficients

D_{10}	---		
D_{15}	---	D_{30}	0.150
D_{50}	0.225	D_{60}	0.268
D_{85}	0.387	D_{90}	0.416
D_{95}	0.813		
C_U	---	C_C	---

TIERRA
GEOTECHNICAL • MATERIALS
ENVIRONMENTAL • ENGINEERING

Grain Size Distribution Report
Edward Medard - Reservoir Dam
Hillsborough County, Florida

Tierra Project No.: 6511-21-328

Station	Offset	Sample No.	Depth (ft)
---	---	MA-4	10.0-14.0

Grain Size Distribution Curve

Material Description	Classification USCS	Classification AASHTO
	SC	---

Sieve Number	Diameter (mm)	Percent Finer by Weight (%)
3/4"	19.000	100
3/8"	9.500	100
4	4.750	100
10	2.000	100
40	0.425	97.7
60	0.250	83.2
100	0.150	44.4
200	0.075	16.3

Coefficients

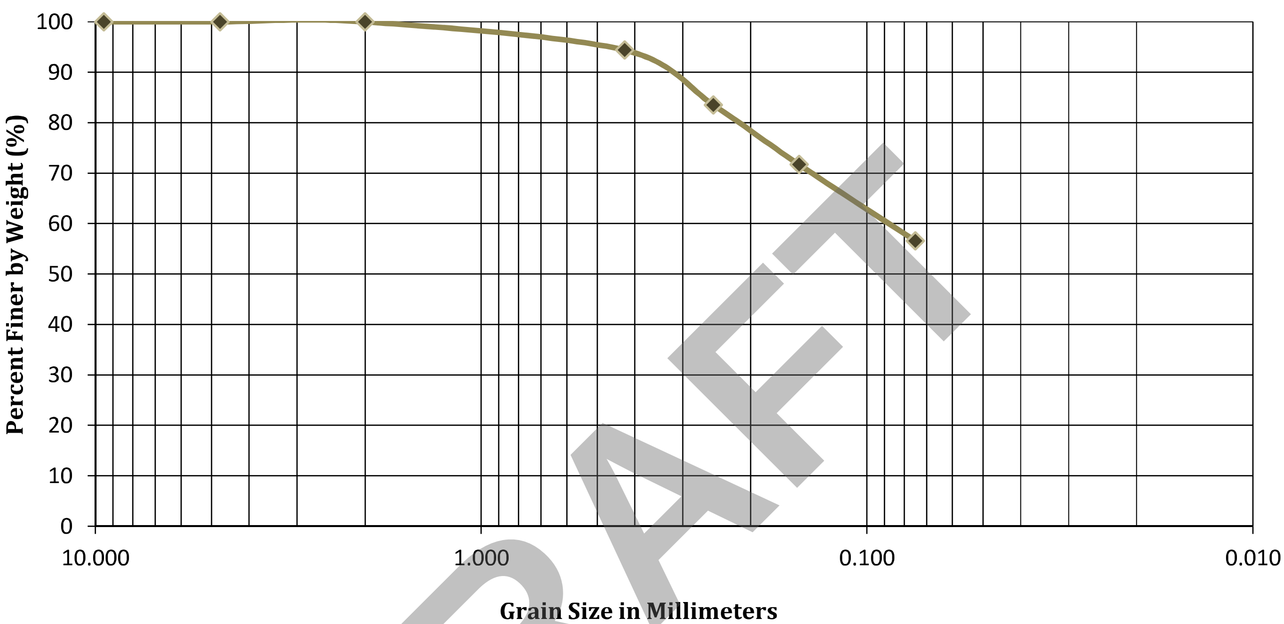
D_{10}	---		
D_{15}	---	D_{30}	0.105
D_{50}	0.161	D_{60}	0.184
D_{85}	0.267	D_{90}	0.321
D_{95}	0.385		
C_U	---	C_C	---

Grain Size Distribution Report
Edward Medard - Reservoir Dam
Hillsborough County, Florida

Tierra Project No.: 6511-21-328

Station	Offset	Sample No.	Depth (ft)
---	---	MA-5	10.0-15.0

Grain Size Distribution Curve



Material Description	Classification	
	USCS	AASHTO
	CH	---

Sieve Number	Diameter (mm)	Percent Finer by Weight (%)
3/4"	19.000	100
3/8"	9.500	100
4	4.750	100
10	2.000	100
40	0.425	94.4
60	0.250	83.5
100	0.150	71.7
200	0.075	56.6

Coefficients

D_{10}	---	D_{30}	---
D_{50}	---	D_{60}	0.088
D_{85}	0.269	D_{90}	0.343
D_{95}	0.502		
C_U	---	C_C	---

TIERRA
GEOTECHNICAL • MATERIALS
ENVIRONMENTAL • ENGINEERING