ENVIRONMENTAL RESOURCE PERMIT APPLICATION

DECEMBER 2017

FLORIDA INLAND NAVIGATION DISTRICT
DREDGED MATERIAL MANAGEMENT AREA BV-24A
BREVARD COUNTY, FLORIDA

ATTACHMENT 11

GEOTECHNICAL REPORTS

Preliminary Geotechnical Engineering Report

Phases I and II
BV-24A Dredged Material Management Area (DMMA)
Brevard County, Florida

November 13, 2017
Terracon Project No. HB155022

Prepared for:
Taylor Engineering, Inc.
Jacksonville, Florida

Prepared by:
Dunkelberger Engineering & Testing,
A Terracon Company
Port St. Lucie, Florida

November 13, 2017

Taylor Engineering, Inc.
10151 Deerwood Park Blvd.
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Attn: Jonathan Armbruster, P.E. … via e-mail (jarmbruster@taylorengineering.com)
Vice President

Re: Preliminary Geotechnical Engineering Report – Phases I and II
BV-24A Dredged Material Management Area (DMMA)
Brevard County, Florida
Dunkelberger Project Number: HB155022

Dear Mr. Armbruster:

Dunkelberger Engineering and Testing, A Terracon Company (DUNKELBERGER) has completed the initial phases of geotechnical engineering services for the above referenced project. This study was carried out in general accordance with our subcontract agreement (Taylor Engineering Contract No. C2015-065) dated January 4, 2015.

This preliminary report presents the findings of both the *Geotechnical Field Investigation and Laboratory Analysis* phase and the *Groundwater Modeling* phase of the contract work scope.

The geotechnical findings for the permanent pipeline alignment of the project have been presented separately in an addendum to this report.

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

Sincerely,
Dunkelberger Engineering and Testing, Inc. a Terracon Company

DOUGLAS S. DUNKELBERGER
LICENSE
No 33317
STATE OF
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BREVARD COUNTY, FLORIDA
Terracon Project No. HB155022
November 13, 2017

1.0 PROJECT & SITE DESCRIPTION

The proposed BV-24A Dredged Material Management Area (DMMA) is located east of Grant-Valkaria, Florida in Brevard County. The BV-24A DMMA is one of eight sites selected to provide long-term dredged material containment capacity for the Intracoastal Waterway (ICWW) in Brevard County. It is intended to serve Reach VI located between Turkey Creek and the Brevard County - Indian River County line at Sebastian Inlet. The site is situated about ¼ mile west of the ICWW. A *Site Vicinity Map* is provided as *Sheet 1*. The overall site boundaries surround approximately 112.5 acres of vegetated land. Wetlands are located throughout the site. Several paths traverse through the site which are consistently used as equestrian or all-terrain vehicle trails. Two horse farms lie to the south and southeast of the site and an abandoned Oldcastle Coastal plant lies to the northeast.

2.0 PROPOSED CONSTRUCTION

The purpose of this study phase was to obtain and summarize data characterizing the subsurface conditions within the site to be used for subsequent detailed engineering analyses pertaining to both the design and construction of the DMMA. The data collection included field and laboratory parameters necessary for the set up and calibration of groundwater flow models that will be used in the next phase of study to evaluate potential saline impacts on the aquifer from the DMMA operation.

Background information concerning the design, construction and operation of the DMMA was provided by Taylor Engineering within the following five documents:

1) *BV-24A DMMA Management Plan (October 2015)*- summary of preliminary design, site preparation, and site management features
2) *BV-24A DMMA Engineering Narrative (October 2015)*- abbreviated summary of the site's key proposed engineering parameters
3) *BV-24A DMMA Environmental Site Documentation (September 2015)*- summary of documented on-site and nearby adjacent vegetation habitats and wildlife habitats
4) *Morgan & Eklund Topographic and Boundary Survey (July 2015)- survey of the topography and boundaries of the site including pipeline easement.*

5) *Morgan & Eklund Core Boring and Monitoring Well Stake Out (January 2016)- survey of boring and monitoring well locations including ground elevations.*

From the document review, we understand that the proposed DMMA footprint is expected to cover 63.1 acres of the site (includes perimeter roads and ditches) with a design capacity of approximately 1,084,100 cubic yards of dredged materials. To provide that storage capacity, perimeter earthen dikes will be constructed to a final crest elevation of +36.7 feet (approximately 16 feet above the existing mean site grade of +20.2 feet NAVD) with respect to the North American Vertical Datum of 1988 (NAVD). Preliminary design of the dikes indicates 3:1 (horizontal: vertical) side slopes with a 15-foot wide crest. The interior area of the containment embankment will be excavated to an elevation of +15.7 feet NAVD (about 4 ½ feet below the existing mean site grade) as a borrow source. The borrow fill, with an estimated quantity of 265,614 cubic yards, will be used to construct the dike and access ramps.

Native vegetation covers the majority of the site consisting of palmetto prairies, pine flatwoods, and sand pines. Multiple freshwater marshes (wetlands) were also found throughout the site. Wildlife habitat of significance includes gopher tortoises and scrub jays.

3.0 SCOPE OF WORK

The overall geotechnical work scope consists of: (1) geotechnical field investigation and laboratory analysis; (2) engineering analyses, recommendations, and design; (3) summary report and recommendations; and (4) assistance with construction drawings and specifications. That scope will be completed in four separate phases (Phases I through IV). This study, being the initial phase, involved collection of field and laboratory data to support the detailed engineering analyses of subsequent phases. The specific tasks of the Phase I work scope are listed below:

- Review of existing data (geotechnical, hydrological and hydrogeological)
- Compilation of nearby well, septic tank and pond inventory information
- Sampling and laboratory testing of ICWW sediments to be dredged
- Geotechnical field work (subsurface exploration) and laboratory testing for DMMA design and groundwater modelling.
- Preliminary groundwater modeling (set up , calibration and initial operational runs)
- Preparation of this preliminary (progress) geotechnical engineering report.

4.0 REVIEW OF AVAILABLE DATA

4.1 USGS Topographic Map

A copy of the USGS Topographic Map is provided as *Sheet 2* of this report. Reference to the map shows the site area with a west to east downward slope ranging in elevation from approximately

+25 feet to +15 feet with respect to the National Geodetic Vertical Datum of 1929 (NGVD '29). The elevation at the central area of the site is about +20 (ft.-NGVD). The average elevation of the site based on the ground surface elevations obtained at the boring and monitoring well locations (provided by Morgan and Eklund, Inc.) is about +20 feet as referenced to the North American Vertical Datum of 1988 (NAVD88).

The map also depicts the site surface as vegetated land with green shading and containing multiple wetlands.

4.2 Brevard County Soil Conservation Survey

The Soil Survey of Brevard County, Florida as prepared by the United States Department of Agriculture (USDA), Soil Conservation Service (SCS; later renamed the Natural Resource Conservation Service – NRCS) identifies the majority of soil types in the proposed DMMA footprint area of the site as Immokalee Sand (Map Unit 28) and Pomello Sand (Map Unit 49) with a localized area of Myakka Sand, Depressional (Map Unit 38).

The Immokalee Sand and Pomello Sand soil types which cover about 95% of the proposed DMMA footprint are generally sandy and devoid of organic (muck) soils, clay/silt soils, and rock at shallow depths. As an exception, the Myakka Sand, Depressional soil type occurs in a circular-shaped, wetland feature on the south side of the proposed dike alignment. This area is of importance due to surficial layers of muck (unsuitable soil) commonly found in wetland areas. More detailed descriptions of the primary soil classifications are provided below.

28 – Immokalee Sand. This soil type has 0 to 2 percent slopes and is poorly drained. Under natural conditions, this soil type has a depth to water table of 6 to 18 inches. This soil type consists of relatively clean sands to a depth of 35 inches. A layer of black weakly cemented fine sand with organic coating, locally known as hardpan, is indicated from 35 to 54 inches. Thereafter, to the maximum defined depth of 80 inches, the soil profile consists of loamy sands.

49 – Pomello Sand. This soil type has 0 to 2 percent slopes and is moderately well drained. Under natural conditions, this soil type has a depth to water table of 24 to 42 inches. This soil type consists of relatively clean sands to a depth of 42 inches. A layer of black weakly cemented sand with organic coating, locally known as hardpan, is indicated from 42 to 54 inches. Thereafter, to the maximum defined depth of 80 inches, the soil profile consists of additional clean sands.

38 – Myakka Sand, depressional. This soil type has 0 to 2 percent slopes and is very poorly drained. Under natural conditions, this soil type has a water table at the ground surface. This soil type consists of relatively clean sands to a depth of 20 inches. A layer of black weakly cemented sand with organic coating, locally known as hardpan, is indicated from 20 to 36 inches. Thereafter, to the maximum defined depth of 85 inches, the soil profile consists of additional clean sands.

The Soil Survey is not intended as a substitute for site-specific geotechnical exploration; rather it is a useful tool in planning a project scope in that it provides information on soil types likely to be found. Boundaries between adjacent soils types on the Soil Survey maps are approximate. The Soil Survey is included as *Sheet 3*.

4.3 Regional Geology

The geology at the site (Reference Florida Geologic Survey: Geologic Map of Florida, dated 2002, revised in 2006) is mapped with the Anastasia Formation. The Anastasia Formation generally is recognized near the coast, generally composed of sands and coquinoid limestones. The most recognized materials found within the Anastasia Formation are coquina of whole or fragmented shells in a matrix of sand which is often cemented. The Anastasia Formation forms part of the surficial aquifer system. Below the surficial aquifer lies the Hawthorn Formation which is considered an intermediate confining unit. The Hawthorn Formation begins at approximately Elevation -85 feet NAVD and separates the surficial aquifer from the Upper Floridan Aquifer at about -300 feet NAVD. The Upper Floridan Aquifer is made up of a Limestone Formation referred to as Basal Hawthorne/ Suwanee and Ocala Limestone.

4.4 Historical Aerial Review

Historical aerial photographs from Years 1943, 1951, 1958, 1994, 1999, 2004, 2005, 2007, 2009, 2013, and 2014 were reviewed for features of geotechnical significance. The noted items are listed below in chronological order.

- 1943: the site is vacant, wooded (vegetated) land
- 1994: the site has ATV/equestrian paths traversing areas of the site, otherwise unchanged
- 1999: the western half of the site appears to have been cleared of tall trees; possibly a controlled burning operation
- 2014: the site appears similar to its current condition

According to available historic aerial photographs and with the exception of a potential clearing or controlled burn operation on the western half of the site, the site appears to have been relatively undisturbed from 1943 to date.

4.5 Nearby Well, Septic Tank and Pond Information

Given the planned disposal of dredged material within the relatively large DMMA footprint and the proximity of surrounding properties, we compiled an inventory of wells, septic tanks, and ponds within an approximately ½ mile radius of the site. Records for wells less than 6 inches in diameter were obtained from St. Johns River Water Management District (SJRWMD) data bases. Larger well (greater than 6 inches in diameter) and septic tank records were obtained from Brevard

County Florida Department of Health data bases. Pond locations were primarily identified using Google Earth aerial images. The compiled data is mapped on *Sheet 4* and summarized in the table below.

Table 4.1 - Nearby Well, Septic Tank, and Pond Information

Item	No. of Items	Type
Wells	66	Potable / Irrigation
Septic Tanks	23	Sewage Disposal
Ponds	10	Retention/Borrow

4.6 Hydrological and Hydrogeological Data

Existing hydrological data was collected from the National Oceanic and Atmospheric Administration (NOAA) and SJRWMD data sources. Historical rainfall amounts and evapotranspiration (ET) rates were researched as water balance parameters necessary for groundwater model calibration. Other SJRWMD sources (East Central Florida Regional Groundwater Flow Model and Floridan Aquifer potentiometric maps) were reviewed to establish the groundwater flow model hydrogeological cross-section (i.e. model layers) as discussed further in **Section 10.0.**

Historical (Years 2004-2014) rainfall and ET data was collected from the SJRWMD and Lake Alfred NOAA weather stations, respectively. The data set for the period of record was used for average yearly and monthly values. Also, a site specific rainfall data set was obtained from the SJRWMD's rainfall radar data base for the period of May 2015 through April 2016 corresponding to the collection period of on-site monitoring well readings.

Eleven (11) existing monitoring wells were constructed on the site. A layout of the monitoring well locations is presented as *Sheet 5*. The ground elevations at the well locations were determined by the project surveyor, Morgan and Eklund, Inc. The depths of the wells were 15 feet with the exception of a single deep well, MW-4, constructed to 40 feet bls.

Initial background groundwater quality data for the wells was collected by Pace Analytical Services Inc. following well construction. The data includes chloride concentration, total dissolved solids, pH, and turbidity. A summary of the data is shown in the following table.

Table 4.2 - Background Groundwater Quality Data (Collected on 4-12-16)

Well ID	Depth (feet)	Chloride Content (mg/L)	Total Dissolved Solids (mg/L)	pH	[(1)]Turbidity (NTU)
MW-1	15	13.2	61	4.6	5.5 / 3.2
MW-2	15	9.8	51	4.7	22.1 / 22.9
MW-3	15	62.0	186	5.0	28.2 / 17.4
MW-4	40	51.9	143	5.0	11.6 / 8.4
MW-5	15	65.8	186	4.7	271.0 / 11.7
MW-6	15	66.0	286	3.8	5.3 / 3.2
MW-7	15	50.3	173	4.8	141.0 / 12.4
MW-8	15	29.5	72	4.8	6.8 / 5.0
MW-9	15	46.9	119	4.6	90.4 / 8.2
MW-10	15	46.6	96	4.4	32.8 / 6.0
MW-11	15	180.0	409	4.1	4.3 / 1.6

(1) Numbers represent initial turbidity and final turbidity after purging.

With respect to the chloride concentrations in the groundwater, the levels were all less than the Florida Department of Environmental Protection's (FDEP) Groundwater Cleanup Target Level (GCTL) of 250 mg/L. The mean (average) and median values for the chloride data are 56.5 mg/L and 50.3 mg/L, respectively.

5.0 DETAILED SITE DESCRIPTION

Over the course of our field exploration, we obtained knowledge regarding the site terrain, vegetation, soil conditions and drainage patterns. A detailed site description with photos is provided herein.

The terrain was mostly flat with overall gradual topographic relief sloping downward from west to east. Several all-terrain and equestrian paths traversed throughout the site and exposed loose, white "sugar" sands.

Figure 5.1 - "Sugar" sand all-terrain/equestrian paths

The remaining areas consisted of natural vegetation and multiple wetlands found throughout the site. The vegetation primarily consisted of short saw palmettos and scattered tall pine trees.

Figure 5.2 - Typical vegetation

The wetlands found at the site were low lying, topographically-closed areas with tall grasses. Wetland bottom conditions ranged from saturated (soggy) to holding several feet of standing water.

Figure 5.3 - Typical wetland

The surficial soils found at the site were light gray clean sands and white "sugar sands" found along the paths described above. Consistent with the topographic relief across the site, surface drainage flow was from west to east. The site experienced significant rainfall during our field exploration causing many of the paths, wetlands, and other low lying areas to contain standing water.

Figure 5.4 - Standing water after heavy rains

Figure 5.5 - Standing water in wetland after heavy rains

Wildlife found during our site visits was minimal. Although tracks were found consistently for deer and raccoons, gopher tortoises were the only species found in addition to their burrows. The presence of gopher tortoises is significant with respect to an earthen dike project given their propensity to burrow through soil.

Figure 5.6 - Gopher tortoise burrow

6.0 FIELD EXPLORATION PROGRAM AND METHODS

The layout of the field exploration program (i.e. test hole locations and monitoring well locations) is shown in *Sheet 5*. Prior to our field exploration, Morgan and Eklund field staked and provided ground elevations for the test hole and monitoring well locations. Ground elevations at each field test location are included on *Sheet 5*. Descriptions of the exploratory program are provided in the following report sections.

6.1 Standard Penetration Test (SPT) Borings

Subsurface conditions within the DMMA footprint were explored with twenty five (25) Standard Penetration Test (SPT) borings. The borings were drilled 15 feet deep in the proposed interior borrow area and 45 to 100 feet in depth along the proposed perimeter dike alignment. The SPT borings were drilled with an ATV-mounted drill rig employing mud-rotary procedures. The drilling involved use of a standard split-barrel driven with a 140-pound automatic hammer (slide hammer) freely falling 30 inches (the Standard Penetration Test per ASTM D 1586). Samples of the in-place materials were recovered continuously to a depth of 10 feet, and then taken at 5-foot vertical intervals to the termination depth of the borehole. SPT “N-values” were recorded at 2-foot vertical intervals within the first 10 feet of the boring and at 5-foot vertical intervals thereafter. Samples recovered from the borings were placed in moisture-proof containers, labeled, and returned to our laboratory for visual-manual classification by a geotechnical engineer. The deep boreholes were subsequently sealed with neat cement grout and the shallow boreholes were sealed with bentonite chips. Subsurface profiles are presented as *Sheets 6 through 12*.

6.2 Cone Penetration Test (CPT) Soundings

Cone Penetrometer Test (CPT) soundings were advanced at seven (7) locations in lieu of SPT borings as a cost effective means to complete the field exploration. The CPT soundings were completed to depths of 35 to 75 feet along the proposed perimeter dike alignment. The CPT method provides continuous readings of soil resistance by use of a track-mounted, mechanical cone penetrometer equipped with a friction mantle (ASTM D 3441). CPT cone bearing resistances and friction sleeve readings were recorded as the penetrometer was pushed into the ground with a hydraulic ram. Detailed graphical logs and correlative parameters are presented in *Appendix A* as *Exhibits A-1* through *A-14*.

6.3 Bulk Samples

Bulk samples were obtained at fifteen (15) locations from the interior borrow area. The samples were obtained from auger borings drilled to depths up to about seven feet using a continuous flight auger (CFA). During the drilling, soil cuttings were raised and expelled at the surface where they were recovered, placed in large bags, labeled, and transported to our laboratory for testing.

6.4 Groundwater Monitoring Wells

Eleven (11) locations were selected for the installation of wells to measure groundwater quality and levels. Nine wells were constructed along the perimeter of the site and two were installed at the center of the site. The two wells installed at the center of the site, MW-4 and MW-5, were installed close to one another and at depths of 40 feet and 15 feet, respectively. The objective of these wells was to assess any influence of potential confining (clay and/or silt) layers by placing the screened intervals of wells both above and below the potential confining layer. A difference in hydrostatic head between the companion shallow and deep wells would suggest the presence of a confining layer which could impact deep foundation, groundwater flow (seepage), and construction dewatering aspects of the project. The perimeter wells were installed to a depth of 15 feet.

The wells consisted of a 5-foot length by 2-inch diameter machine slotted PVC pipe (0.010-inch slot width) screen that was coupled to solid riser pipe of similar composition which rose to about 3 feet above the ground. The deep (40 foot well), MW-4, consisted of the same dimensions with the exception of a 10-foot screen length. The sand pack surrounding the well screen consisted of clean 6/20 silica sand. Bentonite chips were placed above the piezometer screen up to the ground surface. Finally, an aluminum casing with pad lock was placed over the pipe stick-up and a concrete pad was constructed on the ground surface for protection.

6.5 Field Permeability Tests

Two (2) constant head field permeability tests were performed in monitoring wells MW-4 and MW-5. The tests generally consisted of pumping water at a fixed volumetric flow to maintain a constant head near the top of the well pipe. The time was measured for multiple test runs.

Additionally, a shallow temporary piezometer was installed near MW-4 and MW-5 to a depth of 5 feet bls and a third permeability test was performed using procedures described in the South Florida Water Management District (SFWMD) Usual Open Hole test method. The test method consists of installing a 2-inch diameter, full-length, perforated PVC pipe with a clean 6/20 sand pack. Similarly, the test was performed with a constant head maintained at the ground surface.

6.6 Intracoastal Waterway (ICWW) Vibracores

Dredged sediment samples were recovered by our subcontractor, Athena Technologies, Inc., from Reach VI of the Intracoastal Waterway (ICWW) using the Vibracore method. In general, this method consisted of vibrating a thin walled 6-inch diameter steel casing down to the target elevation of -17 feet with respect to Mean Lower Low Water which corresponds to 5 feet below the Federally authorized depth of 12 feet. The casing was then extracted and the sample emptied into containers. The process was repeated until approximately 5 gallons of sediment was recovered at each test location. Dredged sediment sampling was obtained at eleven (11) locations from the proposed dredge areas. The bulk samples, placed in large containers, were labeled by location with State-Plane coordinates and transported back to our laboratory where they were laid out for visual-manual classification by a geotechnical engineer. A layout of the Vibracore locations is shown on *Sheet 13*.

7.0 GENERAL SUBSURFACE CONDITIONS

7.1 Subsoil Conditions

The soil samples collected from the SPT and auger borings were visually-manually classified in accordance with the Unified Soil Classification System (USCS). Subsurface profiles are presented graphically in Sheets 6 through 12. The generalized soil stratification is discussed below.

Table 7.1 - Generalized Soil Stratification

Stratum	Material Description	Unified Soil Classification System (USCS)
1	Gray or brown medium to fine SAND	SP
2	Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan)	SP-SM, SM
3	Light brown slightly silty medium to fine SAND	SP-SM
4	Dark gray to green sandy SILT	ML
5	Gray shelly SAND with varying amounts of silt	SP, SP-SM, SM
6	Green or light gray CLAY, traces of shell	CL, CH
7	Gray to green slightly silty to silty fine SAND	SP-SM, SM

In general, the borings/soundings found about 40 feet of relatively clean, medium to fine sands (SP, SP-SM; Strata 1, 2, and 3) with some test areas indicating isolated 5 +/- foot thick layers of silt between Elevations 0 and -15 feet NAVD. Underlying the sands were typically clays and silts (Strata 4 and 6) with highly variable thicknesses ranging from 5 to 40 feet. Below the silts and clays were typically shelly sands with varying amounts of silt (Stratum 5) extending to the respective boring termination depths.

The SPT N-values, and CPT cone tip readings, indicate that the predominately sandy subsoils beneath the DMMA footprint range from very loose to medium dense in terms of relative density. The deeper shelly sands are typically dense to very dense. With respect to the fine grained layers (i.e. silts/clays, Strata 4 and 6), the isolated upper layers of silt are very soft to soft, while the deeper clay and silt layers are medium stiff to stiff in terms of relative consistency.

Hydraulic conductivity of the sands measured by field permeability tests were 43.5 feet per day in the upper 5 feet, 7.0 feet per day from 10 to 15 feet bls, and 9.4 feet per day from 35 to 40 feet bls.

7.2 Groundwater Conditions

At the time of our field exploration, groundwater was found in each drilled test hole. At these locations, the groundwater level was measured during drilling at elevations between about +22.5 and +14.6 (feet-NAVD). The groundwater depth ranged from at the ground surface to 3.0 feet bls. Additionally, groundwater level readings were taken periodically in the monitoring wells. Those groundwater measurements are shown in the following table.

Table 7.2 - Groundwater Elevations

Date	Groundwater Elevations (Feet - NAVD)										
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11
2/24/16	-	-	+8.3	-	-	+13.3	-	-	+16.8	+17.6	+20.2
2/26/16	+22.5	+17.1	+8.9	+18.2	+19.6	-	+21.7	+19.9	-	-	+20.8
4/12/16	+20.1	+15.9	+7.9	+17.0	+17.0	+12.7	+20.2	+18.8	+15.4	+16.2	+18.7

Similar to the trend of topographic relief across the site, the groundwater flow gradient is from west to east dropping in elevation from about +22 to +12 (feet- NAVD). Comparison of the MW-4 (shallow) and MW-5 (deep) data indicates no significant head differential that may be caused by a confining soil layer.

8.0 LABORATORY TESTING PROGRAM: ON-SITE SOILS

Samples from the borings were reviewed by a geotechnical engineer and classified in accordance with the Unified Soil Classification System (ASTM D 2487) and appropriate geologic nomenclature. Representative samples of the subsurface strata were tested for soil properties as follows.

- Moisture Content (102 Tests)
- Organic Content (3)
- Fines Content (97)
- Gradation (37)
- Modified Proctor Compaction (5)
- Limerock Bearing Ratio (LBR) (3)
- Hydraulic Conductivity (8)
- Triaxial Shear Strength (3)
- Consolidation (4)

The laboratory test results are discussed below and summarized in Tables A through G following Sheet 13.

8.1 Index Properties

Representative samples of the soils recovered from the borings were tested for index properties including moisture content (ASTM D2216), organic content (ASTM D2974), Atterberg Limits (ASTM D4318), fines content (ASTM D1140), and grain size distribution (ASTM D422). A complete summary of the index properties and grain size distribution results are presented in Tables A and B. Grain size distribution curves are provided in *Appendix B* as *Exhibits B-1* through *B-5*. Average values of the test results are summarized in the following table.

Table 8.1 - Index Property Laboratory Test Results (On-Site Soils)

Stratum No.	Soil Type	MC (%)	Atterberg Limits		OC (%)	Amount of Material Passing Sieve Size (%)					
			LL	PI		#4	#10	#40	#60	#100	#200
1	SP	24.6	-	-	-	100	100	94.3	70.2	29.4	3.0
2	SP-SM	21.5	-	-	7.4	100	99.1	91.3	61.8	29.0	10.2
3	SP-SM	23.9	-	-	-	100	100	99.4	97.2	82.1	6.9
4	ML	51.5	45.0	17.3	-	-	-	-	-	-	69.2
5	SP, SP-SM, SM	20.0	-	-	-	97.2	93.1	78.9	60.1	34.2	9.3
6	CL, CH	42.4	35.2	14.3	-	-	-	-	-	-	82.9
7	SP-SM, SM	26.8	NP	NP	-	100	100	90.5	84.8	61.0	9.9

Notes:
1. Soil Type refers to the Unified Soil Classification System Group Symbol (ASTM D2487).
2. MC, LL, PI, and OC indicates moisture content, Liquid Limit, Plasticity Index and organic content, respectively.
3. NP - Not plastic

8.2 Modified Proctor Compaction

Bulk soil samples obtained from the proposed interior borrow area at five (5) locations, from depths of 0 to 7 feet bls, were tested for their compacted moisture/dry density relationship in accordance with the Modified Proctor Compaction Test (ASTM D 1557). The optimum moisture content of the compacted soils ranged between 10.4 and 14.3 percent, and the maximum dry density ranged from 101.9 to 103.1 pounds per cubic foot (pcf). A summary of the test data are provided in Table C.

8.3 Limerock Bearing Ratio (LBR)

Bulk soil samples at three (3) selected locations within the interior borrow area were tested for Limerock Bearing Ratio (LBR). The optimum moisture content of the compacted soils ranged between 12.8 and 13.6 percent, and the maximum dry density ranged from 103.3 to 104.9 pounds per cubic foot (pcf). The LBR values ranged from 41.9 to 59.6. A summary of the test data are provided in Table D.

8.4 Hydraulic Conductivity

Two (2) undisturbed (Shelby tube) samples of the clay (Stratum 6) were extruded and tested for hydraulic conductivity in a triaxial flexible wall permeameter (ASTM D 5084). The hydraulic conductivity of the clays were 4.87×10^{-8} cm/sec and 5.57×10^{-8} cm/sec.

Additionally, three (3) bulk samples of near-surface soils in the proposed interior borrow area were remolded to specific moisture-dry density conditions and tested in the laboratory for hydraulic conductivity. Each sample was remolded to two moisture-density conditions: one near the approximate dry density of the in-situ conditions; and one at approximately 95 percent of its maximum dry density as determined by the Modified Proctor Compaction Test. The hydraulic conductivity of the samples was determined in a rigid-walled permeameter using the constant head method (ASTM D 2434). The hydraulic conductivity of the material obtained from the proposed interior borrow area at in-situ density ranged from 1.70 x 10^{-2} cm/sec to 2.61 x 10^{-2} cm/sec (48.1 to 74.0 feet per day) and the hydraulic conductivity at 95 percent of its maximum dry density ranged from 1.21 x 10^{-2} cm/sec to 2.02 x 10^{-2} cm/sec (34.3 to 57.3 feet per day).

Results of the hydraulic conductivity testing are summarized in Tables E.1, E.2, and E.3. Detailed test reports are provided in *Appendix B* as *Exhibits B-6 to B-13*.

8.5 Triaxial Shear Strength

Consolidated Drained (CD) triaxial shear strength tests with pore pressure measurements were completed on two (2) remolded bulk samples of near-surface sandy soils (depths of 0 to 7 feet bls) representative of those that will be a source of borrow for the dike embankment fill and foundation soils. The soil specimens were prepared at approximately 95 percent of their maximum dry density and ±2 percent of their optimum moisture content as determined by the Modified Proctor Compaction Test. A Consolidated Undrained (CU) test was completed on an undisturbed clay sample obtained from a depth of about 33 feet bls. The specimens were run at consolidation pressures varying for each test. The effective angle of internal soil friction (ϕ') for the sandy soils representative of the embankment and shallow foundation soils were 31.0 and 33.1 degrees. The total strength and effective strength values for cohesion (c) from the triaxial shear strength tests for the clay sample were 562 and 605 pounds per square foot (psf), respectively.

A summary of the triaxial shear strength test results and test parameters are summarized in Table F. Detailed reports of the test results are provided in *Appendix B* as *Exhibits B-14 to B-17*.

8.6 Consolidation

Four (4) undisturbed (Shelby tube) samples of silt (Stratum 4) and clay (Stratum 6) were extruded and tested for one-dimensional consolidation. The tests were conducted at multiple load increments to a maximum load of 16 tons per square foot (tsf). Sample compression was measured using a ½ inch stroke dial gage. Compression index (C_c) values for the four tests ranged from 0.29 to 0.70 on a strain basis. Recompression index (C_r) values for the same four tests ranged from 0.03 to 0.09 on a strain basis. The pre-consolidation pressures ranged from 4.0 ksf to 6.2 ksf. This data, as well as the correlative CPT data, suggests that the silts and clays are slightly to moderately over-consolidated with OCRs ranging from 1.6 to 3.3.

A summary of the consolidation test results are summarized in Table G. Detailed reports of the test results are provided in *Appendix B* as *Exhibits B-18 to B-21*.

9.0 LABORATORY TESTING PROGRAM: DREDGED MATERIALS

Dredged sediment samples from the eleven (11) vibracores were reviewed by a geotechnical engineer and classified in accordance with the Unified Soil Classification System (ASTM D2487) and appropriate geologic nomenclature. Each Vibracore sample was tested for the following properties:

- Gradation
- Leachability

9.1 Index Properties

Representative samples of the soils recovered from the vibracores were tested for grain size distribution (ASTM D422). The Vibracore samples were visually inspected to estimate the amount of muck compared to the total sample volume. A summary of the index properties are presented in the following table. Grain size distribution curves are provided in *Appendix C* as *Exhibit C-1*. The test results are summarized in the following table.

Table 9.1 - Index Property Laboratory Test Results (Dredged Materials)

Vibracore Number	Soil Type	Muck %	Amount of Material Passing Sieve Size (%)									
			1"	¾"	½ "	#4	#10	#20	#40	#60	#100	#200
V-1	SC	20	100	93.2	92.9	85.9	78.1	70.5	63.9	55.0	38.8	18.1
V-2	SC	75	100	100	99.0	92.6	79.8	66.4	54.5	44.6	37.2	28.8
V-3	SC	30	100	100	99.0	91.7	79.0	64.3	56.0	46.1	33.7	15.7
V-4	SP-SC	15	100	100	98.4	85.8	64.2	46.8	36.2	27.4	21.5	10.4
V-5	SP-SC	10	100	100	99.9	95.9	86.3	78.3	69.3	57.5	39.1	10.9
V-6	SP	0	100	100	99.5	95.8	86.2	70.7	58.6	39.7	25.1	3.4
V-7	SP	0	100	100	100	96.8	87.9	80.5	70.5	53.7	42.4	3.2
V-8	SP	10	100	100	100	94.3	82.8	67.9	56.6	45.3	34.3	2.9
V-9	SP-SC	50	100	100	100	90.1	77.8	65.8	55.9	25.4	13.3	7.1
V-10	SP	5	100	100	100	90.8	76.9	58.3	50.7	37.9	23.2	2.7
V-11	SP-SC	80	100	100	100	97.2	93.0	87.2	77.6	50.4	27.5	6.7
AVG	**SP-SC**	**30**	**100**	**99.4**	**99.0**	**97.8**	**92.5**	**81.1**	**68.8**	**59.1**	**43.9**	**10.0**

Notes: 1. Soil Type refers to the Unified Soil Classification System Group Symbol (ASTM D2487).
2. Muck % indicates approximate percentage of muck mixed with the Vibracore sample based on visual observation

9.2 Chloride Leachability Testing

Representative soil samples from each of the eleven (11) vibracore locations were used for our in-house chloride leachability tests. The purpose of the laboratory testing was to simulate an operational condition of the DMMA to evaluate the leaching potential of a 2-foot thick layer (column) of dredged material when subjected to 52 inches of influent. The procedure generally consisted of a PVC pipe setup including two 3-inch diameter pipes, one at 2 feet in length to hold the soil specimen, and the second at 5 feet to hold 52 inches of water. A PVC pipe reducer and ball valve were fastened to the bottom of the pipes to allow pausing of the test. A filter stone was placed in the bottom of each pipe. Containers were placed under each ball valve to capture the leached extract. Two feet of sample was loaded into the tubes and water was subsequently added to saturate the sample. Once the samples were saturated, 52 inches of water (modeling annual rainfall) was loaded onto each sample and the ball valves were opened to begin the test. Chloride and pH tests were run on the liquid extract on an incremental basis after 9 inches of water had passed through the sample. After the complete 52 inches of water had fully passed through, a final set of chloride and pH tests were run.

In addition to our in-house testing, other portions of the eleven (11) vibracore samples were sent to Pace Analytical Services Inc. to test for pH, total chloride of soil, and Synthetic Precipitation Leaching Procedure (SPLP, EPA SW-846 Method 1312) testing. For a previous DMMA project, Toxicity Characteristic Leaching Procedure (TCLP, EPA SW-846, Method 1311) was used to test the vibracore samples. The TCLP generally applies to material sitting in a landfill whereas the SPLP was designed to simulate material sitting in-situ and therefore adopted for this study as the better of the two methods to assess chemical mobility in the open environment.

Results of the in-house soil column leaching tests showed relatively high concentrations of chlorides in the extracted liquid. For 11 column tests, the maximum and average chloride contents of the first 9 inches of percolated liquid extract were 18,750 mg/L and 13,000 mg/L, respectively. Four of the eleven tests were not fully completed due to the low permeability of the vibracore material. The incomplete data was not considered in our analyses. The average final chloride content based on the seven completed tests for the entire 52 inches of liquid extract was 2,800 mg/L. The commercial laboratory SPLP test results, for all 11 samples, averaged 234 mg/L. It is noted as a point of reference that seawater has a chloride concentration of 19,400 mg/L.

The reason for the order-of-magnitude difference between the SPLP and the column leaching is likely attributed to the latter test being larger scale and it is more representative physically of actual field conditions. Therefore, the column leaching data was adopted for use in the groundwater (transient solute transport) model. More specifically, the test data for Sample V-11 represented the highest leaching potential and was used as a conservative basis for both analysis and design which we believe is appropriate given the inherent variability of dredged material consistency.

Referencing the State's Secondary Drinking Water Standard at 250 mg/L, the column leaching test results indicate significant potential for leaching of chlorides particularly during first flushing of newly placed dredged materials.

Detailed results of the leachability testing are presented in *Appendix C* as *Exhibits C-2* through *C-7*.

10.0 GEOTECHNICAL MODEL

Based on the subsurface data collected in the field and the laboratory test results, the following model of representative soil properties was developed for use in subsequent geotechnical analysis of the DMMA.

Elevation (Ft - NAVD)					
+37 to +20	Embankment	$\phi = 31°$	$\phi' = 31°$	k = 40 ft/day γ_{dry} = 103 pcf	
+20 to +10	Sand	$\phi = 31°$	$\phi' = 30°$	k = 60 ft/day	E = 325,000 psf
+10 to -5	Sand	$\phi = 30°$	$\phi' = 30°$	k = 7 ft/day	E = 375,000 psf
-5 to -10	Silt	$\phi = 8°$ c = 560 psf	$\phi' = 20°$ c' = 0 psf	k = 0.00015 ft/day OCR = 3.3	$C_C = 0.47$ $C_R = 0.08$
-10 to -20	Sand	$\phi = 31°$	$\phi' = 31°$	k = 10 ft/day	E = 475,000 psf
-20 to -40	Clay/Silt	$\phi = 8°$ c = 560 psf	$\phi' = 20°$ c' = 0 psf	k = 0.00015 ft/day OCR = 2.0	$C_C = 0.43$ $C_R = 0.05$
-40 to -70	Shelly Sand	$\phi = 33°$	$\phi' = 33°$	k = 10 ft/day	E = 650,000 psf

ϕ - total friction angle	k - permeability
c - total cohesion	E - elastic modulus
ϕ' - effective friction angle	C_C - compressibility coefficient
c' - effective cohesion	C_R - recompression coefficient
γ_{dry} - dry density	OCR - Overconsolidation Ratio

Figure 10.1 - Geotechnical Model

In regard to the model and as it pertains to the proposed dike, the high permeability values of the embankment and shallow foundation soils are of importance as they will cause high seepage rates through the earthen dike which potentially may exit the downstream embankment face and/or toe. The intermediate and deep silt and clay layers indicate high virgin compressibility parameters which would generally result in significant settlement. However, these materials are sufficiently over-consolidated and deep enough below the base of the dike that embankment settlements should be modest. The friction angles of the embankment fill and upper foundation sands are typical values associated with these materials and should not cause issues from a stability standpoint. Additionally, the intermediate layer of silt is of a strength and at a depth to not cause deep-seated stability issues beneath the embankment.

11.0 GROUNDWATER MODELING

11.1 Model Set Up

Two models were set up and calibrated for numerical analysis of transient groundwater flow (MODFLOW) in the site area and transient solute transport (MT3D) under the conditions of dredged material disposal. The groundwater modeling efforts were carried out by Andreyev Engineering, Inc. (AEI) working as a professional sub-consultant to DUNKELBERGER.

The initial set up involved developing a MODFLOW2000 model in a GW-Vistas MODFLOW framework. A grid of 250 cells by 250 cells was used with a constant cell size of 50 feet by 50 feet.

For the initial model set up, the thicknesses of individual aquifer layers were selected based on published geologic data (SJRWMD sources) as well as the site-specific geotechnical data collected as part of this study. Some minor adjustments to individual layer thicknesses were made as part of the model calibration process. The adopted geologic cross-section for the modeling is shown in the following.

+10 to +25 feet-NAVD Ground Surface Elevations

-1	Surficial Aquifer (sand & silty sand)	LAYER 1
-17	Surficial Aquifer (sand & silty sand)	LAYER 2
-85	Surficial Aquifer (sand, clay, shell)	LAYER 3
-300	Aquitard (dense shell & hard clay)	LAYER 4
-600	Upper Floridan Aquifer (limestone)	LAYER 5

Figure 11.1 - Model Geologic Cross Section

Boundary conditions were applied in Layer 1 as illustrated in Figure 9.2 shown below. The Floridian Aquifer (Layer 5) was defined as a constant head boundary at +33 feet NAVD based on published potentiometric pressure maps (SJRWMD).

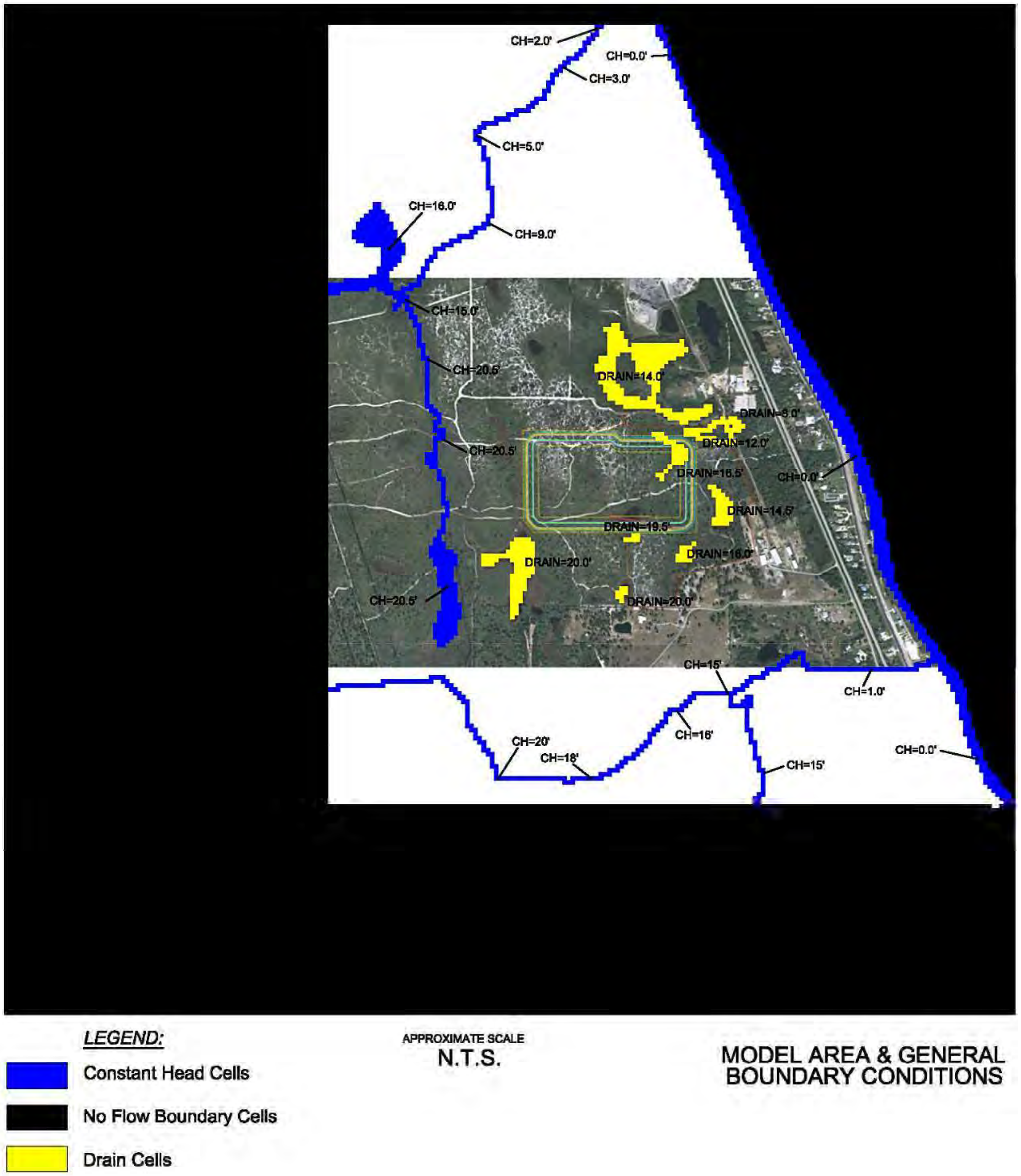


Figure 11.2 - Groundwater Model Area and General Boundary Conditions

The MT3D model setup was consistent with the aforementioned MODFLOW structure and conditions.

11.2 Calibration

11.2.1 MODFLOW

The hydrological data, both historical and site specific, were arranged in a water balance spreadsheet for calculation of net recharge to the shallow aquifer to allow for calibration of the model. The calibration was carried out using a stepped process with five successive stress periods: a long-term (10 years), average background condition (Stress Period 1); and transient site-specific conditions that corresponded to average dry and wet seasons (Stress Periods 2 and 3, respectively) followed by two on-site groundwater measurement events that occurred on February 26, 2016 (Stress Period 4) and April 12, 2016 (Stress Period 5). The steady-state model was executed concurrently with the transient model to achieve the same aquifer parameters during the calibration process.

The rainfall and evaporation/evapotranspiration data used to calculate net recharge for each Stress Period (e.g. SP 1) are summarized in the following tables:

Table 11.1 - SJRWMD Radar Rainfall Data

Month of Year	Year		SP 1	SP 2	SP 3	SP 4	SP 5
	2015	2016	Average	Average Dry	Average Wet	2/26/16	4/12/16
Jan	0.898	7.064	2.48	2.48		7.064	
Feb	2.464	2.450	2.49	2.49		2.450	
Mar	0.608	1.845	2.92	2.92			1.85
Apr	2.861	0.028*	2.08	2.08			0.03
May	1.124		3.94	3.94			
Jun	5.492		5.83		5.83		
Jul	7.213		5.38		5.38		
Aug	5.179		5.78		5.78		
Sep	7.659		7.20		7.2		
Oct	1.894		4.76	4.76		1.894	
Nov	3.055		3.12	3.12		3.055	
Dec	3.233		2.31	2.31		3.233	
Total	**41.68**		**48.29**	**24.10**	**24.19**	**17.70**	**1.87**

* through April 12
SJRWMD – St. John's Regional Water Management District

Table 11.2 - ET Values (Lake Alfred NOAA Station)

	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pan Evap. Rates	60.57	2.88	3.64	4.73	6.36	7.01	7.02	6.76	6.20	5.61	4.40	3.36	2.60
Average ET	40.28	1.92	2.42	3.15	4.23	4.66	4.67	4.50	4.12	3.73	2.93	2.23	1.73

Table 11.3- Lake Alfred Evapotranspiration Data

Month	SP 1	SP 2	SP 3	SP 4	SP 5
	Average	Avg. Dry	Avg. Wet	2/26/2016	4/12/2016
Jan	1.92	1.92		1.92	
Feb	2.42	2.42		2.17	0.25
Mar	3.15	3.15			3.15
Apr	4.23	4.23			1.69
May	4.66	4.66			
Jun	4.67		4.67		
Jul	4.50		4.50		
Aug	4.12		4.12		
Sep	3.73		3.73		
Oct	2.93	2.93		2.93	
Nov	2.23	2.23		2.23	
Dec	1.73	1.73		1.73	
Total	**40.28**	**23.26**	**17.02**	**10.97**	**5.09**

The calculated net recharge for each stress period that was used as part of the calibration process is summarized in the tables below:

Table 11.4 - Model Recharge Calculations (throughout project area)

Date	Time (days)	Rainfall (in)	Calculated ET (in)	Net Recharge (ft/day)	Stress Periods for Model Calibration
10/2/2004					
9/30/2014	3650	482.90	402.79	0.00183	1
5/31/2015	243	24.10	23.26	0.00029	2
9/30/2015	122	24.19	17.02	0.00490	3
2/26/2016	149	17.70	10.97	0.00376	4
4/12/2016	46	1.87	5.09	-0.00583	5

Table 11.5 - Model Recharge Calculations (areas of deeper groundwater)

Date	Time (days)	Rainfall (in)	Calculated ET (in)	Net Recharge (ft/day)	Stress Periods for Model Calibration
10/2/2004					
9/30/2014	3650	482.90	382.79	0.00229	1
5/31/2015	243	24.10	21.93	0.00074	2
9/30/2015	122	24.19	16.35	0.00536	3
2/26/2016	149	17.70	10.16	0.00422	4
4/12/2016	46	1.87	4.84	-0.00537	5

The areas of deeper groundwater are outlined on Figure 9.3 below and were assigned ET values slightly (5%) less than the remainder of modelled area.

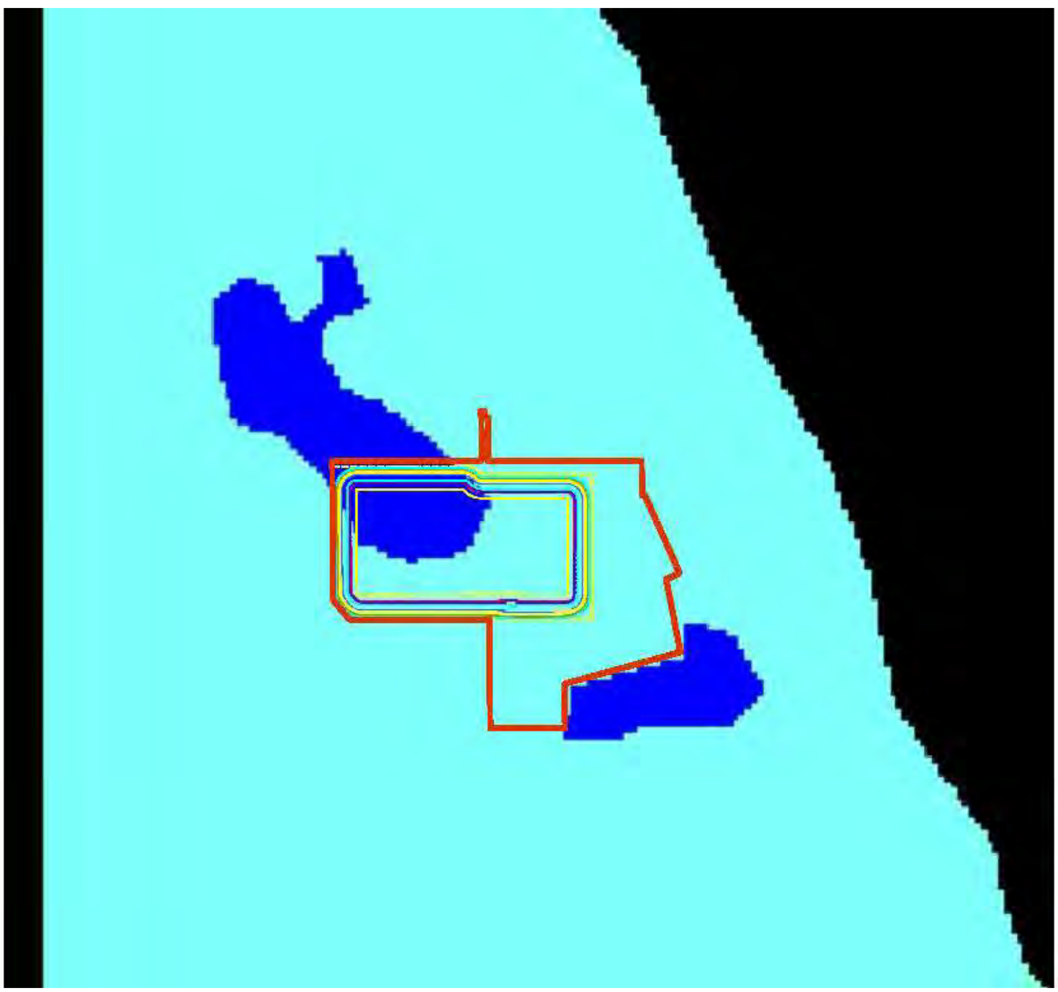


Figure 11.3 - Deep Groundwater Areas

The calibration target points were the on-site monitoring wells with two groundwater level measurement events. The well locations and groundwater elevation data were imported into the model for comparison with the output data. The locations of the target points are shown on the following figure.

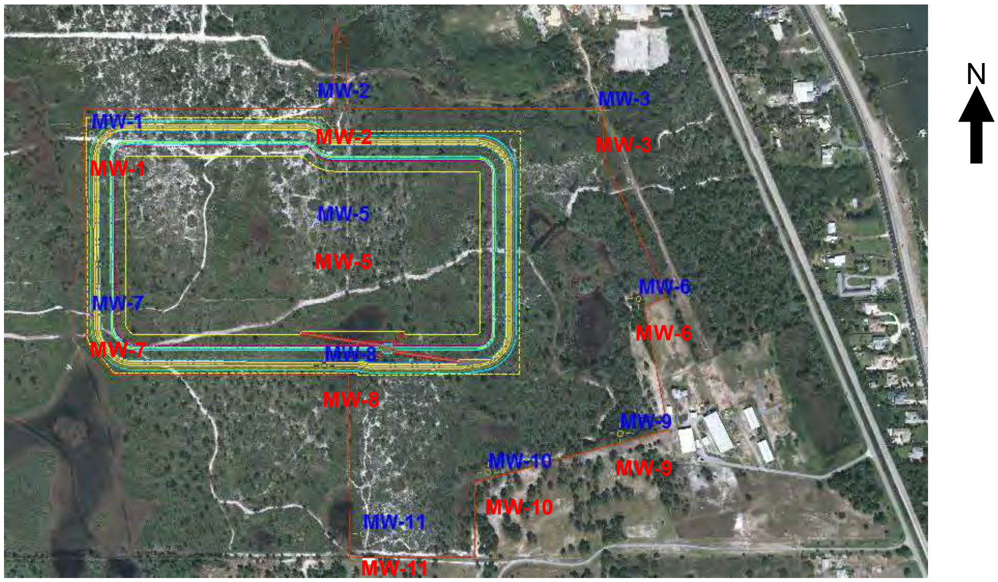


Figure 11.4 - Shallow Monitoring Wells in Layer 1 (Target Calibration Points)

The following series of plots compare modeled and measured (two events) groundwater elevations for each of the eleven target points.

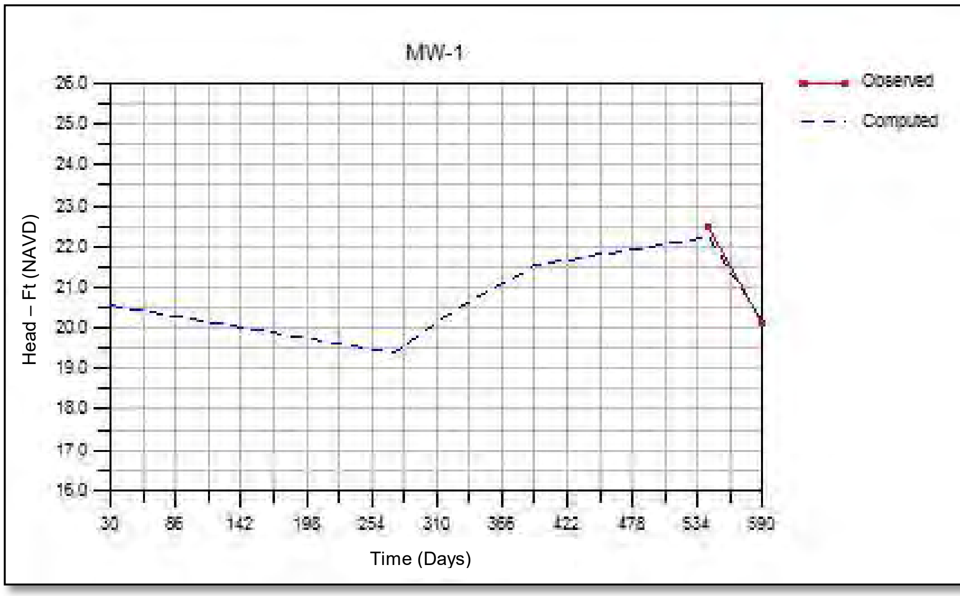


Figure 11.5 - Modeled vs Measured Groundwater Elevations (MW-1)

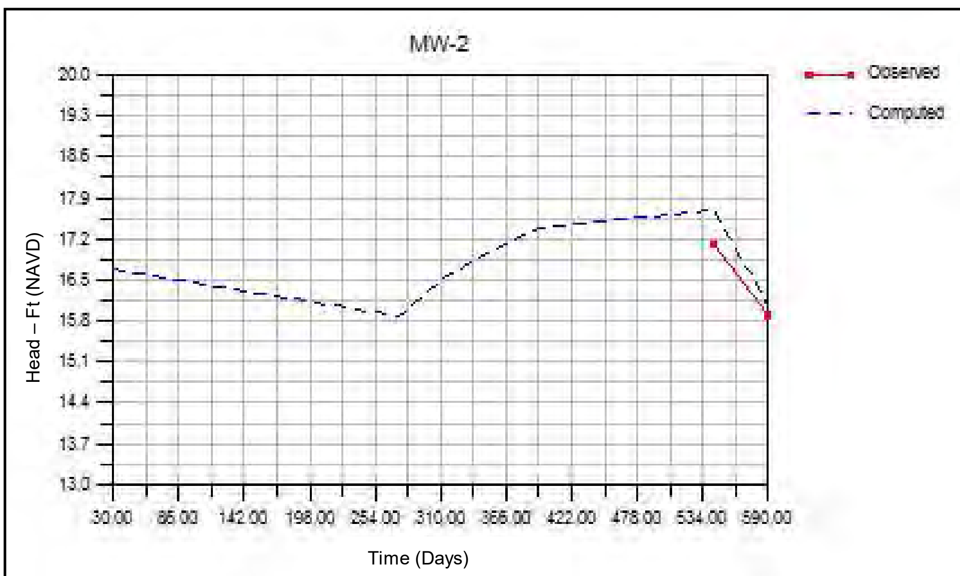


Figure 11.6 - Modeled vs Measured Groundwater Elevations (MW-2)

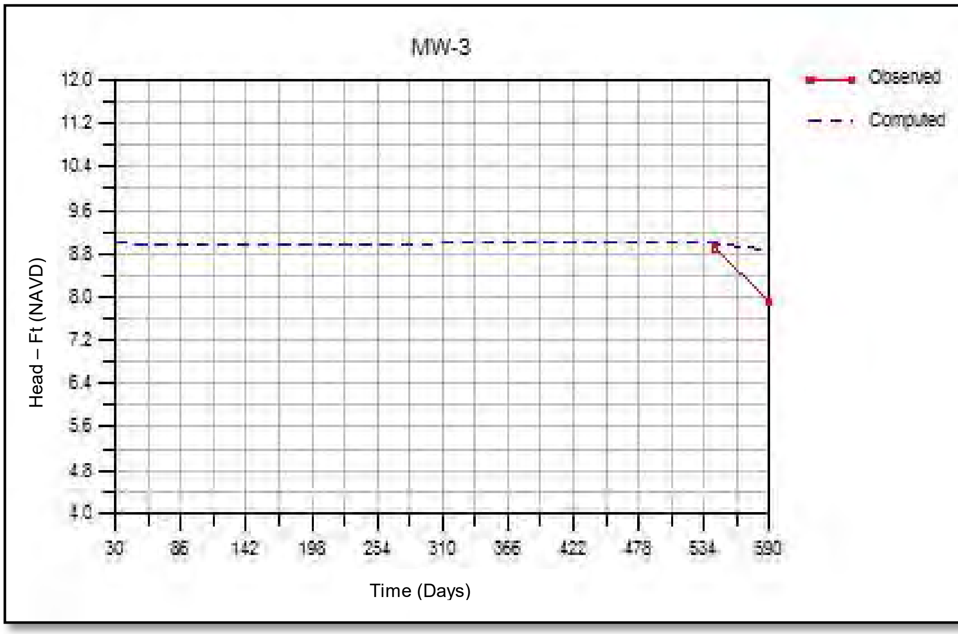


Figure 11.7 - Modeled vs Measured Groundwater Elevations (MW-3)

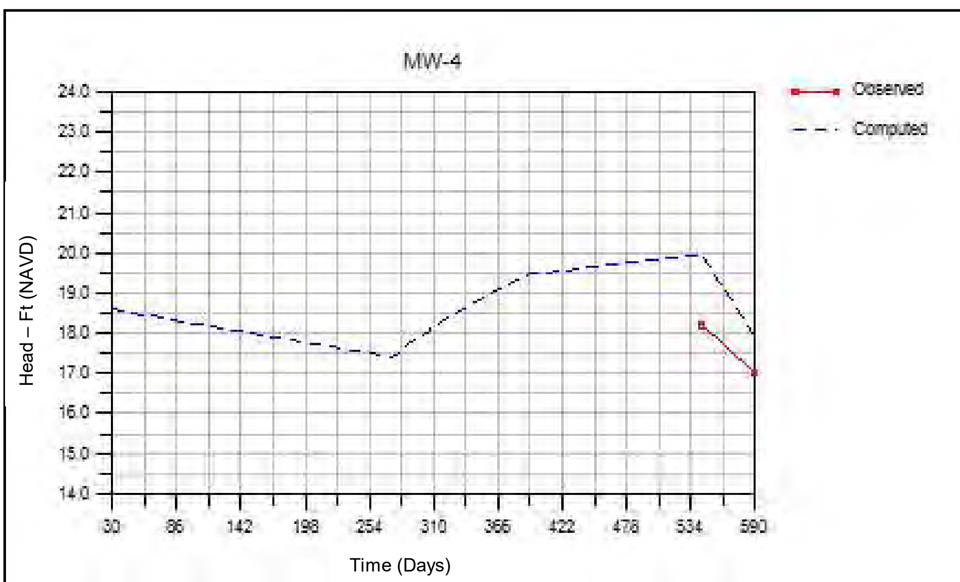


Figure 11.8 - Modeled vs Measured Groundwater Elevations (MW-4)

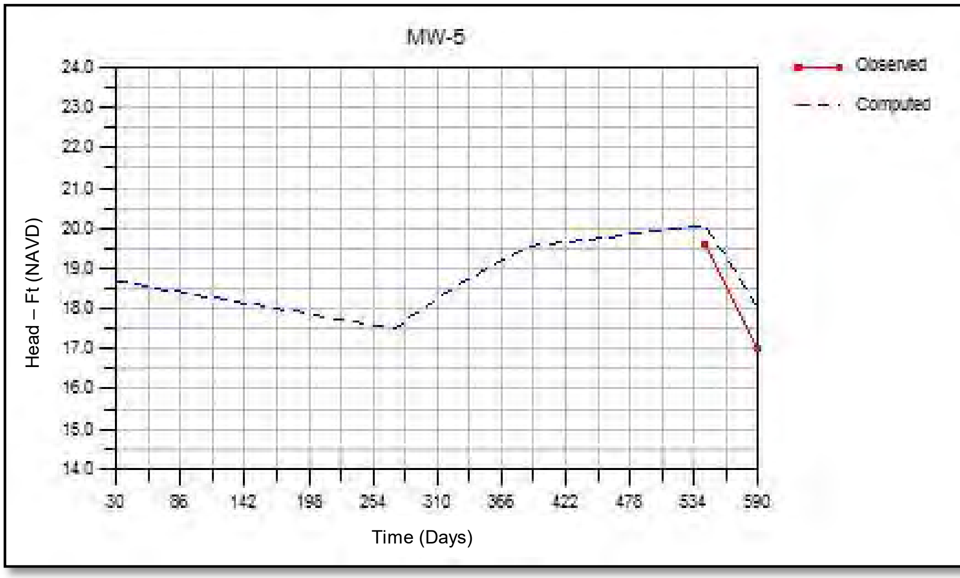


Figure 11.9 - Modeled vs Measured Groundwater Elevations (MW-5)

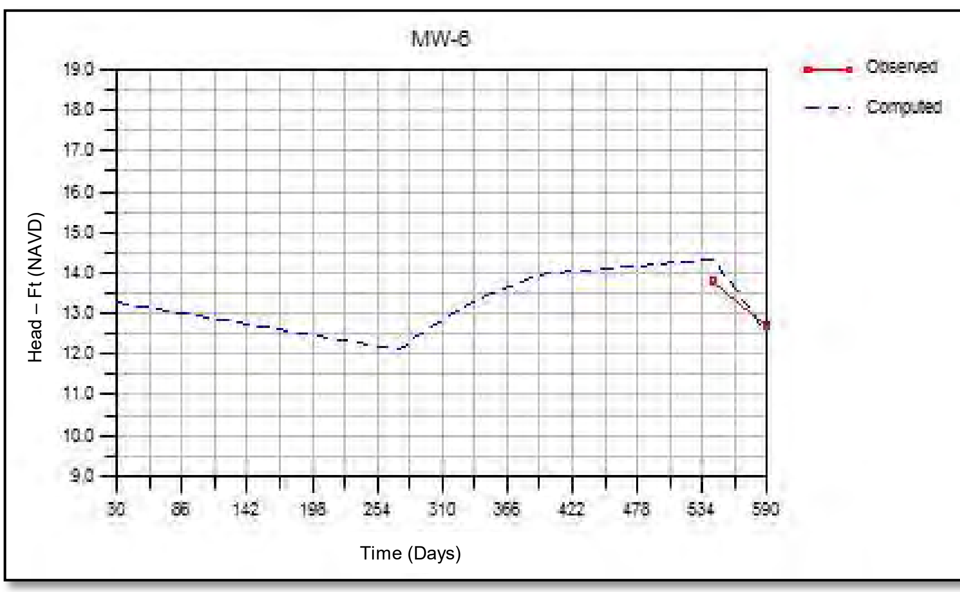


Figure 11.10 - Modeled vs Measured Groundwater Elevations (MW-6)

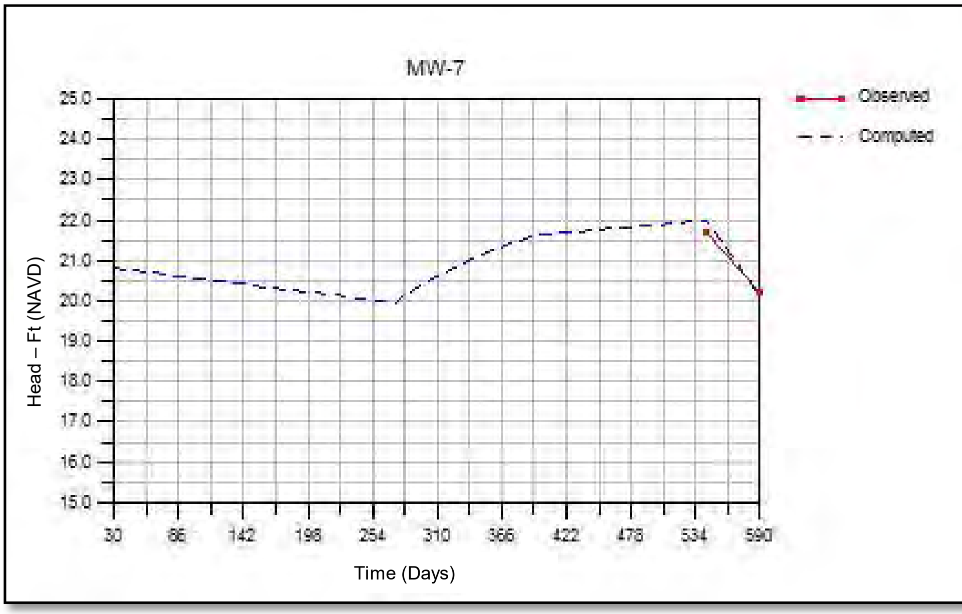


Figure 11.11 - Modeled vs Measured Groundwater Elevations (MW-7)

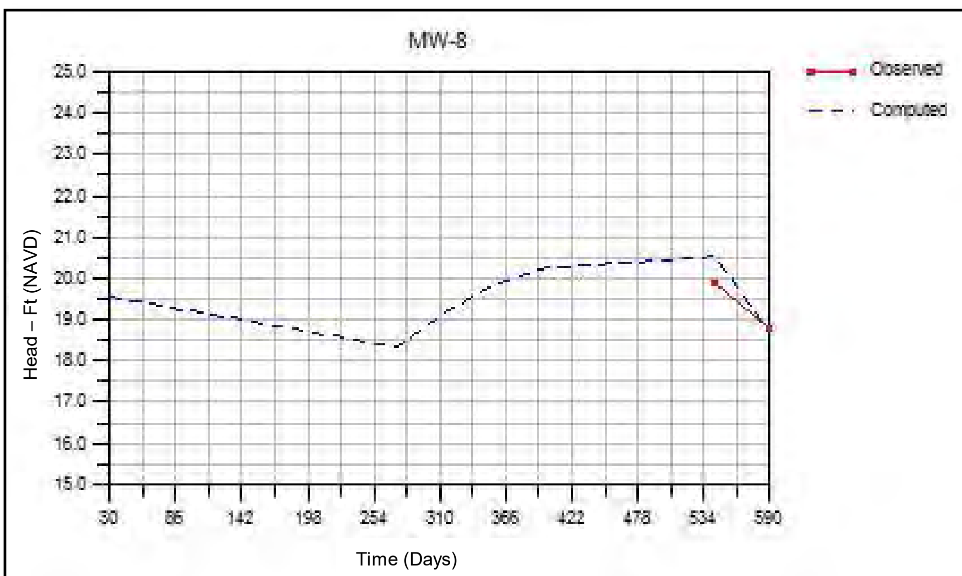


Figure 11.12 - Modeled vs Measured Groundwater Elevations (MW-8)

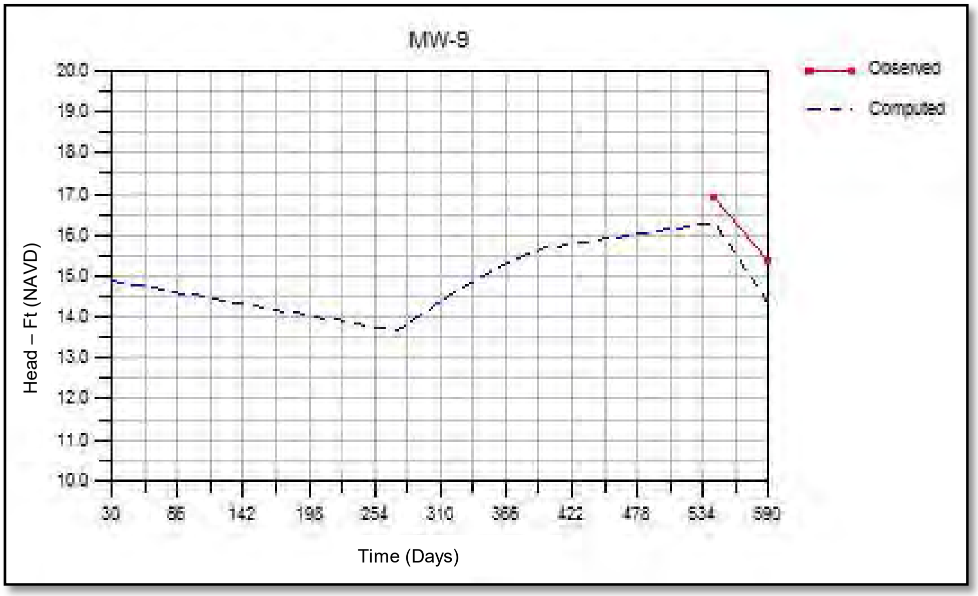


Figure 11.13 - Modeled vs Measured Groundwater Elevations (MW-9)

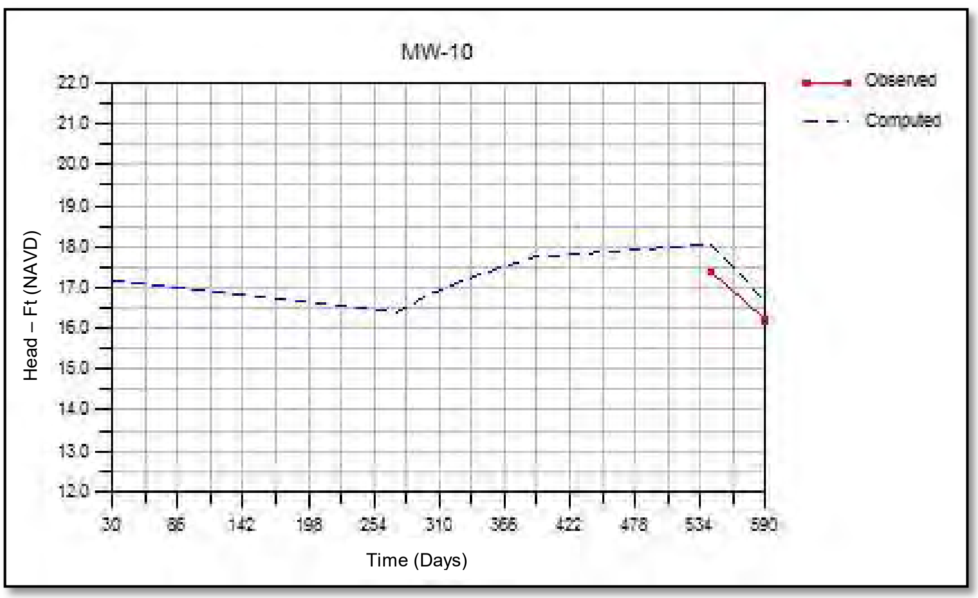


Figure 11.14 - Modeled vs Measured Groundwater Elevations (MW-10)

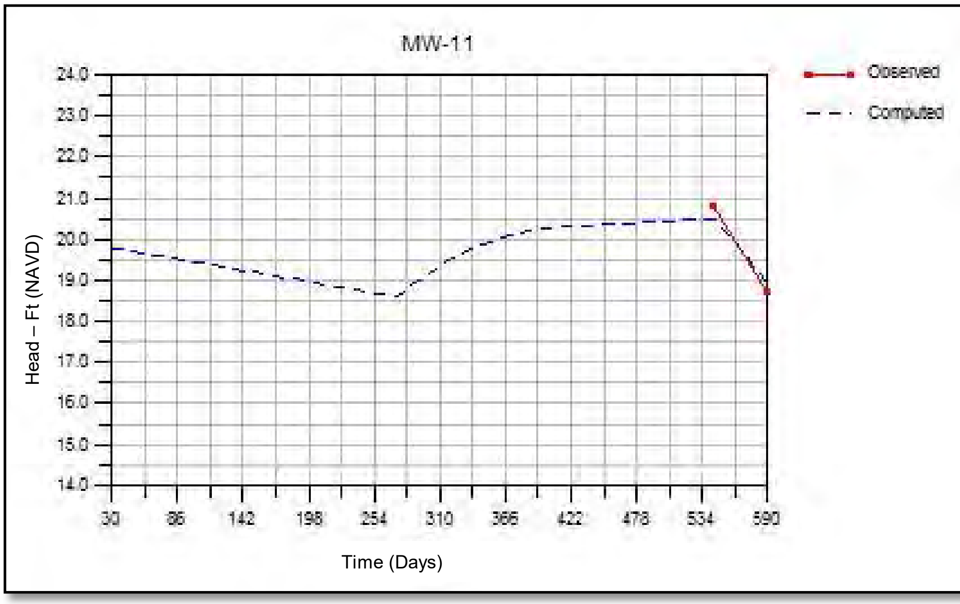


Figure 11.15 - Modeled vs Measured Groundwater Elevations (MW-11)

The graphs indicate that the model is relatively well calibrated based on visual comparison of measured and simulated groundwater levels. More qualitative measures of reasonable calibration performance were provided by goodness-of-fit statistics. The Root-Mean-Square-Error (RMSE) was less than 2 feet for thirteen of the fifteen monitoring well locations. The Nash Sutcliffe (E) was positive for twelve of the locations and greater than 0.5 for ten out of the fifteen monitoring well locations. The calibrated model groundwater elevation contours within the upper four model layers, for both monitoring well measurement events, are presented on *Exhibits D-1 through D-8* in *Appendix D*.

The calibrated aquifer properties for the five-layer geologic profile are listed below:

Table 11.6 - Calibrated Aquifer Properties

Layer No.	Layer Description	Horizontal Hydraulic Conductivity, K_h (ft/day)	Vertical Hydraulic Conductivity, K_v (ft/day)	Storage
1	Surficial Aquifer: fine sand and silty sand	6.5 to 10	3.0 to 5.0	0.17
2	Surficial Aquifer: fine sand and silty sand	3.0 to 8.5	1.5 to 4.0	0.0001
3	Surficial Aquifer: sand, silt and clay	2.5	1.0	0.0001
4	Aquitard: sandy clay and clay with shell	0.01	0.00001	0.0001
5	Floridan Aquifer: Limestone	300	1.0	0.00001

11.2.2 MT3D

The MT3D model adopted the adjustments established in the calibration of the site-specific transient MODFLOW model. Also, the solute transport parameters were based on the laboratory soil column leaching tests completed for this study. Referring to the graph presented below (chloride concentration in mg/L versus time in days), an equivalent MT3D model was developed to represent a laboratory leaching test (Vibracore Soil Sample V11).

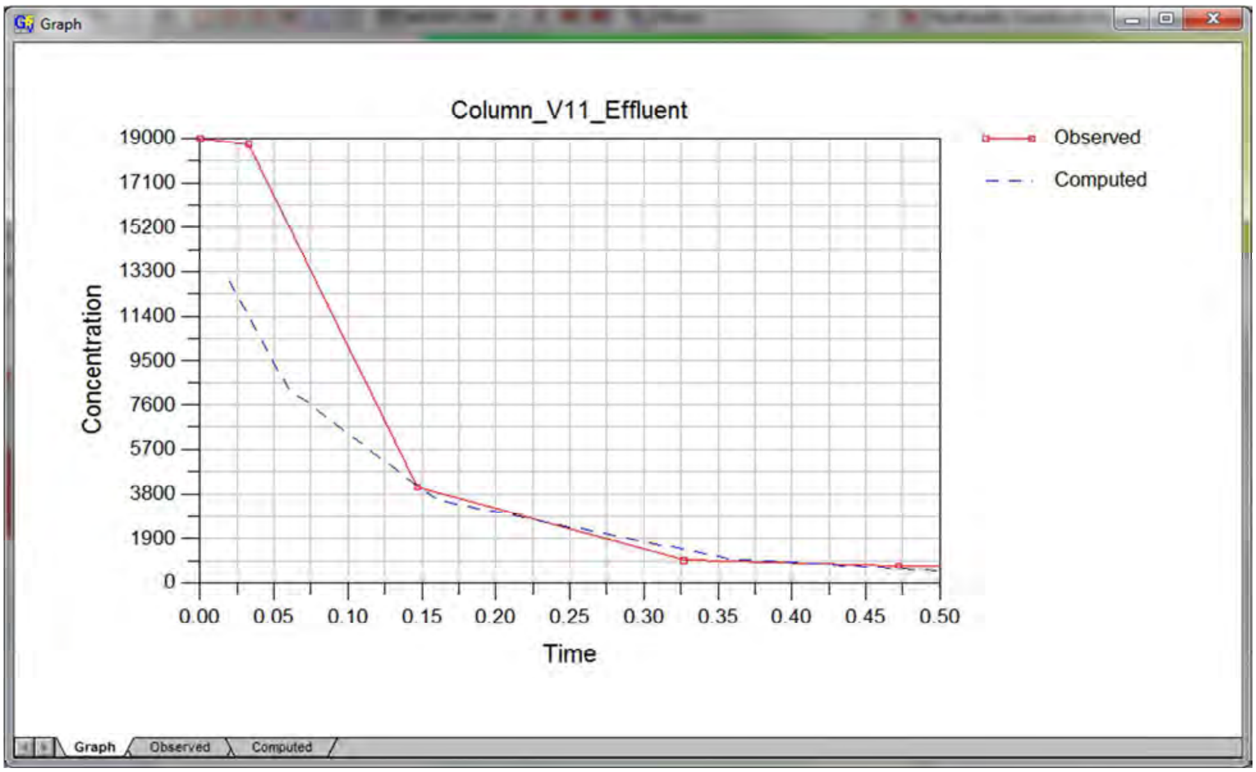


Figure 11.16 - Calibration Representative Column - MT3D Model

Calibration of the model to the laboratory results resulted in a retardation coefficient, k_d, of 0.001 feet and a longitudinal dispersion coefficient of 10 feet. These calibrated parameters were used for the site-specific MT3D modeling discussed in **Section 11.3** below. The sensitivity of varying the retardation coefficient was analyzed as part of the MT3D modeling for the first dredging event.

11.3 MT3D Model Simulation without Site Controls

Based on the Taylor Engineering, Inc. *Management Plan (October 2015)*, the MT3D model simulation considered a 50-year span of operation with dredging events at 10-year intervals to predict the extent of saline water migration from the DMMA into the local surficial aquifer. The dredge material was assumed to be saturated with brackish water at a chloride concentration of

19,000 mg/L as the maximum value from the laboratory leaching tests. A median background groundwater chloride concentration of 50 mg/L (Section 4.6), being the average measured value from the eleven monitoring wells, was assigned to all layers and boundaries in the model.

The top elevation of the dredged material was progressively increased for each of the five loading events as illustrated below in **Table 11.7**.

Table 11.7 - DMMA Basin Dredge Material Top and Bottom Elevations for each Loading Event

Simulation Period	Description	Top of Dredge Material Elevation (feet-NAVD)	Bottom of Dredge Material Elevation (feet-NAVD)
0 - 10 years	Saturated dredge material having a chloride concentration of 19,000 mg/L is added to the site for a period of 28-days, followed by 9 years and 11 months of recovery	+19.11	+15.71
10 - 20 years		+22.51	+19.11
20 - 30 years		+25.91	+22.51
30 - 40 years		+29.31	+25.91
40 - 50 years		+32.71	+29.31

To simulate the dredge loading and resting cycles, a total of five separate MT3D models were set up for 28 days of loading followed by 9 years and 11 months of resting. The resulting chloride concentration from the end of a resting period was imported into the next MT3D model as a starting condition and the same sequence of dredge material loading for 28 days followed by 9 years and 11 months of resting was repeated in the model. A more detailed description of the model set up and execution is presented below.

Dredged Material Event No. 1 (10 Year Simulation)

The first simulated dredging event included results from Stress Period #1 (a 28-day period) and Stress Period #2 (a 9-year and 11-month period). The initial groundwater condition for this simulation (chloride concentration across the model domain) was set at a background concentration of 50 mg/L. The General Head Boundary (GHB) condition was initially applied at Elevation +20.00 feet (NAVD) over the basin bottom area. After the first 28-day stress period, the basin boundary condition was removed to allow water elevations to rise and fall with time over a 9-year and 11-month stress period until the next dredging event. The chloride concentration of the water coming out of the dredge material was set at 19,000 mg/L.

Saline water migration begins immediately as the water from the dredged material pumped to the containment basin moves downward into the surficial aquifer through the basin bottom and then moves laterally following the groundwater flow gradient.

Exhibits E-1 through E-3 and Exhibits E-4 through E-6, in *Appendix E*, show the model results for the first dredge loading and resting cycle, respectively, within Model Layers 1 through 3 (top 100

+/- feet of the surficial aquifer above the Aquitard). The figures show contours of chloride concentration in the groundwater super-imposed on the DMMA footprint and the property boundaries. The minimum chloride concentration plotted is the 60 mg/L contour. The 250 mg/L contour is highlighted and represents the FDEP GCTL.

As shown, the 250 mg/L contour has moved by the end of the first 10-year resting period as much as 400 feet beyond the north property boundary, and just past the northeast and southwest corners, in all three layers. The 250 mg/L contour intercepts the north property boundary at 148 days after the start of dredged material placement. The chloride plume movement is significantly less to the west and south. The greater plume movement to the northeast is the result of the groundwater flow gradient in that same direction.

Within the basin area, saline water has infiltrated to a depth of approximately 100 feet reaching to the top of the Aquitard (Model Layer 4). Groundwater chloride concentrations range from about 5,000 mg/L, between 5 feet and 9 feet below the basin bottom, to less than 60 mg/L below the 100-foot depth. The chloride concentrations are greatest near the surface of the water table and lessen with depth due to mixing with the ambient groundwater and the restriction of confining soil layers. Likewise, the horizontal spread of the chloride plume shows decreasing concentrations due to mixing with ambient groundwater.

For the 10-Year Simulation, the retardation coefficient, $k_{d,}$ was both increased and decreased up to 20% while plotting the position of the 250 mg/L contour for each percentage of change in the retardation coefficient. The results are shown on Figures 11.17 and 11.18 below.

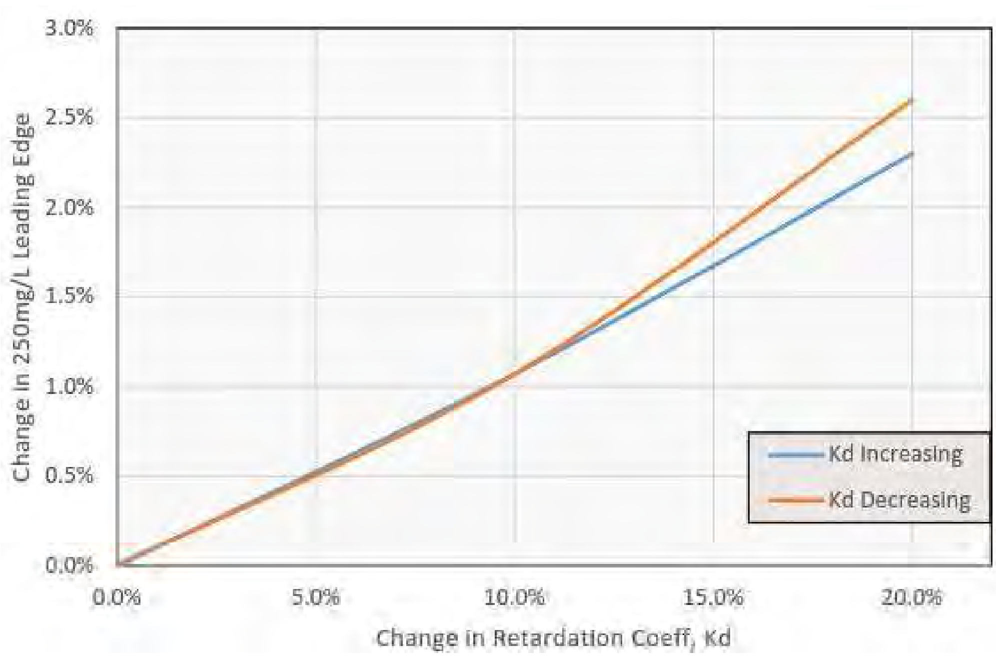


Figure 11.17 - Sensitivity Results for Northerly Moving Edge

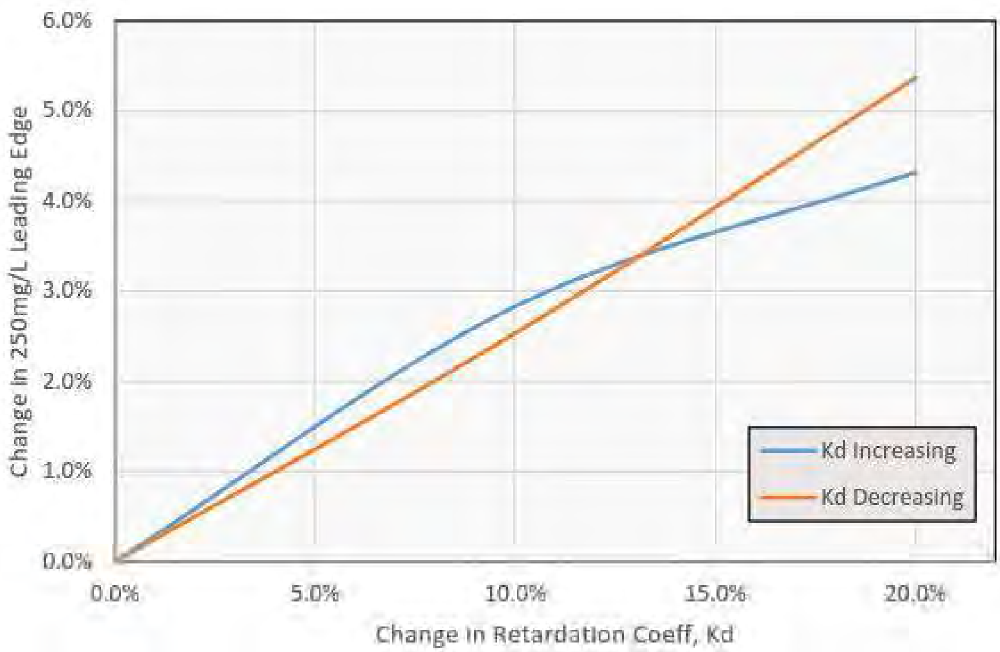


Figure 11.18 - Sensitivity Results for Easterly Moving Edge

The graphs indicate sensitivity relationships of 4:1 (retardation coefficient change, %: distance change, %) and 8:1 for the easterly and northerly movement, respectively, of the 250 mg/L contour leading edge. An order of magnitude change, both up and down, in the retardation coefficient indicated sensitivity ratios ranging from 89:1 to 16:1 representing distance changes of 10 to 55%, respectively, for the leading edge of the 250 mg/L contour. The analysis reflects fairly low sensitivity for the retardation coefficient which provides for relatively high confidence in the MT3D model results.

Dredged Material Event No. 2 (20 Year Simulation)

The second simulated event included results from Stress Period #3 (a 28-day period) and Stress Period #4 (a 9-year and 11-month period). The initial model conditions for this simulation were imported from the end of Stress Period #2. However, the GHB was raised to Elevation +22.51 feet for a period of 28 days (Stress Period #3) as presented in **Table 9.6**. The chloride concentration coming out of the dredge material was again set at 19,000 mg/L. The saline water migration from the containment basin was assumed to start leaking immediately. The chloride plume from the second dredging event joined with the plume remnants from the first dredging event. This co-joining of plumes created some irregularities in the plume shape and contours (see *Exhibits E-7 through E-12*).

At the end of Stress Period #4 (i.e. the second 10-year resting period), the 250 mg/L contour in the top three layers has extended as much as 600 feet beyond the north and east property boundaries. The 1,000 mg/L contour has also moved past those same boundaries. In addition, the 250 mg/L contour has migrated to a maximum distance of about 200 feet past the southwest property corner. The mounding effect of impounded water within the containment basin accounts for the increased spreading of the plume.

Dredged Material Events Nos. 3 through 5 (30, 40 and 50 Year Simulations)
The remaining three dredging events (Years 30, 40 and 50 simulations) were modeled in the same manner as described above for the first two events. These simulations are represented by Stress Periods #5 through #10 consisting of three consecutive cycles with 28 days of dredge material loading followed by 9-year and 11-month periods of resting. The resulting chloride concentration contour maps in Layers 1 through 3 for each event are presented in *Exhibits E-13 through E-30*.

The modeling results for the last three simulations show a progressive increase in the lateral movement of the plume. The 250 mg/L contour has extended eastward to just short of U.S. 1 and 500 to 1,000 feet beyond the north, west, and south property boundaries. The 5,000 mg/L contour has also moved past portions of the north and east property lines within Layers 1, 2 and 3.

11.4 MT3D Model Simulation with Site Controls

The groundwater model runs, without any special engineering controls as presented in the above **Section 11.3**, indicated the following:

- The chloride plume (i.e. 250 mg/L chloride concentration contour line) intercepts the north property boundary at about 148 days after the start of the first dredging event.
- By Year 30, the 250 mg/L contour line has moved in the shallow aquifer beyond most of the perimeter property boundaries.
- At the end of the final year (Year 50), the same contour has extended as much as 350 feet beyond the north and east property boundaries.

The model was then adjusted with a variety of engineering controls to evaluate methods to restrict the spread of the chloride plume. The performance criteria for the engineering controls were to: (1) restrict the horizontal movement of the chloride plume (250 mg/L contour) to within the property boundaries during the 50-year operational life of the DMMA and (2) limit drawdown to ½ foot in off-site wetlands.

The engineering controls that were initially considered included:

- Perimeter ditches
- Underdrains
- Pumped wells
- Vertical barrier (seepage cut-off wall)

The early model runs indicated significant flaws with both the underdrains (constructability issues) and the pumped wells (wetland drawdown impacts) and they were not considered further.

The subsequent model runs were an interactive process to evaluate the effectiveness of ditch control in combination with a vertical barrier and adjustment of the DMMA footprint (i.e. increased separation from the property boundary).

Ditch Control (original DMMA footprint)

The model was set-up with the original DMMA geometry, per the *Management Plan* (October 2015), and with a ditch control (i.e. invert elevation) at ½ to 1 foot below the Seasonal High Groundwater Level (SHGWL). The results indicated, as illustrated in the screen capture below, that the chloride plume moved past the north boundary by the end of the first (Year 10) dredging and resting event.

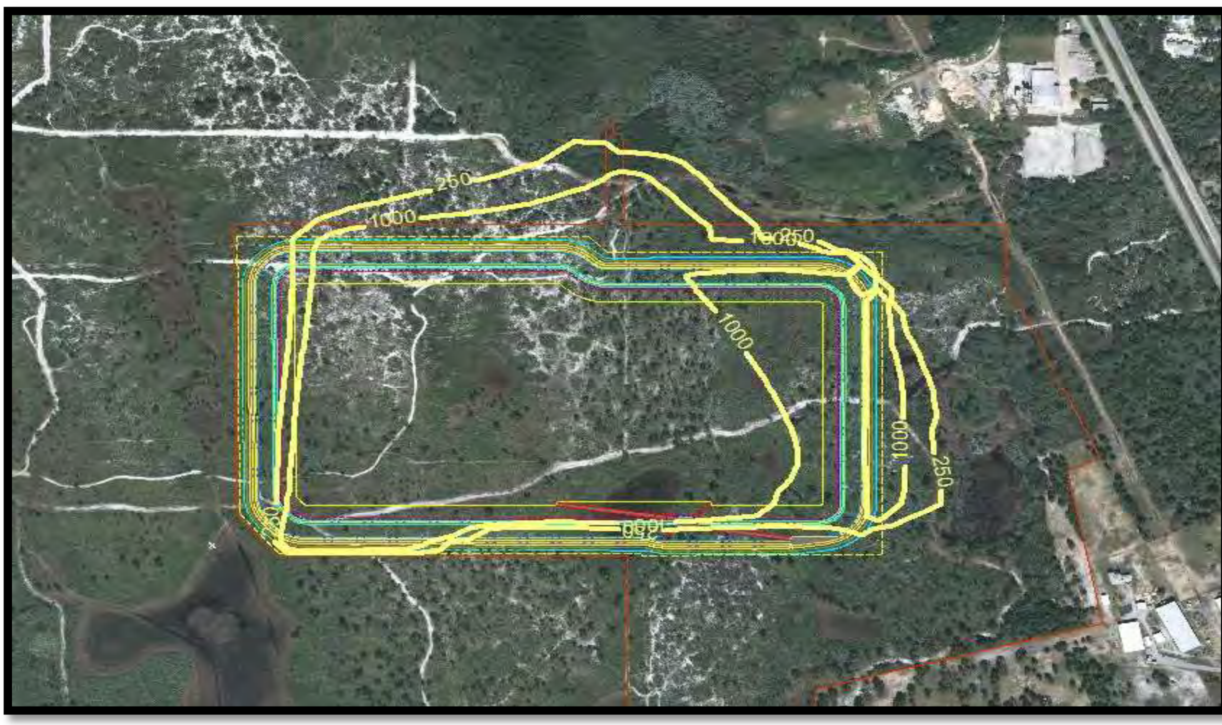


Figure 11.19 - Original Footprint with Ditch Control: Chloride Plume Movement Year 10 / Layer 1

Further lowering of the ditch control elevation provided better control of the chloride plume but resulted in excessive drawdown in the off-site wetlands. Thus, it was decided jointly by DUNKELBERGER and Taylor Engineering, Inc. to model a revised DMMA footprint by adjusting its perimeter at greater distance from the property boundaries to allow use of lower ditch controls.

Ditch Control (initially revised DMMA footprint)

The footprint was modified by moving the perimeter ditch line inward to a minimum distance of about 175 from the property boundaries. It was also stretched to the south to off-set the area reduced by the greater set-back distance. The revised shape of the footprint is illustrated below:

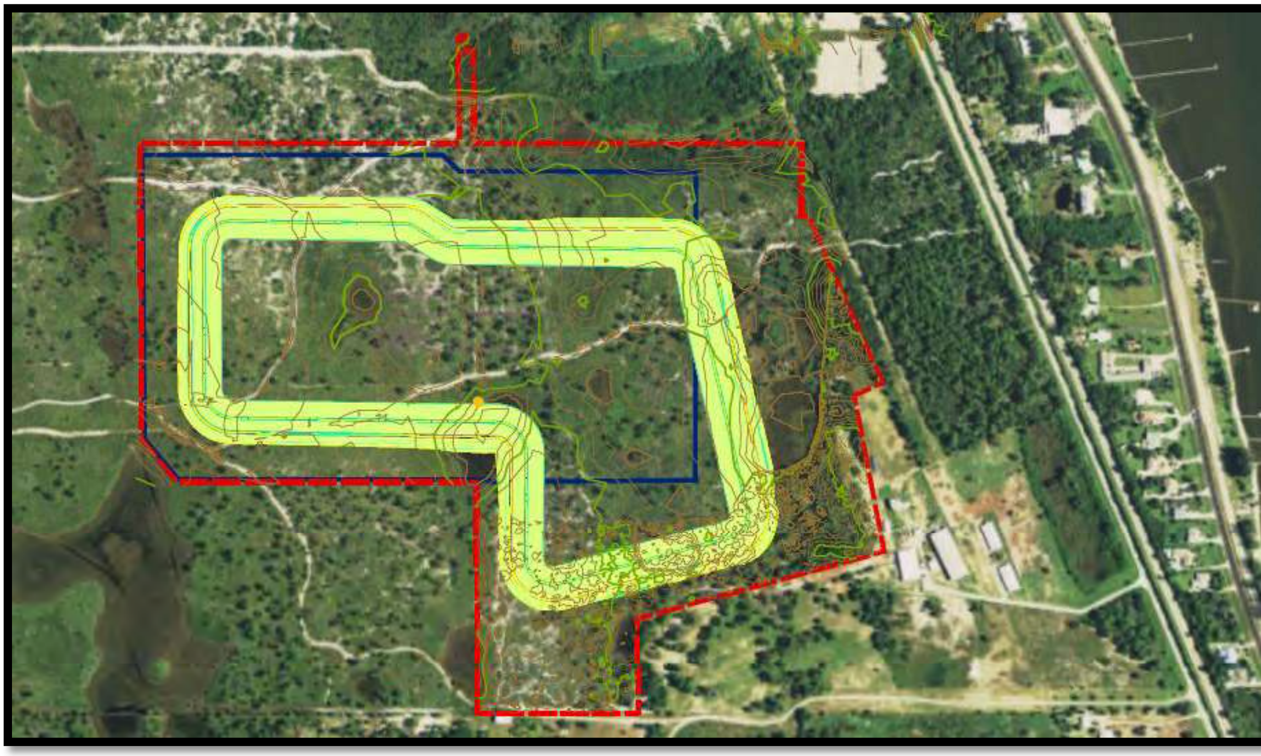


Figure 11.20 - Revised (Set Back) Footprint

The greater set-back distance allowed for a lowered ditch control at 1 foot (west side) to 2 feet (east side) below the SHGWL without creating excessive drawdown in the off-site wetlands. Chloride plume movement was also further restricted although the 250 mg/L contour reached the north and east property boundaries by the end of the second (Year 20) dredging event.

The results suggested that the required restriction on plume movement could be achieved by further adjustment of the footprint geometry and ditch controls with the possible addition of a vertical barrier (seepage cut-off wall) along the north and east sides of the perimeter ditch.

Accordingly, the set-back distance was increased slightly while dropping the ditch control to 3 feet on its east side and wrapping a vertical barrier around the east, northeast, and southeast parts of the DMMA perimeter. The results were that wetland impacts (drawdown) were acceptable while the chloride plume was maintained within the property boundaries through the last (Year 50) dredging event as shown below:

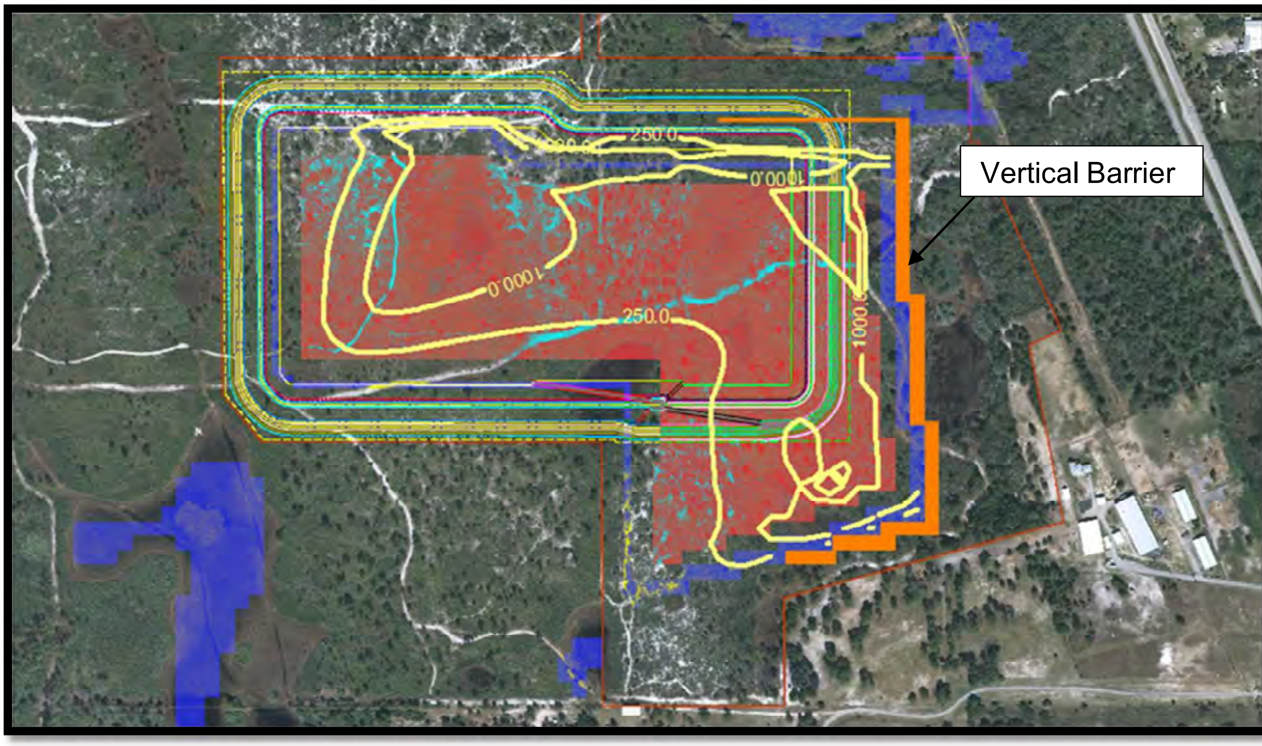


Figure 11.21 - Revised Footprint With Ditch and Vertical Barrier Controls: Chloride Plume Movement Year 50 / Layer 1

Since the vertical barrier, most likely a soil-bentonite cut-off wall, would be an expensive feature it was decided to evaluate further adjustment of the ditch controls using a more accurate (digitized) layout of the revised DMMA geometry.

<u>Ditch Control (finally revised DMMA footprint)</u>

The next model runs incorporated the digitized DMMA geometry, eliminated the vertical barrier, and interactively adjusted the ditch control with further lowering on the east side to meet the performance criteria with respect to plume movement and wetland drawdown. The criteria were achieved with a ditch control varying from ½ foot to 4 feet below the SHGWL. The highest point of the ditch is on the west side and the bottom slopes downward to a low point near the northeast corner of the DMMA. The model results, reflecting acceptable chloride plume movement and wetland drawdown, are presented on Exhibits F-1 through F-30 and Exhibits F-31 and F-32, respectively.

The modelled ditch controls (i.e. inverts) are presented as elevations in feet (per NAVD-88) on Exhibit F33.

12.0 ADDITIONAL STUDY

The revised DMMA footprint, required for groundwater (i.e. chloride plume movement) control, represents an approximately 500-foot shift of the southeasterly stretch of the perimeter dike as compared to the original position. The exploratory borings completed during an earlier phase (Phase I) of study were aligned with the original footprint. Thus, a significant gap of exploratory data now exits along the southeasterly segment of the revised DMMA footprint. We recommend the drilling of supplemental borings in this area to confirm consistency with the earlier borings and current assumptions being used for Phase III design-level geotechnical analyses.

13.0 SUMMARY AND RECOMMENDATIONS

With the topographic relief across the site, the planned dike construction will involve fill heights ranging from 14 to 20 feet on the west and east sides, respectively, of the site.

The proposed DMMA footprint area is underlain by a thick (100 feet +/-) deposit of mostly granular soils consisting of relatively clean to slightly silty sands containing broken shell with variable layers of fine grained soils (silts and clays). The sands are generally loose to medium dense in terms of relative density. The fine-grained materials are generally medium stiff to stiff.

A large wetland lies along the southern dike centerline. Surficial muck (unsuitable foundation materials) is commonly found in these wetlands. If found, the muck would require full removal and replacement. The area of this wetland is 76,500 square feet. With an assumed typical depth of 12 inches, the required excavation volume would be 3,000 to 4,000 cubic yards.

For preliminary design purposes, the shallow to moderate depth sand deposits are relatively strong, minimally compressible, and therefore will provide suitable foundation support for embankment fill heights up to 20 feet. Borrow excavations, as presently planned to depths up to 7 feet (4 ½ feet on average), should produce a blend of relatively clean sands that would be suitable for general embankment fill at a side slope inclination of 3:1 (horizontal: vertical) as presently planned. In a compacted condition, these sands show high permeability values in the range of 34 to 57 feet per day. High permeability values for embankment materials are of importance as they will cause high seepage rates through the earthen dike which potentially may exit the downstream embankment face and/or toe. These materials may require mixing or zoning of less permeable soils, and/or installation of seepage collection features such as toe or blanket drains, in the dike embankment.

The silts and clays are slightly to moderately over-consolidated, moderately compressible, and will result in maximum settlements of approximately 4 inches beneath the easterly perimeter dike.

The groundwater flow gradient mimics the topographic decline from west to east across the site.

Depths to groundwater measured in on-site monitoring wells during the study period (i.e. dry season, however abnormally wet) ranged from 3 to 8 feet below the existing ground surface. Groundwater control (dewatering) will likely be needed to accomplish fill placement at lower elevations, excavation of borrow, and removal of wetland areas within the DMMA footprint in the dry. The dewatering required for mass earthwork should involve the usual methods of rim ditches, pumped sumps, and on-site impoundment of pump discharge waters. However, dewatering means and methods are the responsibility of the contractor.

Initial groundwater quality data collected by Pace Analytical for on-site monitoring wells shows background chloride concentrations ranging from 10 to 180 mg/L.

Sample of sediments from the target dredge area indicated relatively high leaching potential of chlorides based on laboratory test results. A MT3D contaminate transport model was set up, based on site specific parameters, and calibrated using the laboratory soil column leaching test results.

The calibrated MT3D model was run to simulate a series of operational events during a 50-year service life. The simulations were of dredging events occurring at 10-year intervals and consisting of 28-day loading periods followed by 9 years and 11 months of resting. At the end of the final (Year 50), the model results indicated that the chloride plume carried a concentration of 10,000 mg/L to a depth of about 100 feet beneath the DMMA footprint. The presence of an Aquitard at that depth restricted further vertical movement of the plume. The horizontal spread of the plume was predominately northeasterly following the hydraulic down-gradient in that same direction. At Year 50, the 5,000 mg/L contour of the chloride plume in the upper part of the aquifer extended 350 feet beyond the east and north property boundaries.

By Year 30, the 250 mg/L contour of the chloride plume had moved in the shallow aquifer to beyond most of the perimeter property line.

For the next step (Phase II) of the study, the same operational events were modelled but with the addition of engineering controls to evaluate measures to mitigate chloride plume movement, both vertically and horizontally, in the shallow aquifer. The performance criteria for the engineering controls were to: (1) restrict the horizontal movement of the chloride plume (250 mg/L contour) to within the property boundaries during the 50-year operational life of the DMMA and (2) limit drawdown to ½ foot in off-site wetlands. The following engineering controls were considered:

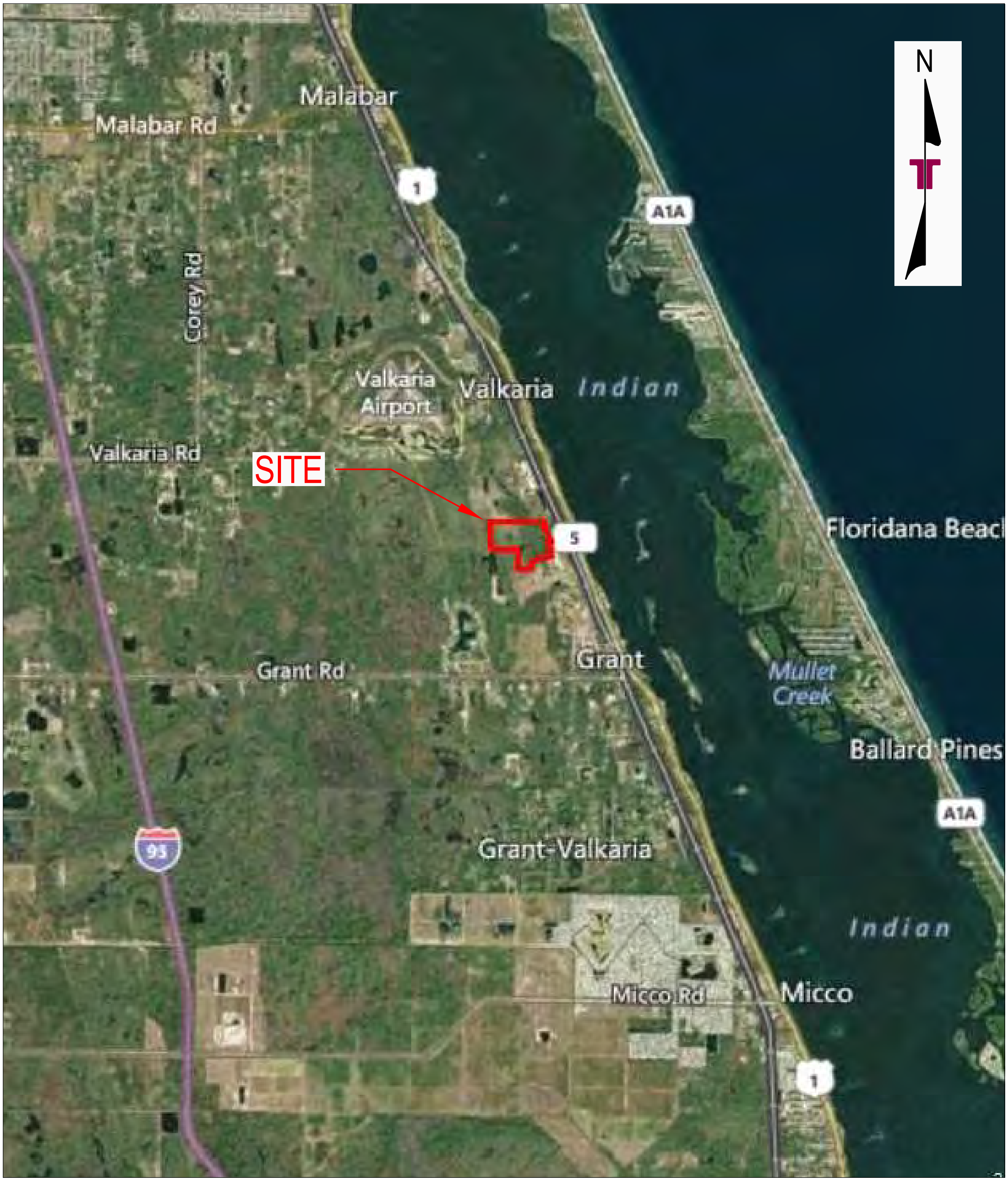
1) Perimeter ditch system with piped discharge (outfall) to the ICWW
2) Underdrain system with outfall
3) Pumped wells with outfall
4) Vertical barrier (seepage cut-off wall)
5) Combination of the above

The results of the Phase II modelling effort indicate that a revised DMMA footprint, with greater set-back distance from the property boundaries as compared to the original geometry, with a relatively deep, sloping ditch control can meet the required performance criteria with respect to chloride plume movement and wetland drawdown. We believe that this option represents the most practical (i.e. cost effective) option to do so. The low point of the ditch system will, however, need to outfall to the ICWW via a permanent, closed discharge pipeline.

14.0 GENERAL COMMENTS

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.



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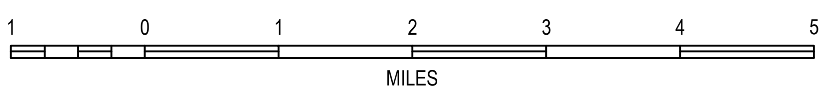

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	SITE VICINITY MAP	SHEET
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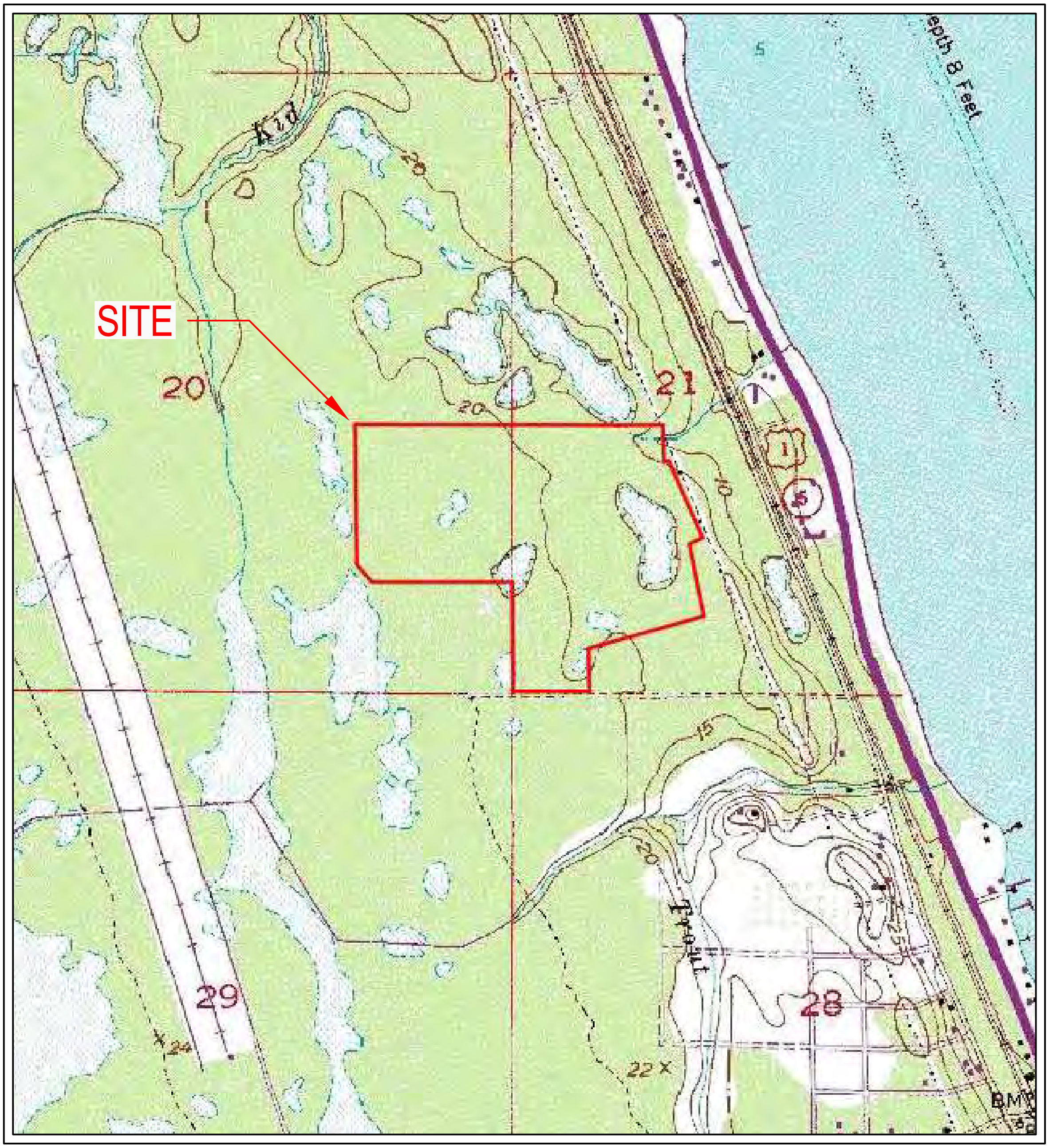
Checked By: DD	File No. -		TAYLOR ENGINEERING, INC.	
Approved By: KA	Date: 5/26/16	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986 PH. (772) 343-9787 FAX. (772) 343-9404	DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida	

UNITED STATES — DEPARTMENT OF THE INTERIOR — GEOLOGICAL SURVEY



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FEET

CONTOUR INTERVAL 5 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

GRANT, FLORIDA

1949; PHOTO REVISED 1970

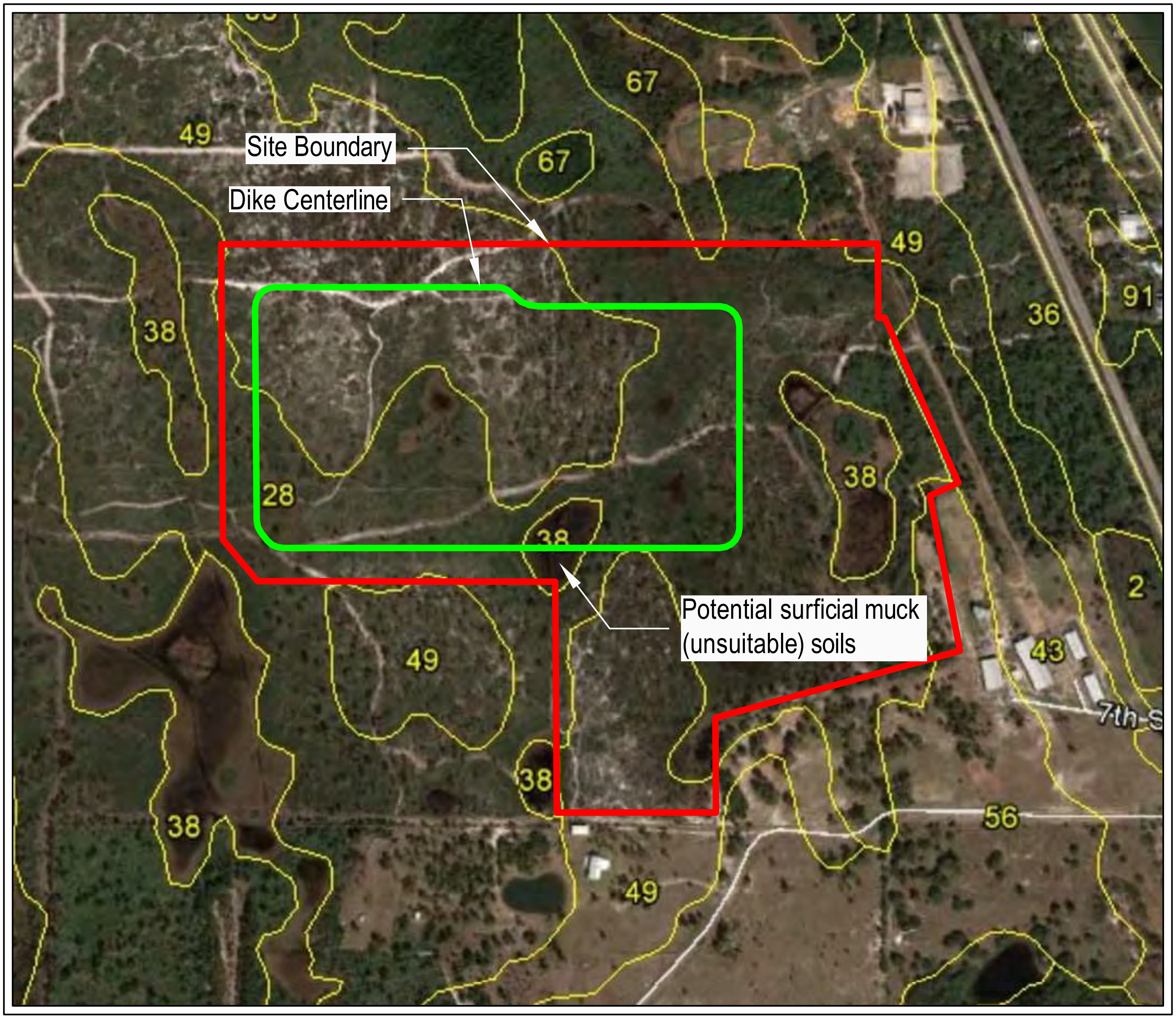
7.5 MINUTE SERIES (TOPOGRAPHIC)

N

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	TOPOGRAPHIC VICINITY MAP
Drawn By: BL	Scale: AS SHOWN		GEOTECHNICAL SITE EXPLORATION
Checked By: DD	File No. -		TAYLOR ENGINEERING, INC.
Approved By: KA	Date: 5/26/16	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986 PH. (772) 343-9787 FAX. (772) 343-9404	DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida

SHEET

2



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FEET

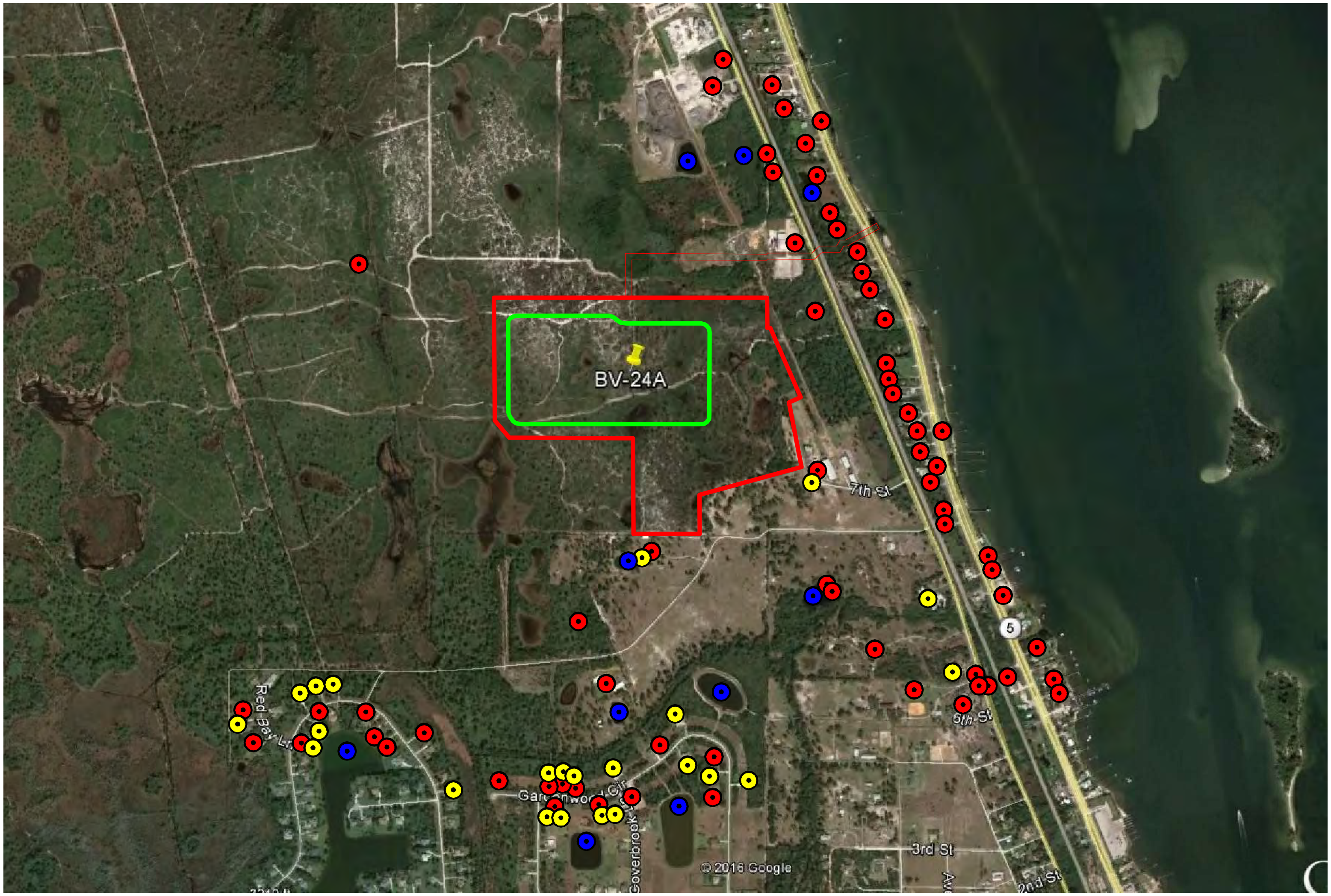
SOIL LEGEND

28	IMMOKALEE SAND
38	MYAKKA SAND, DEPRESSIONAL
49	POMELLO SAND
56	ST. LUCIE FINE SANDS, 0 TO 5 PERCENT SLOPES
67	TOMOKA MUCK, UNDRAINED

N

U.S.D.A. SOIL SURVEY FOR BREVARD COUNTY, FLORIDA
ISSUED: JANUARY 1987

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	SOIL SURVEY MAP	SHEET
Drawn By: BL	Scale: AS SHOWN	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION	3
Checked By: DD	File No. -	PH. (772) 343-9787 FAX. (772) 343-9404	TAYLOR ENGINEERING, INC.	
Approved By: KA	Date: 5/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A	
			Brevard County Florida	

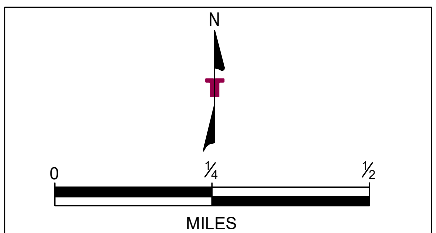


SOURCE: GOOGLE EARTH PRO

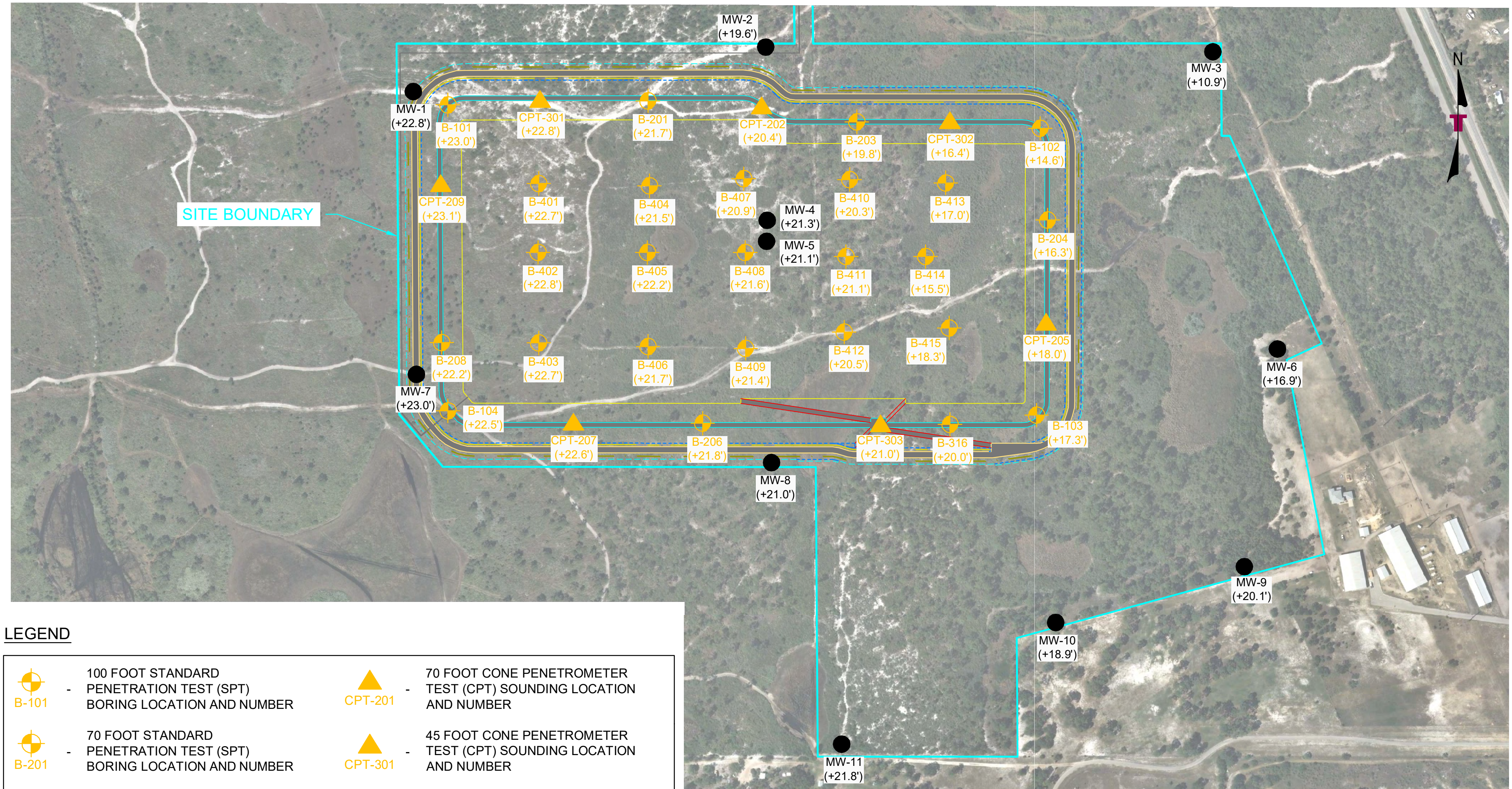
LEGEND

- WELL
- SEPTIC TANK
- POND

Locations are approximate



Project Mngr: DD	Project No. HB155022	**DUNKELBERGER engineering & testing, inc.** A Terracon COMPANY	HYDROLOGICAL DATA INVENTORY MAP	SHEET
Drawn By: BL	Scale: AS SHOWN		GEOTECHNICAL SITE EXPLORATION	4
Checked By: DD	File No. -		TAYLOR ENGINEERING, INC.	
Approved By: KA	Date: 5/26/16	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986 PH. (772) 343-9787 FAX. (772) 343-9404	DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida	



LEGEND

B-101	- 100 FOOT STANDARD PENETRATION TEST (SPT) BORING LOCATION AND NUMBER	CPT-201	- 70 FOOT CONE PENETROMETER TEST (CPT) SOUNDING LOCATION AND NUMBER
B-201	- 70 FOOT STANDARD PENETRATION TEST (SPT) BORING LOCATION AND NUMBER	CPT-301	- 45 FOOT CONE PENETROMETER TEST (CPT) SOUNDING LOCATION AND NUMBER
B-301	- 45 FOOT STANDARD PENETRATION TEST (SPT) BORING LOCATION AND NUMBER	MW-1	- MONITORING WELL LOCATION AND NUMBER
B-401	- 15 FOOT STANDARD PENETRATION TEST (SPT) BORING LOCATION AND NUMBER	(+22.8')	- INDICATED THE GROUND SURFACE ELEVATION WITH RESPECT TO NAVD88)

Locations are approximate

SOURCE: TAYLOR ENGINEERING, INC.

0' 200' 400' 800' 1200'

Project Mngr: DD Drawn By: BL Checked By: DD Approved By: KA	Project No. HB155022 Scale: AS SHOWN File No. - Date: 3/26/16	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY 607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986 PH. (772) 343-9787 FAX. (772) 343-9404	TEST LOCATION PLAN GEOTECHNICAL SITE EXPLORATION TAYLOR ENGINEERING, INC. DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida	SHEET 5

LEGEND

1. Gray or brown medium to fine SAND. (SP)
2. Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan). (SP-SM, SM)
3. Light brown slightly silty medium to fine SAND. (SP-SM)
4. Dark gray to green sandy SILT. (ML)
5. Gray shelly SAND with varying amounts of silt. (SP, SP-SM, SM)
6. Green or light gray CLAY, traces of shell. (CL, CH)
7. Gray to green slightly silty to silty fine SAND. (SP-SM, SM)

SP - Unified Soil Classification System Group Symbol (ASTM D 2487)

N - Indicates the number of blows of a 140 pound hammer, freely falling a distance of 30 inches, required to drive a 2-inch diameter sampler 12 inches (ASTM D 1586

B-101 - Standard Penetration Test (SPT) boring and number

MC - Moisture Content (%)

OC - Organic Content (%)

-200 - Amount finer than the U.S. No. 200 Sieve (%)

+22.9' 2-17-16 - Elevation of groundwater (feet-NAVD) and date measured

WOH - Indicates sampler advanced due to weight of hammer

50/1 - Indicates fifty blows required to drive sampler 1 inch

LL - Liquid Limit (%)

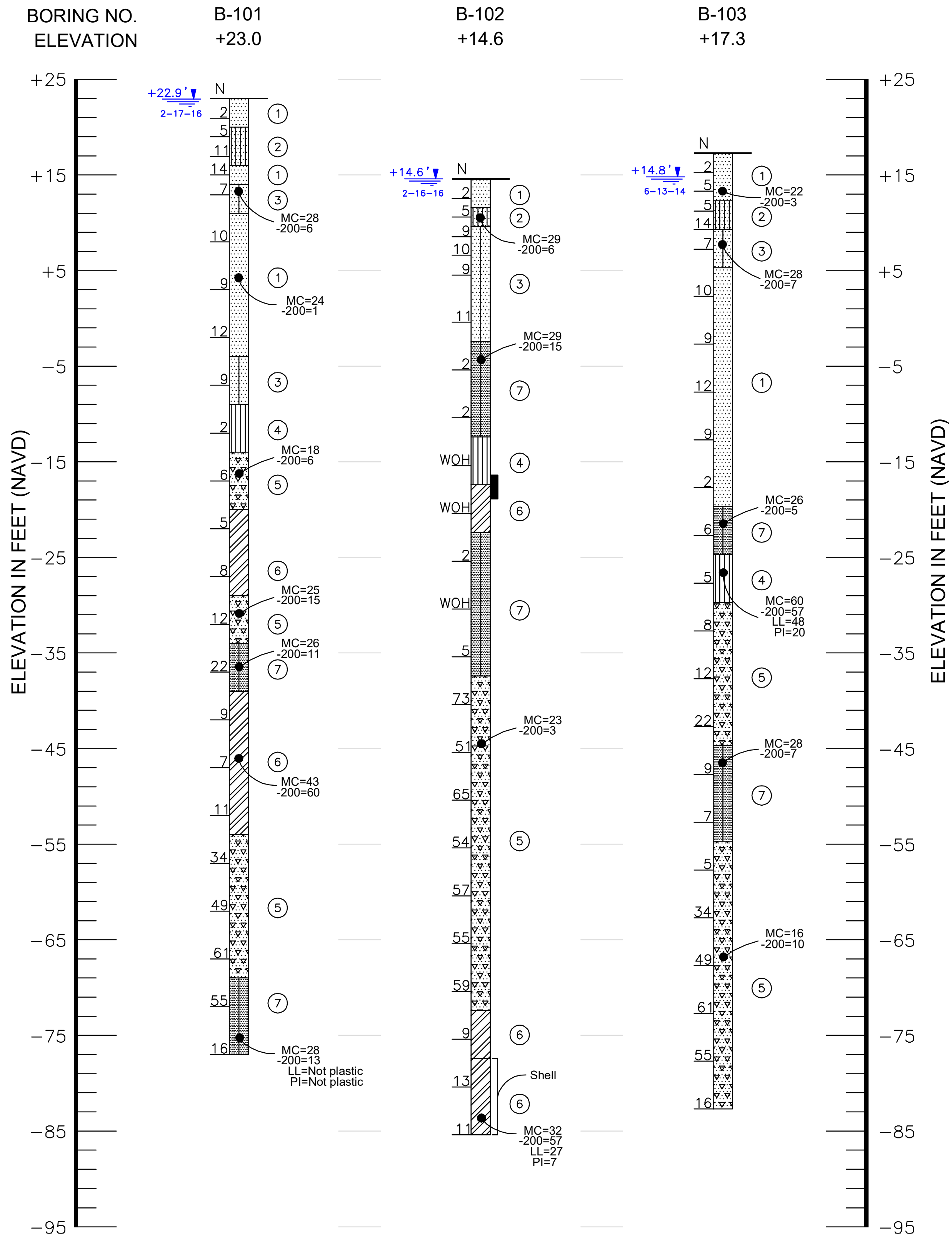
PI - Plasticity Index (%)

▌ - Indicated location of undisturbed (Shelby tube) sample collection

NOTES

1. Borings were drilled February 15, 2016 through February 26, 2016 using an ATV mounted Deidrich 50 (D-50) drill rig.
2. Strata boundaries are approximate and represent soil strata at each test hole location only. Soil transitions may be more gradual than implied.
3. Groundwater elevations shown on the subsurface profiles represent groundwater surfaces on the dates shown. Groundwater level fluctuations should be anticipated throughout the year.

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	LEGEND	SHEET
Drawn By: BL	Scale: AS-SHOWN		GEOTECHNICAL SITE EXPLORATION	6
Checked By: BL	File No. -		TAYLOR ENGINEERING, INC.	
Approved By: KA	Date: 5/26/16	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986 PH. (772) 343-9787 FAX. (772) 343-9404	DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida	



LEGEND

1. Gray or brown medium to fine SAND. (SP)
2. Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan). (SP-SM, SM)
3. Light brown slightly silty medium to fine SAND. (SP-SM)
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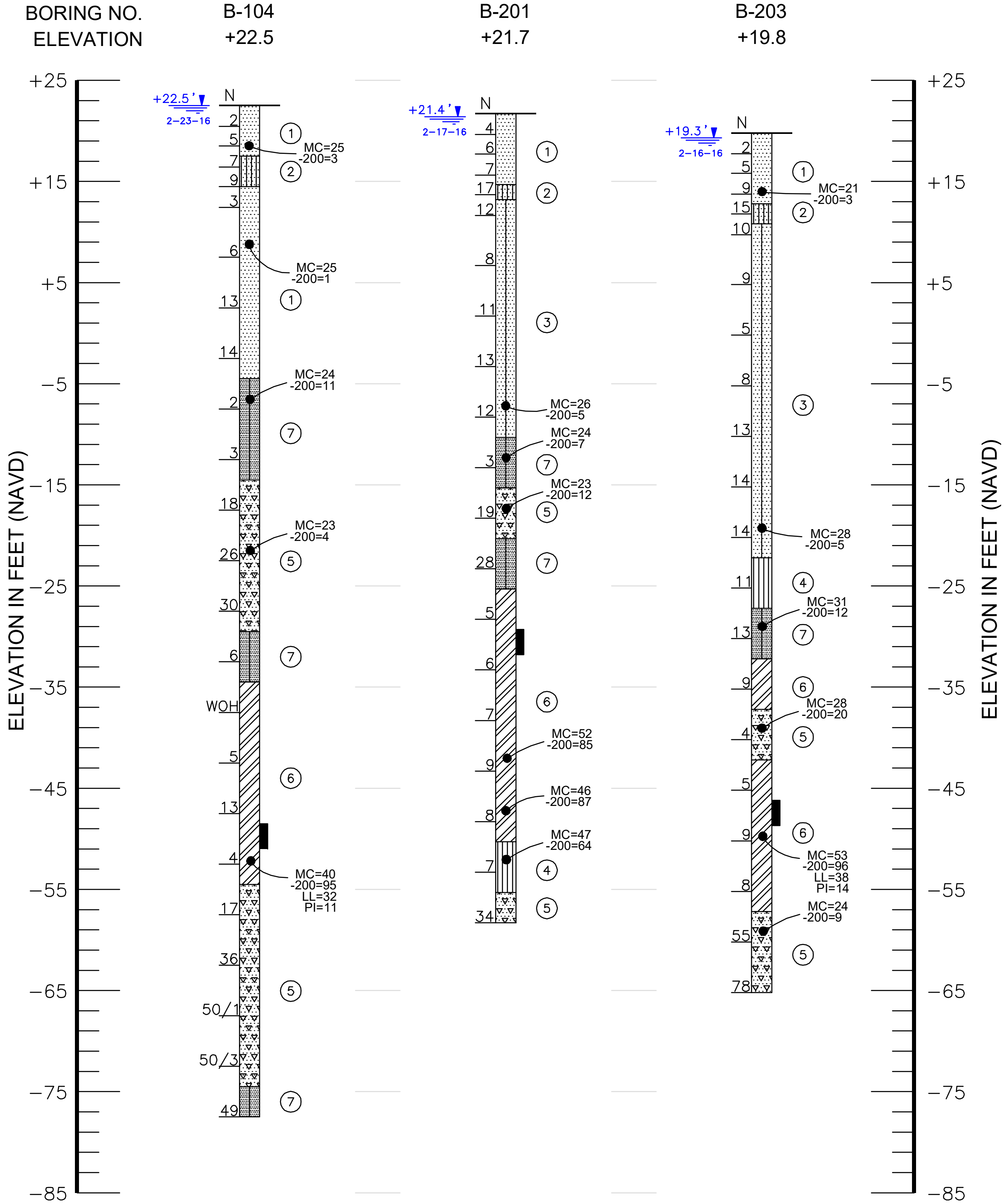
5. Gray shelly SAND with varying amounts of silt. (SP, SP-SM, SM)
6. Green or light gray CLAY, traces of shell. (CL, CH)
7. Gray to green slightly silty fine to silty SAND. (SP-SM, SM)

Project Mngr: DD	Project No. HB155022	**DUNKELBERGER** engineering & testing, inc. A Terracon COMPANY	SUBSURFACE PROFILES
Drawn By: BL	Scale: 1" = 10'	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION
Checked By: DD	File No. -	PH. (772) 343-9787 FAX. (772) 343-9404	TAYLOR ENGINEERING, INC.
Approved By: KA	Date: 3/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A
			Brevard County Florida

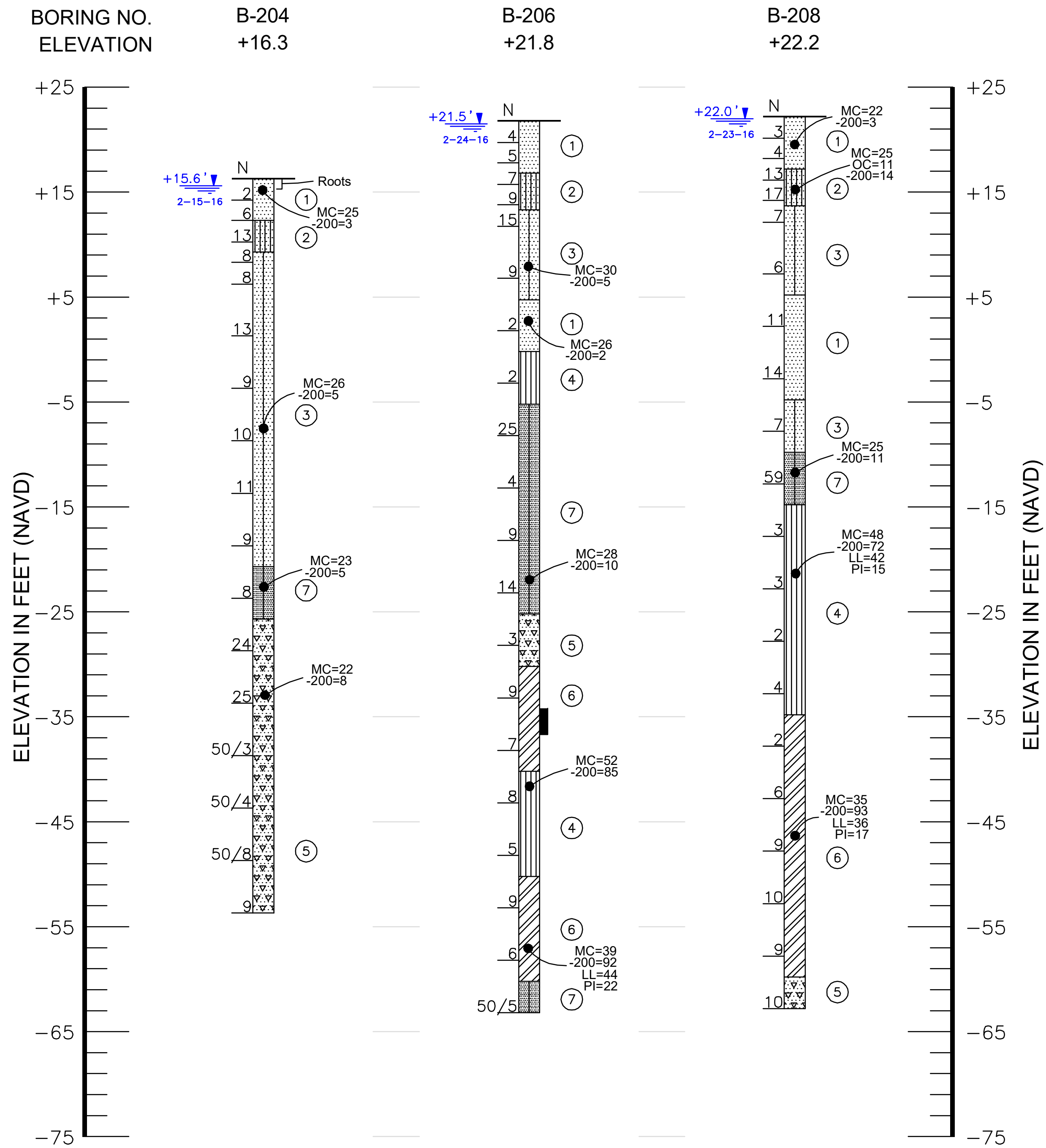
SHEET 7



LEGEND

- (1) Gray or brown medium to fine SAND. (SP)
- (2) Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan). (SP-SM, SM)
- (3) Light brown slightly silty medium to fine SAND. (SP-SM)
- (4) Dark gray to green sandy SILT. (ML)
- (5) Gray shelly SAND with varying amounts of silt. (SP, SP-SM, SM)
- (6) Green or light gray CLAY, traces of shell. (CL, CH)
- (7) Gray to green slightly silty fine to silty SAND. (SP-SM, SM)

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	SUBSURFACE PROFILES	SHEET
Drawn By: BL	Scale: 1" = 10'	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION	8
Checked By: DD	File No. -	PH. (772) 343-9787 FAX. (772) 343-9404	TAYLOR ENGINEERING, INC.	
Approved By: KA	Date: 3/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida	

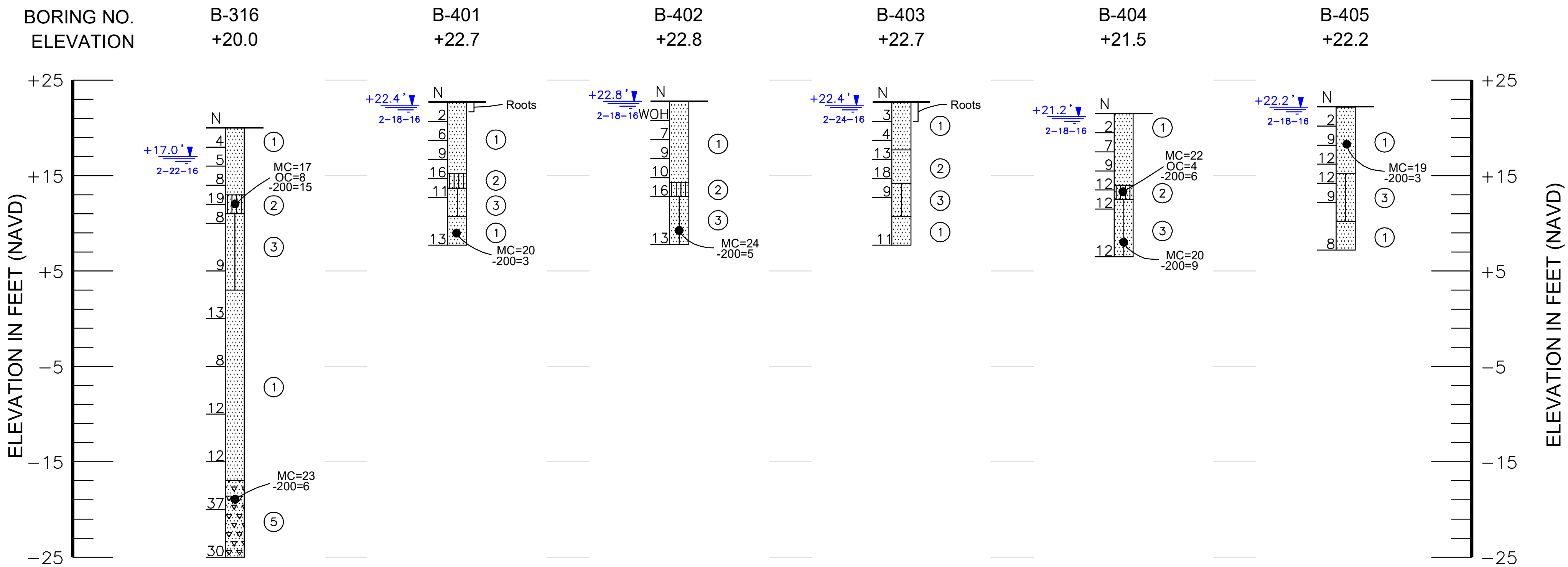


LEGEND

(1)	Gray or brown medium to fine SAND. (SP)
(2)	Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan). (SP-SM, SM)
(3)	Light brown slightly silty medium to fine SAND. (SP-SM)
(4)	Dark gray to green sandy SILT. (ML)
(5)	Gray shelly SAND with varying amounts of silt. (SP, SP-SM, SM)
(6)	Green or light gray CLAY, traces of shell. (CL, CH)
(7)	Gray to green slightly silty fine to silty SAND. (SP-SM, SM)

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	SUBSURFACE PROFILES
Drawn By: BL	Scale: 1" = 10'	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION
Checked By: DD	File No. -	PH. (772) 343-9787 FAX (772) 343-9404	TAYLOR ENGINEERING, INC.
Approved By: KA	Date: 3/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida

SHEET 9

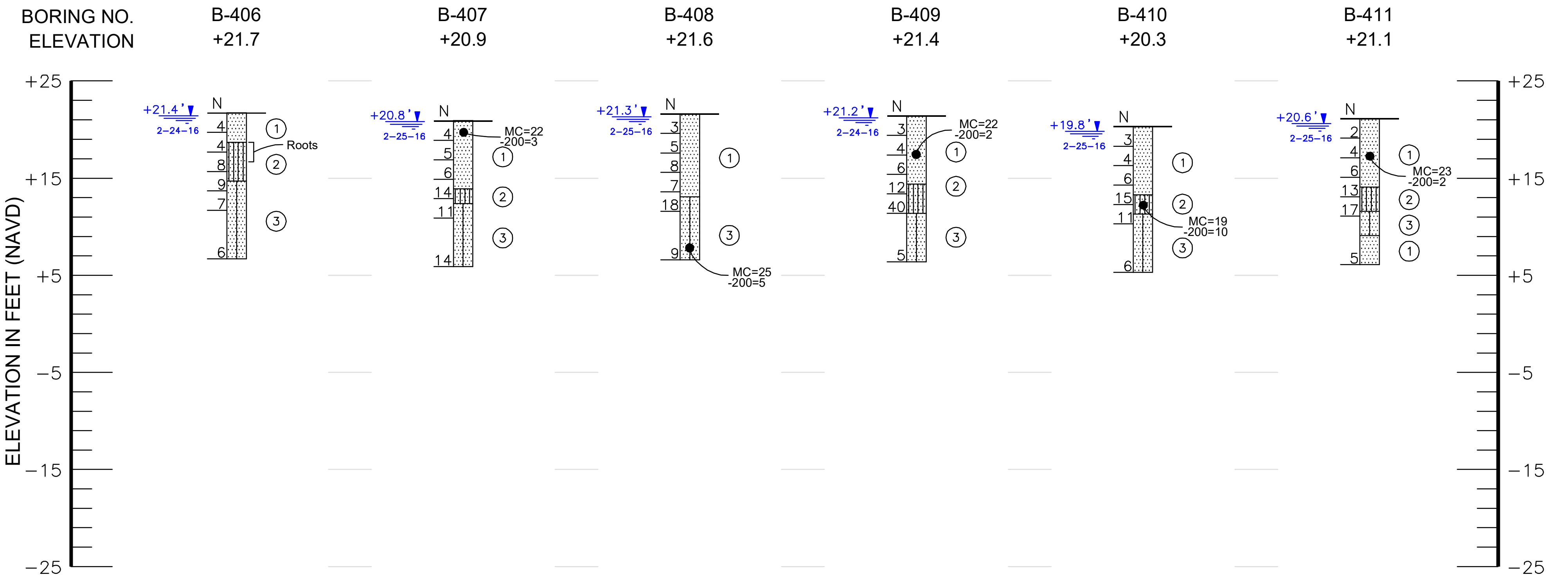


LEGEND

1. Gray or brown medium to fine SAND. (SP)
2. Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan). (SP-SM, SM)
3. Light brown slightly silty medium to fine SAND. (SP-SM)
4. Dark gray to green sandy SILT. (ML)
5. Gray shelly SAND with varying amounts of silt. (SP, SP-SM, SM)
6. Green or light gray CLAY, traces of shell. (CL, CH)
7. Gray to green slightly silty fine to silty SAND. (SP-SM, SM)

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	SUBSURFACE PROFILES
Drawn By: BL	Scale: 1" = 10'	607 NW COMMODITY COVE, PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION
Checked By: DD	File No. -	PH. (772) 343-9787, FAX. (772) 343-9404	TAYLOR ENGINEERING, INC.
Approved By: KA	Date: 3/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A, Brevard County, Florida

SHEET 10

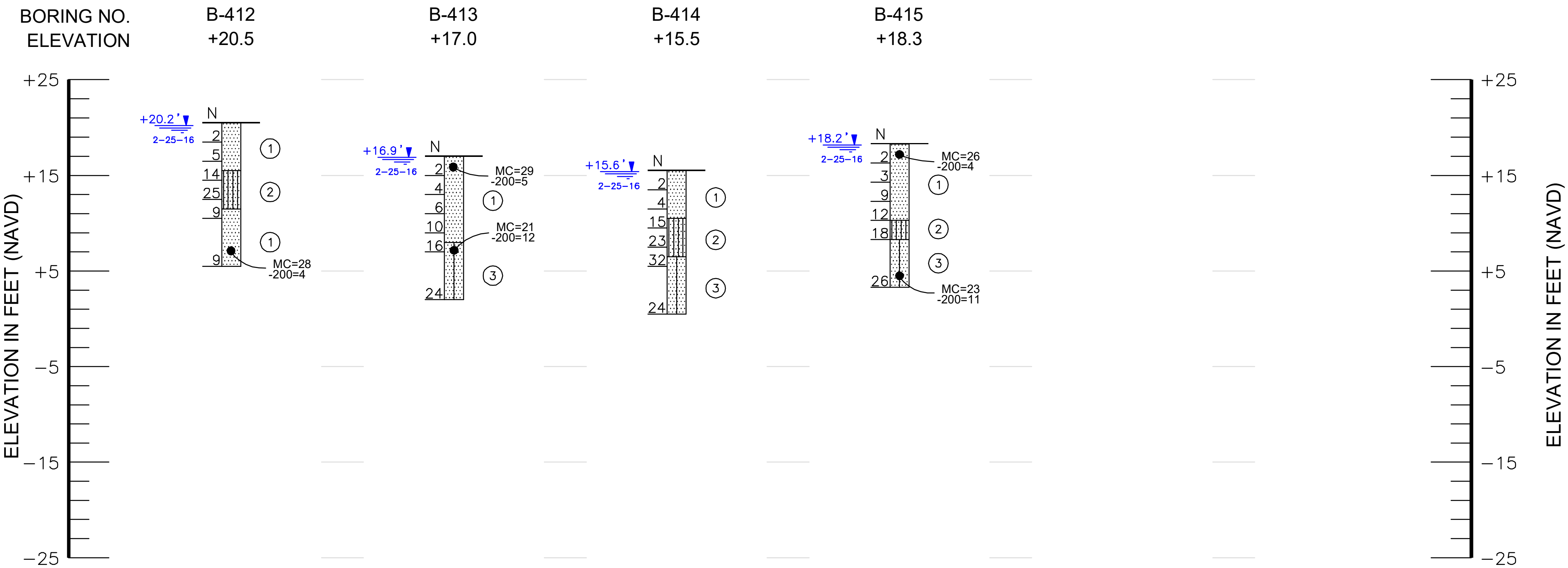


LEGEND

1. Gray or brown medium to fine SAND. (SP)
2. Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan). (SP-SM, SM)
3. Light brown slightly silty medium to fine SAND. (SP-SM)
4. Dark gray to green sandy SILT. (ML)
5. Gray shelly SAND with varying amounts of silt. (SP, SP-SM, SM)
6. Green or light gray CLAY, traces of shell. (CL, CH)
7. Gray to green slightly silty fine to silty SAND. (SP-SM, SM)

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	SUBSURFACE PROFILES
Drawn By: BL	Scale: 1" = 10'	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION
Checked By: DD	File No. -	PH. (772) 343-9787 FAX. (772) 343-9404	TAYLOR ENGINEERING, INC.
Approved By: KA	Date: 3/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida

SHEET 11



LEGEND

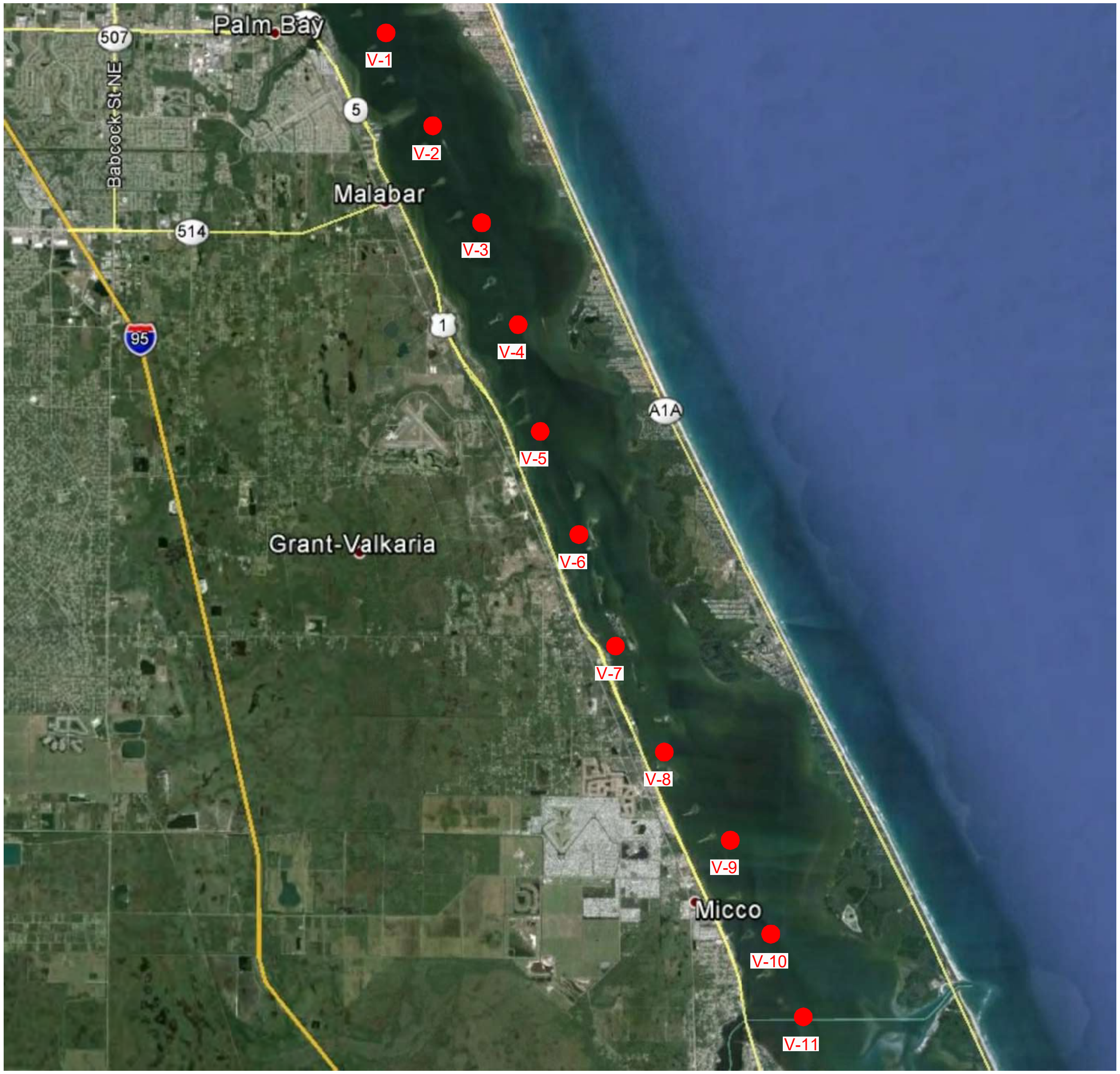
1	Gray or brown medium to fine SAND. (SP)
2	Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan). (SP-SM, SM)
3	Light brown slightly silty medium to fine SAND. (SP-SM)
4	Dark gray to green sandy SILT. (ML)
5	Gray shelly SAND with varying amounts of silt. (SP, SP-SM, SM)
6	Green or light gray CLAY, traces of shell. (CL, CH)
7	Gray to green slightly silty fine to silty SAND. (SP-SM, SM)

Project Mngr: DD	Project No. HB155022
Drawn By: BL	Scale: 1" = 10'
Checked By: DD	File No. -
Approved By: KA	Date: 3/26/16

DUNKELBERGER engineering & testing, inc.
A Terracon COMPANY
607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986
PH. (772) 343-9787 FAX. (772) 343-9404

SUBSURFACE PROFILES
GEOTECHNICAL SITE EXPLORATION
TAYLOR ENGINEERING, INC.
DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A
Brevard County Florida

SHEET
12



SOURCE: GOOGLE EARTH PRO

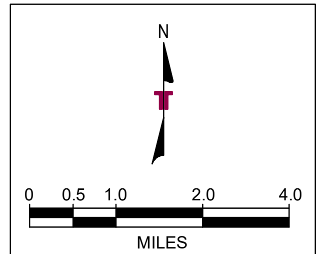
STATE-PLANE COORDINATES		
VIBRACORE NO.	NORTHING	EASTING
V-1	796408.32	1345623.44
V-2	799587.99	1339442.26
V-3	802904.71	1332943.36
V-4	805319.46	1326244.75
V-5	806869.92	1319150.80
V-6	809477.04	1312317.33
V-7	811849.13	1304957.15
V-8	815128.46	1297939.66
V-9	819627.28	1292100.20
V-10	822348.58	1285885.45
V-11	824503.59	1280396.94

Coordinates recorded in NAD83 State Plane, Florida East (Zone 0901), U.S. Survey Feet by Athena Technologies, Inc.

LEGEND

● V-1 - VIBRACORE LOCATION AND NUMBER

Locations are approximate



Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	VIBRACORE LOCATION PLAN
Drawn By: BL	Scale: AS SHOWN	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION
Checked By: DD	File No. -	PH. (772) 343-9787 FAX. (772) 343-9404	TAYLOR ENGINEERING, INC.
Approved By: KA	Date: 5/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida

SHEET 13

Table A
Summary of Site Soil Index Properties
BV-24A DMMA, Brevard County, Florida

Stratum Number	Sample Location	Sample Depth (ft)	Moisture Content (%)	Amount Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Organic Content (%)
1	B-103	3 - 5	27.5	4.9	-	-	-
1	B-104	3 - 5	25.3	2.8	-	-	-
1	B-204	0 - 2	25.2	3.0	-	-	-
1	B-208	2 - 4	22.0	2.7	-	-	-
1	B-401	13 - 15	20.2	3.3	-	-	-
1	B-407	0 - 2	22.1	3.2	-	-	-
1	B-409	3 - 5	21.6	2.0	-	-	-
1	B-412	13 - 15	27.9	3.7	-	-	-
1	B-413	0 - 2	28.5	4.8	-	-	-
1	B-415	0 - 2	25.9	3.8	-	-	-
1	MIN		20.2	2.0	-	-	-
1	MAX		28.5	4.9	-	-	-
1	AVERAGE		24.6	3.4	-	-	-
2	B-208	6 - 8	25.1	13.5	-	-	11.0
2	B-316	7 - 9	17.4	14.8	-	-	7.7
2	B-404	7 - 9	22.1	6.1	-	-	3.6
2	MIN		17.4	6.1	-	-	3.6
2	MAX		25.1	14.8	-	-	11.0
2	AVERAGE		21.5	11.5	-	-	7.4
3	B-103	9 - 11	27.5	7.0	-	-	-
3	B-201	28 - 30	26.4	5.1	-	-	-
3	B-204	23 - 25	25.6	5.2	-	-	-
3	B-402	13 - 15	23.5	5.2	-	-	-
3	B-404	13 - 15	20.2	8.6	-	-	-
3	B-413	9 - 11	20.7	12.4	-	-	-
3	B-415	13 - 15	23.4	10.9	-	-	-
3	MIN		20.2	5.1	-	-	-
3	MAX		27.5	12.4	-	-	-
3	AVERAGE		23.9	7.8	-	-	-
4	B-103	43 - 45	59.5	56.5	47.8	19.8	-
4	B-201	73 - 75	46.7	63.5	-	-	-
4	B-206	63 - 65	51.9	84.6	-	-	-
4	B-208	43 - 45	47.8	72.2	42.1	14.8	-
4	MIN		46.7	56.5	42.1	14.8	-
4	MAX		59.5	84.6	47.8	19.8	-
4	AVERAGE		51.5	69.2	45.0	17.3	-

Table A (continued)
Summary of Site Soil Index Properties
BV-24A DMMA, Brevard County, Florida

Stratum Number	Sample Location	Sample Depth (ft)	Moisture Content (%)	Amount Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Organic Content (%)
5	B-101	38 - 40	18.3	6.4	-	-	-
5	B-103	83 - 85	16.0	9.9	-	-	-
5	B-201	38 - 40	23.4	12.4	-	-	-
5	B-204	48 - 50	22.2	7.8	-	-	-
5	MIN		16.0	6.4	-	-	-
5	MAX		23.4	12.4	-	-	-
5	AVERAGE		20.0	9.1	-	-	-

6	B-101	68 - 70	43.1	59.6	-	-	-
6	B-102	98 - 100	31.9	56.5	26.8	6.7	-
6	B-104	73 - 75	39.8	94.8	31.8	11.3	-
6	B-201	63 - 65	51.9	84.6	-	-	-
6	B-201	68 - 70	45.8	87.4	-	-	-
6	B-203	68 - 70	53.3	96.4	37.5	14.4	-
6	B-206	78 - 80	38.7	91.5	44.0	22.0	-
6	B-208	68 - 70	34.7	92.6	36.0	16.9	-
6	MIN		31.9	56.5	26.8	6.7	-
6	MAX		53.3	96.4	44.0	22.0	-
6	AVERAGE		42.4	82.9	35.2	14.3	-

7	B-101	58 - 60	25.8	11.1	-	-	-
7	B-101	98 - 100	28.4	13.3	Non-plastic	Non-plastic	-
7	B-102	18 - 20	28.8	14.7	-	-	-
7	B-103	63 - 65	27.5	7.0	-	-	-
7	B-104	28 - 30	23.7	11.4	-	-	-
7	B-201	33 - 35	23.8	7.3	-	-	-
7	B-203	48 - 50	30.6	12.3	-	-	-
7	B-206	43 - 45	27.9	10.0	-	-	-
7	B-208	33 - 35	24.9	11.3	-	-	-
7	MIN		23.7	7.0	-	-	-
7	MAX		30.6	14.7	-	-	-
7	AVERAGE		26.8	10.9	-	-	-

Table B
Summary of Sieve Analysis
BV-24A DMMA, Brevard County, Florida

Stratum Number	Sample Location	Sample Depth (ft)	USCS	Amount Passing Sieve Size (%)							
				3/8"	#4	#10	#20	#40	#60	#100	#200
1	B-101	18 - 20	SP	100.0	100.0	100.0	99.7	96.0	78.7	24.5	0.8
1	B-103	3 - 5	SP	100.0	100.0	100.0	99.7	92.3	63.2	29.8	2.7
1	B-104	13 - 15	SP	100.0	100.0	100.0	100.0	96.9	75.1	21.9	1.4
1	B-203	5 - 7	SP	100.0	100.0	100.0	99.8	93.0	64.6	31.1	3.2
1	B-206	18 - 20	SP	100.0	100.0	100.0	99.9	94.6	83.7	39.5	1.9
1	B-405	3 - 5	SP	100.0	100.0	100.0	99.7	93.9	65.7	33.3	3.0
1	B-411	3 - 5	SP	100.0	100.0	100.0	99.8	93.4	60.5	25.7	2.2
2	B-102	3 - 5	SP-SM	100.0	100.0	98.4	98.1	90.9	60.3	26.2	6.4
2	B-410	7 - 9	SP-SM	100.0	100.0	99.8	99.2	91.7	63.2	31.8	10.1
3	B-101	9 - 11	SP-SM	100.0	100.0	100.0	99.9	99.5	96.7	84.7	6.3
3	B-203	38 - 40	SP-SM	100.0	100.0	100.0	99.9	98.7	97.6	89.4	5.2
3	B-206	13 - 15	SP	100.0	100.0	100.0	100.0	99.9	99.5	88.9	4.9
3	B-408	13 - 15	SP-SM	100.0	100.0	100.0	100.0	99.3	94.9	65.4	5.1
5	B-101	53 - 55	SM	100.0	100.0	99.0	96.3	90.4	78.6	50.3	15.4
5	B-102	58 - 60	SP	100.0	100.0	100.0	100.0	98.7	49.5	10.1	3.0
5	B-104	43 - 45	SP	100.0	98.9	95.9	89.7	83.8	66.4	18.1	3.7
5	B-203	58 - 60	SM	100.0	91.1	84.5	77.3	73.0	70.2	66.6	20.4
5	B-203	78 - 80	SP-SM	100.0	95.8	88.6	76.6	60.7	41.3	21.5	8.5
5	B-316	38 - 40	SP-SM	100.0	97.7	90.5	76.4	66.6	54.7	38.4	5.5
7	B-103	38 - 40	SP-SM	100.0	100.0	100.0	99.5	98.0	94.9	62.7	5.4
7	B-204	38 - 40	SP-SM	100.0	100.0	100.0	94.9	83.0	74.8	59.3	5.2
1	Borrow[1]	0 - 7	SP	100.0	100.0	100.0	99.8	94.3	62.3	26.8	2.8
1	Borrow[1]	0 - 7	SP	100.0	100.0	100.0	99.8	94.5	64.6	30.0	4.9
1	Borrow[1]	0 - 7	SP	100.0	100.0	100.0	99.8	92.1	59.4	26.6	3.0
1	Borrow[1]	0 - 7	SP	100.0	100.0	99.9	99.7	93.7	62.3	28.4	3.3
1	Borrow[1]	0 - 7	SP	100.0	100.0	99.5	99.0	90.7	52.7	20.7	2.5

(1) Samples collected in bulk using a continuous flight auger from proposed interior borrow area

Table C
Modified Proctor (ASTM D1557) Compaction Results
BV-24A DMMA, Brevard County, Florida

Sample Location	Sample Depth (ft)	USCS	Fines Content (%)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)
B-401 / B-402	0 - 7	SP	2.8	14.3	101.9
B-405 / B-406	0 - 7	SP	4.9	11.9	101.9
B-407 / B-408	0 - 7	SP	3.0	13.1	103.1
B-411 / B-412	0 - 7	SP	3.3	10.8	102.7
B-413 / B-414	0 - 7	SP	2.5	10.4	102.7

Samples collected in bulk using a continuous flight auger from proposed interior borrow area
Fines content refers to amount passing No. 200 Sieve

Table D
Limerock Bearing Ratio (LBR) Results
BV-24A DMMA, Brevard County, Florida

Sample Location	Sample Depth (ft)	USCS	Fines Content (%)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)	LBR
B-403 / B-404	0 - 7	SP	4.1	13.3	103.3	41.9
B-409 / B-410	0 - 7	SP	2.4	12.8	104.9	54.5
B-413 / B-414	0 - 7	SP	2.2	13.6	103.4	59.6

Samples collected in bulk using a continuous flight auger from proposed interior borrow area
Fines content refers to amount passing No. 200 Sieve
Optimum moisture content and maximum dry unit weight determined in accordance with Modified Proctor test

Table E.1
Summary of Hydraulic Conductivity Test Results
BV-24A DMMA, Brevard County, Florida
Sand Samples

Sample Location	Sample Depth (ft)	USCS	Sample Type	Fines Content (%)	Initial Conditions			Confining Stress (psi)	Hydraulic Conductivity	
					Moisture Content (%)	Dry Unit Weight (pcf)	Estimated Relative Compaction (%)		cm/sec	ft/day
B-401	0 - 7	SP	Remolded	< 5	12.8	103.3	101.4	-	1.24E-02	35.2
B-401	0 - 7	SP	Remolded	< 5	12.3	94.9	93.1	-	2.48E-02	70.3
B-408	0 - 7	SP	Remolded	< 5	13.3	101.3	98.3	-	1.21E-02	34.3
B-408	0 - 7	SP	Remolded	< 5	13.2	94.7	91.9	-	1.70E-02	48.1
B-415	0 - 7	SP	Remolded	< 5	13.1	102.6	99.9	-	2.02E-02	57.3
B-415	0 - 7	SP	Remolded	< 5	13.1	94.7	92.2	-	2.38E-02	67.6

Samples collected in bulk using a continuous flight auger from proposed interior borrow area
Fines content refers to amount passing No. 200 Sieve

Table E.2
Summary of Hydraulic Conductivity Test Results
BV-24A DMMA, Brevard County, Florida
Fine Grained Samples

Sample Location	Sample Depth (ft)	USCS	Sample Type	Fines Content (%)	Initial Conditions		Confining Stress (psi)	Hydraulic Conductivity	
					Moisture Content (%)	Dry Unit Weight (pcf)		cm/sec	ft/day
B-102	31 - 33	CL	Undisturbed	85.0	51.6	68.7	3.0	4.87E-08	1.38E-04
B-203	66 - 68	CH	Undisturbed	98.7	53.6	67.4	3.0	5.57E-08	1.58E-04

Fines content refers to amount passing No. 200 Sieve

Table E.3
Summary of Hydraulic Conductivity Test Results
BV-24A DMMA, Brevard County, Florida
Field Tests

Sample Location	Screen Interval (ft)	USCS	Sample Type	Hydraulic Conductivity	
				cm/sec	ft/day
PZ-1	0 - 5	SP	Insitu	1.53E-02	43.5
MW-4	10 - 15	SP-SM	Insitu	2.47E-03	7.0
MW-5	35 - 40	SP-SM	Insitu	3.32E-03	9.4

PZ-1 located near MW-4 and MW-5

Table F
Summary of Triaxial Shear Test Results
BV-24A DMMA, Brevard County, Florida

Sample Location	Test Method	Representative Area	Sample Type	Sample Depth (ft)	USCS	Total Strength Parameters		Effective Strength Parameters	
						Cohesion (C, psf)	Internal Friction Angle (φ, deg)	Cohesion (C', psf)	Internal Friction Angle (φ', deg)
Borrow[1]	Consolidated Drained	Embankment Soils	Remolded[2]	0 - 7	SP	-	-	274	31.0
Borrow[1]	Consolidated Drained	Foundation Soils	Remolded[2]	0 - 7	SP	-	-	389	33.1
B-102	Consolidated Undrained	Foundation Soils	Undisturbed	31 - 33	CL	562	8.2	605	15.0

(1) Samples collected in bulk using a continuous flight auger from proposed interior borrow area

(2) Samples remolded to 95% of their Modified Proctor determined maximum dry density

Table G
Summary Consolidation Test Results
BV-24A DMMA, Brevard County, Florida

Sample Location	Sample Depth (ft)	USCS	Moisture Content (%)	Dry Unit Weight (pcf)	Fines Content (%)	Liquid Limit	Plasticity Index	Coefficient of Compression	Coefficient of Recompression	Void Ratio	Pre-Consolidation Pressure (ksf)	Over-Consolidation Ratio
B-102	31 - 33	CL	48.0	74.2	85.0	34.0	16.7	0.47	0.08	1.27	4.0	3.3
B-104	71 - 73	ML	39.5	80.9	87.2	38.0	11.0	0.29	0.03	1.10	4.2	1.6
B-203	66 - 68	CH	61.6	63.5	98.7	67.8	43.0	0.70	0.09	1.65	6.2	2.5
B-206	56 - 58	CL	27.7	86.5	82.4	43.0	23.0	0.31	0.04	0.96	4.4	2.0

Fines content refers to amount passing No. 200 Sieve

APPENDIX A
CONE PENETROMETER TEST (CPT) LOGS

CPT LOG NO. CPT-202

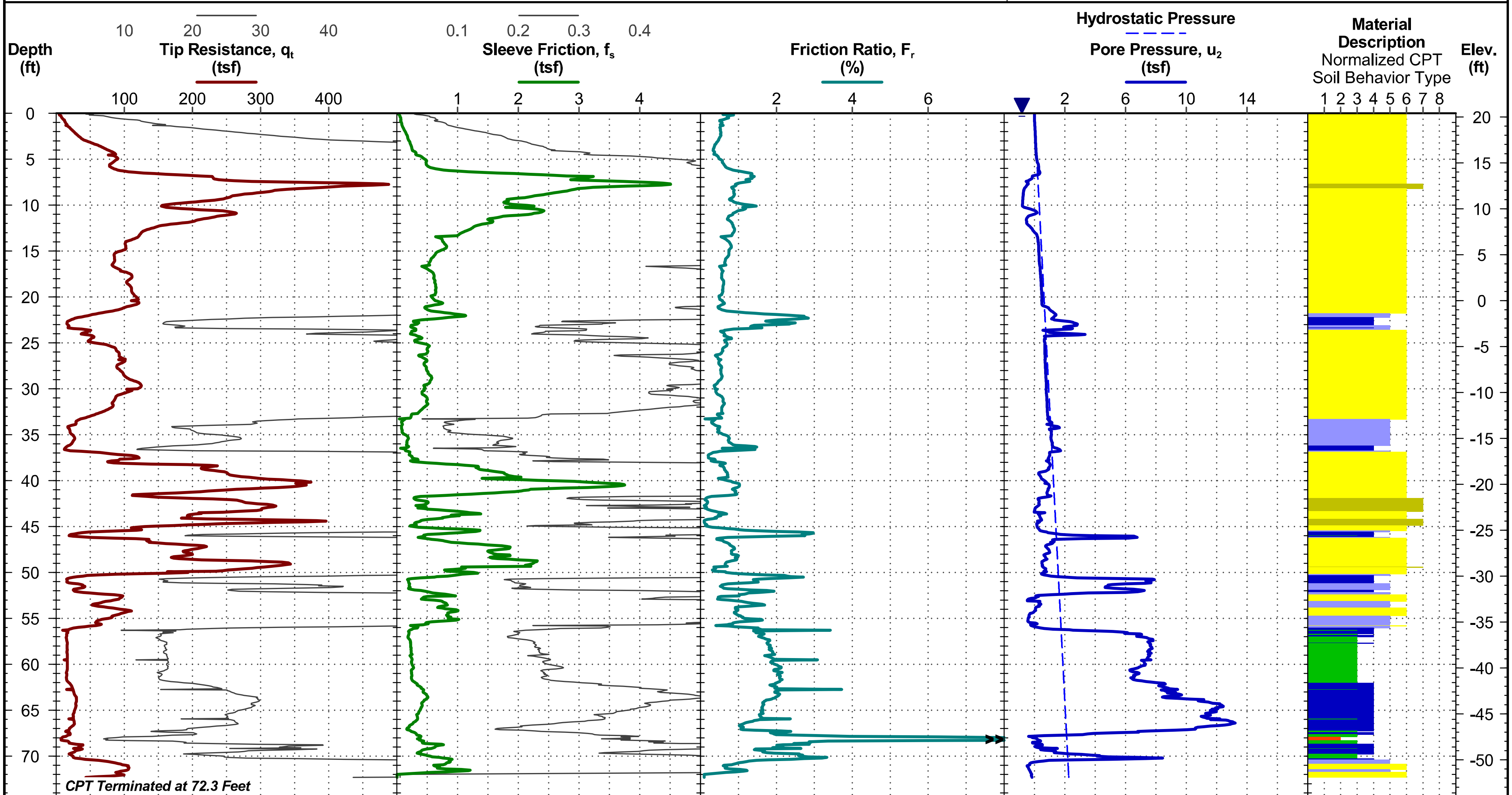
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 20.4 ft

SITE: Brevard County, FL



See CPT General Notes for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

0 ft estimated water depth
(used in normalizations and correlations; see CPT General Notes)

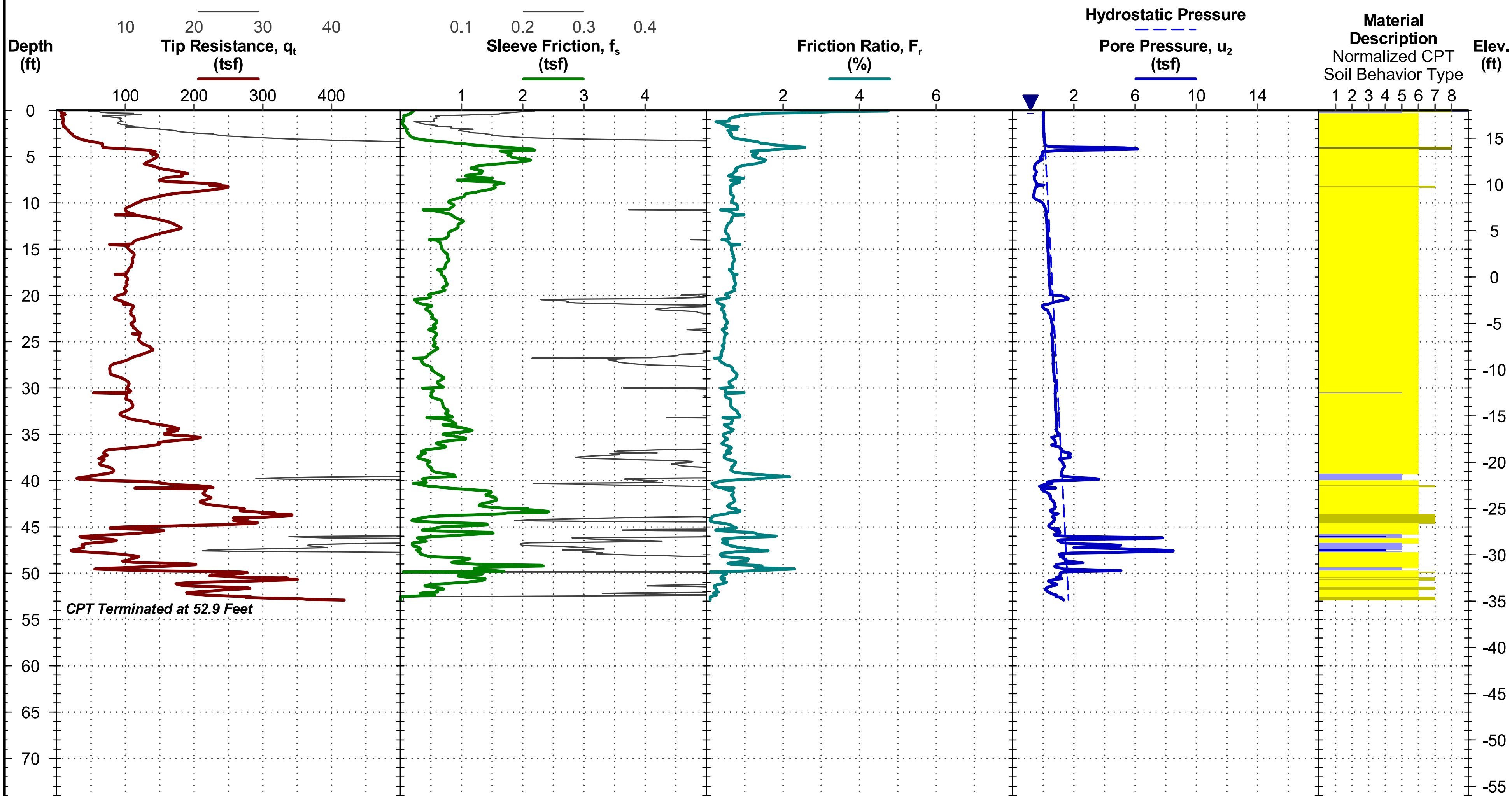
Probe no. DPG1228 with net area ratio of 0.8
U2 pore pressure transducer location
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER engineering & testing, inc.
A Terracon COMPANY

CPT Started: 2/18/2016	CPT Completed: 2/18/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-1

CPT LOG NO. CPT-205

PROJECT: BV-24A DMMA	**CLIENT:** Taylor Engineering, Inc.	**TEST LOCATION:** See Sheet 5 Surface Elev.: 18.0 ft
SITE: Brevard County, FL		



See CPT General Notes for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION 0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)	Probe no. DPG1228 with net area ratio of 0.8 U2 pore pressure transducer location Manufactured by Vertek; calibrated 12/27/2014 Tip and sleeve areas of 15 cm^2 and 225 cm^2 Ring friction reducer with O.D. of 2 in	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	CPT Started: 2/19/2016 Rig: 735 Project No.: HB155022	CPT Completed: 2/19/2016 Operator: Tony Antonatos Exhibit: A-2

CPT LOG NO. CPT-207

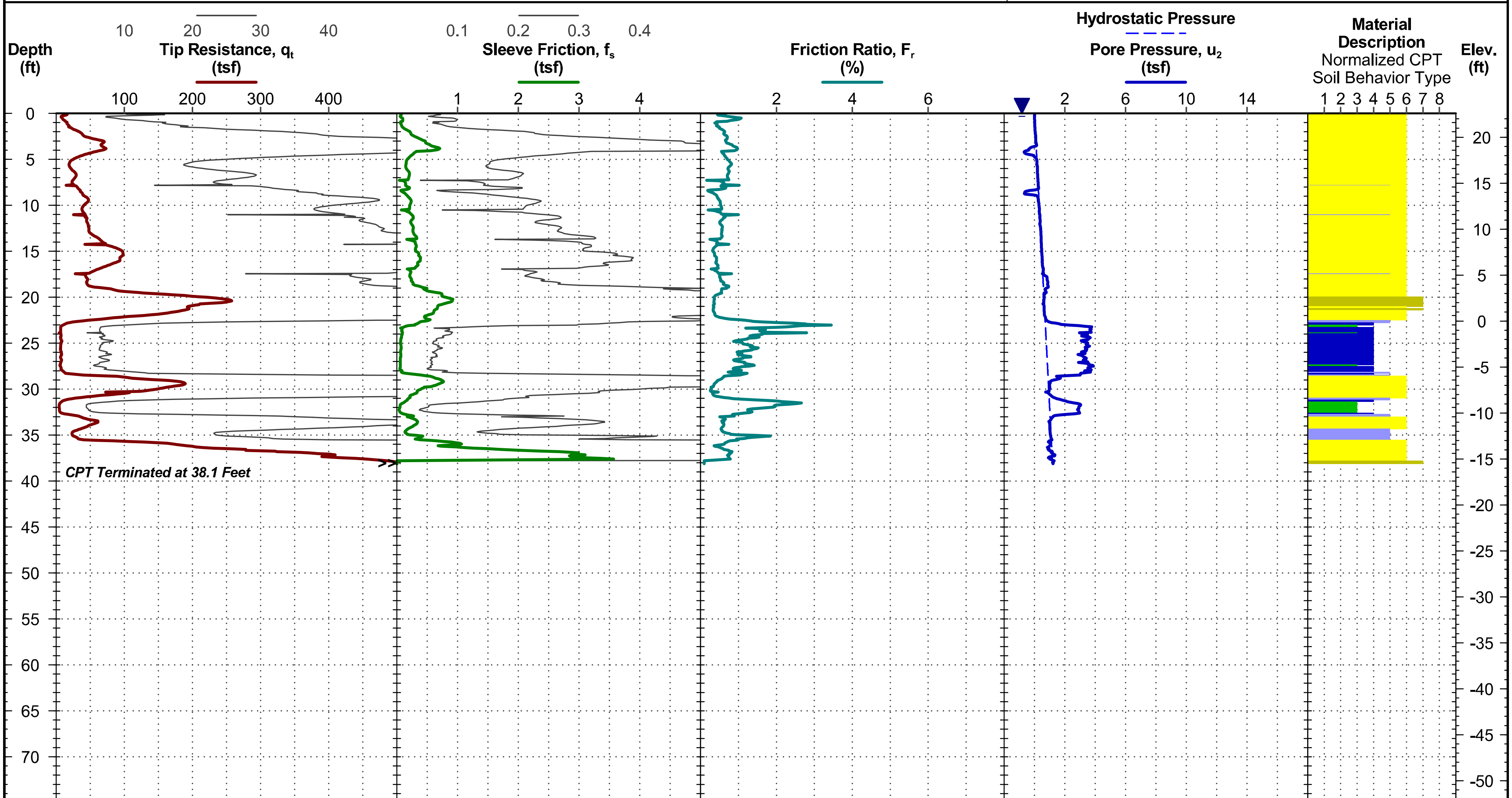
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 22.6 ft

SITE: Brevard County, FL



See CPT General Notes for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.

CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)

Probe no. DPG1228 with net area ratio of 0.8
U2 pore pressure transducer location
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER engineering & testing, inc. A Terracon COMPANY

CPT Started: 2/18/2016	CPT Completed: 2/18/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-3

CPT LOG NO. CPT-209

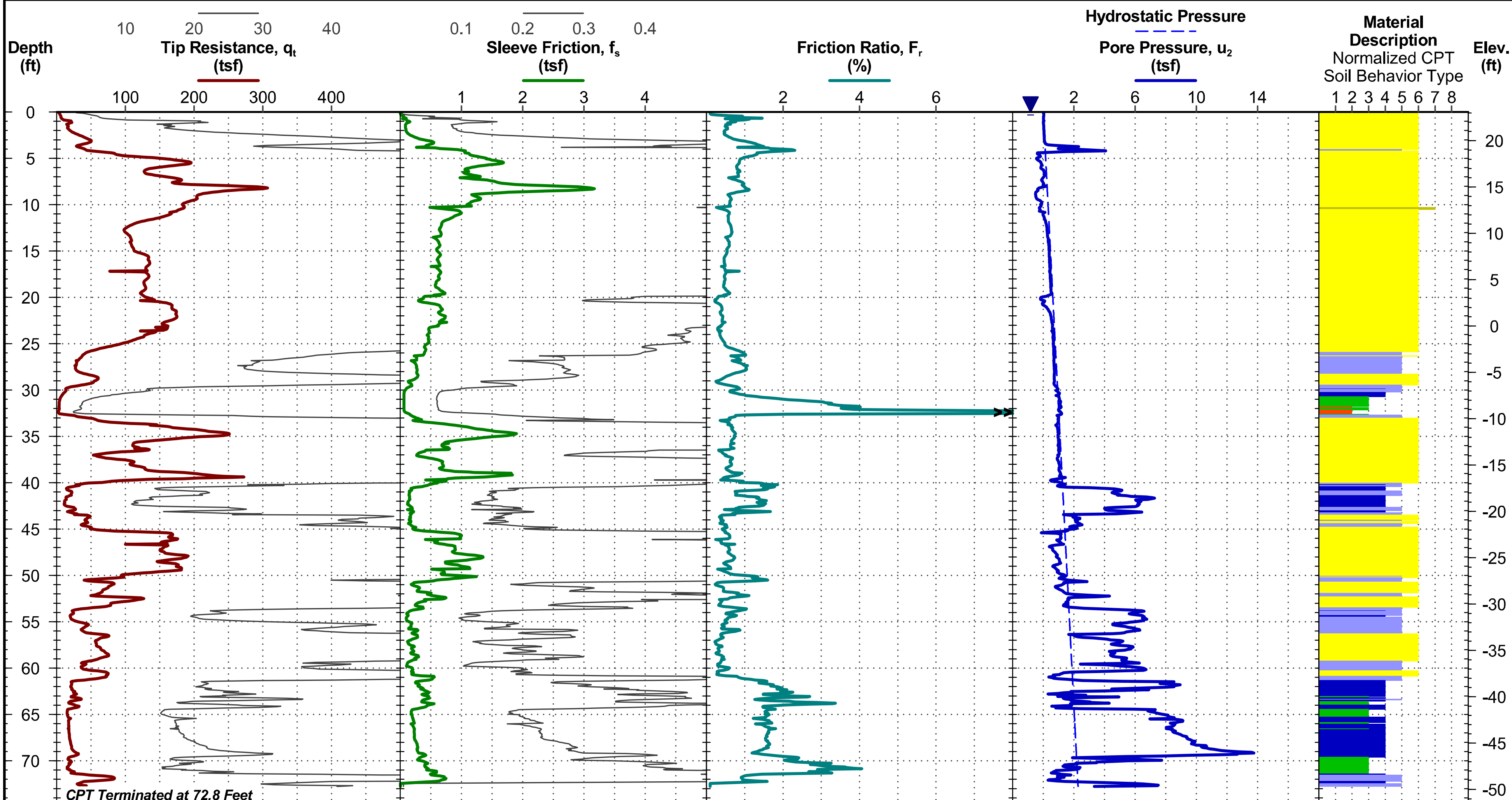
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 23.1 ft

SITE: Brevard County, FL



See CPT General Notes for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)

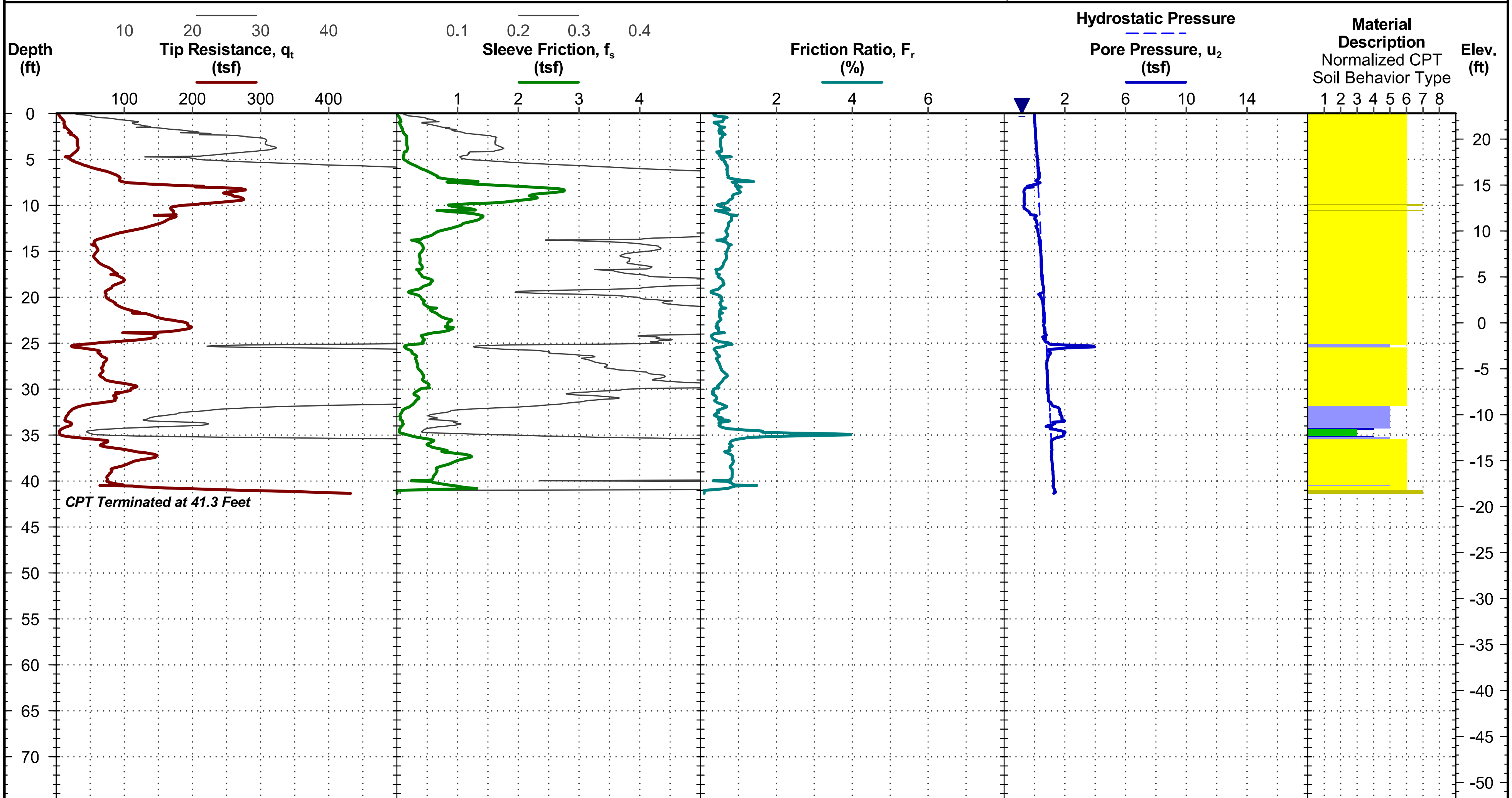
Probe no. DPG1228 with net area ratio of 0.8
U2 pore pressure transducer location
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm² and 225 cm²
Ring friction reducer with O.D. of 2 in

DUNKELBERGER engineering & testing, inc.
A Terracon COMPANY

CPT Started: 2/18/2016	CPT Completed: 2/18/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-4

CPT LOG NO. CPT-301

PROJECT: BV-24A DMMA	**CLIENT:** Taylor Engineering, Inc.	**TEST LOCATION:** See Sheet 5 Surface Elev.: 22.8 ft
SITE: Brevard County, FL		



See CPT General Notes for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION 0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)	Probe no. DPG1228 with net area ratio of 0.8 U2 pore pressure transducer location Manufactured by Vertek; calibrated 12/27/2014 Tip and sleeve areas of 15 cm^2 and 225 cm^2 Ring friction reducer with O.D. of 2 in	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	CPT Started: 2/17/2016 Rig: 735 Project No.: HB155022	CPT Completed: 2/17/2016 Operator: Tony Antonatos Exhibit: A-5

CPT LOG NO. CPT-302

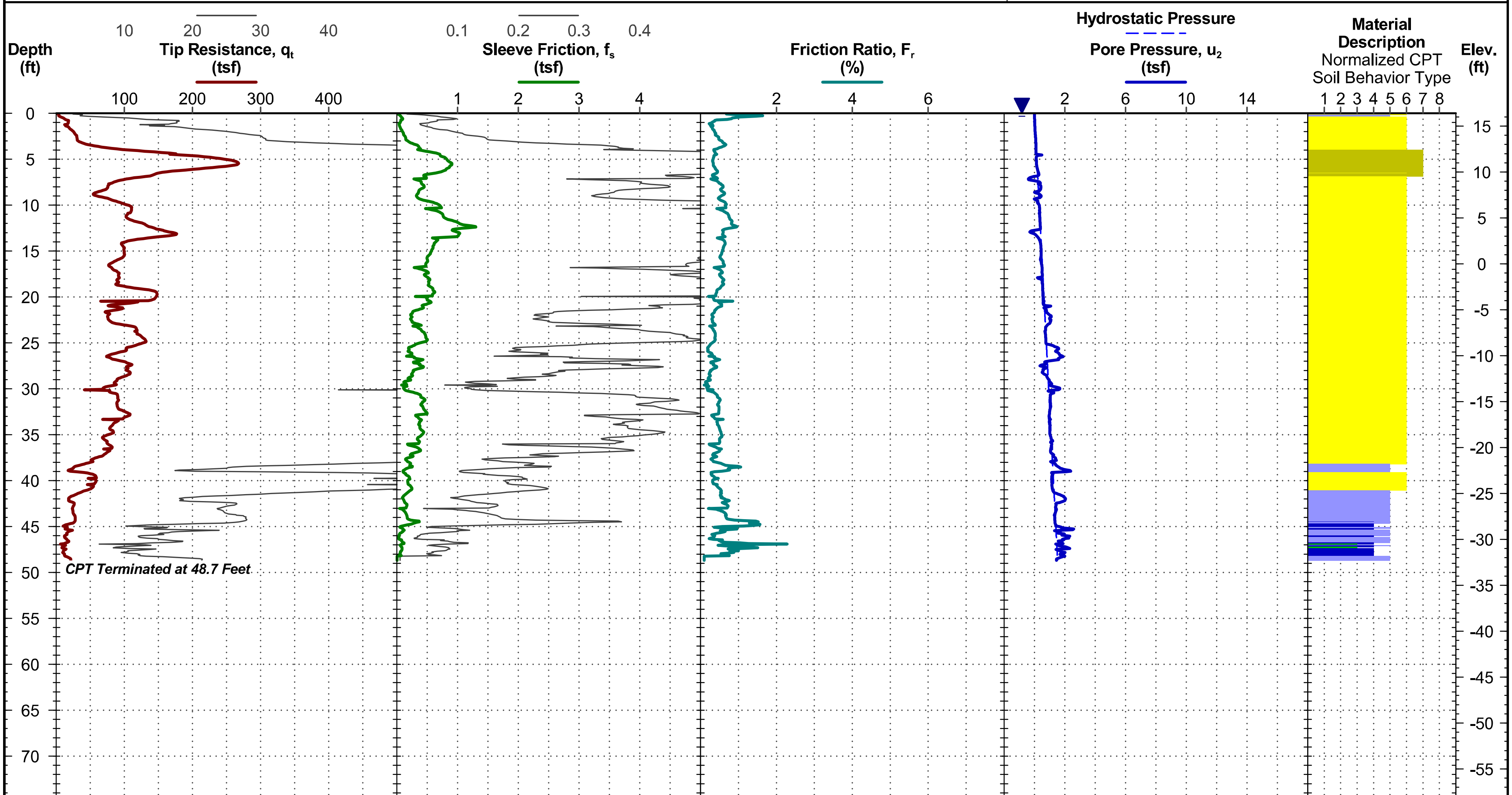
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 16.4 ft

SITE: Brevard County, FL



See CPT General Notes for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

WATER LEVEL OBSERVATION

0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)

Probe no. DPG1228 with net area ratio of 0.8
U2 pore pressure transducer location
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER engineering & testing, inc. A Terracon COMPANY

CPT Started: 2/18/2016

CPT Completed: 2/18/2016

Rig: 735

Operator: Tony Antonatos

Project No.: HB155022

Exhibit: A-6

CPT LOG NO. CPT-303

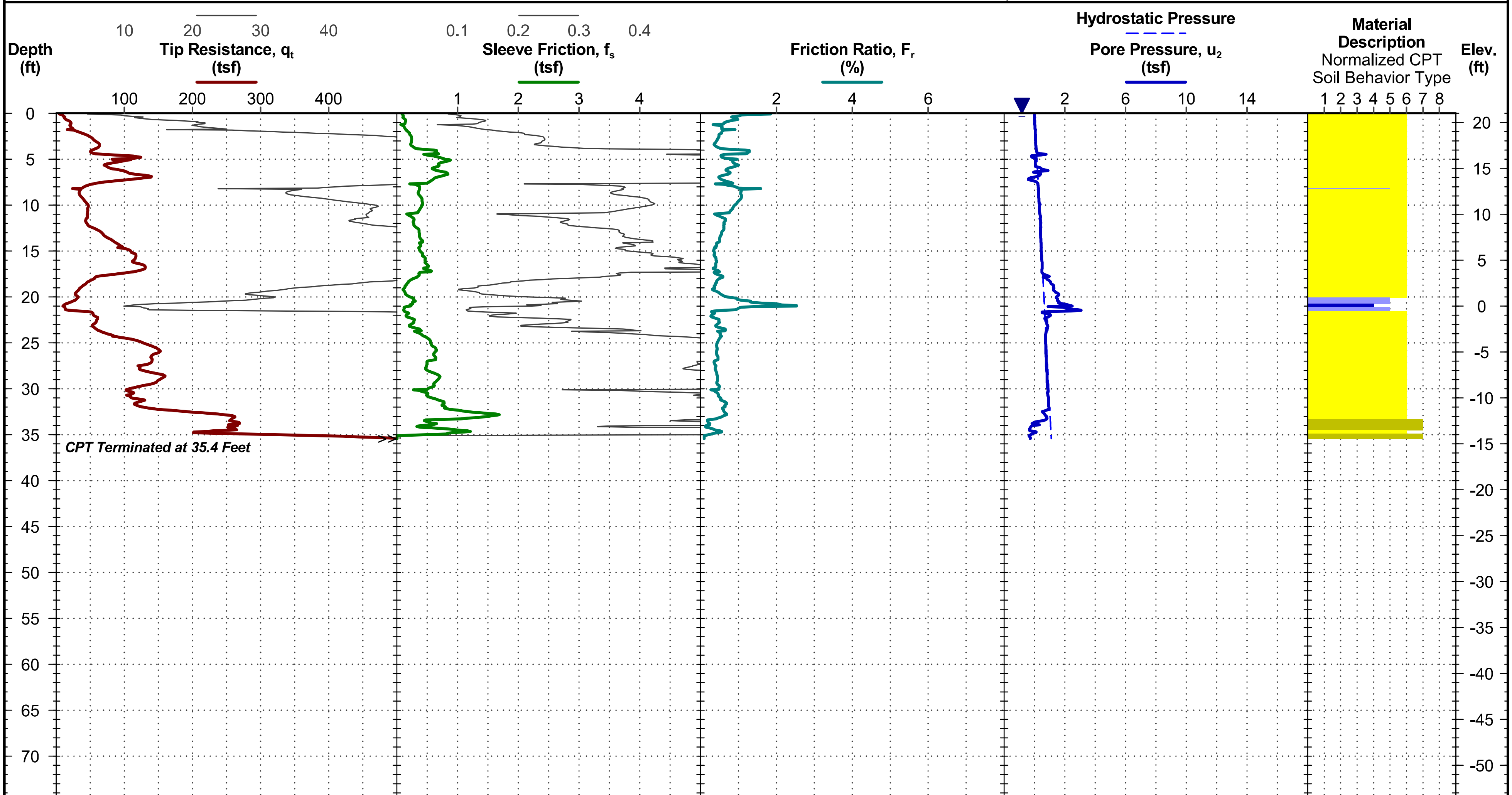
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 21.0 ft

SITE: Brevard County, FL



See CPT General Notes for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

0 ft estimated water depth
(used in normalizations and correlations; see CPT General Notes)

Probe no. DPG1228 with net area ratio of 0.8
U2 pore pressure transducer location
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

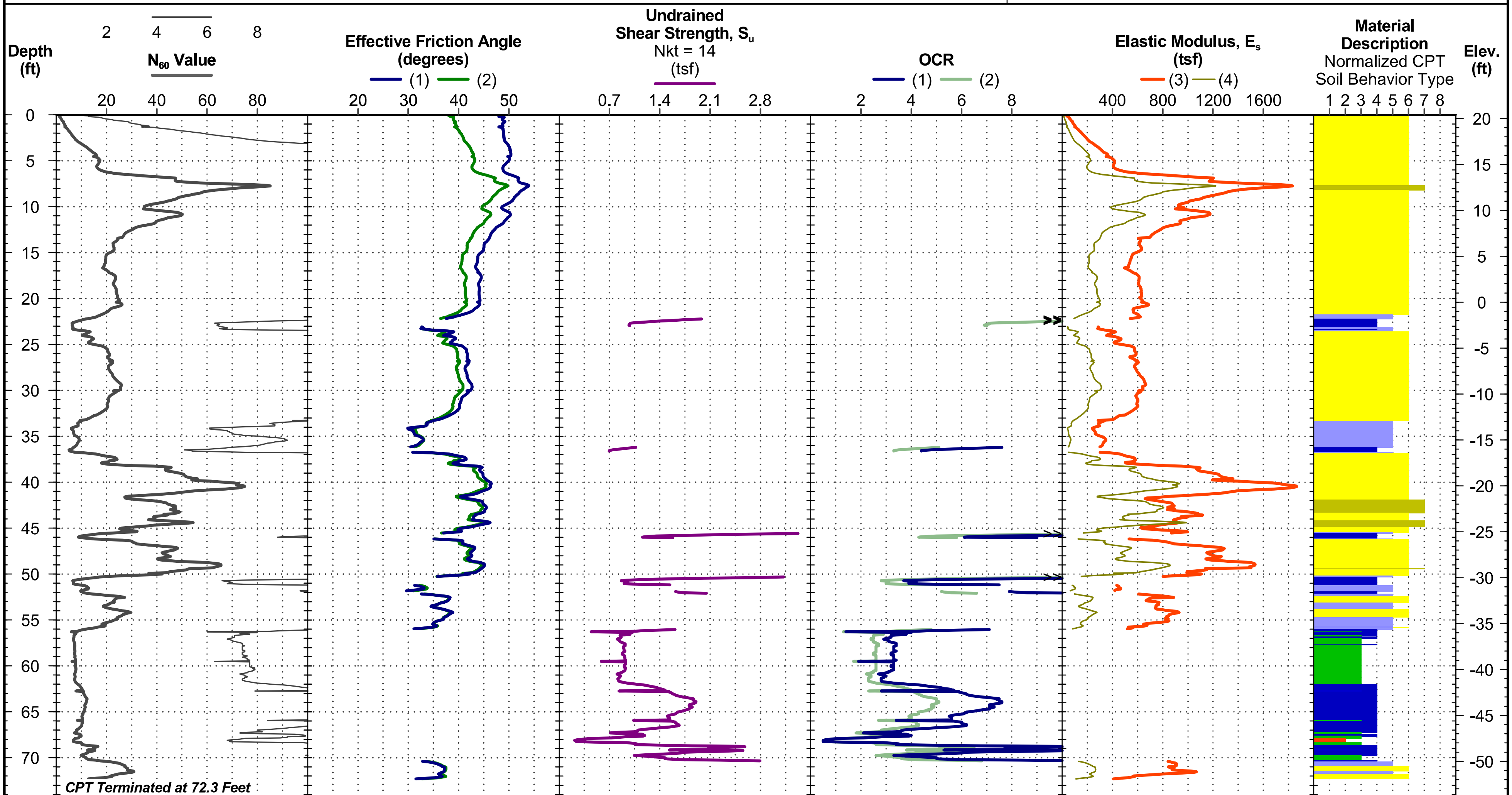
DUNKELBERGER
engineering & testing, inc.
A Terracon COMPANY

CPT Started: 2/19/2016	CPT Completed: 2/19/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-7

CPT CORRELATIVE PARAMETER LOG NO. CPT-202

SEE CPT LOG NO. CPT-202 FOR DETAILED TEST RESULTS

PROJECT: BV-24A DMMA	**CLIENT:** Taylor Engineering, Inc.	**TEST LOCATION:** See Sheet 5 Surface Elev.: 20.4 ft
SITE: Brevard County, FL		



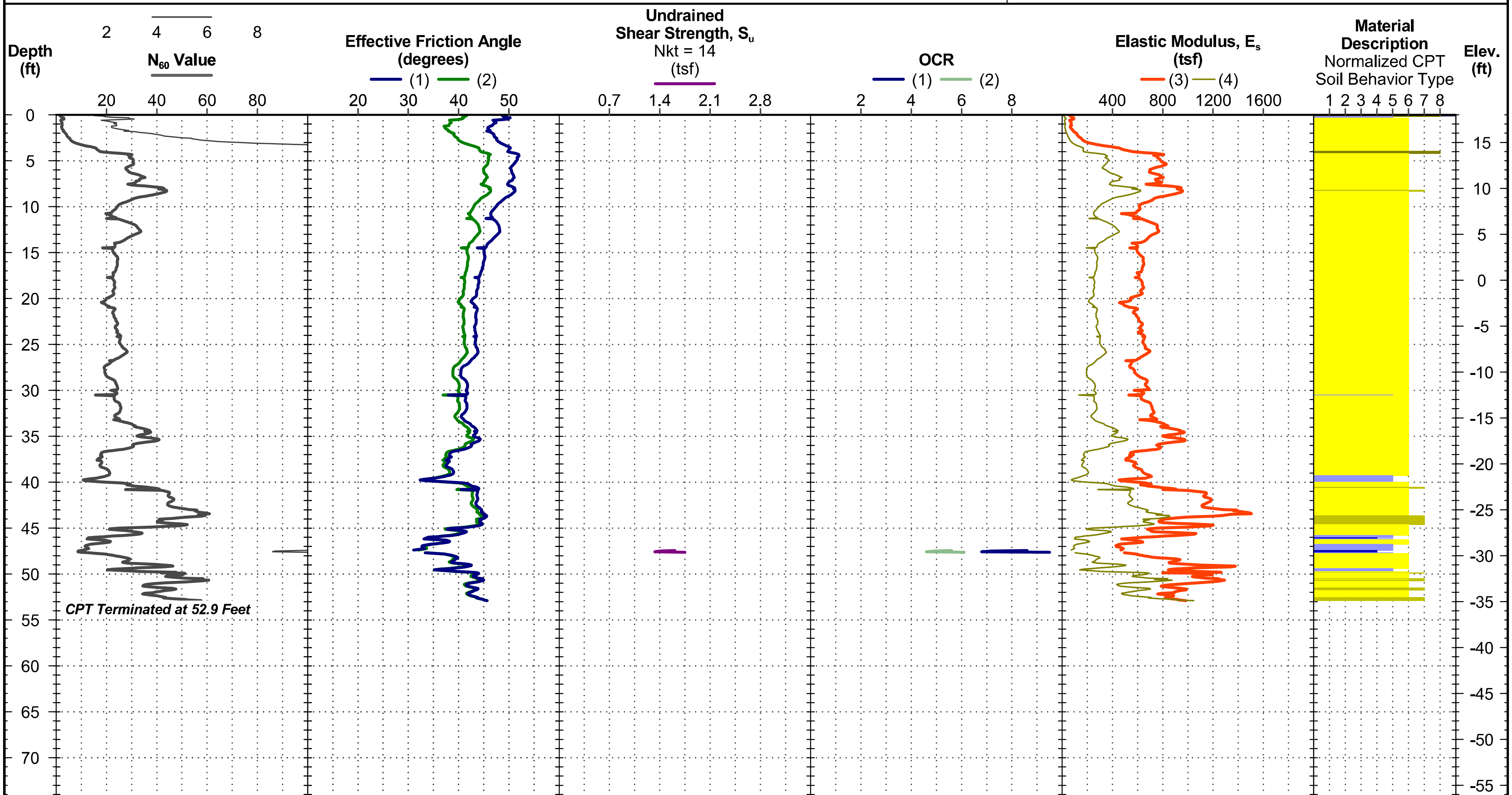
Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION	Notes:	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY		
0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)	Probe no. DPG1228 with net area ratio of 0.8 Manufactured by Vertek; calibrated 12/27/2014 Tip and sleeve areas of 15 cm^2 and 225 cm^2 Ring friction reducer with O.D. of 2 in		CPT Started: 2/18/2016 Rig: 735 Project No.: HB155022	CPT Completed: 2/18/2016 Operator: Tony Antonatos Exhibit: A-8

CPT CORRELATIVE PARAMETER LOG NO. CPT-205

SEE CPT LOG NO. CPT-205 FOR DETAILED TEST RESULTS

PROJECT: BV-24A DMMA	**CLIENT:** Taylor Engineering, Inc.	**TEST LOCATION:** See Sheet 5 Surface Elev.: 18.0 ft
SITE: Brevard County, FL		



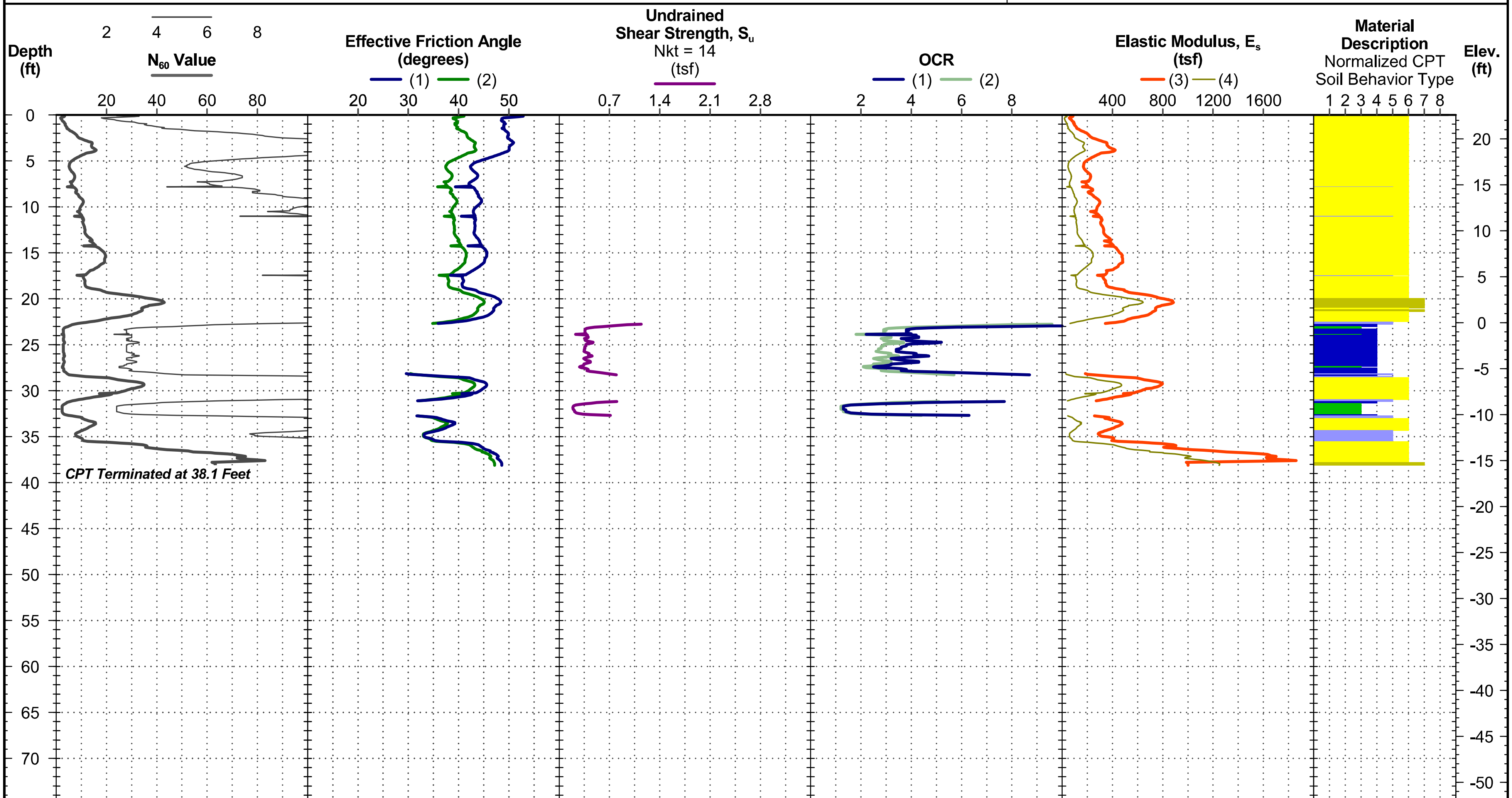
Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION	Notes:	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	CPT Started: 2/19/2016	CPT Completed: 2/19/2016
0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)	Probe no. DPG1228 with net area ratio of 0.8 Manufactured by Vertek; calibrated 12/27/2014 Tip and sleeve areas of 15 cm^2 and 225 cm^2 Ring friction reducer with O.D. of 2 in		Rig: 735	Operator: Tony Antonatos
			Project No.: HB155022	Exhibit: A-9

CPT CORRELATIVE PARAMETER LOG NO. CPT-207

SEE CPT LOG NO. CPT-207 FOR DETAILED TEST RESULTS

PROJECT: BV-24A DMMA	**CLIENT:** Taylor Engineering, Inc.	**TEST LOCATION:** See Sheet 5 Surface Elev.: 22.6 ft
SITE: Brevard County, FL		



Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION 0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)	Notes: Probe no. DPG1228 with net area ratio of 0.8 Manufactured by Vertek; calibrated 12/27/2014 Tip and sleeve areas of 15 cm^2 and 225 cm^2 Ring friction reducer with O.D. of 2 in	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	CPT Started: 2/18/2016 Rig: 735 Project No.: HB155022	CPT Completed: 2/18/2016 Operator: Tony Antonatos Exhibit: A-10

CPT CORRELATIVE PARAMETER LOG NO. CPT-209

SEE CPT LOG NO. CPT-209 FOR DETAILED TEST RESULTS

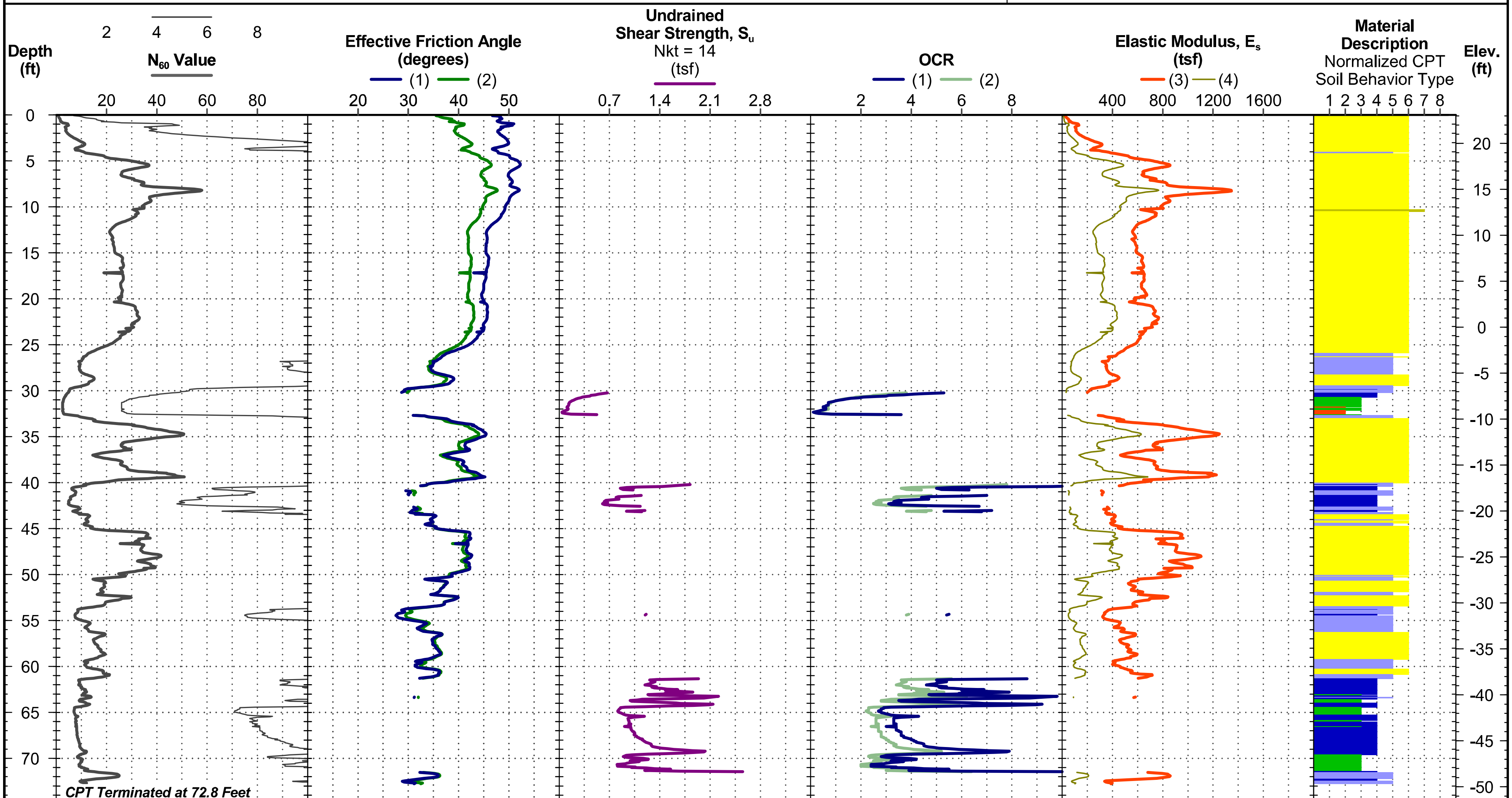
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 23.1 ft

SITE: Brevard County, FL



Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION

0 ft estimated water depth
(used in normalizations and correlations; see CPT General Notes)

Notes:
Probe no. DPG1228 with net area ratio of 0.8
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER engineering & testing, inc. A Terracon COMPANY

CPT Started: 2/18/2016	CPT Completed: 2/18/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-11

CPT CORRELATIVE PARAMETER LOG NO. CPT-301

SEE CPT LOG NO. CPT-301 FOR DETAILED TEST RESULTS

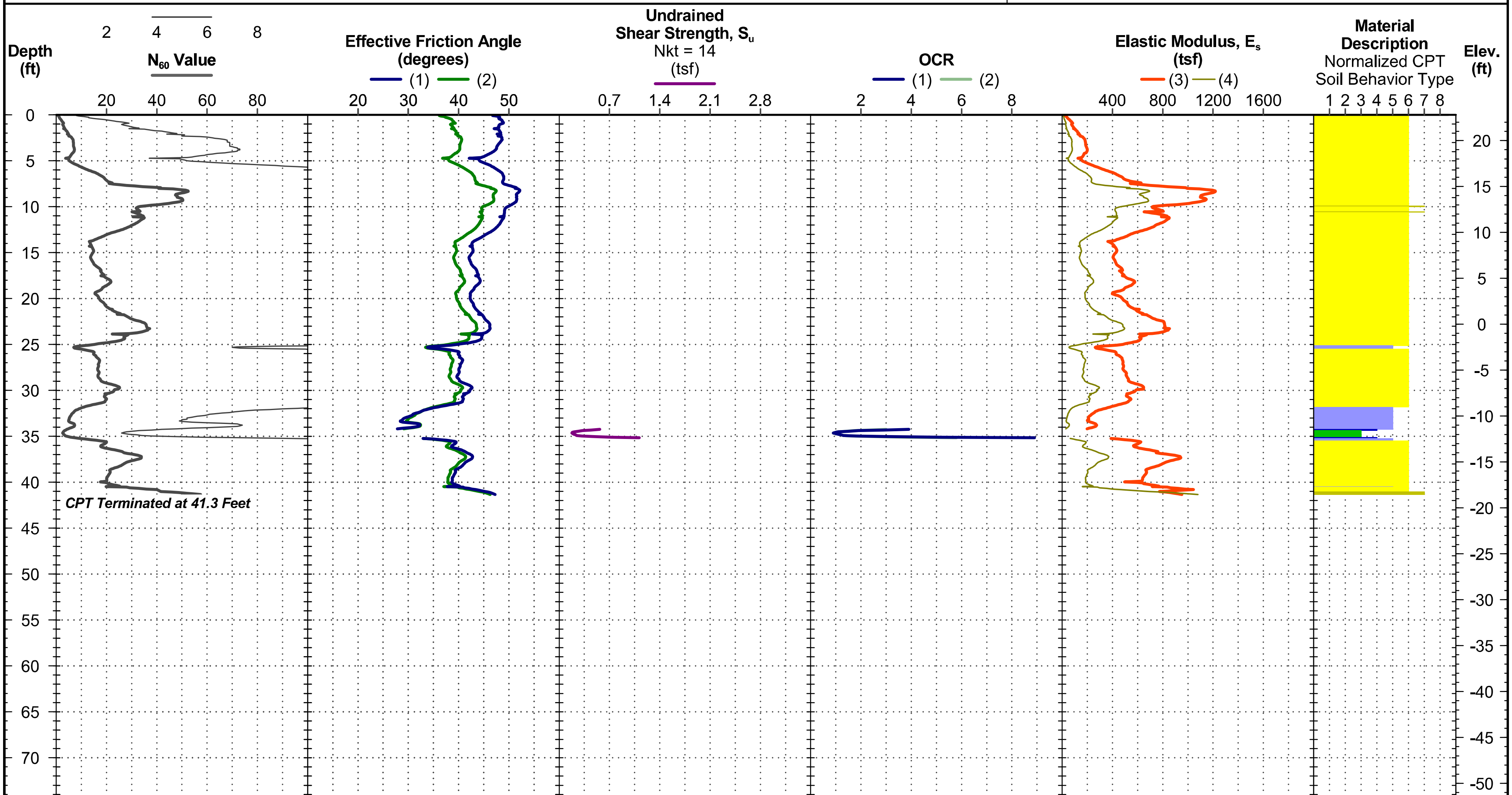
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 22.8 ft

SITE: Brevard County, FL



Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION

0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)

Notes:
Probe no. DPG1228 with net area ratio of 0.8
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER engineering & testing, inc.
A Terracon COMPANY

CPT Started: 2/17/2016	CPT Completed: 2/17/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-12

CPT CORRELATIVE PARAMETER LOG NO. CPT-302

SEE CPT LOG NO. CPT-302 FOR DETAILED TEST RESULTS

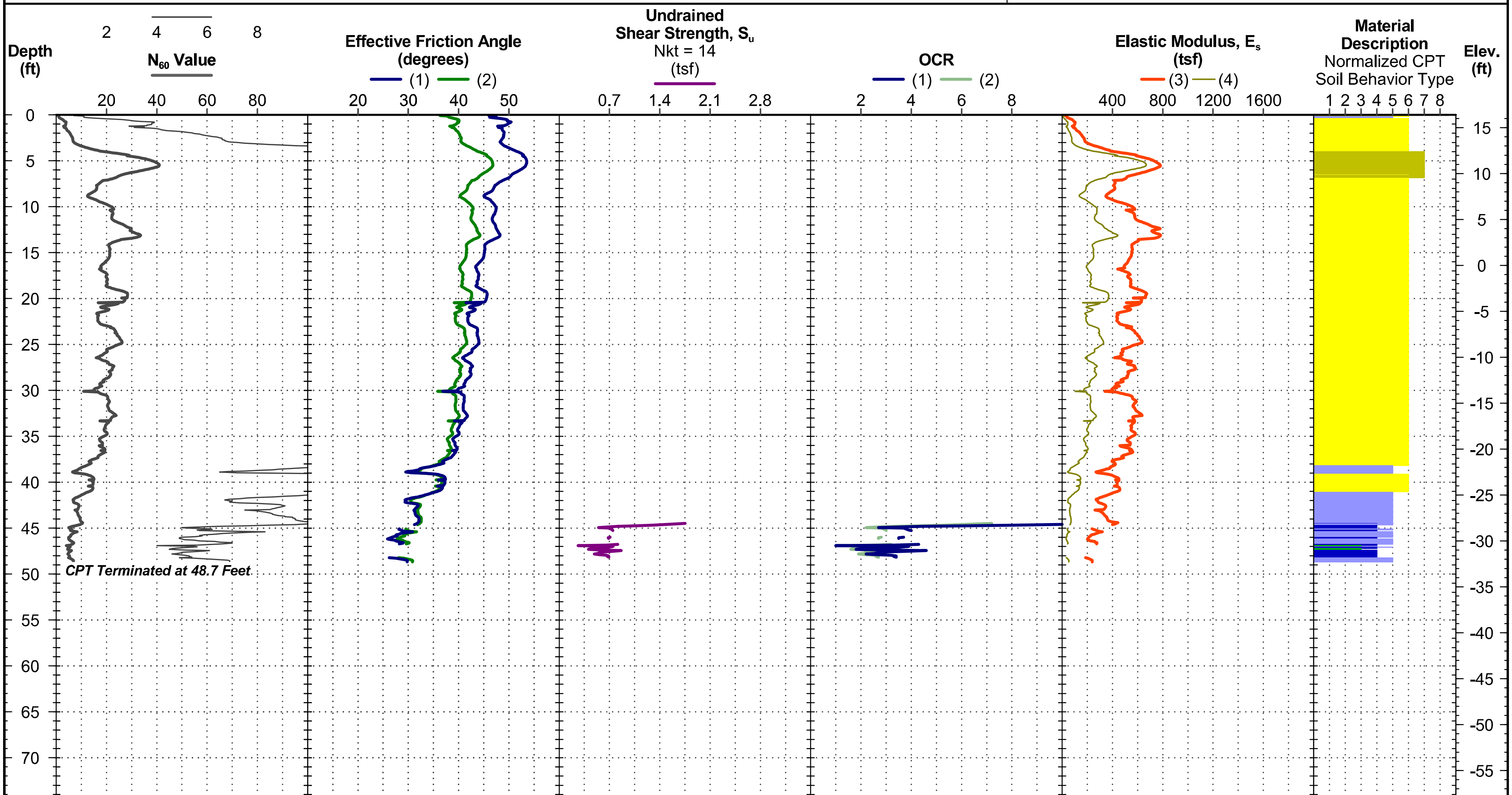
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 16.4 ft

SITE: Brevard County, FL



Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION	Notes:	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	CPT Started: 2/18/2016	CPT Completed: 2/18/2016
0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)	Probe no. DPG1228 with net area ratio of 0.8 Manufactured by Vertek; calibrated 12/27/2014 Tip and sleeve areas of 15 cm^2 and 225 cm^2 Ring friction reducer with O.D. of 2 in		Rig: 735	Operator: Tony Antonatos
			Project No.: HB155022	Exhibit: A-13

CPT CORRELATIVE PARAMETER LOG NO. CPT-303

SEE CPT LOG NO. CPT-303 FOR DETAILED TEST RESULTS

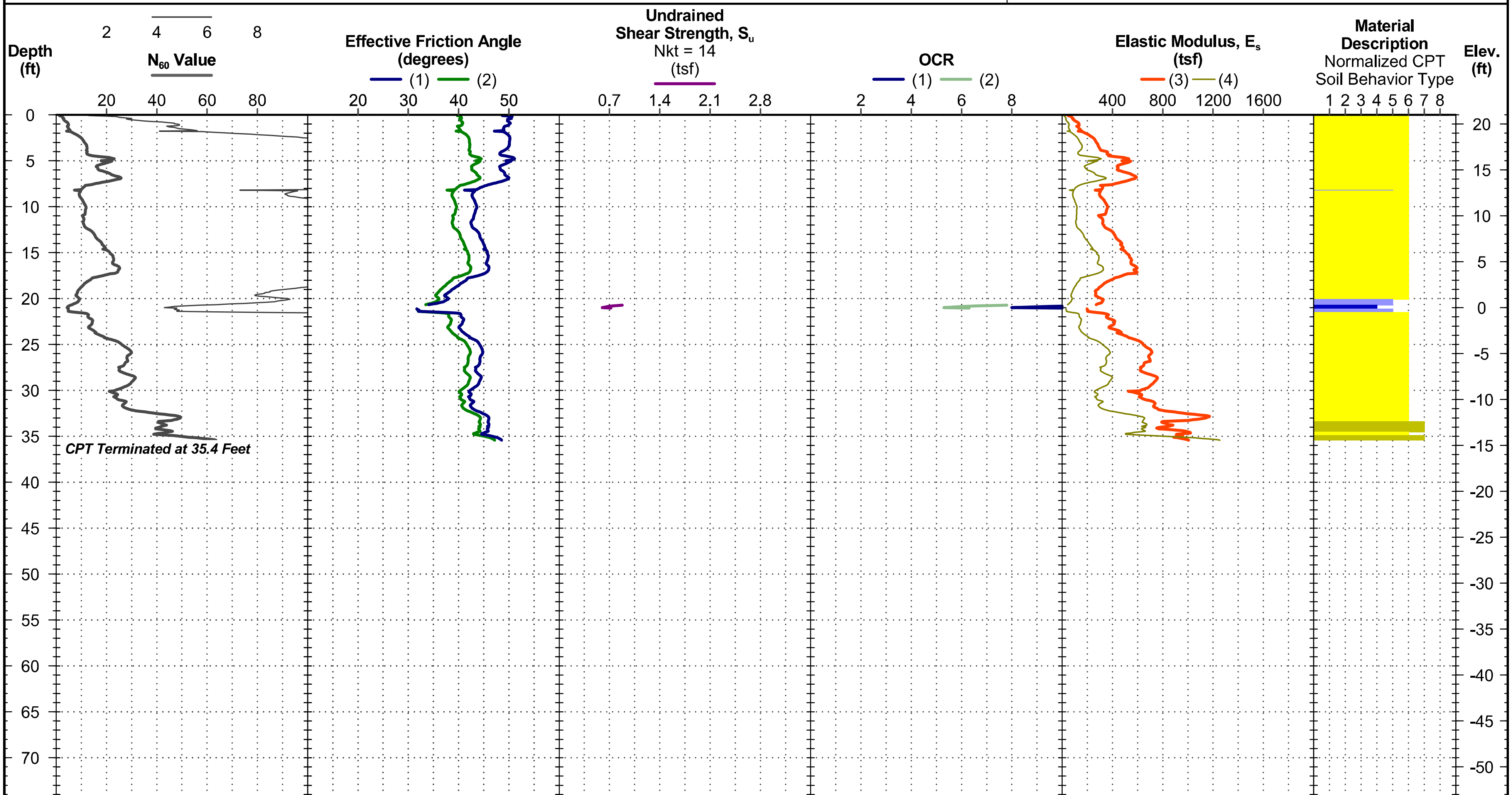
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 21.0 ft

SITE: Brevard County, FL



Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION

0 ft estimated water depth
(used in normalizations and correlations; see CPT General Notes)

Notes:
Probe no. DPG1228 with net area ratio of 0.8
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

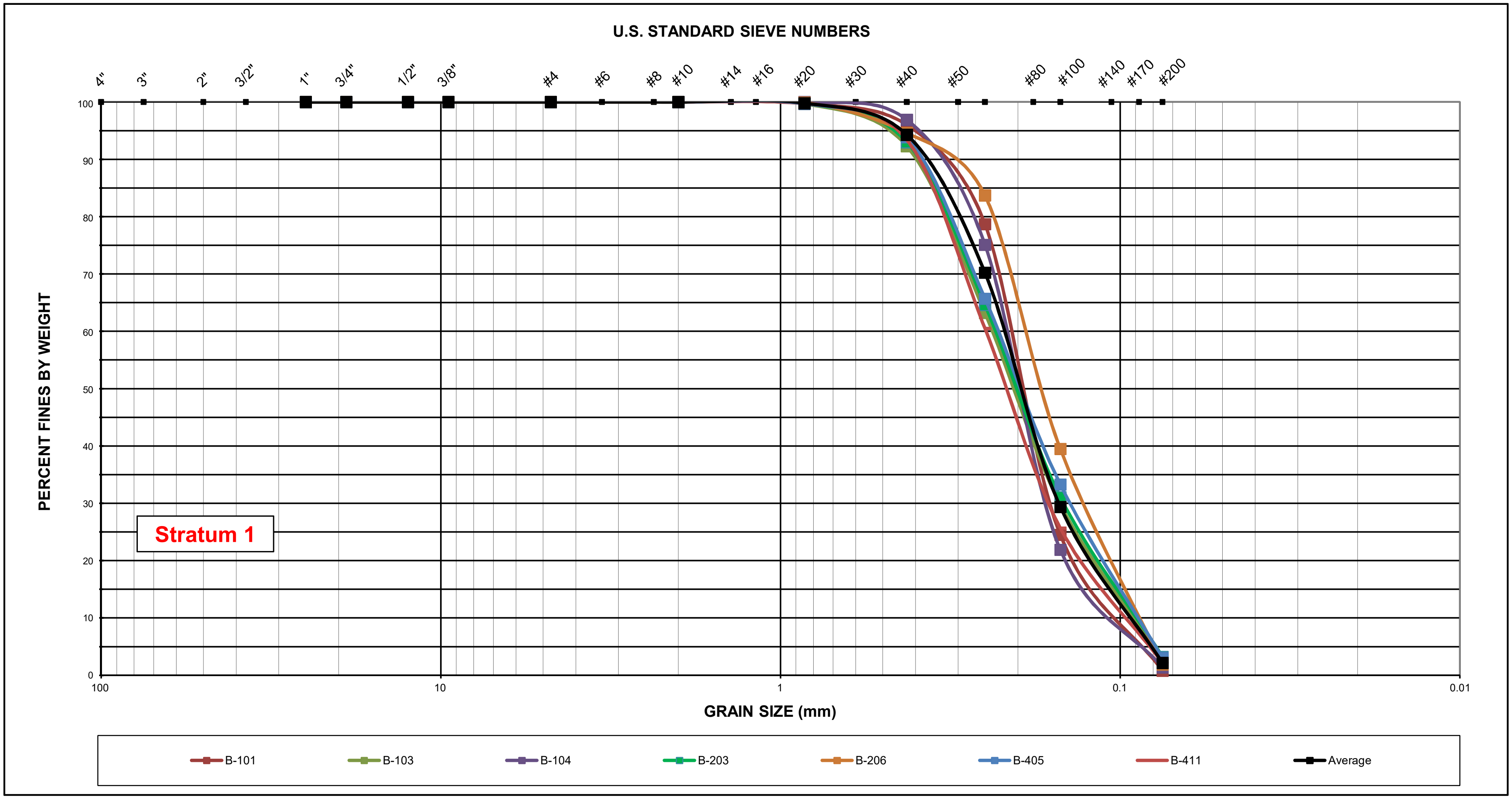
DUNKELBERGER engineering & testing, inc.
A Terracon COMPANY

CPT Started: 2/19/2016	CPT Completed: 2/19/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-14

APPENDIX B
LABORATORY TESTING REPORTS

DUNKELBERGER
engineering & testing, inc.
A Terracon COMPANY

Particle Size Analysis of Soil

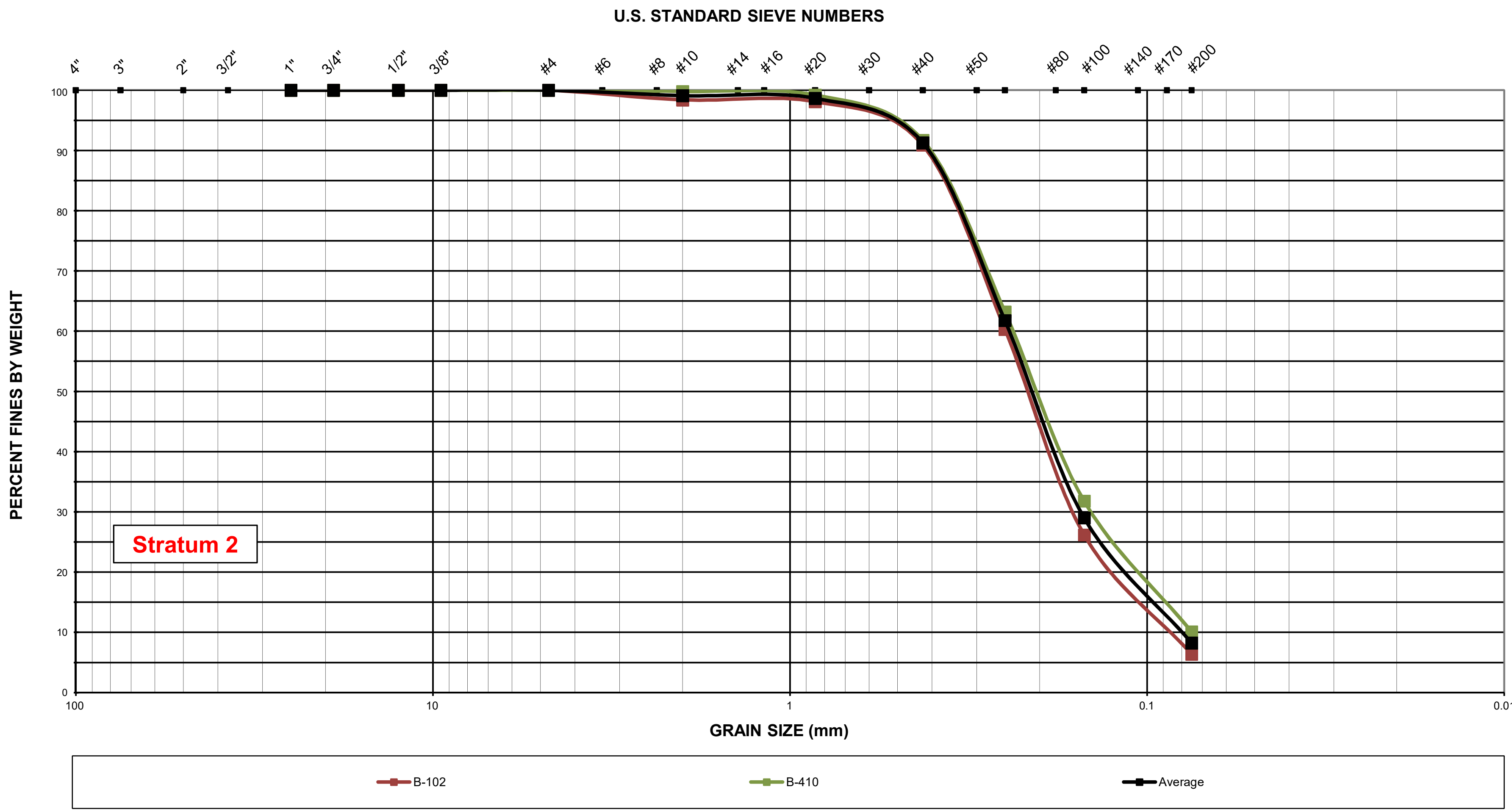


Boring Location	Depth (feet)	USCS Classification	Percent Passing Sieve										
			1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
B-101	18 - 20	SP	100.0	100.0	100.0	100.0	100.0	100.0	99.7	96.0	78.7	24.5	0.8
B-103	3 - 5	SP	100.0	100.0	100.0	100.0	100.0	100.0	99.7	92.3	63.2	29.8	2.7
B-104	13 - 15	SP	100.0	100.0	100.0	100.0	100.0	100.0	100.0	96.9	75.1	21.9	1.4
B-203	5 - 7	SP	100.0	100.0	100.0	100.0	100.0	100.0	99.8	93.0	64.6	31.1	3.2
B-206	18 - 20	SP	100.0	100.0	100.0	100.0	100.0	100.0	99.9	94.6	83.7	39.5	1.9
B-405	3 - 5	SP	100.0	100.0	100.0	100.0	100.0	100.0	99.7	93.9	65.7	33.3	3.0
B-411	3 - 5	SP	100.0	100.0	100.0	100.0	100.0	100.0	99.8	93.4	60.5	25.7	2.2
			-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-
Average			100.0	100.0	100.0	100.0	100.0	100.0	99.8	94.3	70.2	29.4	2.2

Exhibit B-1

DUNKELBERGER engineering & testing, inc. A Terracon COMPANY

Particle Size Analysis of Soil



Boring Location	Depth (feet)	USCS Classification	Percent Passing Sieve										
			1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
B-102	3 - 5	SP-SM	100.0	100.0	100.0	100.0	100.0	98.4	98.1	90.9	60.3	26.2	6.4
B-410	7 - 9	SP-SM	100.0	100.0	100.0	100.0	100.0	99.8	99.2	91.7	63.2	31.8	10.1
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
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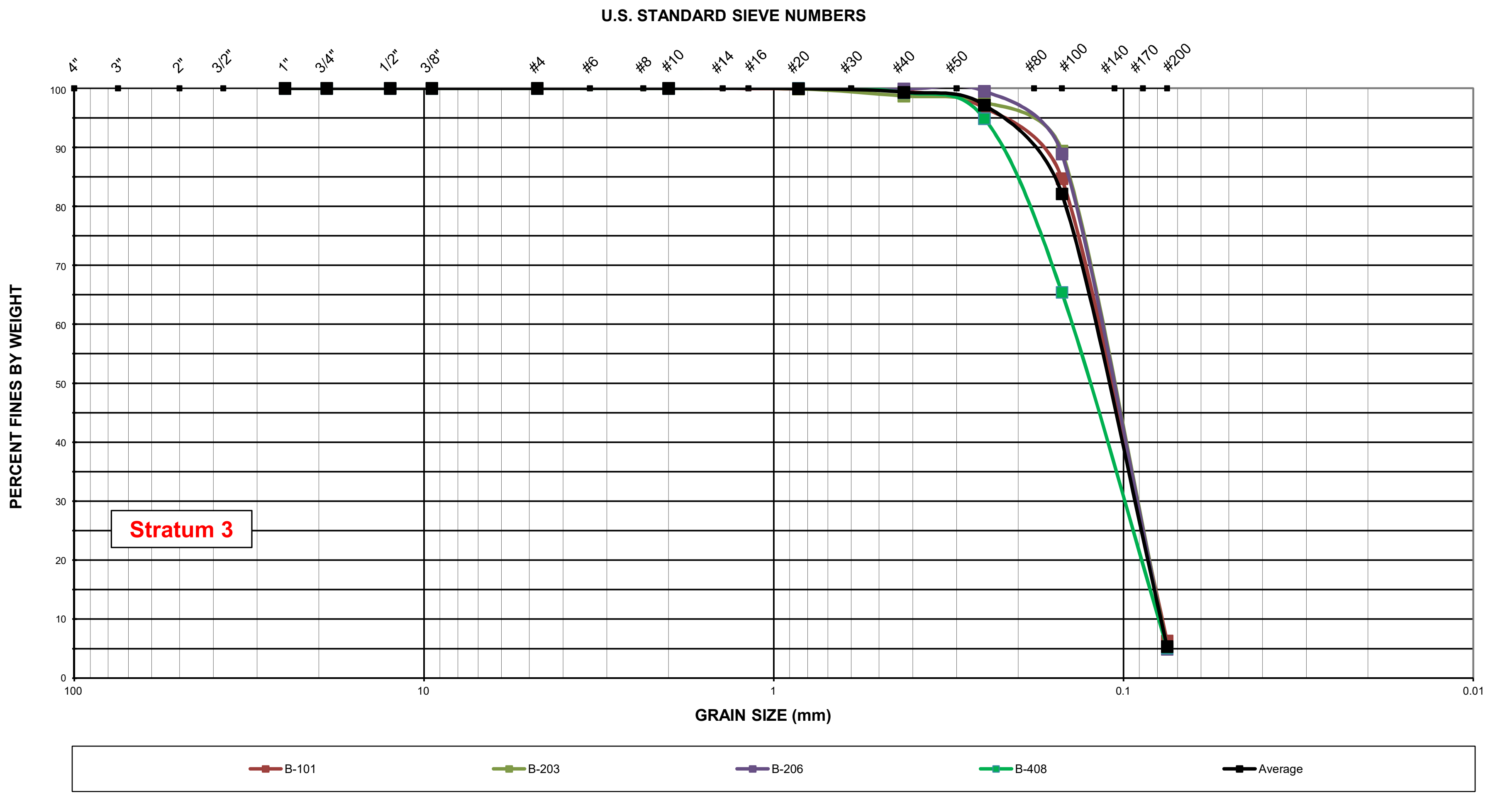
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	-	SP-SM	100.0	100.0	100.0	100.0	100.0	99.1	98.7	91.3	61.8	29.0	8.3

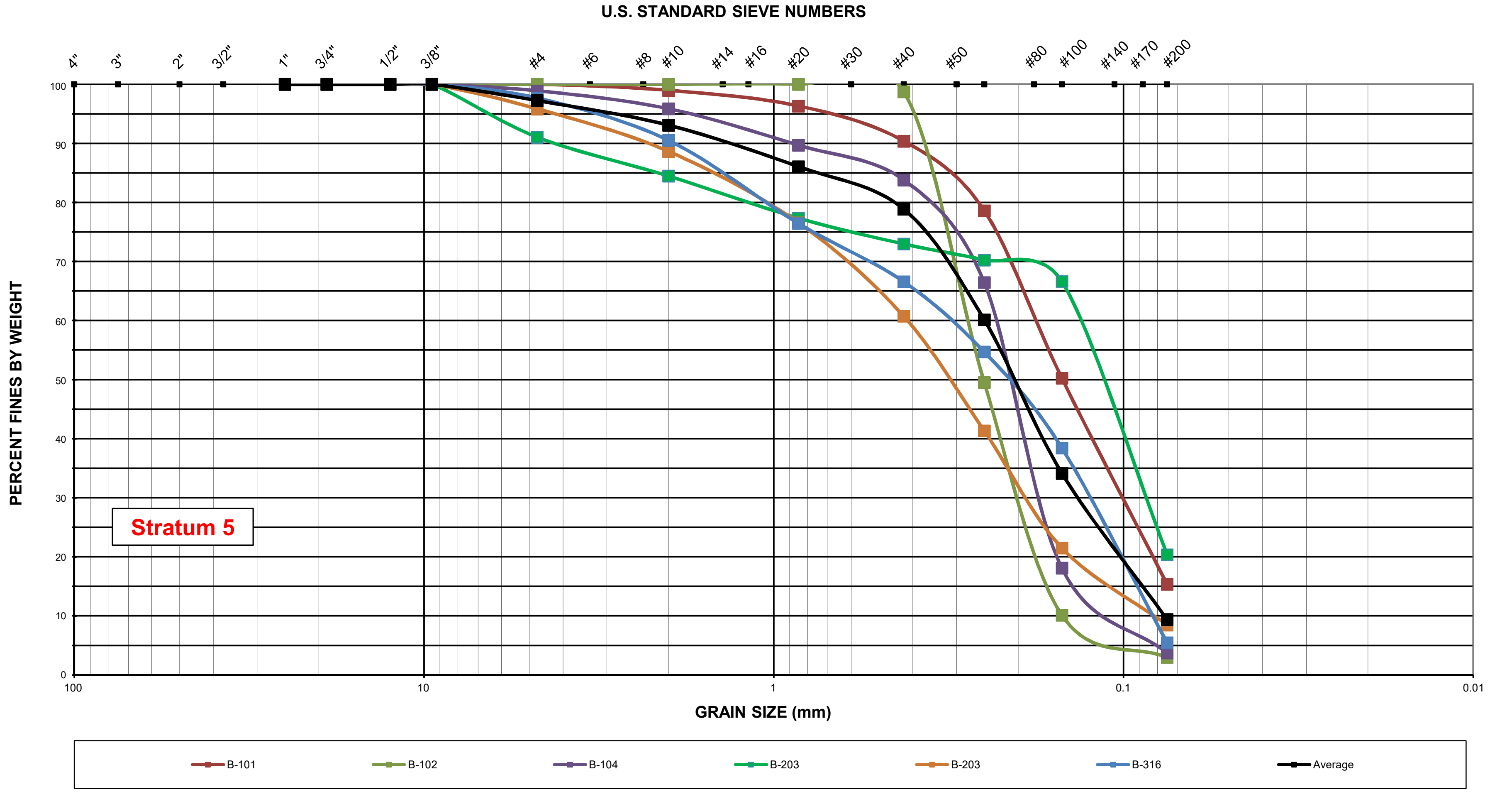
Exhibit B-2

Particle Size Analysis of Soil



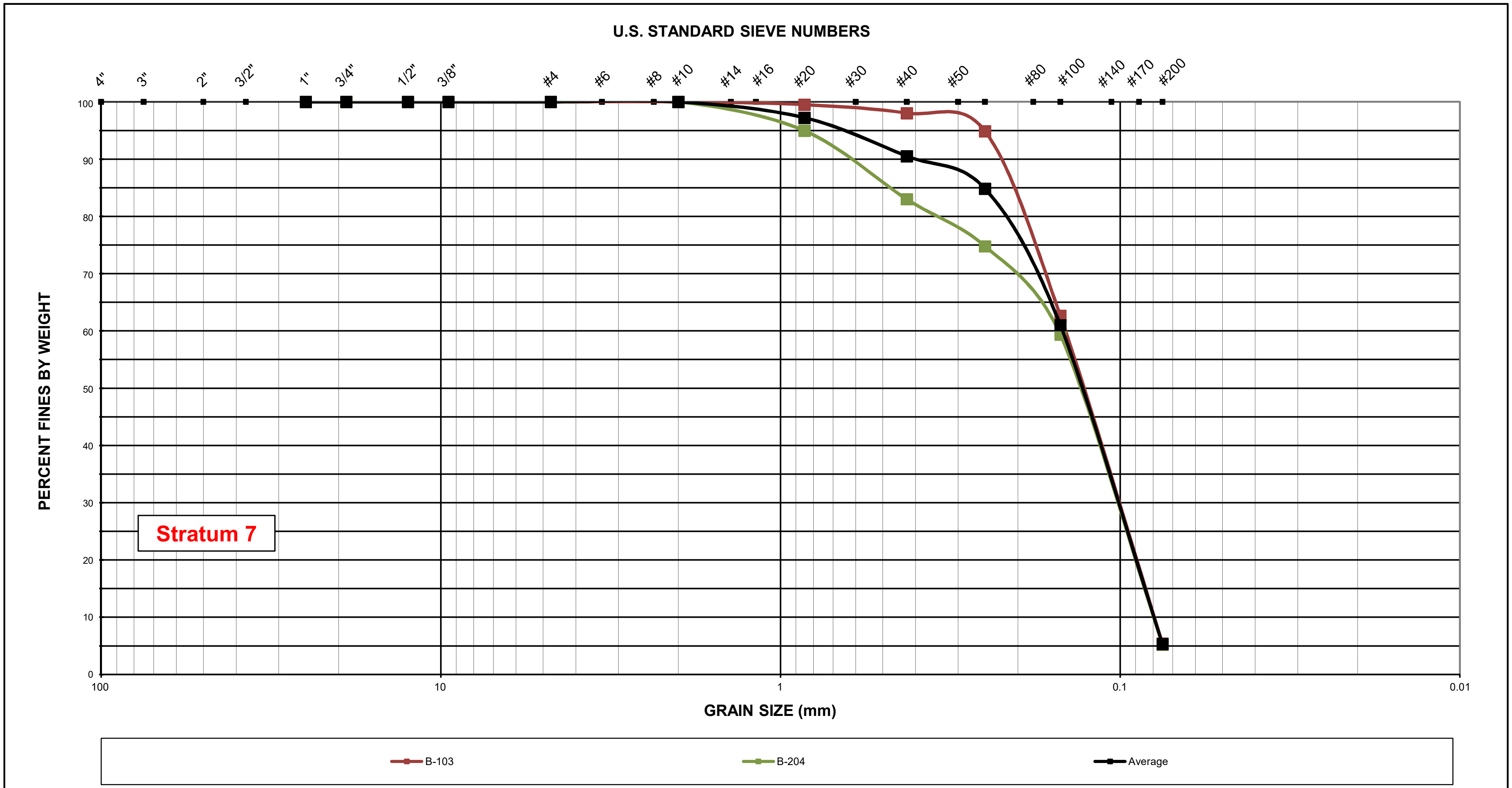
Boring Location	Depth (feet)	USCS Classification	Percent Passing Sieve										
			1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
B-101	9 - 11	SP-SM	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.5	96.7	84.7	6.3
B-203	38 - 40	SP-SM	100.0	100.0	100.0	100.0	100.0	100.0	99.9	98.7	97.6	89.4	5.2
B-206	13 - 15	SP	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.5	88.9	4.9
B-408	13 - 15	SP-SM	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.3	94.9	65.4	5.1
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
Average			100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.4	97.2	82.1	5.4

Particle Size Analysis of Soil

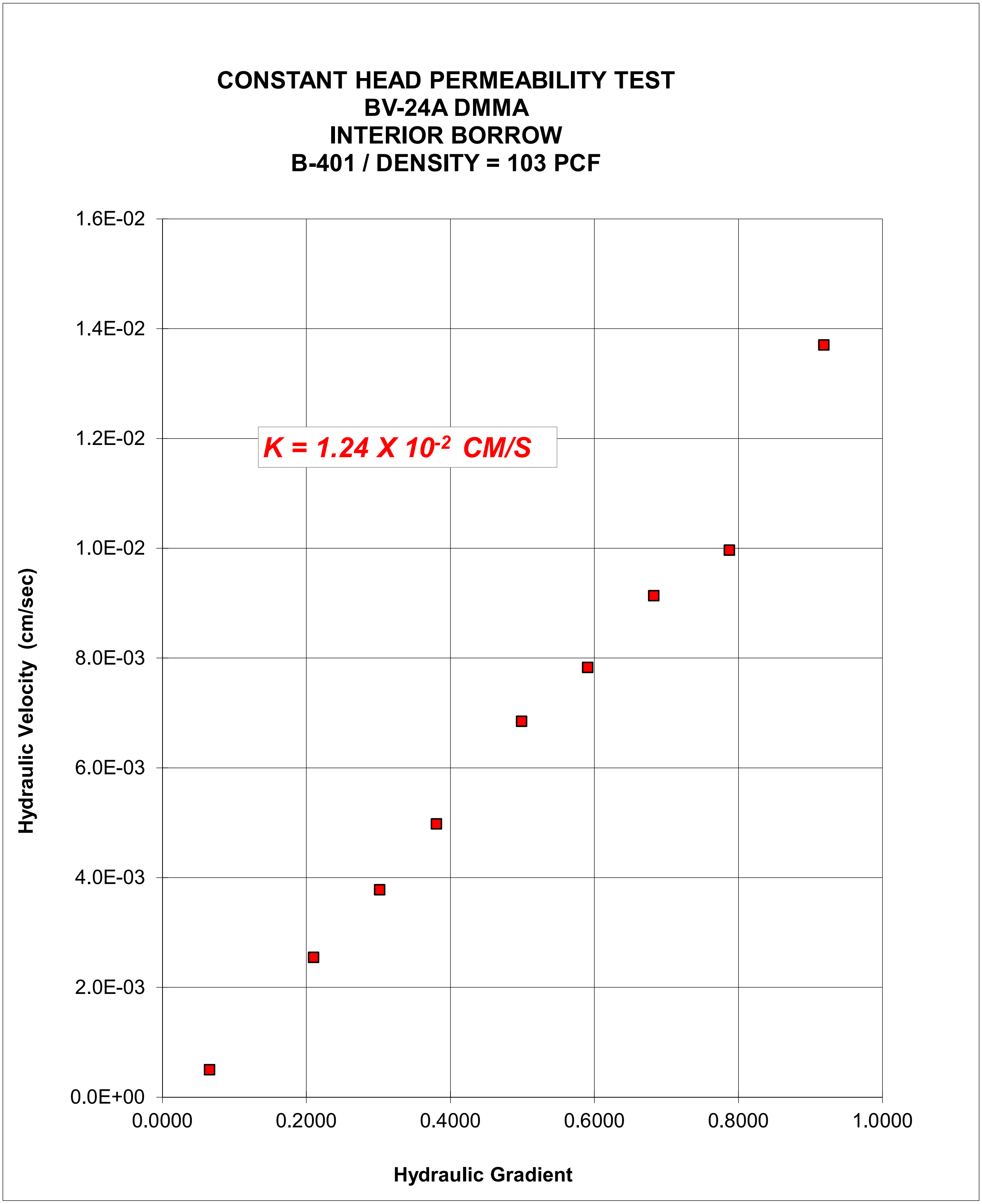


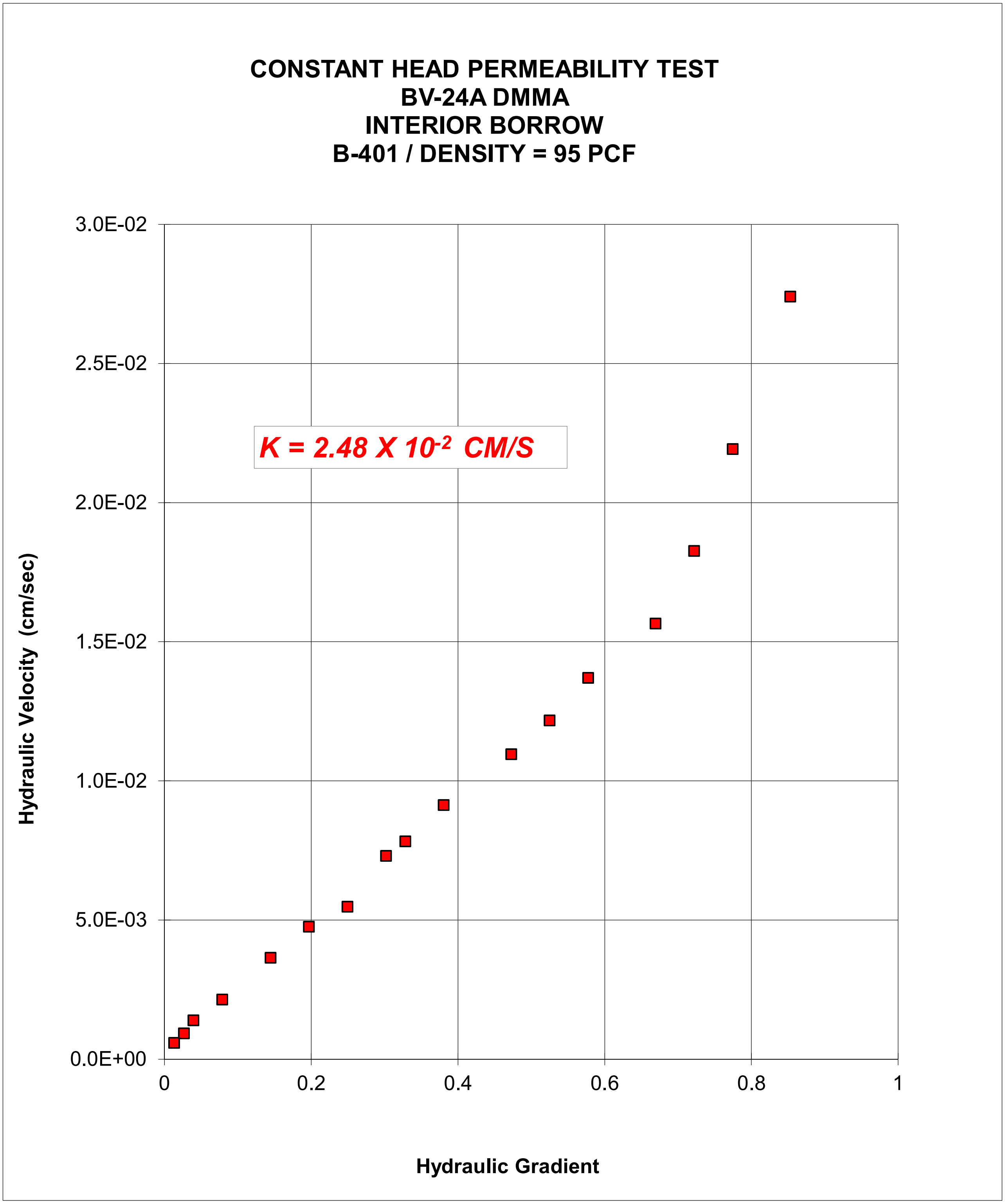
Boring Location	Depth (feet)	USCS Classification	Percent Passing Sieve										
			1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
B-101	53 - 55	SM	100.0	100.0	100.0	100.0	100.0	99.0	96.3	90.4	78.6	50.3	15.4
B-102	58 - 60	SP	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.7	49.5	10.1	3.0
B-104	43 - 45	SP	100.0	100.0	100.0	100.0	98.9	95.9	89.7	83.8	66.4	18.1	3.7
B-203	58 - 60	SM	100.0	100.0	100.0	100.0	91.1	84.5	77.3	73.0	70.2	66.6	20.4
B-203	78 - 80	SP-SM	100.0	100.0	100.0	100.0	95.8	88.6	76.6	60.7	41.3	21.5	8.5
B-316	38 - 40	SP-SM	100.0	100.0	100.0	100.0	97.7	90.5	76.4	66.6	54.7	38.4	5.5
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
Average			100.0	100.0	100.0	100.0	97.2	93.1	86.1	78.9	60.1	34.2	9.4

Particle Size Analysis of Soil



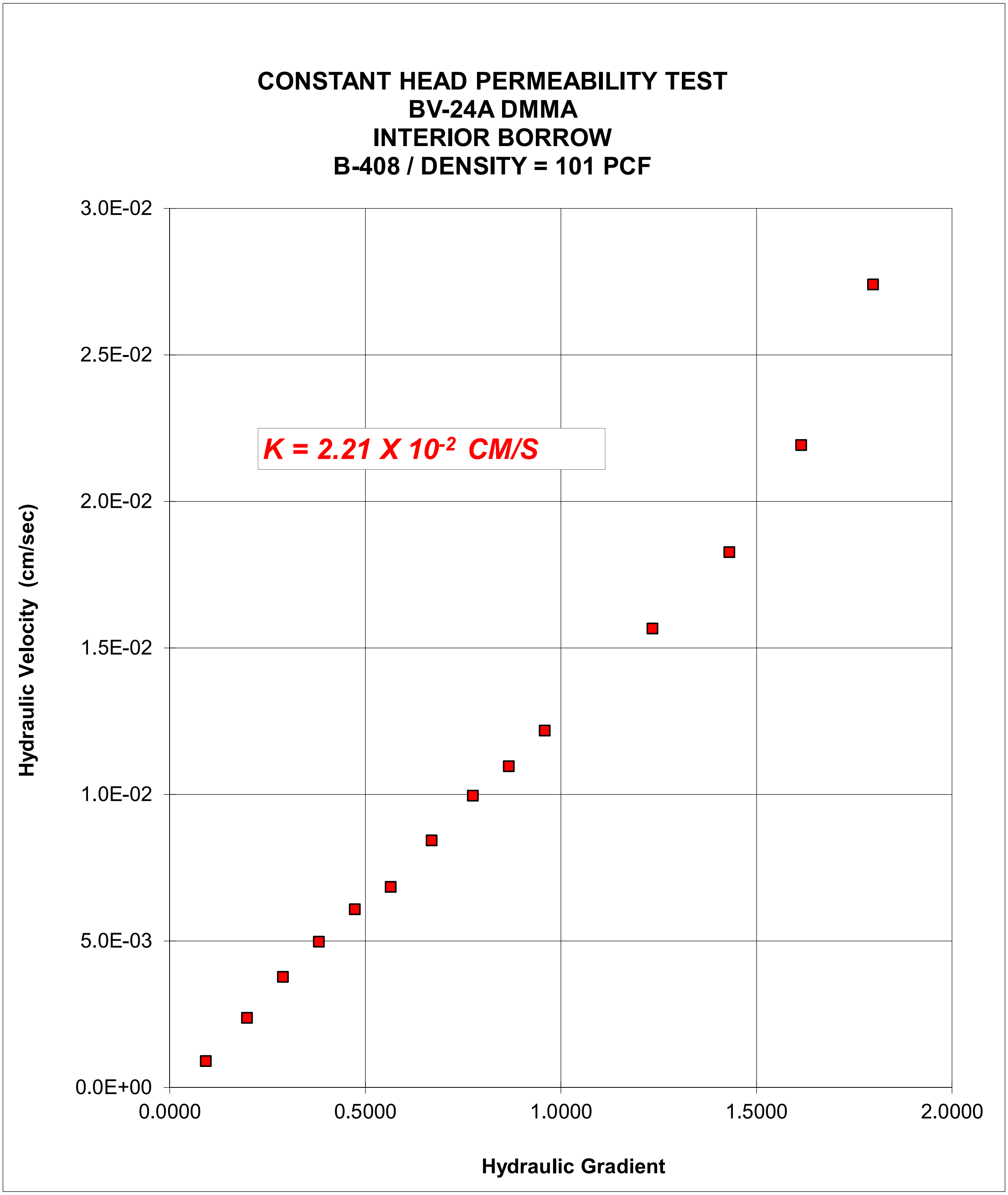
Boring Location	Depth (feet)	USCS Classification	Percent Passing Sieve										
			1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
B-103	38 - 40	SP-SM	100.0	100.0	100.0	100.0	100.0	100.0	99.5	98.0	94.9	62.7	5.4
B-204	38 - 40	SP-SM	100.0	100.0	100.0	100.0	100.0	100.0	94.9	83.0	74.8	59.3	5.2
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
Average			100.0	100.0	100.0	100.0	100.0	100.0	97.2	90.5	84.8	61.0	5.3

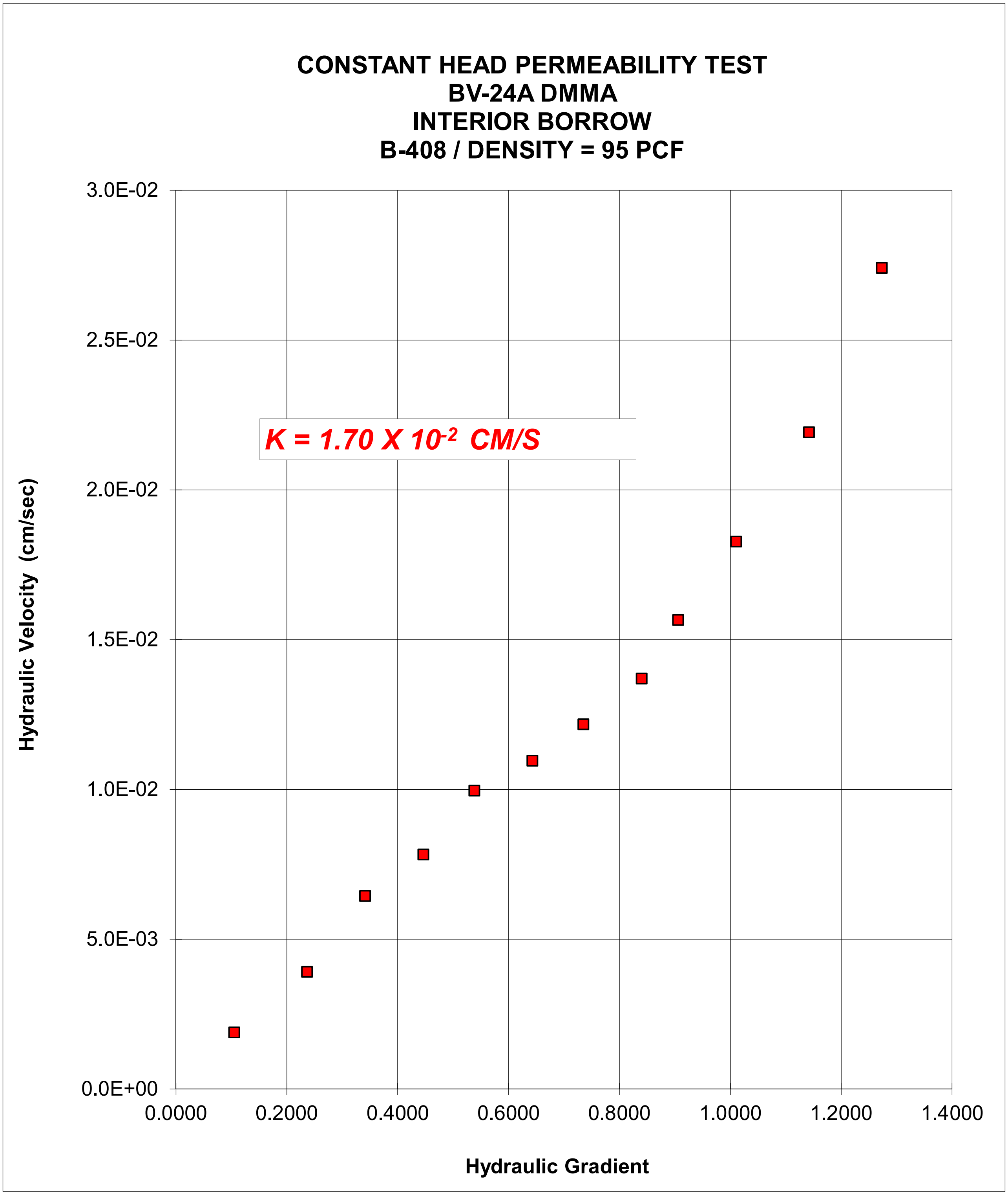

CONSTANT HEAD PERMEABILITY TEST
BV-24A DMMA
INTERIOR BORROW
B-401 / DENSITY = 103 PCF
K = 1.24 X 10-2 CM/S
Hydraulic Velocity (cm/sec)
Hydraulic Gradient
0.0E+00
2.0E-03
4.0E-03
6.0E-03
8.0E-03
1.0E-02
1.2E-02
1.4E-02
1.6E-02
0.0000
0.2000
0.4000
0.6000
0.8000
1.0000

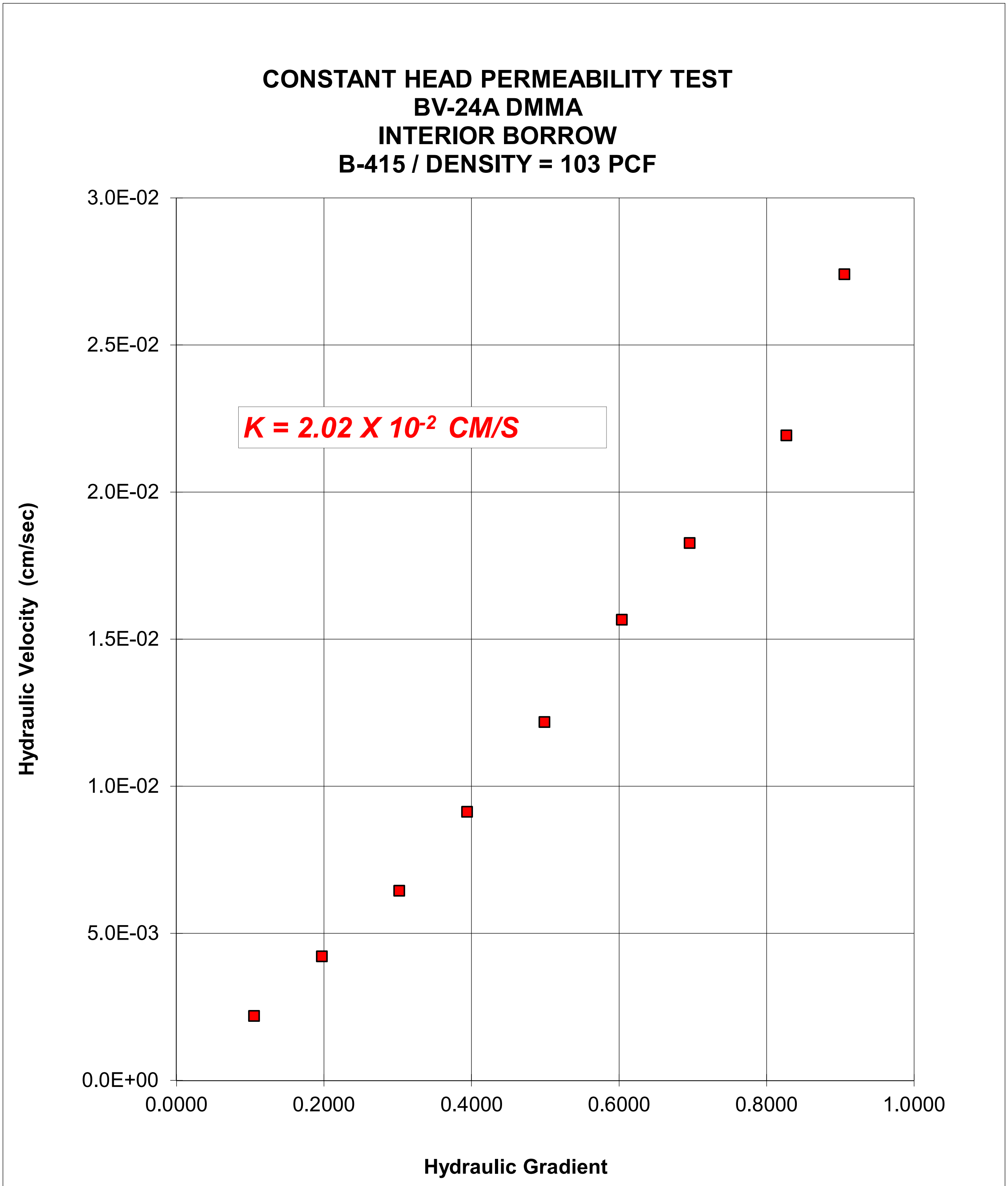


CONSTANT HEAD PERMEABILITY TEST
BV-24A DMMA
INTERIOR BORROW
B-401 / DENSITY = 95 PCF
K = 2.48 X 10-2 CM/S
Hydraulic Velocity (cm/sec)
3.0E-02
2.5E-02
2.0E-02
1.5E-02
1.0E-02
5.0E-03
0.0E+00
0
0.2
0.4
0.6
0.8
1
Hydraulic Gradient

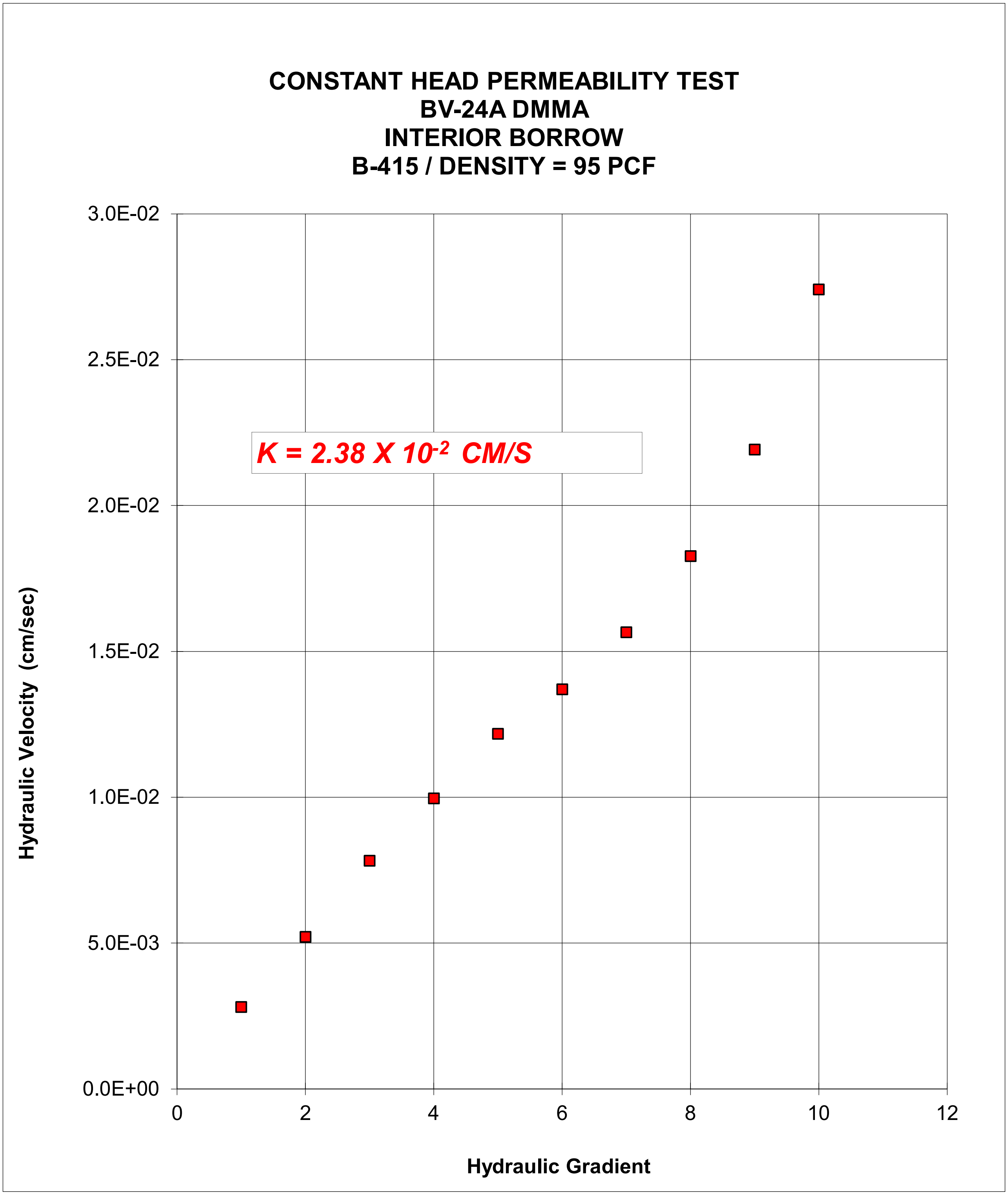
Exhibit B-7


CONSTANT HEAD PERMEABILITY TEST
BV-24A DMMA
INTERIOR BORROW
B-408 / DENSITY = 101 PCF
K = 2.21 X 10-2 CM/S
Hydraulic Velocity (cm/sec)
3.0E-02
2.5E-02
2.0E-02
1.5E-02
1.0E-02
5.0E-03
0.0E+00
0.0000
0.5000
1.0000
1.5000
2.0000
Hydraulic Gradient


CONSTANT HEAD PERMEABILITY TEST
BV-24A DMMA
INTERIOR BORROW
B-408 / DENSITY = 95 PCF
K = 1.70 X 10-2 CM/S
Hydraulic Velocity (cm/sec)
Hydraulic Gradient
3.0E-02
2.5E-02
2.0E-02
1.5E-02
1.0E-02
5.0E-03
0.0E+00
0.0000
0.2000
0.4000
0.6000
0.8000
1.0000
1.2000
1.4000



CONSTANT HEAD PERMEABILITY TEST
BV-24A DMMA
INTERIOR BORROW
B-415 / DENSITY = 103 PCF
K = 2.02 X 10-2 CM/S
3.0E-02
2.5E-02
2.0E-02
1.5E-02
1.0E-02
5.0E-03
0.0E+00
0.0000
0.2000
0.4000
0.6000
0.8000
1.0000
Hydraulic Velocity (cm/sec)
Hydraulic Gradient


CONSTANT HEAD PERMEABILITY TEST
BV-24A DMMA
INTERIOR BORROW
B-415 / DENSITY = 95 PCF
K = 2.38 X 10-2 CM/S
Hydraulic Velocity (cm/sec)
3.0E-02
2.5E-02
2.0E-02
1.5E-02
1.0E-02
5.0E-03
0.0E+00
0
2
4
6
8
10
12
Hydraulic Gradient

HYDRAULIC CONDUCTIVITY TEST RESULTS
(ASTM D 5084 - Method C)

PROJECT NAME: BV-24A
SAMPLE ID: B-102 (31 - 33 ft)

Hydraulic Conductivity = 4.87E-08 cm/sec

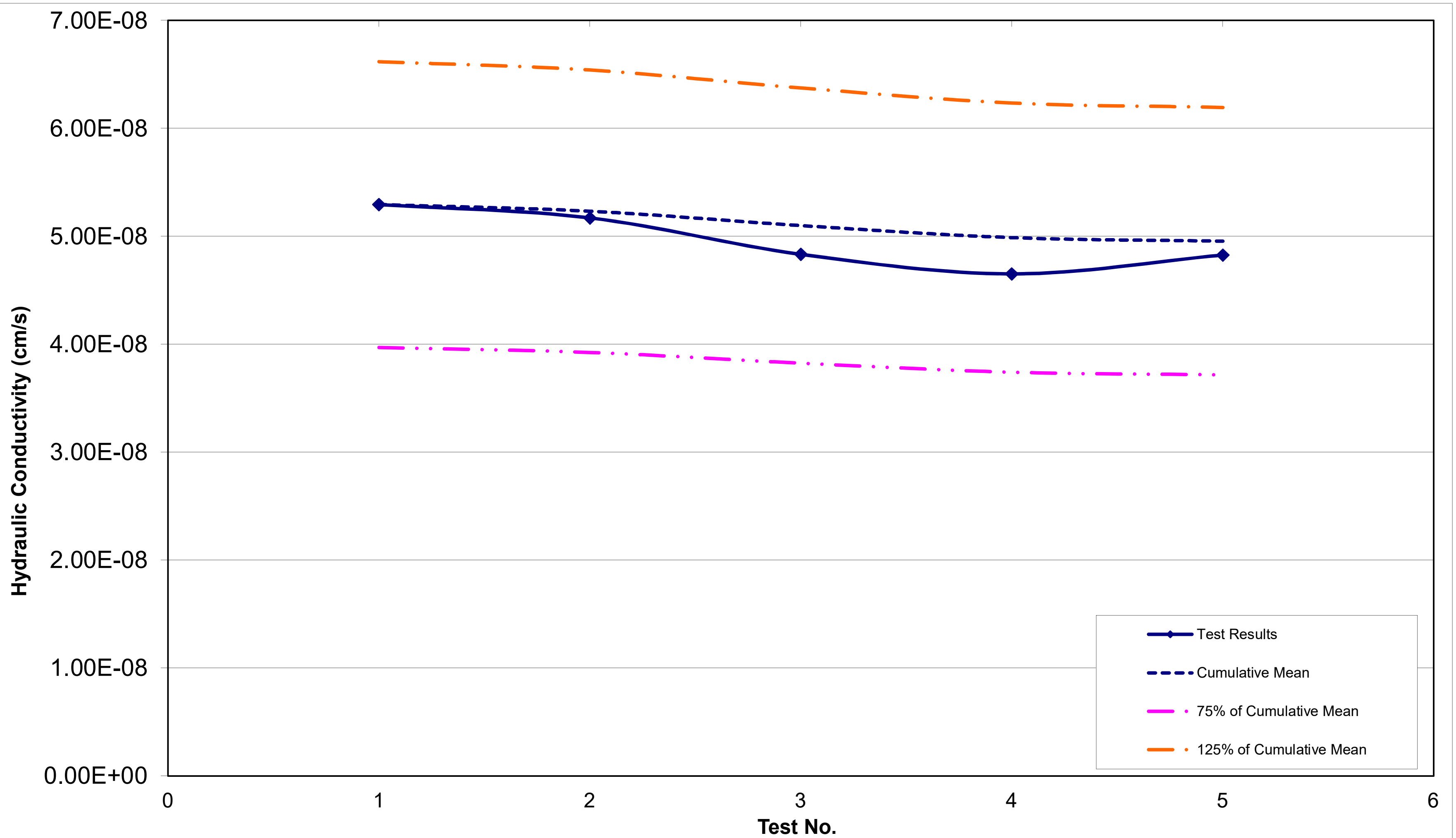


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Exhibit B-12

HYDRAULIC CONDUCTIVITY TEST RESULTS

(ASTM D 5084 - Method C)

PROJECT NAME: BV-24A
SAMPLE ID: B-203 (66 - 68 ft)

Hydraulic Conductivity = 5.57E-08 cm/sec

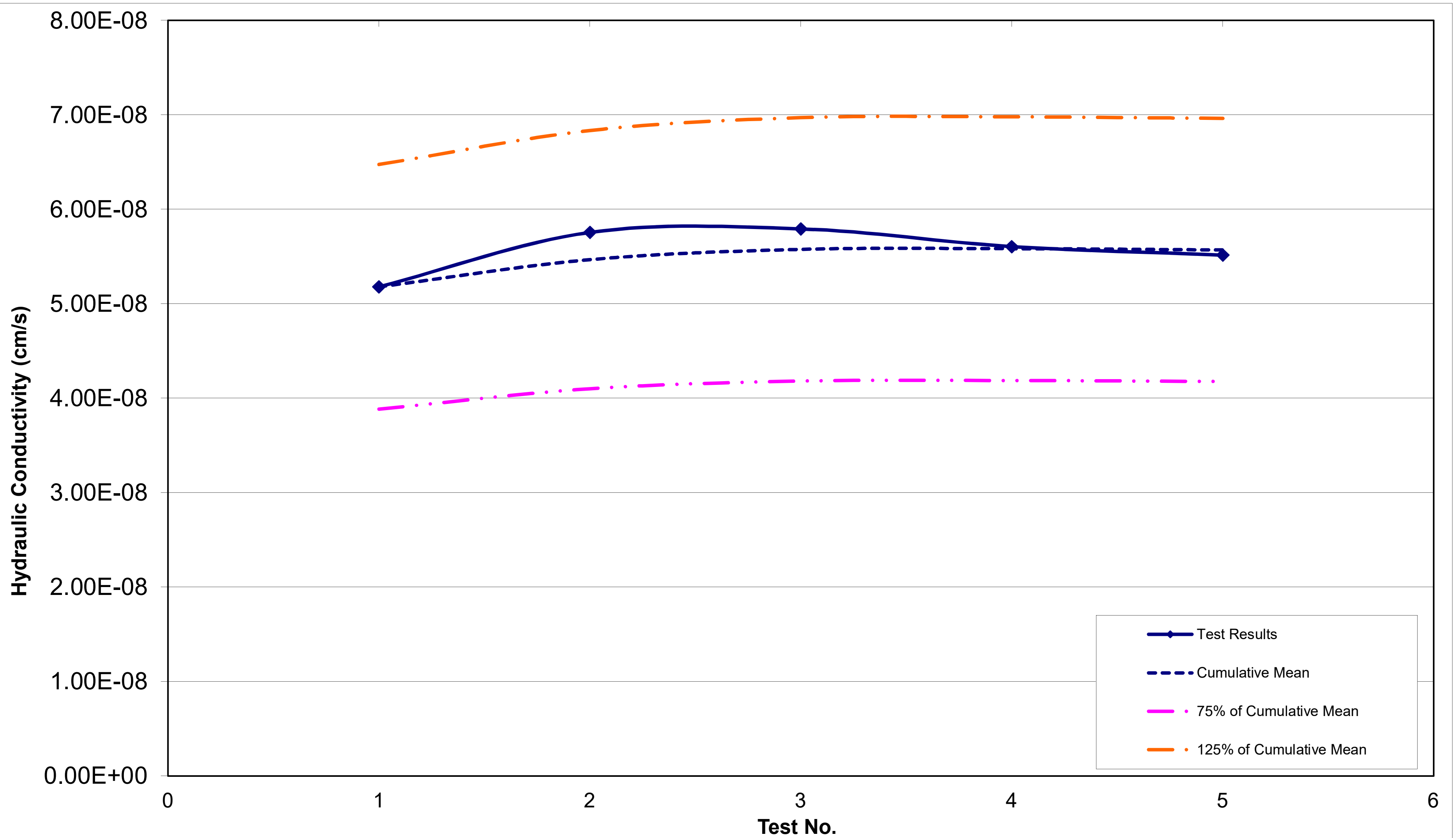

Exhibit B-13

TRIAXIAL SHEAR TEST REPORT

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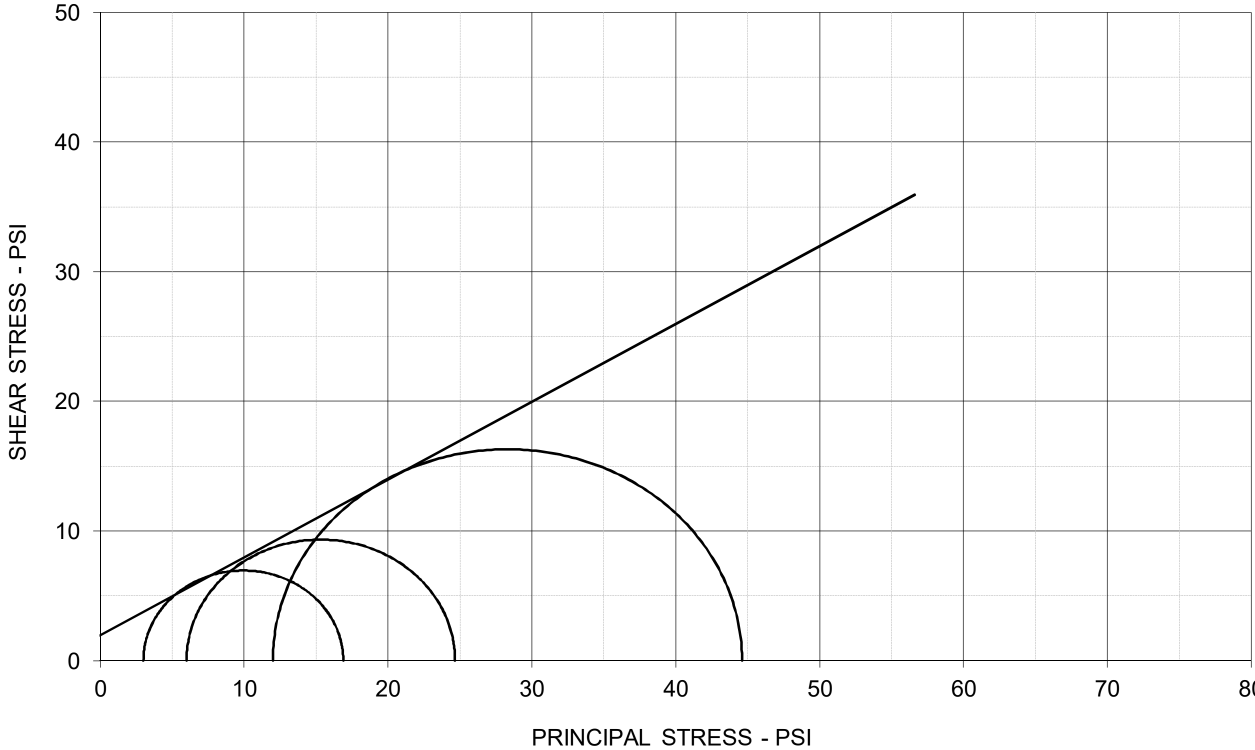
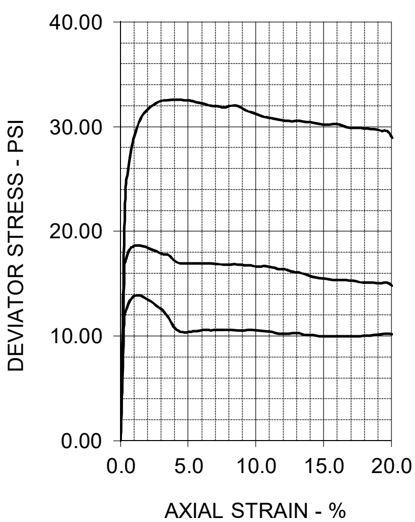


EFFECTIVE STRESS PARAMETERS	ϕ ' = 31.0 deg	c' = 1.9 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	15.0	15.0	15.0	
Dry Density - pcf	96.9	96.9	96.9	
Diameter - inches	2.80	2.80	2.80	
Height - inches	5.60	5.60	5.60	
AT TEST				
Final Moisture - %	27.0	27.1	26.7	
Dry Density - pcf	96.9	97.0	97.3	
Calculated Diameter (in.)	2.79	2.80	2.76	
Height - inches	5.58	5.59	5.49	
Effect. Cell Pressure - psi	3.0	6.0	12.0	
Failure Stress - psi	13.89	18.66	32.61	
Total Pore Pressure - psi	50.0	50.0	50.0	
Strain Rate - inches/min.	0.05600	0.05600	0.05600	
Failure Strain - %	1.4	1.4	4.3	
σ_1' Failure - psi	16.89	24.66	44.61	
σ_3' Failure - psi	3.00	6.00	12.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CD Triaxial
SAMPLE TYPE: Remolded
DESCRIPTION: Gray Fine-Medium Sand
SAMPLE LOCATION: 401-402
ASSUMED SPECIFIC GRAVITY: 2.70
LL: NP PL: NP PI: NP Percent -200: 2.8
REMARKS: Specimens remolded to 95% at opt.

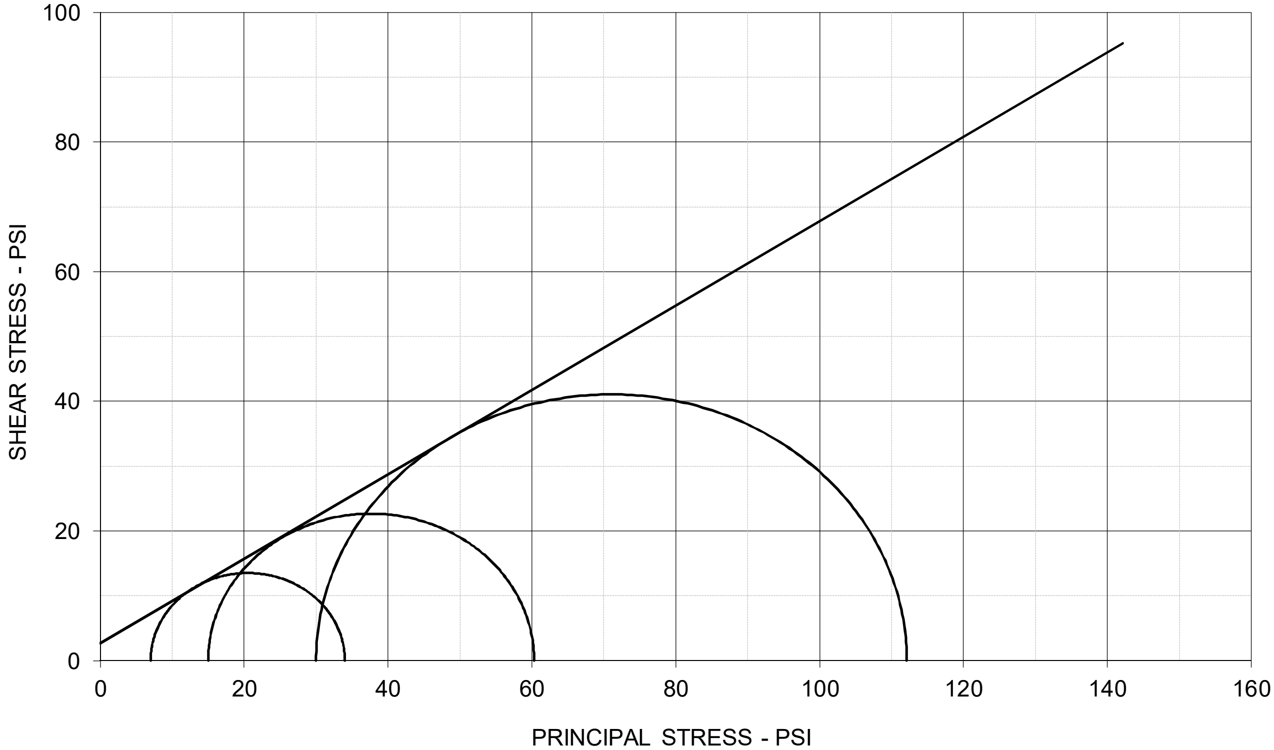
PROJECT INFORMATION

PROJECT: BV-24A DMMA
LOCATION: Grant-Valkaria, FL
PROJECT NO: HB155022
CLIENT: Taylor Engineering, Inc
DATE: 5/24/16

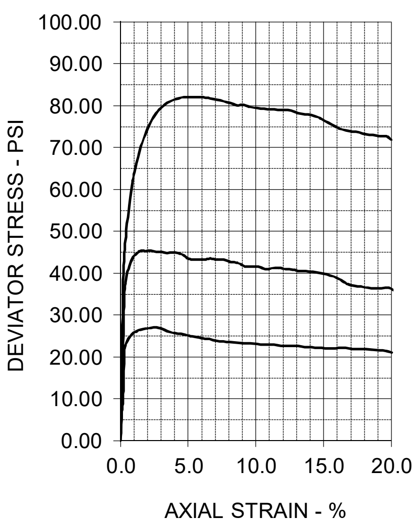
TERRACON | Exhibit B-14

TRIAXIAL SHEAR TEST REPORT

DUNKELBERGER engineering & testing, inc. A Terracon COMPANY



EFFECTIVE STRESS PARAMETERS	φ ' = 33.1 deg	c' = 2.7 psi

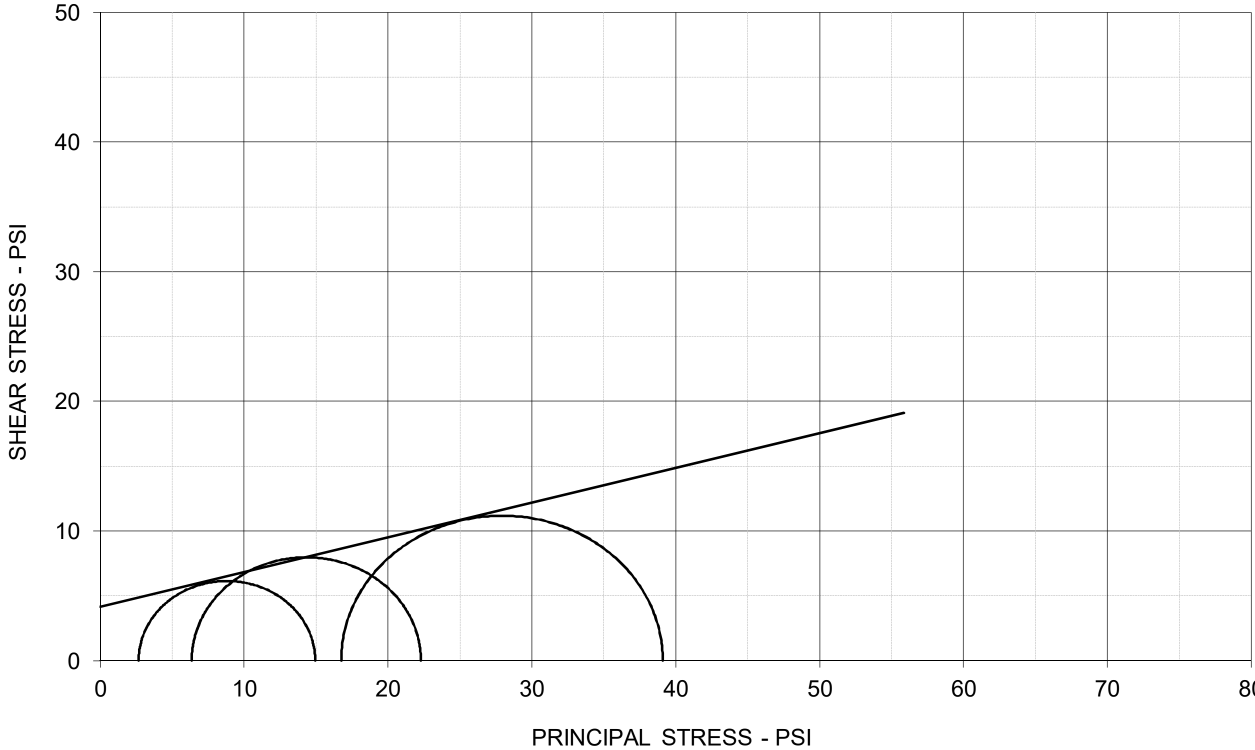


SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	10.0	10.0	10.0	
Dry Density - pcf	97.9	97.9	97.9	
Diameter - inches	2.80	2.80	2.80	
Height - inches	5.60	5.60	5.60	
AT TEST				
Final Moisture - %	26.2	26.0	26.0	
Dry Density - pcf	98.0	98.2	98.4	
Calculated Diameter (in.)	2.76	2.75	2.77	
Height - inches	5.47	5.46	5.51	
Effect. Cell Pressure - psi	7.0	15.0	30.0	
Failure Stress - psi	27.01	45.32	82.12	
Total Pore Pressure - psi	50.0	50.0	50.0	
Strain Rate - inches/min.	0.05600	0.05600	0.05600	
Failure Strain - %	2.7	2.3	5.1	
σ_1' Failure - psi	34.01	60.32	112.12	
σ_3' Failure - psi	7.00	15.00	30.00	

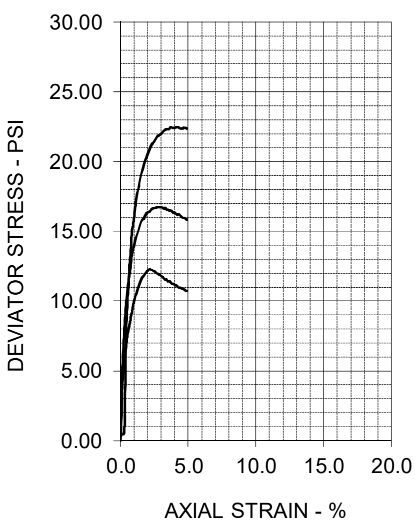
TEST DESCRIPTION	PROJECT INFORMATION
TYPE OF TEST & NO: CD Triaxial	PROJECT: BV-24A DMMA
SAMPLE TYPE: Remolded	LOCATION: Grant-Valkaria, FL
DESCRIPTION: Gray Fine-Medium Sand	PROJECT NO: HB155022
SAMPLE LOCATION: 413-414	CLIENT: Taylor Engineering, Inc
ASSUMED SPECIFIC GRAVITY: 2.70	DATE: 5/24/16
LL: NP PL: NP PI: NP Percent -200: 2.5	TERRACON
REMARKS: Specimens remolded to 95% at opt.	Exhibit B-15

TRIAXIAL SHEAR TEST REPORT

DUNKELBERGER engineering & testing, inc.
A Terracon COMPANY



EFFECTIVE STRESS PARAMETERS	ϕ ' = 15.0 deg	c' = 4.2 psi

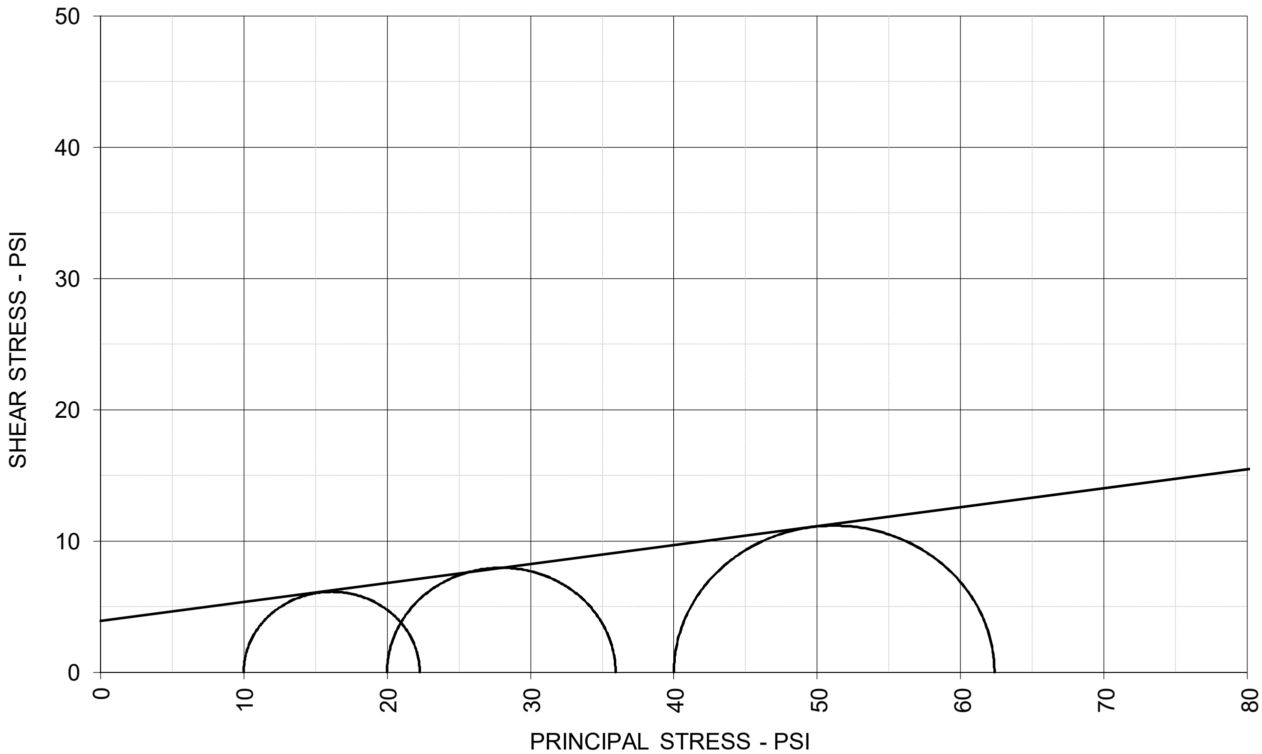


SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	54.0	54.0	54.0	
Dry Density - pcf	68.6	68.6	68.6	
Diameter - inches	2.86	2.86	2.86	
Height - inches	5.69	5.69	5.69	
AT TEST				
Final Moisture - %			42.9	
Dry Density - pcf	69.6	72.3	77.6	
Calculated Diameter (in.)	2.83	2.85	2.83	
Height - inches	5.60	5.66	5.61	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.27	15.93	22.35	
Total Pore Pressure - psi	57.3	63.6	73.3	
Strain Rate - inches/min.	0.00060	0.00060	0.00060	
Failure Strain - %	2.1	4.8	4.9	
σ_1' Failure - psi	14.94	22.29	39.10	
σ_3' Failure - psi	2.67	6.36	16.75	

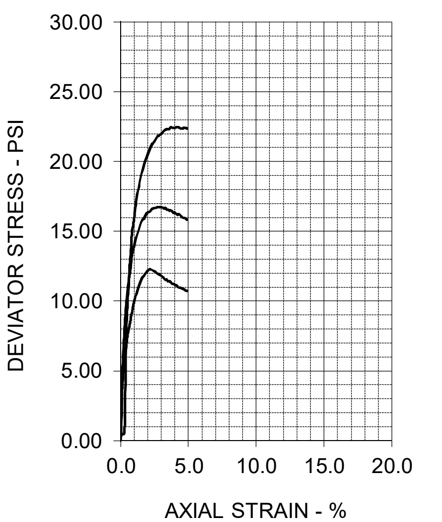
TEST DESCRIPTION	PROJECT INFORMATION
TYPE OF TEST & NO: CU with Pore Pressure	PROJECT: BV-24A DMMA
SAMPLE TYPE: Tube	LOCATION: Grant-Valkaria, FL
DESCRIPTION: Grayish Brown Clay	PROJECT NO: HB155022
SAMPLE LOCATION: B102 31.0-33.5 ft	CLIENT: Taylor Engineering, Inc
ASSUMED SPECIFIC GRAVITY: 2.70	DATE: 5/26/16
LL: X PL: X PI: X Percent -200: X	**TERRACON** Exhibit B-16
REMARKS: Multistage Triaxial	

TRIAXIAL SHEAR TEST REPORT

DUNKELBERGER engineering & testing, inc. A Terracon COMPANY



TOTAL STRESS PARAMETERS	φ = 8.2 deg	c = 3.9 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	54.0	54.0	54.0	
Dry Density - pcf	68.6	68.6	68.6	
Diameter - inches	2.86	2.86	2.86	
Height - inches	5.69	5.69	5.69	
AT TEST				
Final Moisture - %			42.9	
Dry Density - pcf	69.6	72.3	77.6	
Calculated Diameter (in.)	2.83	2.85	2.83	
Height - inches	5.60	5.66	5.61	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.27	15.93	22.35	
Total Pore Pressure - psi	57.3	63.6	73.3	
Strain Rate - inches/min.	0.00060	0.00060	0.00060	
Failure Strain - %	2.1	4.8	4.9	
σ_1 Failure - psi	22.27	35.93	62.35	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

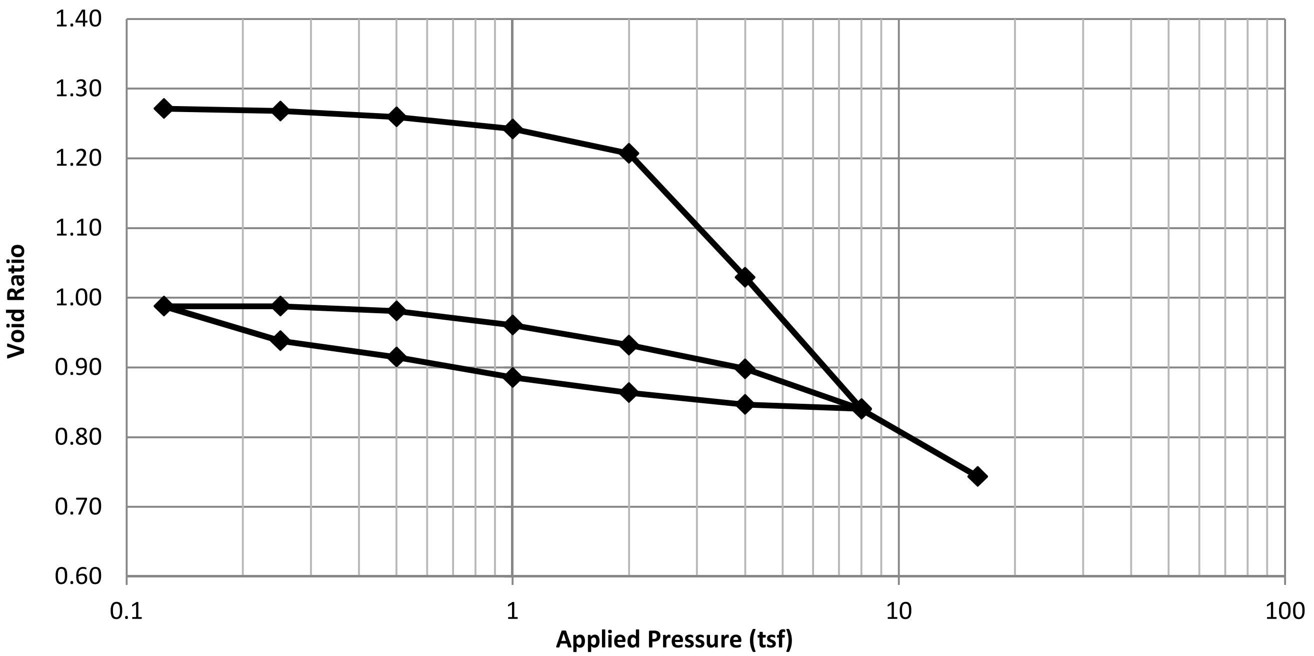
TYPE OF TEST & NO: CU with Pore Pressure
SAMPLE TYPE: Tube
DESCRIPTION: Grayish Brown Clay
SAMPLE LOCATION: B102 31.0-33.5 ft
ASSUMED SPECIFIC GRAVITY: 2.70
LL: X PL: X PI: X Percent -200: X
REMARKS: Multistage Triaxial

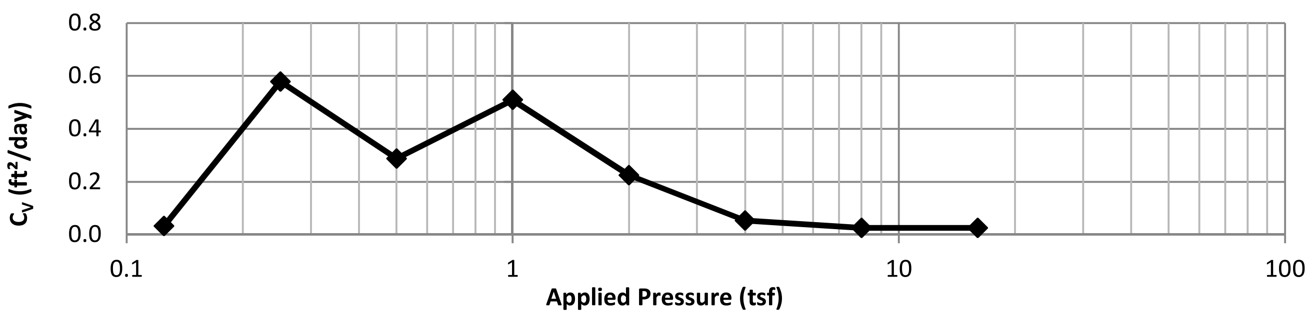
PROJECT INFORMATION

PROJECT: BV-24A DMMA
LOCATION: Grant-Valkaria, FL
PROJECT NO: HB155022
CLIENT: Taylor Engineering, Inc
DATE: 5/26/16

TERRACON | Exhibit B-17

CONSOLIDATION TEST REPORT





Boring	Sample Depth (feet)	Material Description	USCS
B-102	31 to 33.5	Dark gray clay	CL

LL	PI	SG (Assume)	Dry Density (pcf)		Moisture Content (%)		Void Ratio		P_C (ksf)	C_C	C_R	-200 (%)
			Initial	Final	Initial	Final	Initial	Final				
34.0	16.7	2.7	74.2	96.6	48.0	27.6	1.27	0.74	4.0	0.47	0.08	85.0

Project	Project Number	Client
BV-24A DMMA Brevard County, Florida	HB155022	Taylor Engineering

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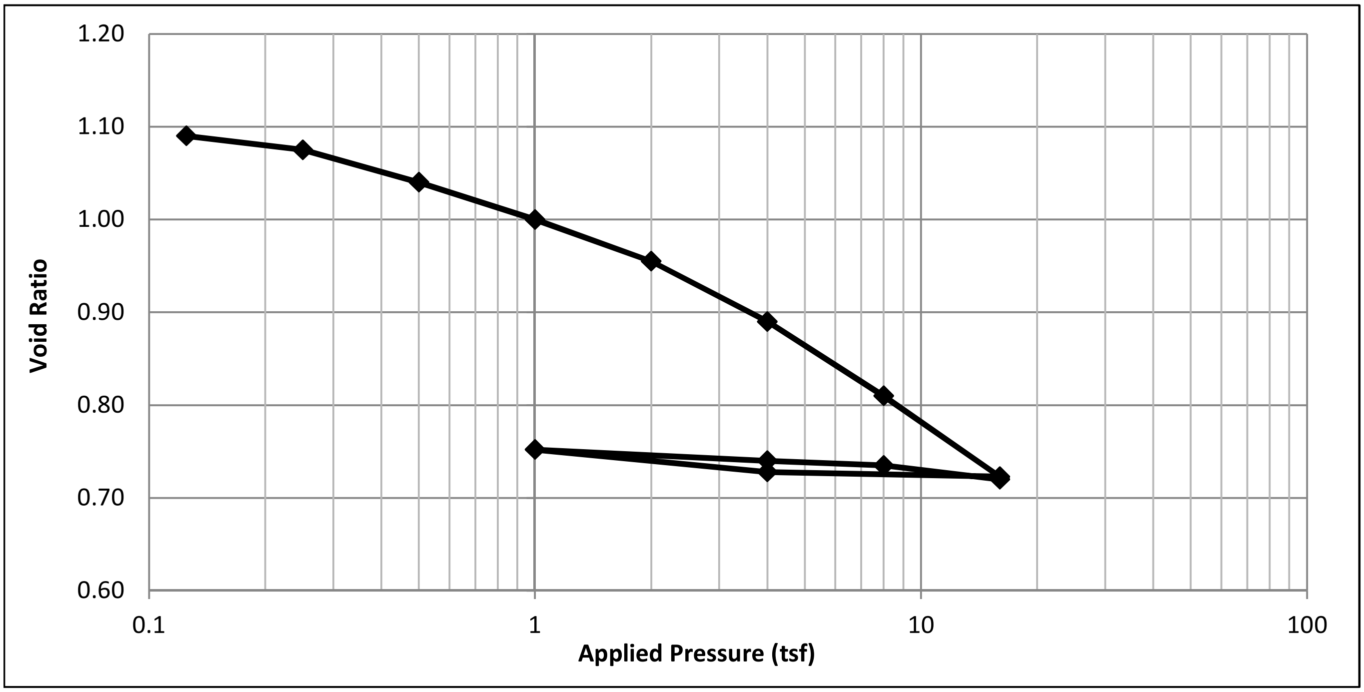
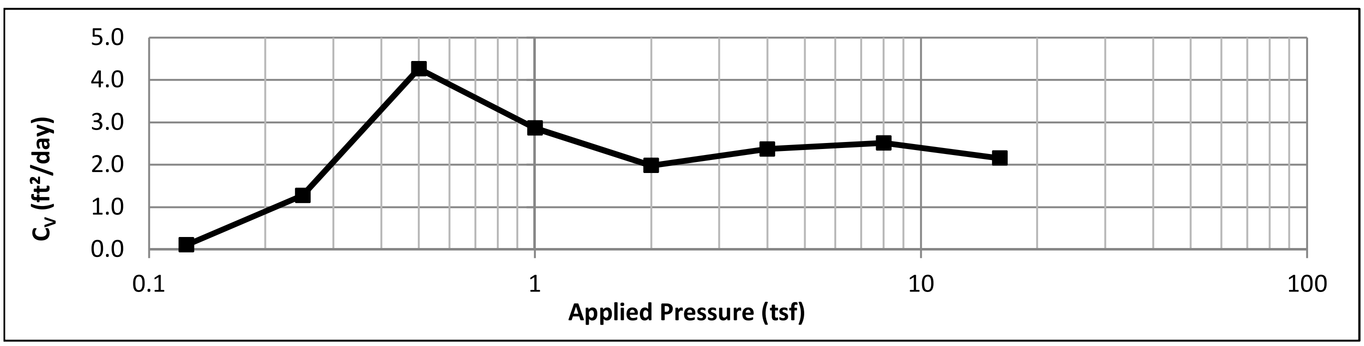
Exhibit B-18

CONSOLIDATION TEST REPORT





Boring	Sample Depth (feet)	Material Description	USCS
B-104	71 to 73.5	Light gray silt with traces of shell	ML

LL	PI	SG (Assume)	Dry Density (pcf)		Moisture Content (%)		Void Ratio		P_C (ksf)	C_C	C_R	-200 (%)
			Initial	Final	Initial	Final	Initial	Final				
38.0	11.0	2.7	80.9	98.0	39.5	29.9	1.10	0.72	3.0	0.29	0.03	87.2

Project	Project Number	Client
BV-24A DMMA Brevard County, Florida	HB155022	Taylor Engineering

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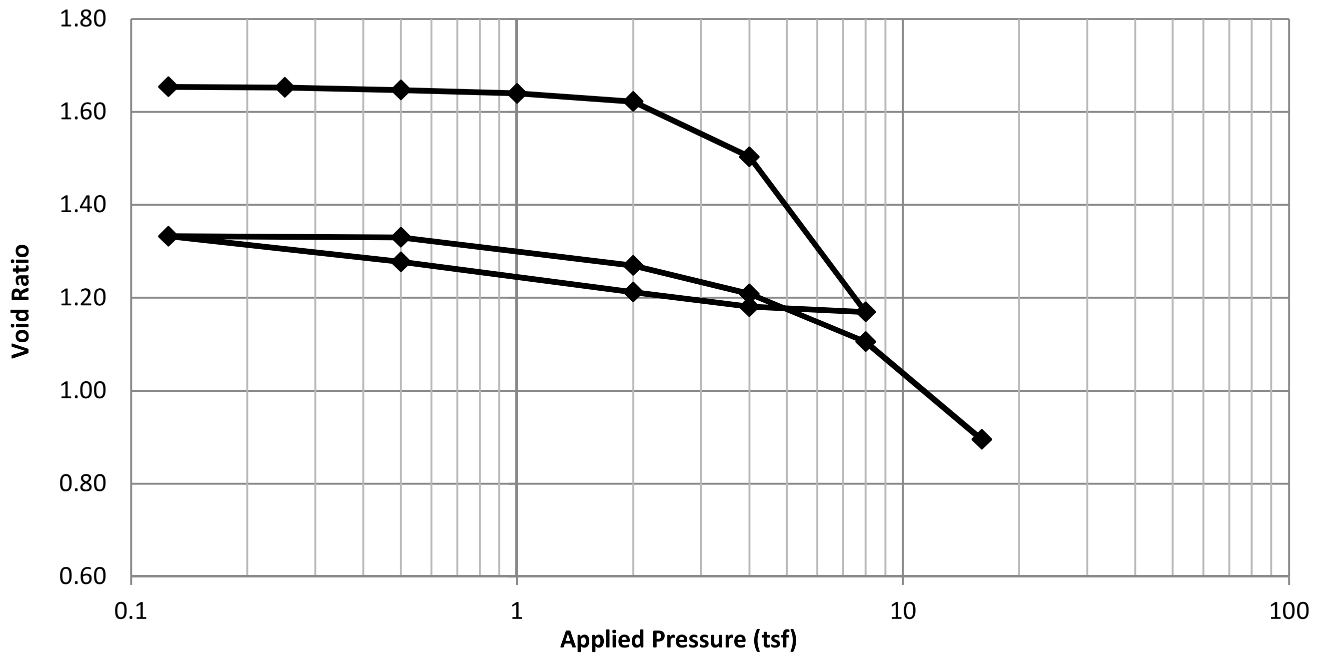
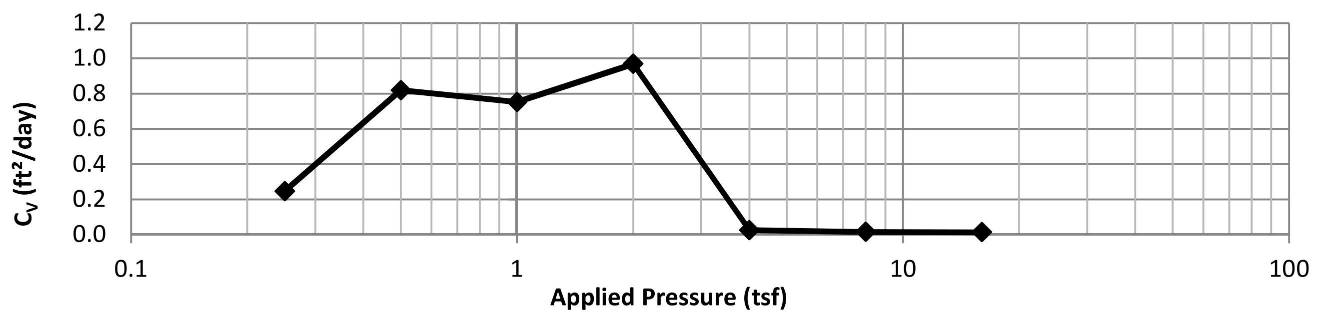
Exhibit B-19

CONSOLIDATION TEST REPORT





Boring	Sample Depth (feet)	Material Description	USCS
B-203	66 to 68.5	Dark gray clay	CH

LL	PI	SG (Assume)	Dry Density (pcf)		Moisture Content (%)		Void Ratio		P_C (ksf)	C_C	C_R	-200 (%)
			Initial	Final	Initial	Final	Initial	Final				
6.0	43.0	2.7	63.5	88.9	61.6	35.3	1.65	0.90	6.2	0.70	0.09	98.7

Project	Project Number	Client
BV-24A DMMA Brevard County, Florida	HB155022	Taylor Engineering

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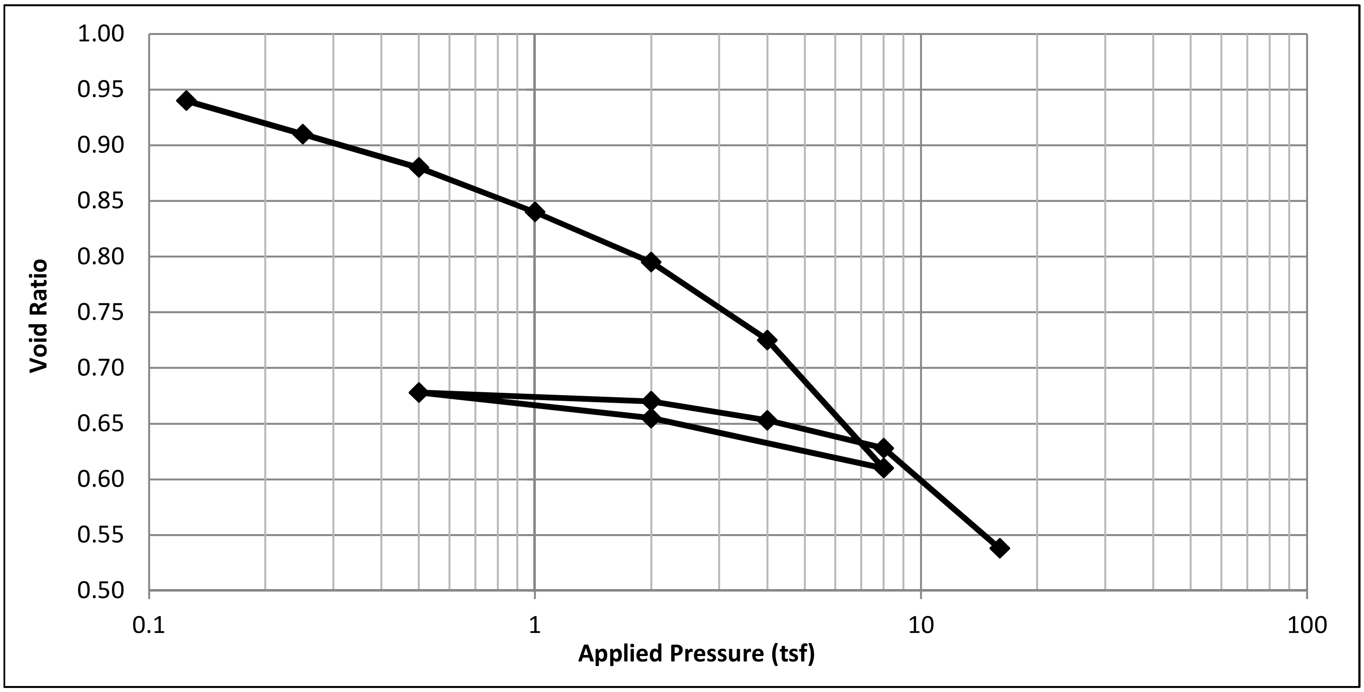
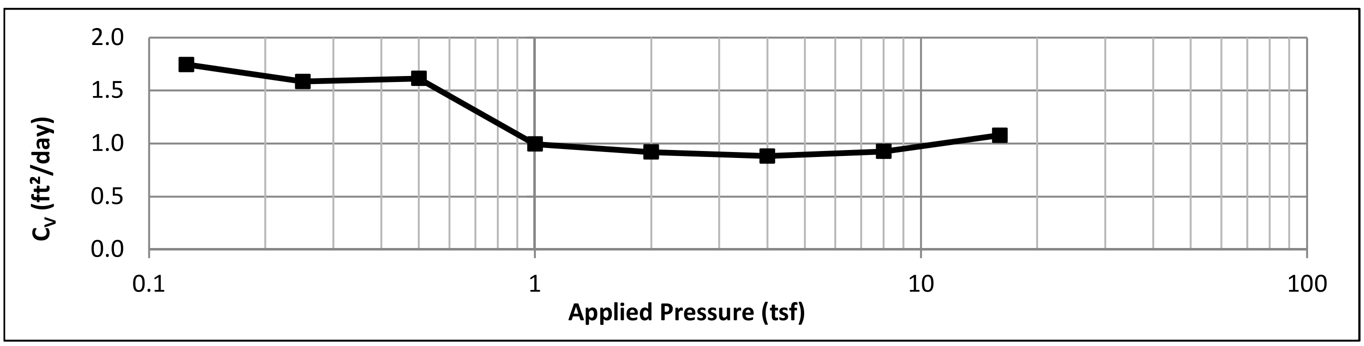
A Terracon COMPANY

Exhibit B-20

CONSOLIDATION TEST REPORT





Boring	Sample Depth (feet)	Material Description	USCS
B-206	56 - 58.5	Dark gray CLAY	CL

LL	PI	SG (Assume)	Dry Density (pcf)		Moisture Content (%)		Void Ratio		P_C (ksf)	C_C	C_R	-200 (%)
			Initial	Final	Initial	Final	Initial	Final				
43.0	23.0	2.7	86.5	109.4	27.7	26.1	0.96	0.54	4.2	0.31	0.04	82.4

Project	Project Number	Client
BV-24A DMMA Brevard County, Florida	HB155022	Taylor Engineering

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Exhibit B-21

APPENDIX C
DREDGED MATERIAL LABORATORY RESULTS

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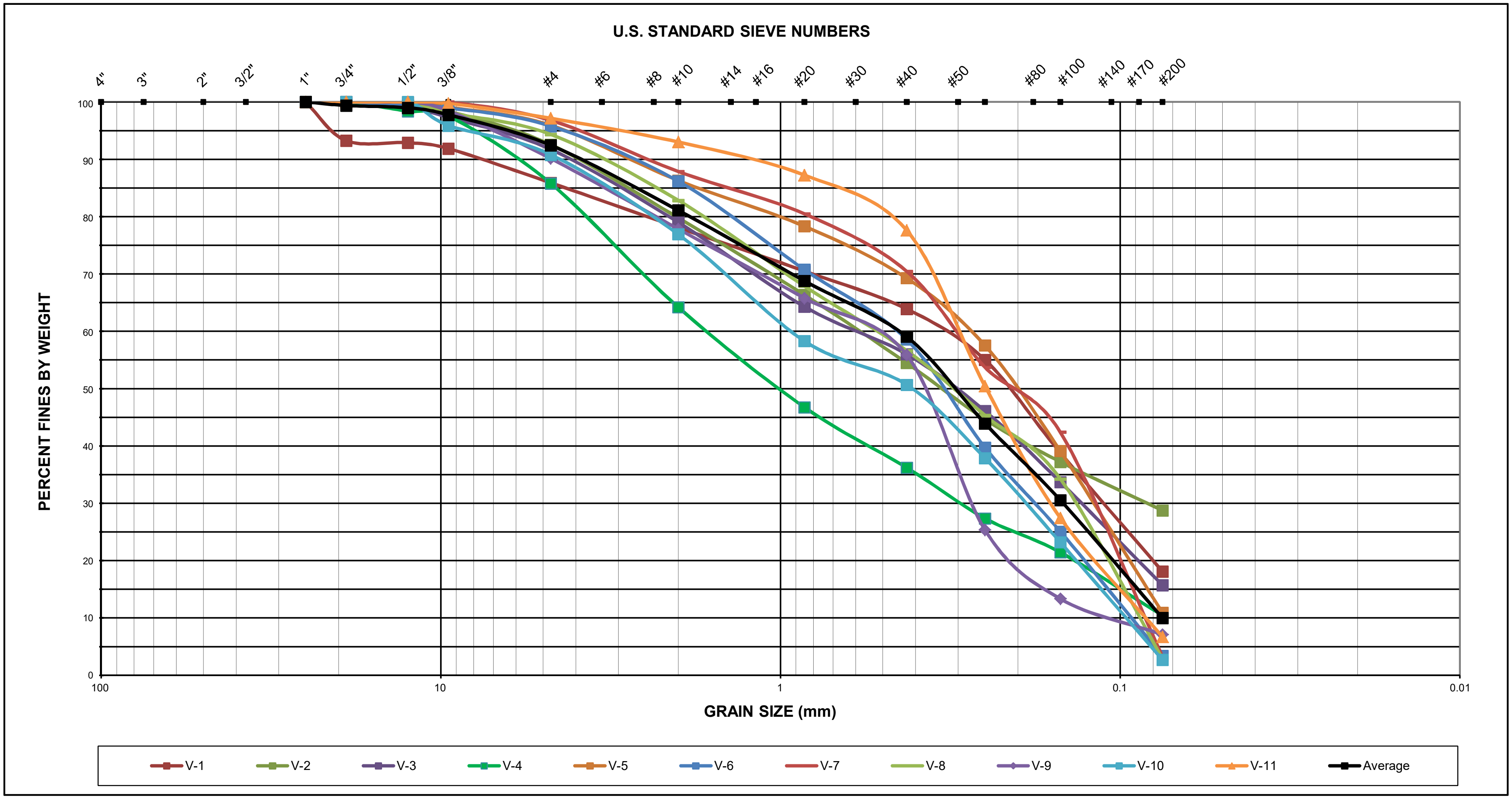
Particle Size Analysis of Soil



Boring Location	Depth (feet)	USCS Classification	Percent Passing Sieve										
			1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
V-1		SC	100.0	93.2	92.9	91.9	85.9	78.1	70.5	63.9	55.0	38.8	18.1
V-2		SC	100.0	100.0	99.0	98.4	92.6	79.8	66.4	54.5	44.6	37.2	28.8
V-3		SC	100.0	100.0	99.0	97.3	91.7	79.0	64.3	56.0	46.1	33.7	15.7
V-4		SP-SC	100.0	100.0	98.4	97.6	85.8	64.2	46.8	36.2	27.4	21.5	10.4
V-5		SP-SC	100.0	100.0	99.9	99.1	95.9	86.3	78.3	69.3	57.5	39.1	10.9
V-6		SP	100.0	100.0	99.5	99.0	95.8	86.2	70.7	58.6	39.7	25.1	3.4
V-7		SP	100.0	100.0	100.0	100.0	96.8	87.9	80.5	70.5	53.7	42.4	3.2
V-8		SP	100.0	100.0	100.0	98.1	94.3	82.8	67.9	56.6	45.3	34.3	2.9
V-9		SP-SC	100.0	100.0	100.0	98.5	90.1	77.8	65.8	55.9	25.4	13.3	7.1
V-10		SP	100.0	100.0	100.0	95.9	90.8	76.9	58.3	50.7	37.9	23.2	2.7
V-11		SP-SC	100.0	100.0	100.0	99.8	97.2	93.0	87.2	77.6	50.4	27.5	6.7
-			-	-	-	-	-	-	-	-	-	-	-
Average		SP-SC	100.0	99.4	99.0	97.8	92.5	81.1	68.8	59.1	43.9	30.6	10.0

Exhibit C-1

Influent Parameters:	Chloride Content:	94
	pH:	9.2

Sample ID V1

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
43055	4.8	33.9	1	13200	8.3
			2		
			3		
			4		
			5		
			6		
			Sum/Avg		
			Comp		

Pace Results:

SPLP Total Chl = 295 mg/L

Sample ID V2

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
8792	7.7	54.3	1	13200	6.3
43089	11.6	82.3	2	4320	9.0
			3		
			4		
			5		
			6		
			Sum/Avg		
			Comp		

Pace Results:

SPLP Total Chl = 183 mg/L

Sample ID V3

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
188	9.0	63.6	1	12000	7.7
2390	17.6	124.7	2	1440	9.4
13865	27.0	190.9	3	1440	9.7
36744	37.2	263.0	4	1200	10.0
			5	1440	10.4
			6		
			Sum/Avg	3504	9.4
			Comp		

Pace Results:

SPLP Total Chl = 311 mg/L

Sample ID V4

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
85	9.0	63.6	1	9600	8.7
269	18.0	127.2	2	1680	9.3
847	27.2	192.6	3	1200	9.7
1438	31.8	224.8	4	960	9.7
4634	45.0	318.1	5	1200	8.7
6061	48.6	343.5	6	960	9.5
			Sum/Avg	2600	9.3
			Comp	2400	9.4

Pace Results:

SPLP Total Chl = 162 mg/L

Sample ID V5

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
870	8.9	62.8	1	14400	8.9
11724	18.0	127.2	2	1440	7.8
35702	25.2	178.1	3	1440	9.8
			4	1680	9.3
			5	1920	8.8
			6	2160	9.4
			Sum/Avg	3840	9.0
			Comp	4320	9.4

Pace Results:

SPLP Total Chl = 175 mg/L

Sample ID V6

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
25	15.0	106.0	1	9600	8.9
29	18.6	131.5	2	1920	9.2
44	26.5	187.5	3	1680	9.1
66	35.6	251.9	4	2160	9.3
95	45.4	320.6	5	1680	9.2
130	51.8	366.4	6	1920	9.1
			Sum/Avg	3160	9.1
			Comp	3120	9.0

Pace Results:

SPLP Total Chl = 136 mg/L

"Comp" indicated a composite sample of all liquid exract passed through soil column.

Exhibit C-2

Influent Parameters:	Chloride Content:	94	
	pH:	9.2	

Sample ID **V7**

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
30	9.0	63.6	1	10800	8.1
59	17.9	126.4	2	2160	9.3
100	27.3	192.6	3	1920	9.1
144	36.0	254.5	4	1920	9.0
201	45.2	319.8	5	1920	9.0
269	53.6	379.2	6	1920	8.9
			Sum/Avg	3440	8.9
			Comp	3120	9.0

Pace Results:

SPLP Total Chl = 252 mg/L

Sample ID **V8**

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
16	9.0	63.6	1	14400	8.1
39	17.9	126.4	2	1920	8.7
70	26.8	189.2	3	1200	8.7
111	35.9	253.6	4	1200	8.7
157	45.3	319.8	5	1200	8.5
205	53.6	379.2	6	1200	8.8
			Sum/Avg	3520	8.6
			Comp	2880	8.7

Pace Results:

SPLP Total Chl = 253 mg/L

Sample ID **V9**

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
35	9.0	63.6	1	18000	8.2
100	17.9	126.4	2	3600	8.8
347	25.1	177.3	3	1200	9.2
1660	34.3	242.6	4	1200	9.4
10366	44.8	316.4	5	1200	9.3
21744	52.1	368.1	6	960	9.8
			Sum/Avg	4360	9.1
			Comp	2640	9.4

Pace Results:

SPLP Total Chl = 252 mg/L

Sample ID **V10**

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
21	9.0	63.6	1	8880	7.9
37	17.5	123.8	2	1440	8.4
66	27.0	190.9	3	960	9.2
97	36.0	254.5	4	960	9.3
135	45.4	320.6	5	960	8.8
182	52.1	368.1	6	1200	9.0
			Sum/Avg	2400	8.8
			Comp	3120	7.3

Pace Results:

SPLP Total Chl = 250 mg/L

Sample ID **V11**

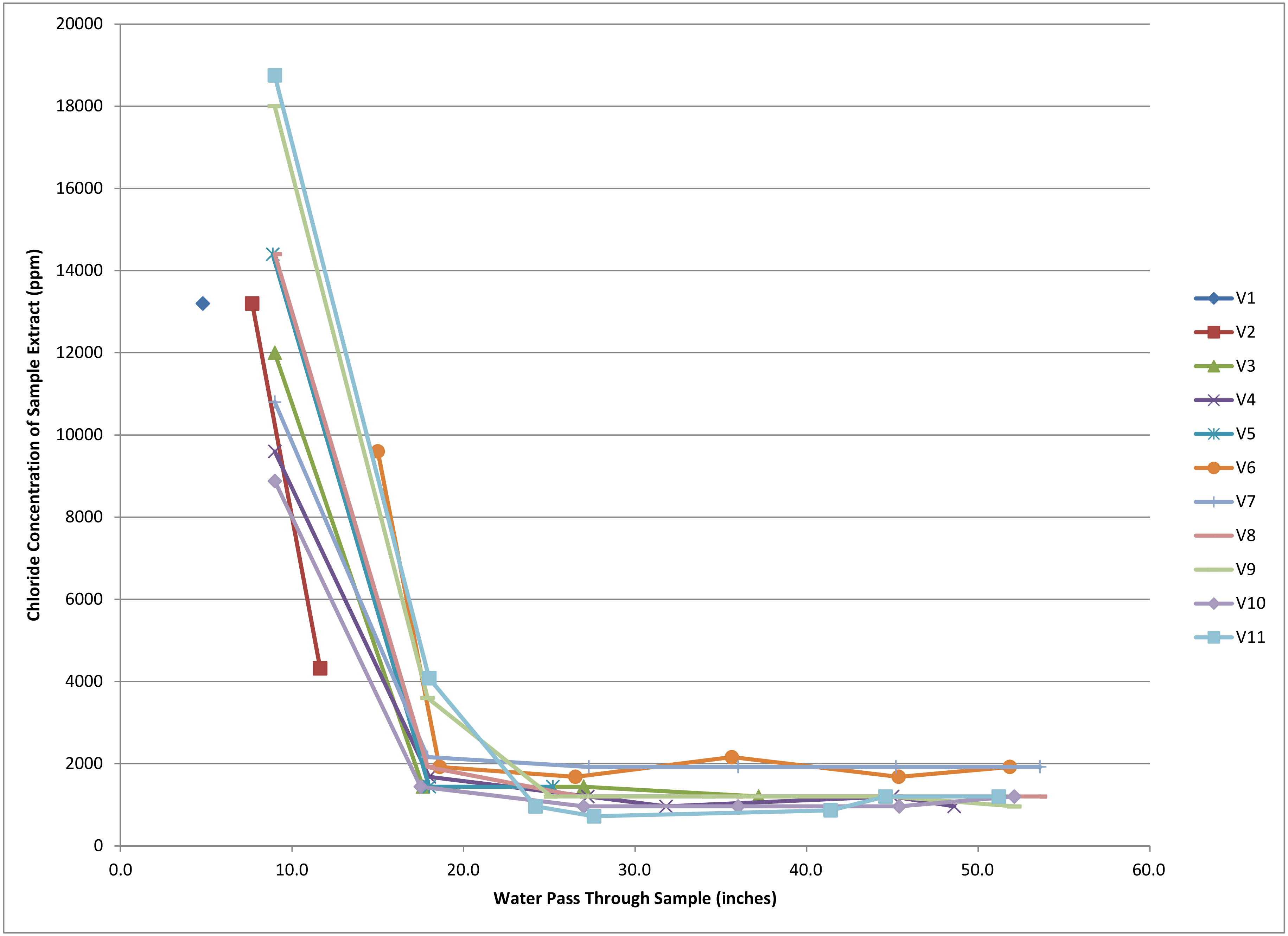
Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
48	9.0	63.6	1	18750	7.1
211	18.0	127.2	2	4080	7.5
471	24.2	171.3	3	960	8.5
680	27.6	195.1	4	720	8.7
7239	41.4	292.6	5	864	9.2
10071	44.6	315.5	6	1200	8.8
22764	51.2	362.2	7	1200	8.8
			Sum/Avg	3968	8.4
			Comp	2400	9.3

Pace Results:

SPLP Total Chl = 305 mg/L

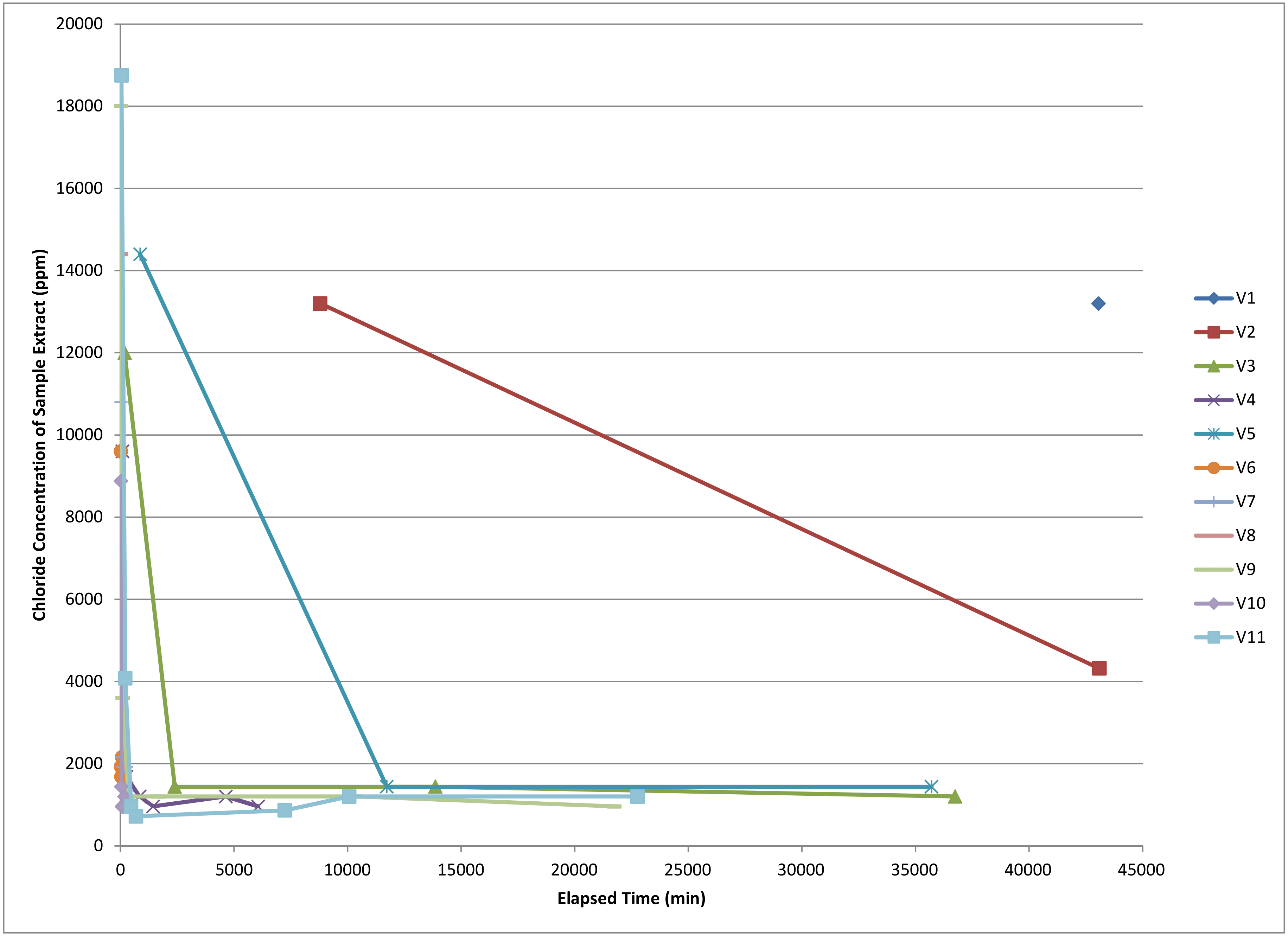
"Comp" indicated a composite sample of all liquid exract passed through soil column.

Exhibit C-3



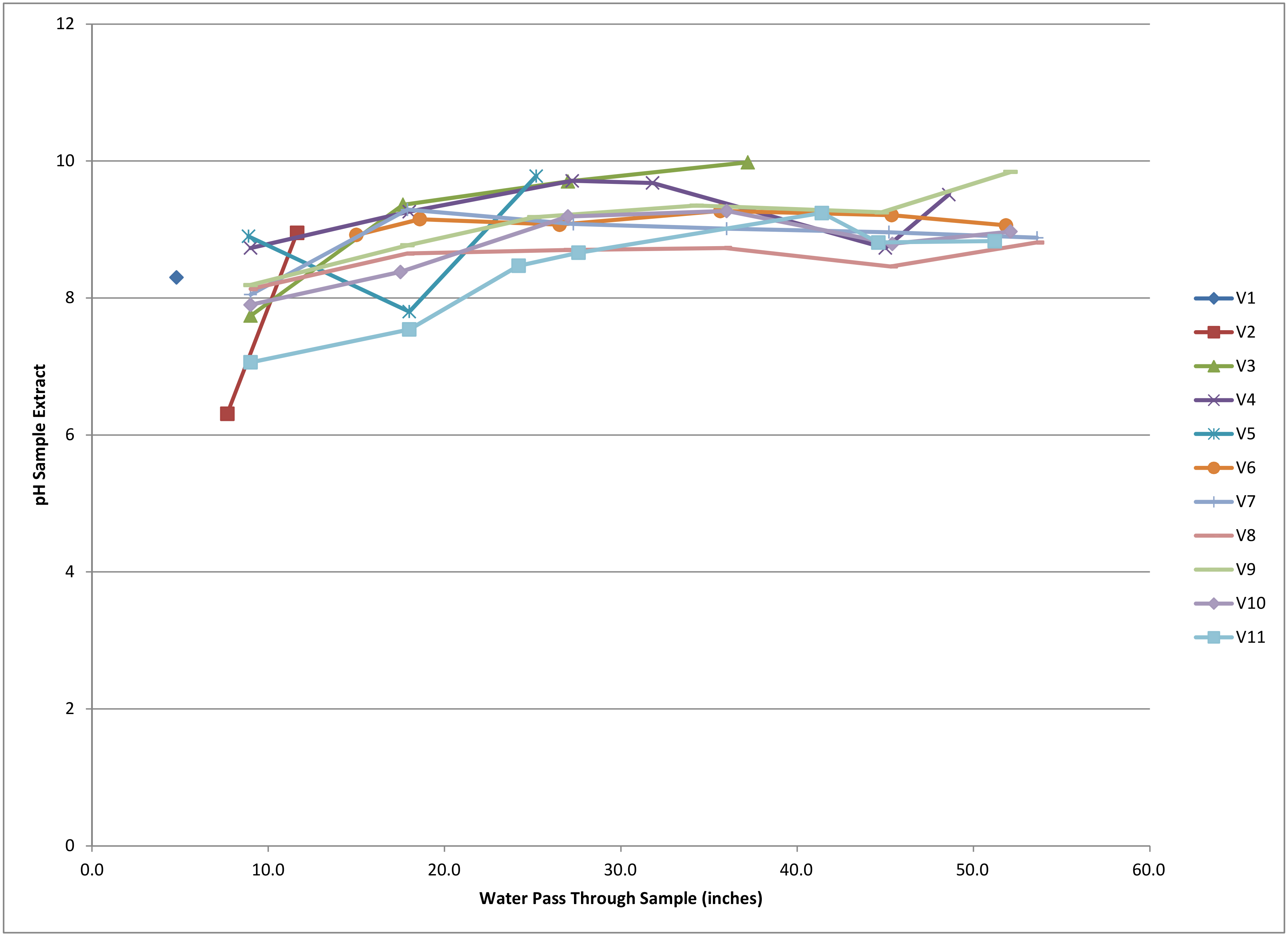
DUNKELBERGER engineering & testing, inc. A Terracon COMPANY

Exhibit C-4



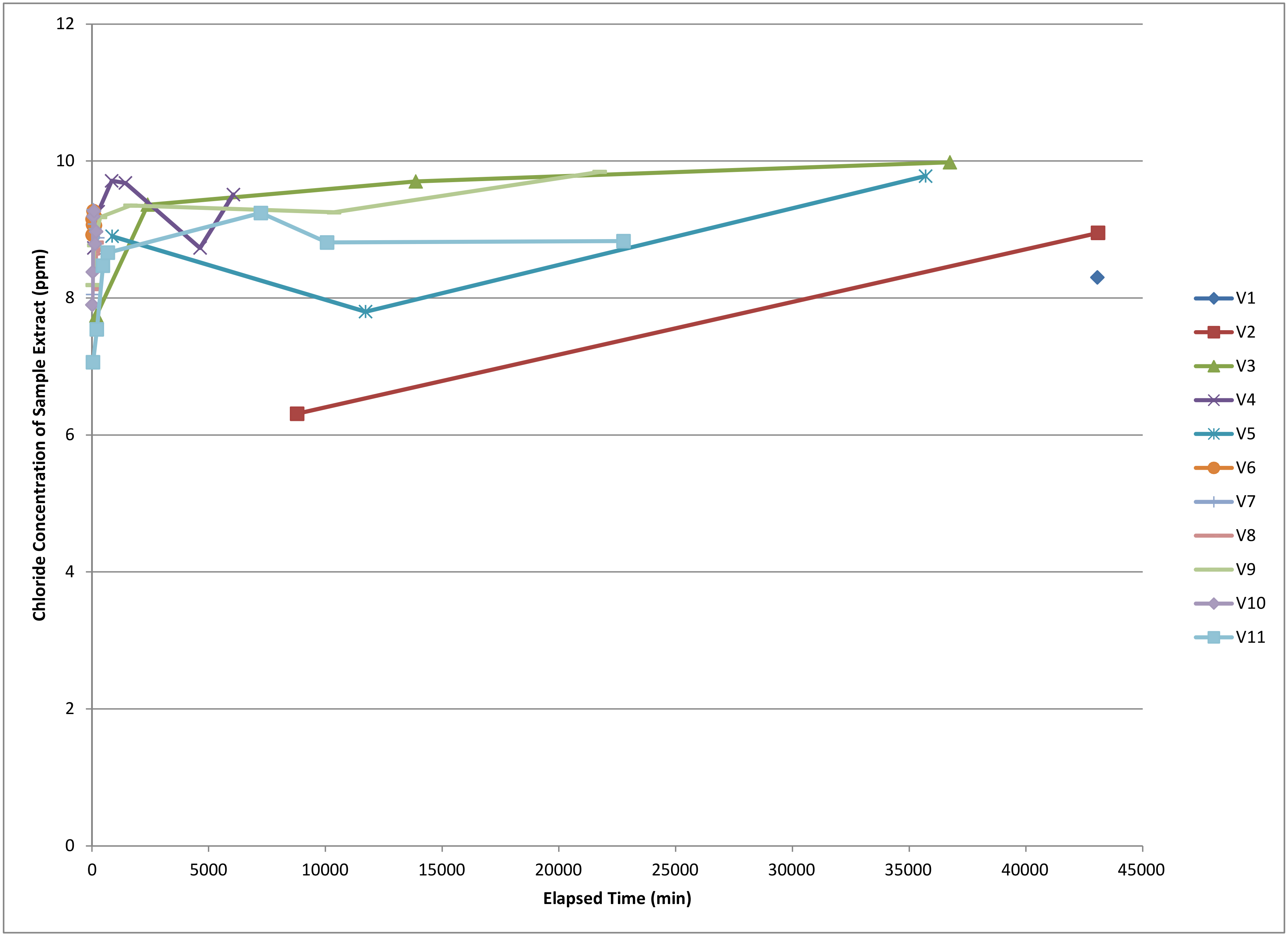
DUNKELBERGER
engineering & testing, inc.
A Terracon COMPANY

Exhibit C-5



DUNKELBERGER
engineering & testing, inc.
A Terracon COMPANY

Exhibit C-6



DUNKELBERGER
engineering & testing, inc.
A Terracon COMPANY

Exhibit C-7

APPENDIX D
GROUNDWATER MODELING – CALIBRATION RUNS

N

Legend:

Model Predicted Groundwater Elevation Contour (ft NAVD) for 2/26/2016 - Layer 1

DMMA Boundary

Property Boundary

0 1,000 2,000 Feet

1 inch = 1,000 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/05/16	ENGINEER:NA	GROUNDWATER MODELING **BV-24A** BREVARD COUNTY, FL
	PN:GPGW-16-013	DRAWN BY: DLS	GROUNDWATER MODEL CALIBRATION EXHIBIT D-1

N

Legend:

Model Predicted Groundwater Elevation Contour (ft NAVD) for 2/26/2016 - Layer 2

DMMA Boundary

Property Boundary

0 1,000 2,000 Feet

1 inch = 1,000 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/05/16	ENGINEER:NA	GROUNDWATER MODELING BV-24A BREVARD COUNTY, FL
	PN:GPGW-16-013	DRAWN BY: DLS	GROUNDWATER MODEL CALIBRATION EXHIBIT D-2

Legend:

Model Predicted Groundwater Elevation Contour (ft NAVD) for 2/26/2016 - Layer 3

DMMA Boundary

Property Boundary

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/05/16	ENGINEER:NA	GROUNDWATER MODELING **BV-24A** BREVARD COUNTY, FL
	PN:GPGW-16-013	DRAWN BY: DLS	GROUNDWATER MODEL CALIBRATION EXHIBIT D-3

Legend:

Model Predicted Groundwater Elevation Contour (ft NAVD) for 2/26/2016 - Layer 4

DMMA Boundary

Property Boundary

N

0 1,000 2,000 Feet

1 inch = 1,000 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/05/16	ENGINEER:NA	GROUNDWATER MODELING BV-24A BREVARD COUNTY, FL
	PN:GPGW-16-013	DRAWN BY: DLS	GROUNDWATER MODEL CALIBRATION
			EXHIBIT D-4

N

Legend:

Model Predicted Groundwater Elevation Contour (ft NAVD) for 4/12/2016 - Layer 1

DMMA Boundary

Property Boundary

0 1,000 2,000 Feet

1 inch = 1,000 feet

ANDREYEV ENGINEERING, INC.

GROUNDWATER MODELING

BV-24A

BREVARD COUNTY, FL

GROUNDWATER MODEL CALIBRATION

APPROXIMATE SCALE: AS SHOWN	DATE: 05/05/16	ENGINEER:NA	
	PN:GPGW-16-013	DRAWN BY: DLS	EXHIBIT D-5

N

Legend:

Model Predicted Groundwater Elevation Contour (ft NAVD) for 4/12/2016 - Layer 2

DMMA Boundary

Property Boundary

0 1,000 2,000 Feet

1 inch = 1,000 feet

ANDREYEV ENGINEERING, INC.

GROUNDWATER MODELING

BV-24A

BREVARD COUNTY, FL

GROUNDWATER MODEL CALIBRATION

APPROXIMATE SCALE: AS SHOWN	DATE: 05/05/16	ENGINEER:NA	
	PN:GPGW-16-013	DRAWN BY: DLS	EXHIBIT D-6

N

Legend:

Model Predicted Groundwater Elevation Contour (ft NAVD) for 4/12/2016 - Layer 3

DMMA Boundary

Property Boundary

0 1,000 2,000 Feet

1 inch = 1,000 feet

ANDREYEV ENGINEERING, INC.

GROUNDWATER MODELING

BV-24A

BREVARD COUNTY, FL

GROUNDWATER MODEL CALIBRATION

APPROXIMATE SCALE: AS SHOWN	DATE: 05/05/16	ENGINEER:NA	EXHIBIT D-7
	PN:GPGW-16-013	DRAWN BY: DLS	

Legend:

Model Predicted Groundwater Elevation Contour (ft NAVD) for 4/12/2016 - Layer 4

DMMA Boundary

Property Boundary

ANDREYEV ENGINEERING, INC.

GROUNDWATER MODELING

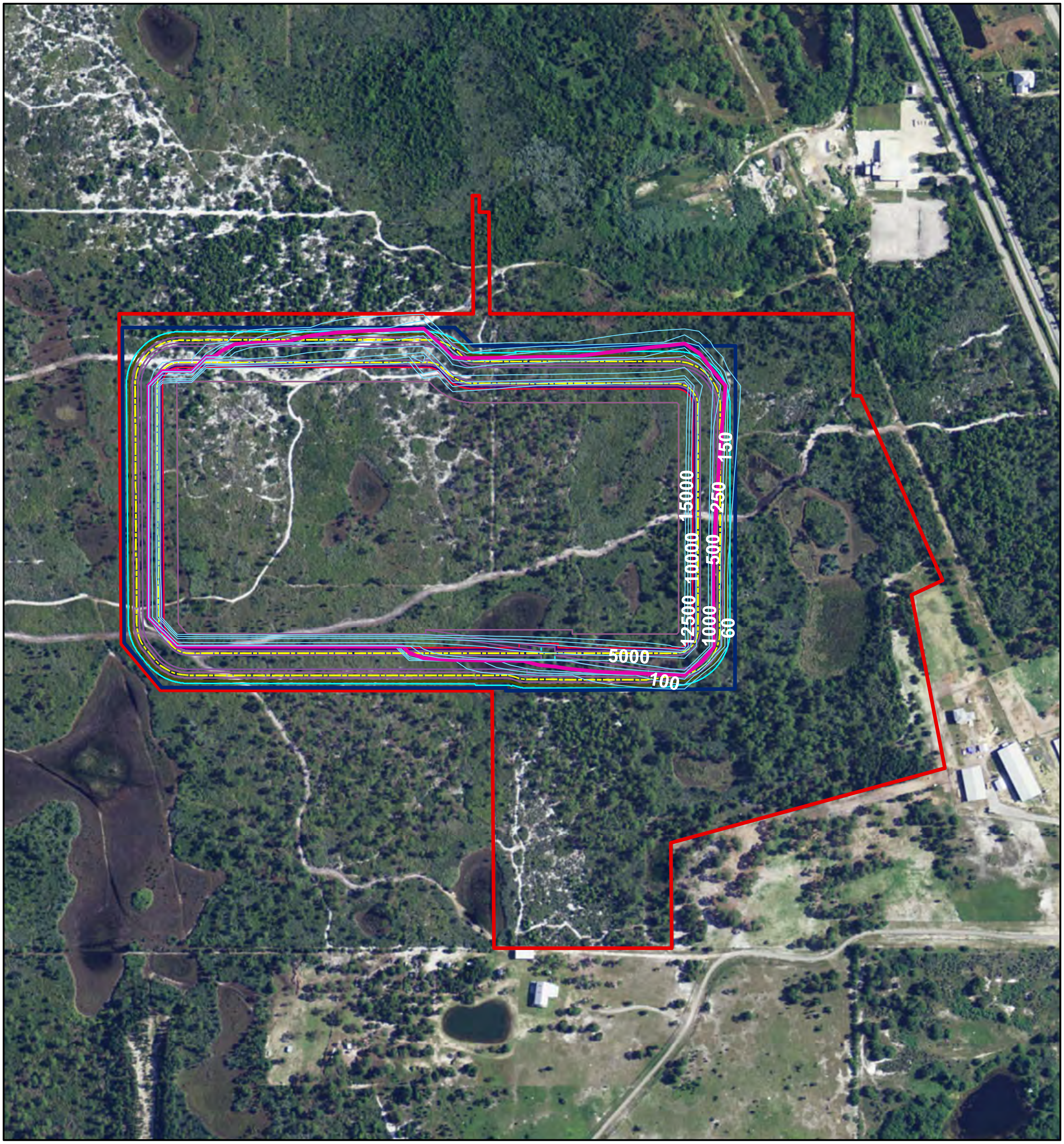
BV-24A

BREVARD COUNTY, FL

GROUNDWATER MODEL CALIBRATION

APPROXIMATE SCALE: AS SHOWN	DATE: 05/05/16	ENGINEER:NA	
	PN:GPGW-16-013	DRAWN BY: DLS	EXHIBIT D-8

APPENDIX E
GROUNDWATER MODELING – WITHOUT CONTROLS



N

Legend:

Concentrations at the end of 28-days of dredge loading - Layer 1

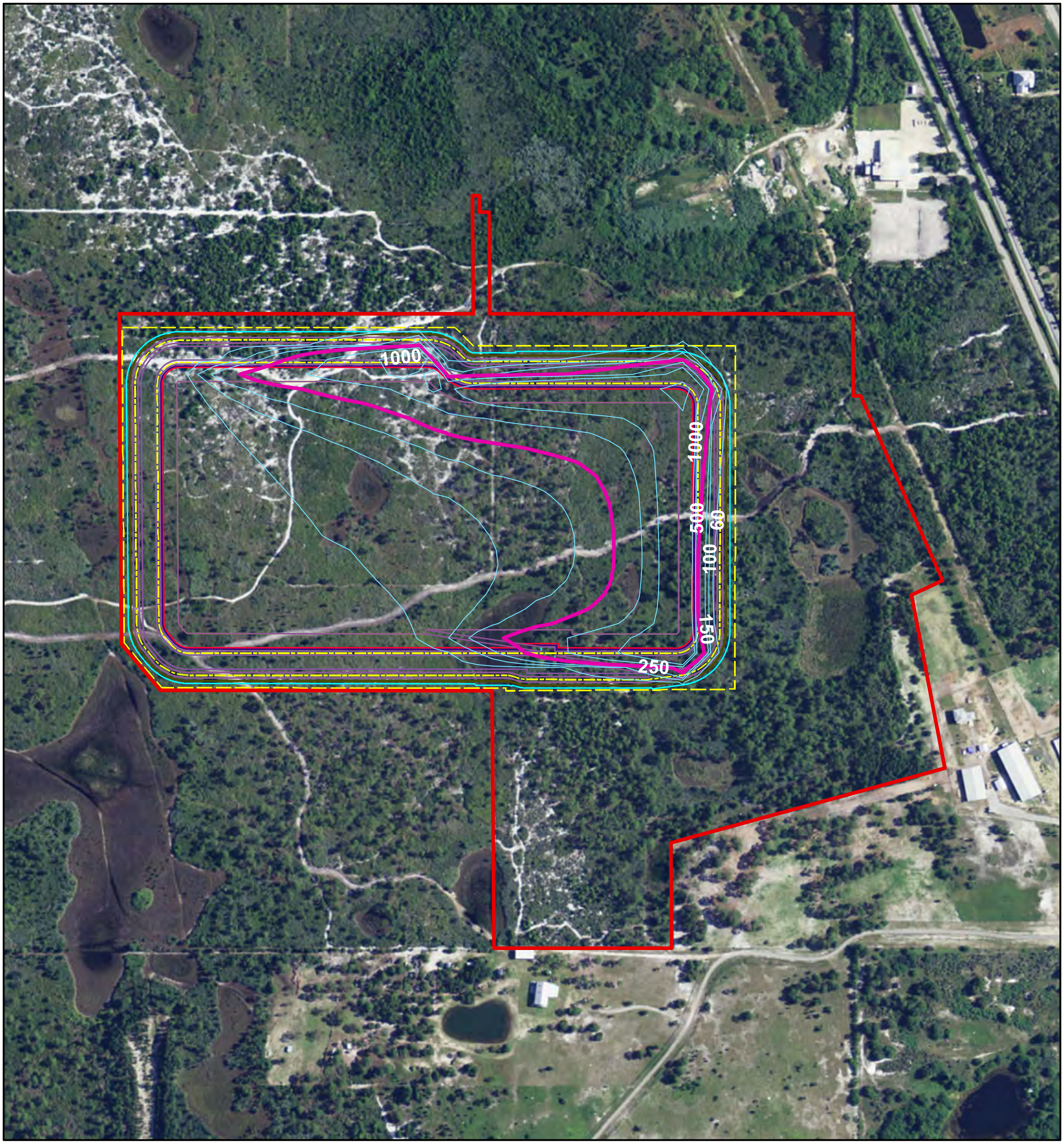
DMMA Boundary

Property Boundary

0 500 1,000 Feet

1 inch = 500 feet

ANDREYEV ENGINEERING, INC.			GROUNDWATER MODELING BV-24A BREVARD COUNTY, FL
APPROXIMATE SCALE:	DATE: 05/25/16	ENGINEER:NA	FIRST DREDGE LOADING & RESTING (0-10 YRS)
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS	EXHIBIT E-1



Legend:

Concentrations at the end of 28-days of dredge loading - Layer 2

DMMA Boundary

Property Boundary

N

0 500 1,000 Feet

1 inch = 500 feet

ANDREYEV ENGINEERING, INC.

GROUNDWATER MODELING

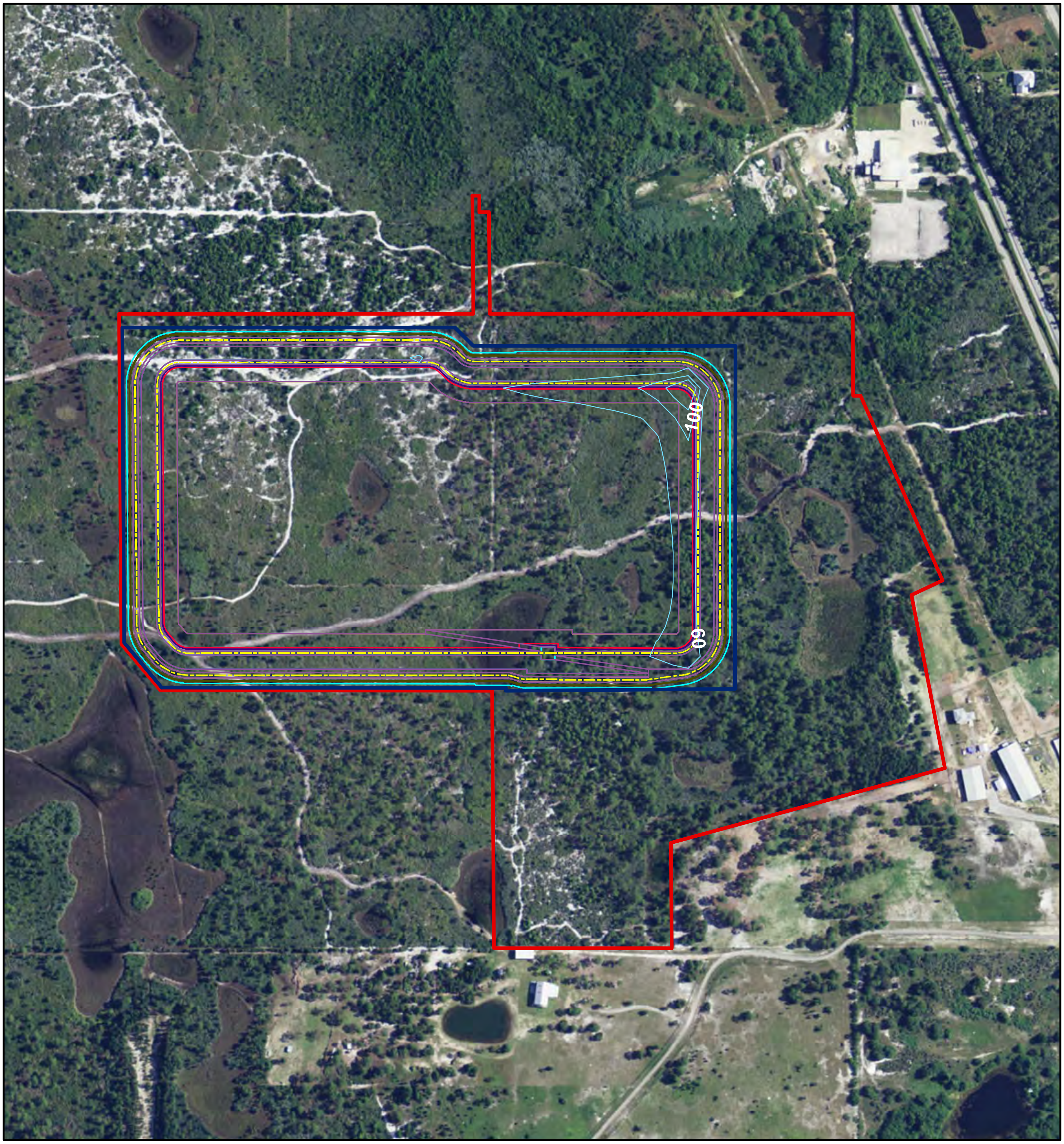
BV-24A

BREVARD COUNTY, FL

FIRST DREDGE LOADING & RESTING (0-10 YRS)

EXHIBIT E-2

APPROXIMATE SCALE:	DATE: 05/25/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS



N

Legend:

Concentrations at the end of 28-days of dredge loading - Layer 3

DMMA Boundary

Property Boundary

0 500 1,000 Feet

1 inch = 500 feet

ANDREYEV ENGINEERING, INC.

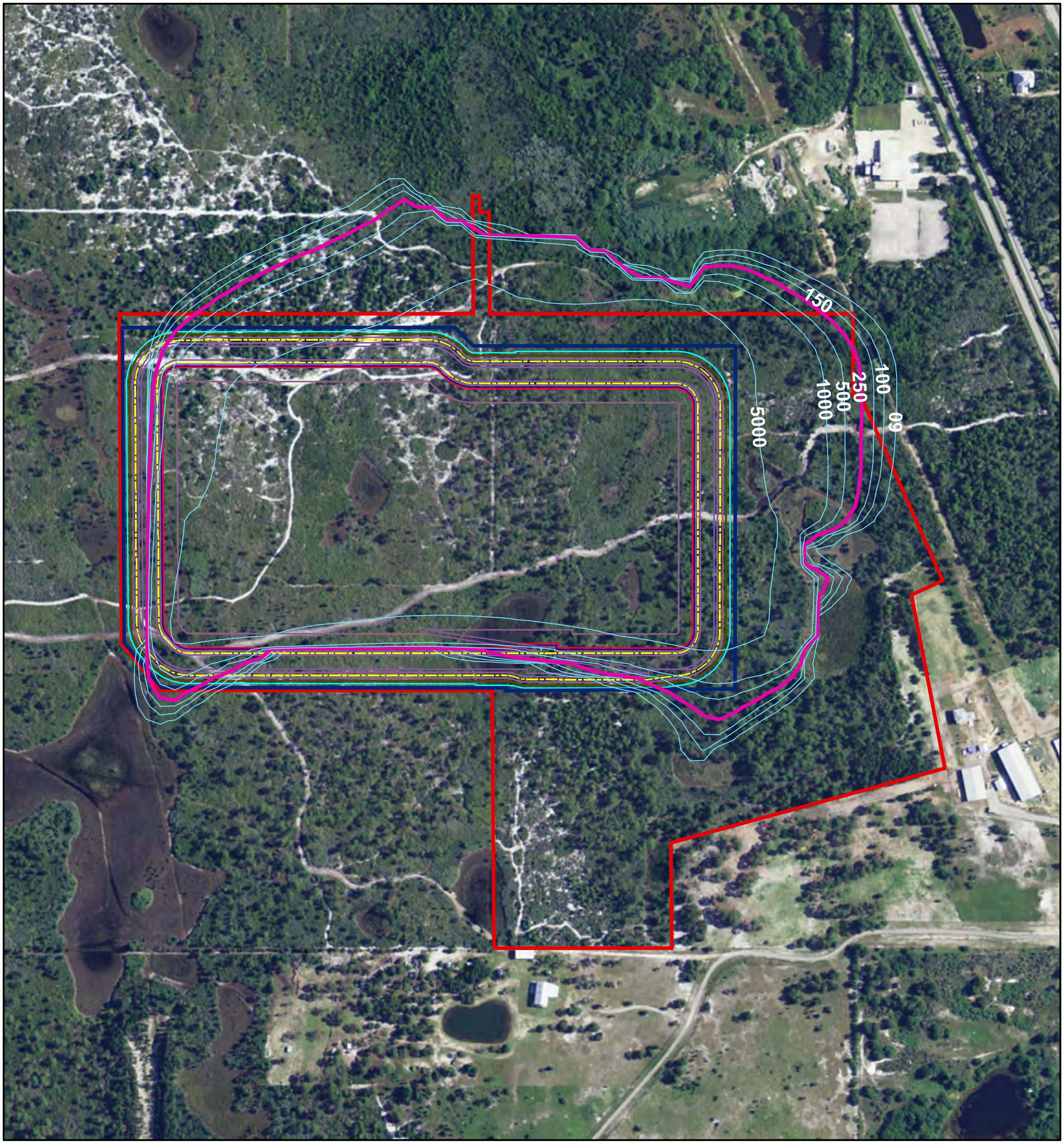
GROUNDWATER MODELING

BV-24A

BREVARD COUNTY, FL

FIRST DREDGE LOADING & RESTING (0-10 YRS)

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA	EXHIBIT E-3
	PN:GPGW-16-013	DRAWN BY: DLS	



N

Legend:

Concentrations at the end of 10-year resting - Layer 1

DMMA Boundary

Property Boundary

0 500 1,000 Feet

1 inch = 500 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA
	PN:GPGW-16-013	DRAWN BY: DLS

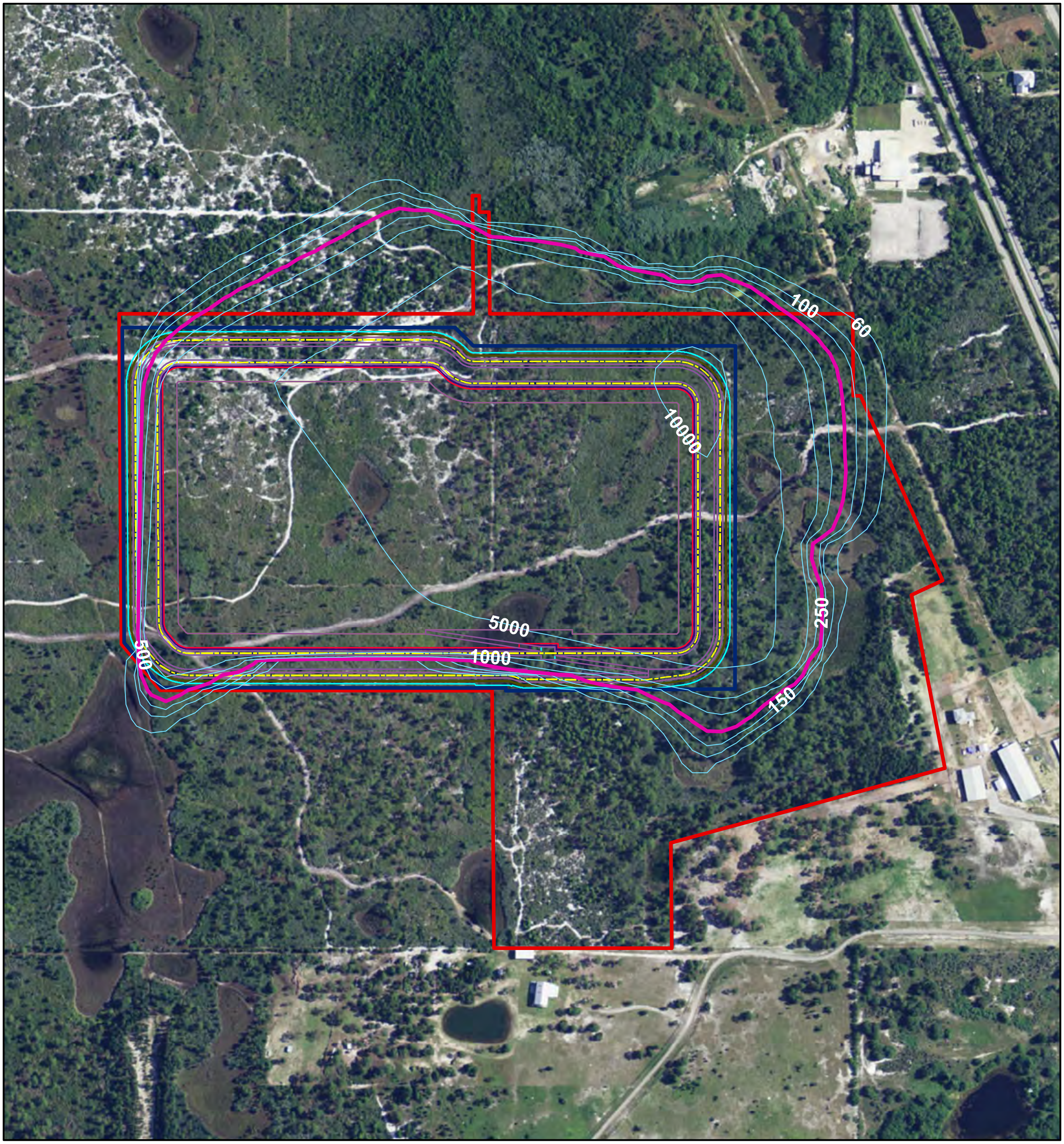
GROUNDWATER MODELING

BV-24A

BREVARD COUNTY, FL

FIRST DREDGE LOADING & RESTING (0-10 YRS)

EXHIBIT E-4



N

Legend:

Concentrations at the end of 10-year resting - Layer 2

DMMA Boundary

Property Boundary

0 500 1,000 Feet

1 inch = 500 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA
	PN:GPGW-16-013	DRAWN BY: DLS

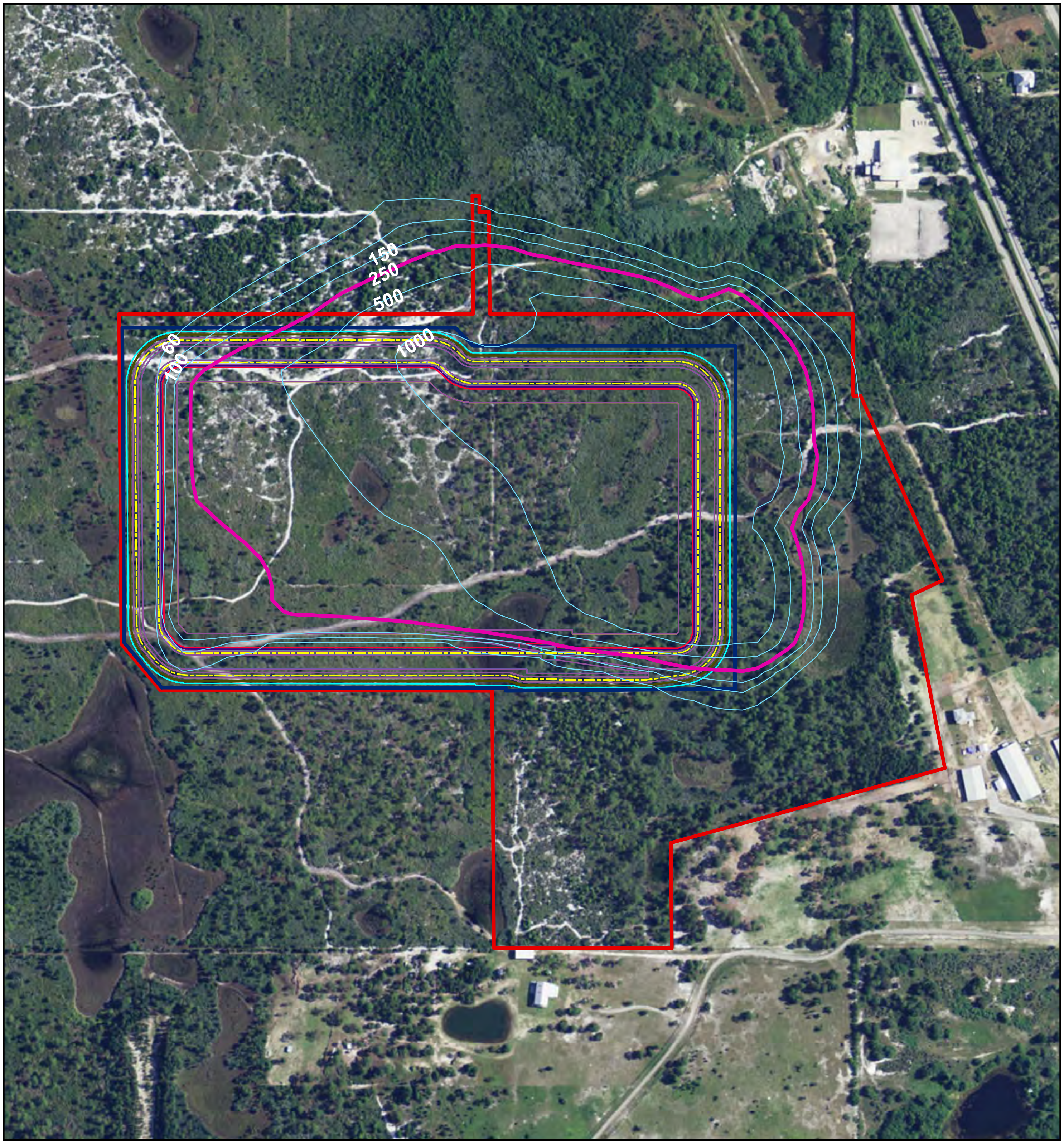
GROUNDWATER MODELING

BV-24A

BREVARD COUNTY, FL

FIRST DREDGE LOADING & RESTING (0-10 YRS)

EXHIBIT E-5



N

Legend:

Concentrations at the end of 10-year resting - Layer 3

DMMA Boundary

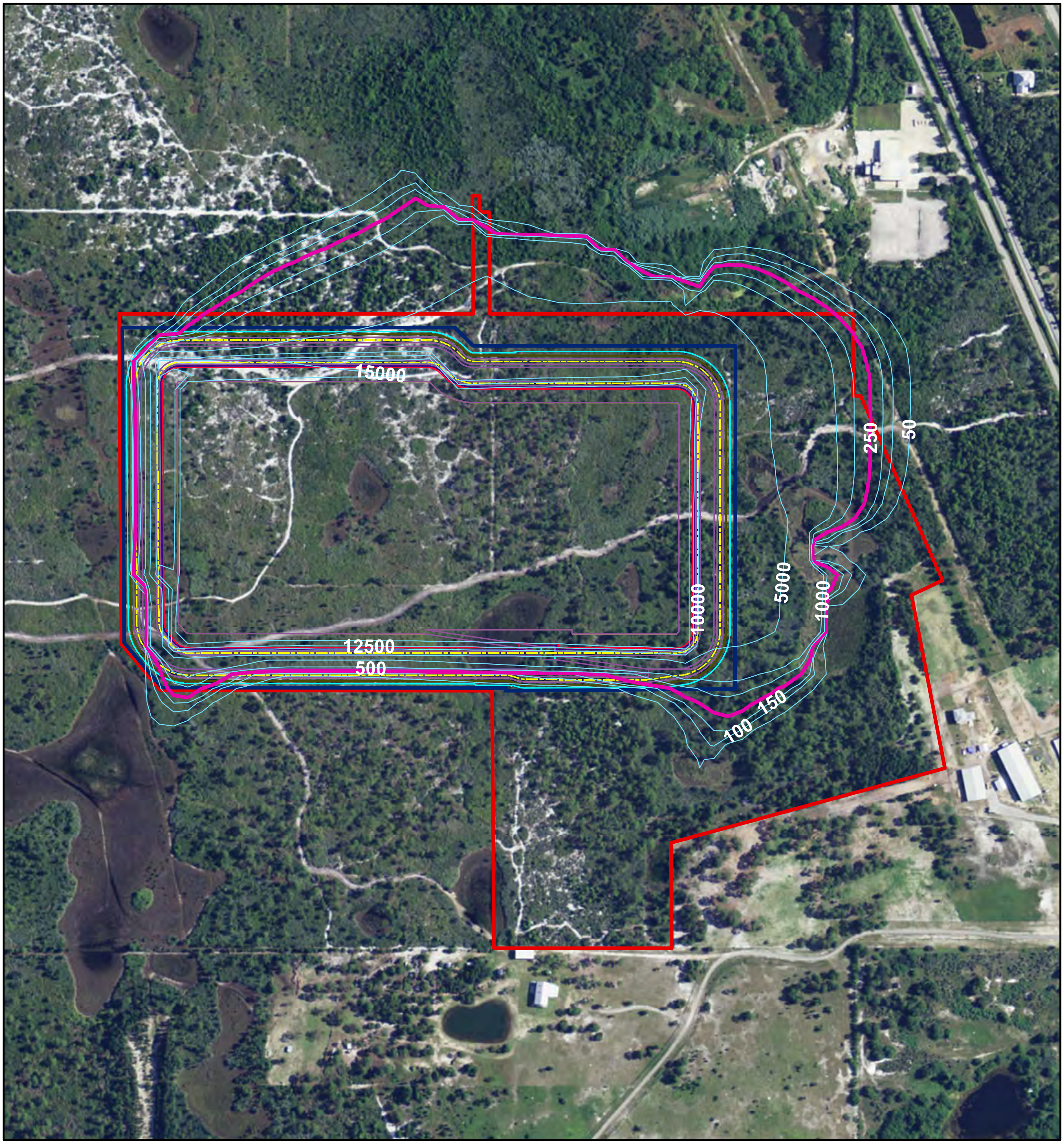
Property Boundary

0 500 1,000 Feet

1 inch = 500 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA	GROUNDWATER MODELING BV-24A BREVARD COUNTY, FL FIRST DREDGE LOADING & RESTING (0-10 YRS)
	PN:GPGW-16-013	DRAWN BY: DLS	EXHIBIT E-6



N

Legend:

Concentrations at the end of 28-days of dredge loading - Layer 1

DMMA Boundary

Property Boundary

0 500 1,000 Feet

1 inch = 500 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE:	DATE: 05/25/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

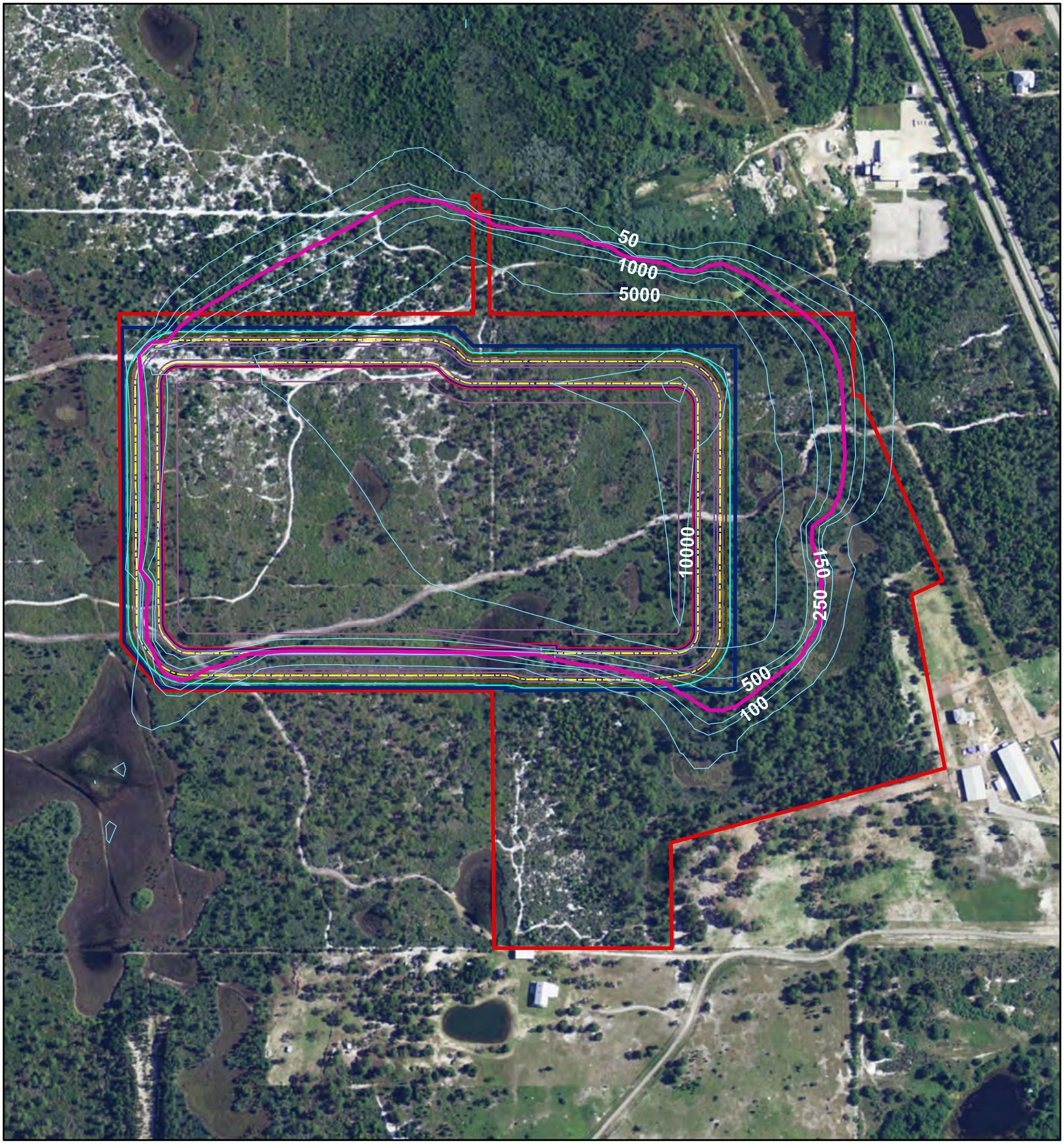
GROUNDWATER MODELING

BV-24A

BREVARD COUNTY, FL

SECOND DREDGE LOADING & RESTING (10-20 YRS)

EXHIBIT E-7



N

Legend:

Concentrations at the end of 28-days of dredge loading - Layer 2

DMMA Boundary

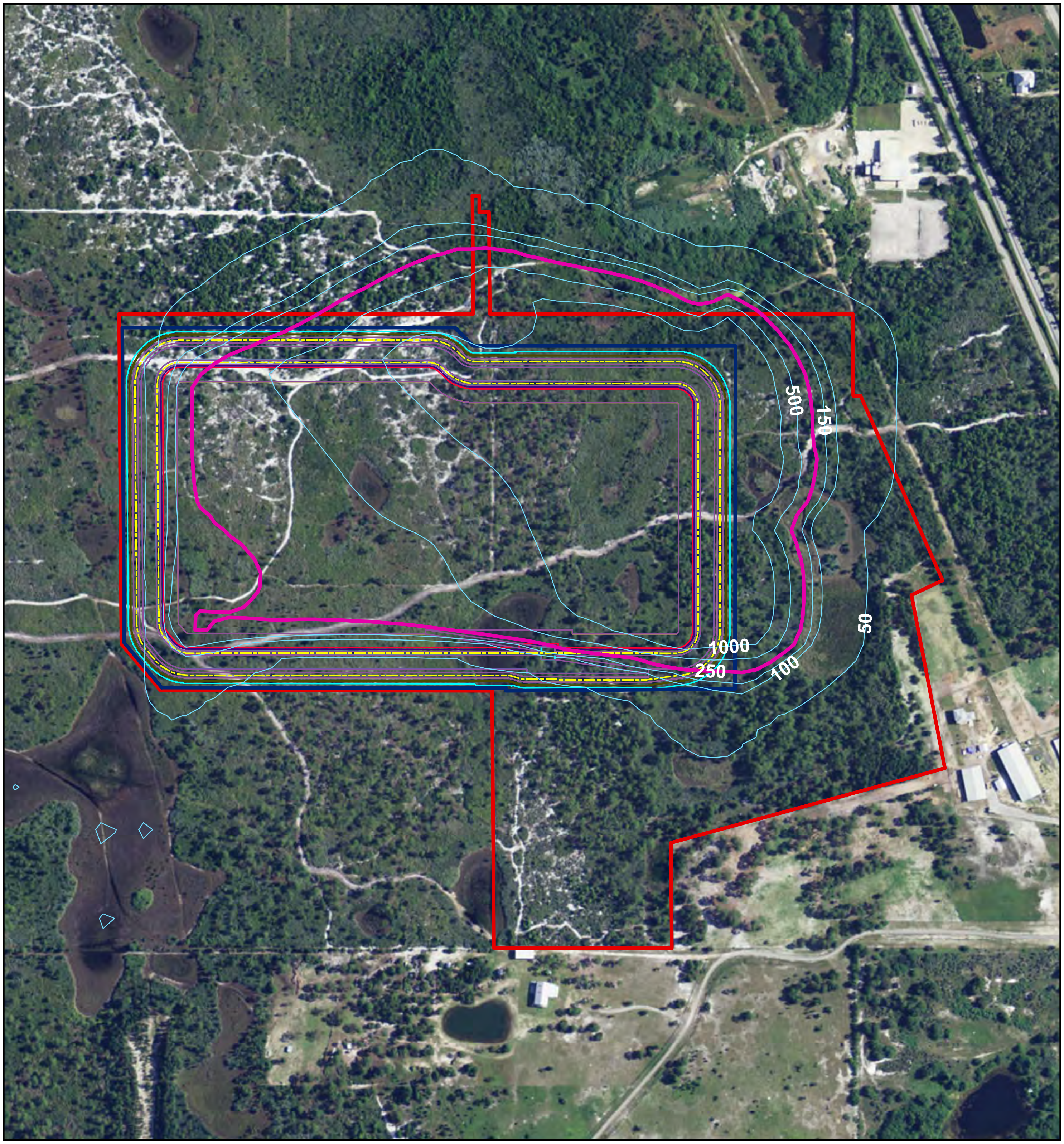
Property Boundary

0 500 1,000 Feet

1 inch = 500 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA	GROUNDWATER MODELING BV-24A BREVARD COUNTY, FL
	PN:GPGW-16-013	DRAWN BY: DLS	SECOND DREDGE LOADING & RESTING (10-20 YRS) EXHIBIT E-8



N

Legend:

Concentrations at the end of 28-days of dredge loading - Layer 3

DMMA Boundary

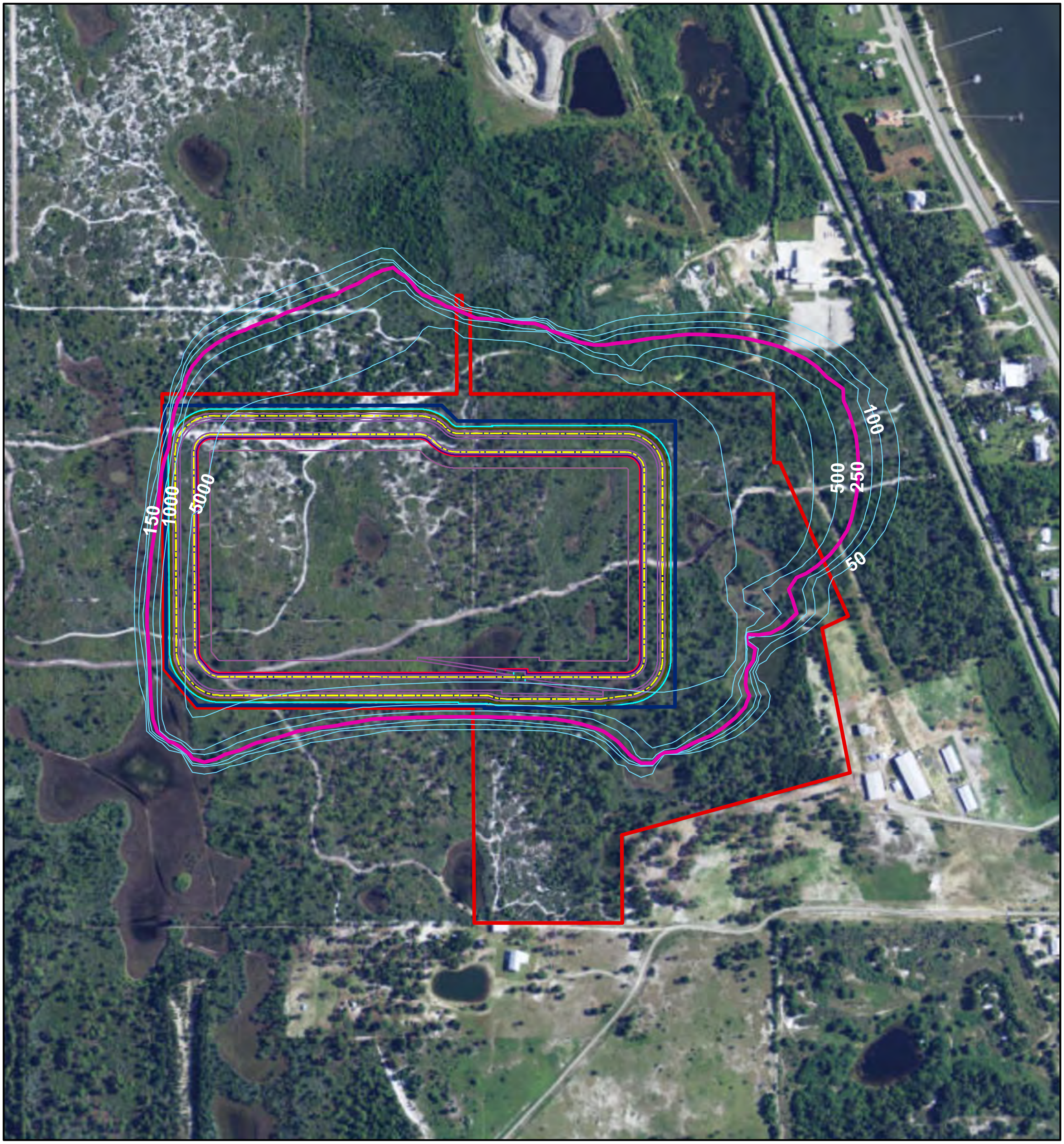
Property Boundary

0 500 1,000 Feet

1 inch = 500 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA	GROUNDWATER MODELING BV-24A BREVARD COUNTY, FL
	PN:GPGW-16-013	DRAWN BY: DLS	SECOND DREDGE LOADING & RESTING (10-20 YRS) EXHIBIT E-9



N

Legend:

Concentrations at the end of 10-year resting - Layer 1

DMMA Boundary

Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA
	PN:GPGW-16-013	DRAWN BY: DLS

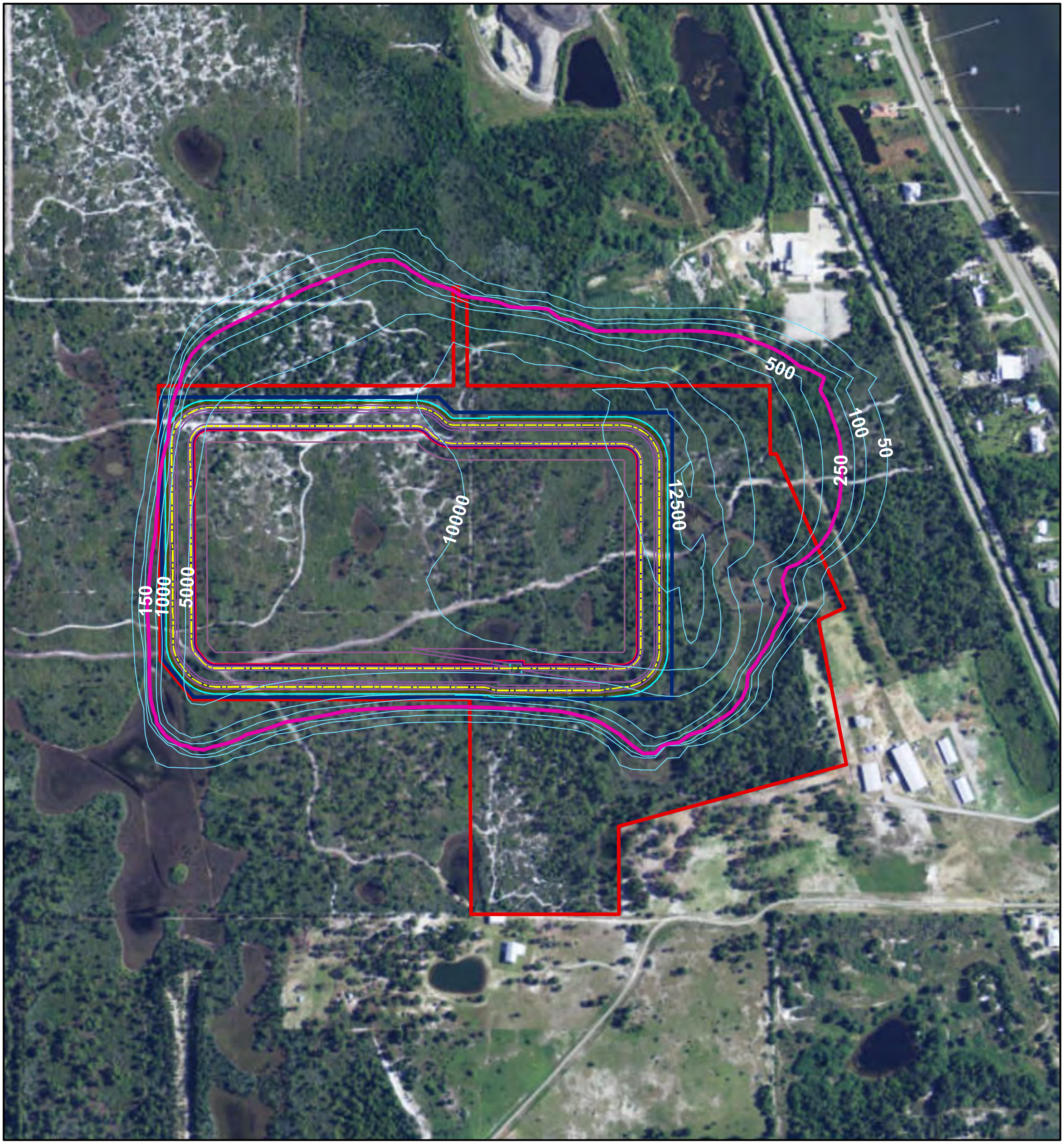
GROUNDWATER MODELING

BV-24A

BREVARD COUNTY, FL

SECOND DREDGE LOADING & RESTING (10-20 YRS)

EXHIBIT E-10



N

Legend:

Concentrations at the end of 10-year resting - Layer 2

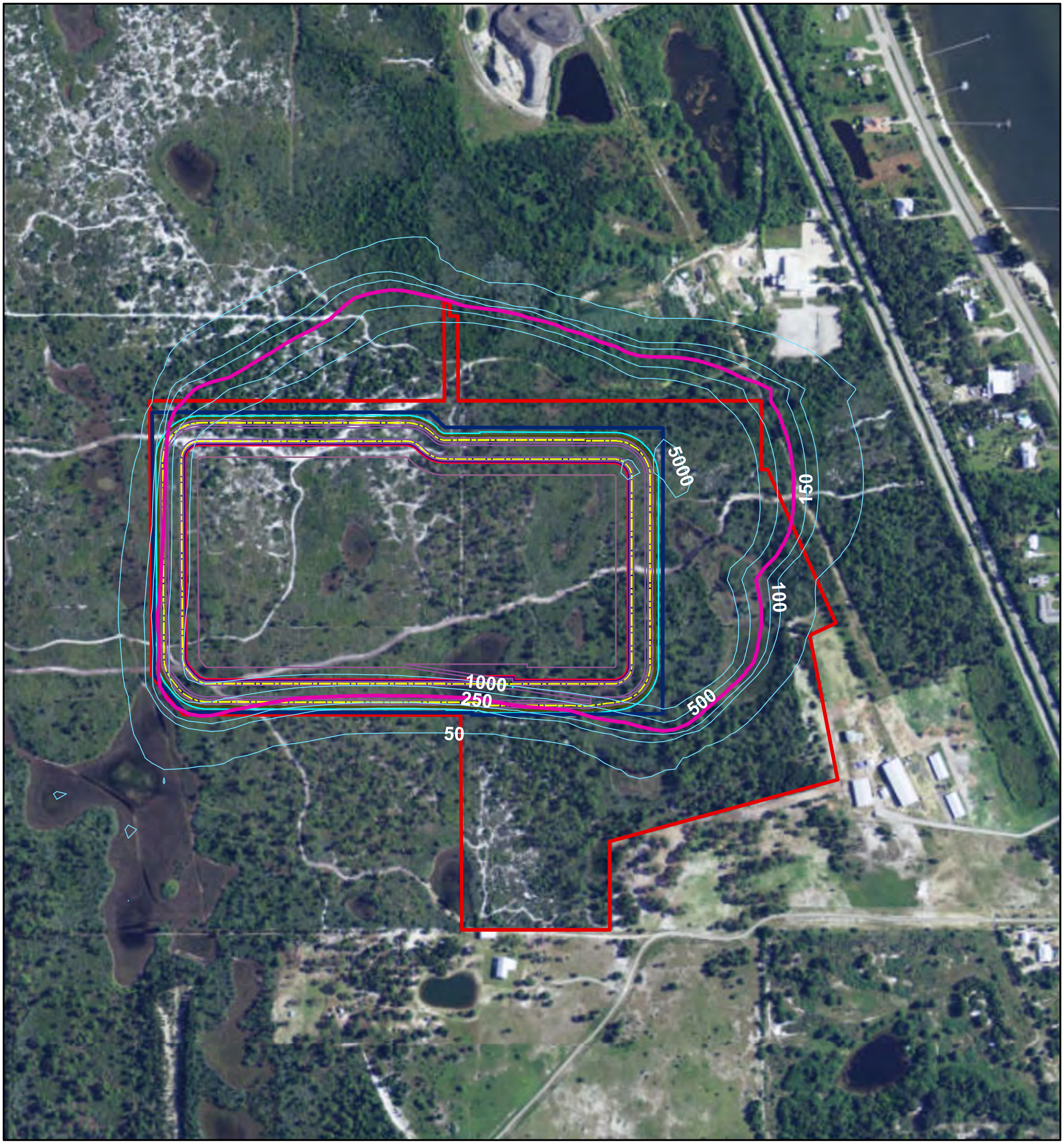
DMMA Boundary

Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.			GROUNDWATER MODELING BV-24A BREVARD COUNTY, FL
APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16 PN:GPGW-16-013	ENGINEER:NA DRAWN BY: DLS	SECOND DREDGE LOADING & RESTING (10-20 YRS) EXHIBIT E-11



N

Legend:

Concentrations at the end of 10-year resting - Layer 3

DMMA Boundary

Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.

GROUNDWATER MODELING

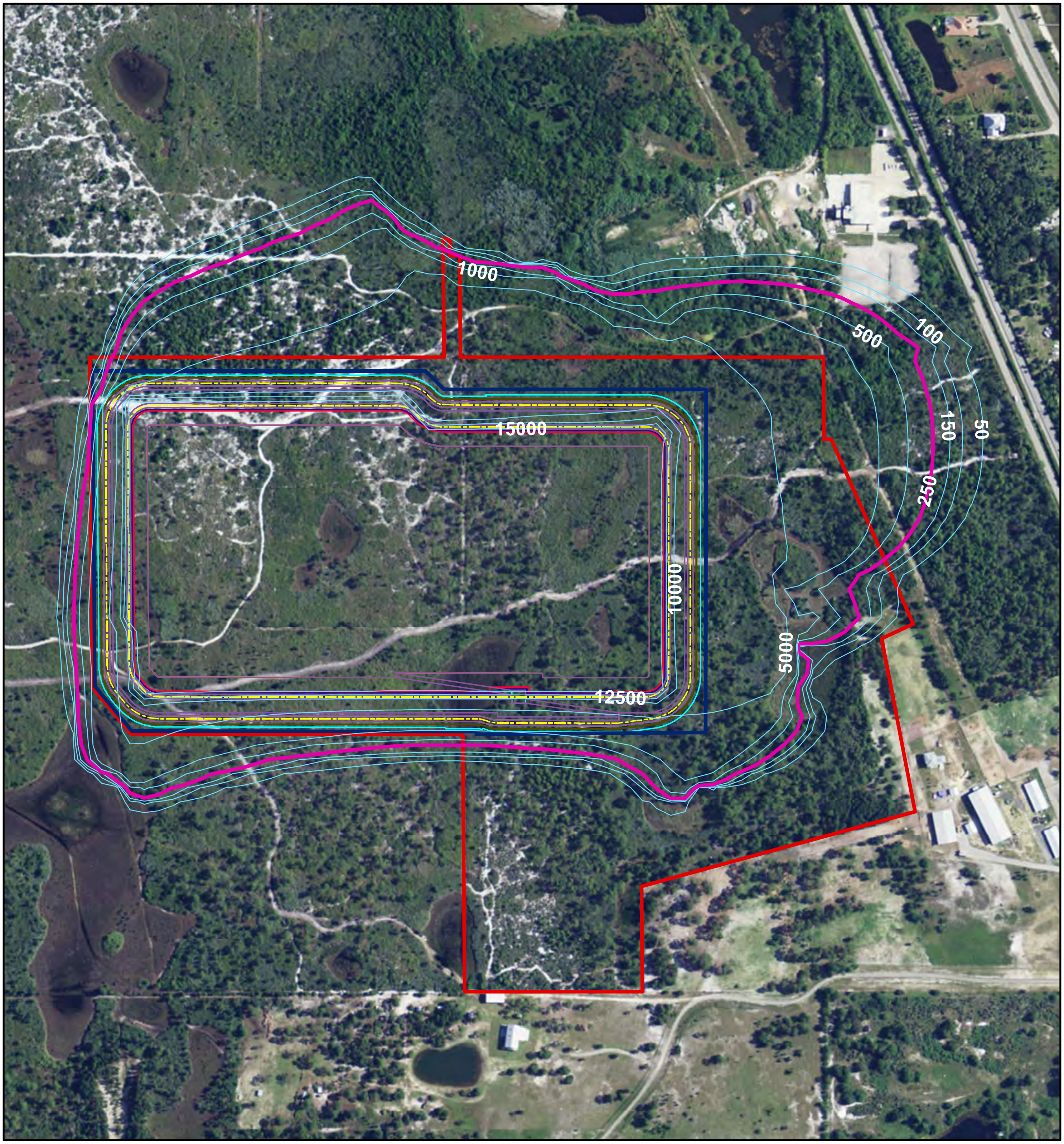
BV-24A

BREVARD COUNTY, FL

SECOND DREDGE LOADING & RESTING (10-20 YRS)

EXHIBIT E-12

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA
	PN:GPGW-16-013	DRAWN BY: DLS



N

Legend:

Concentrations at the end of 28-days of dredge loading - Layer 1

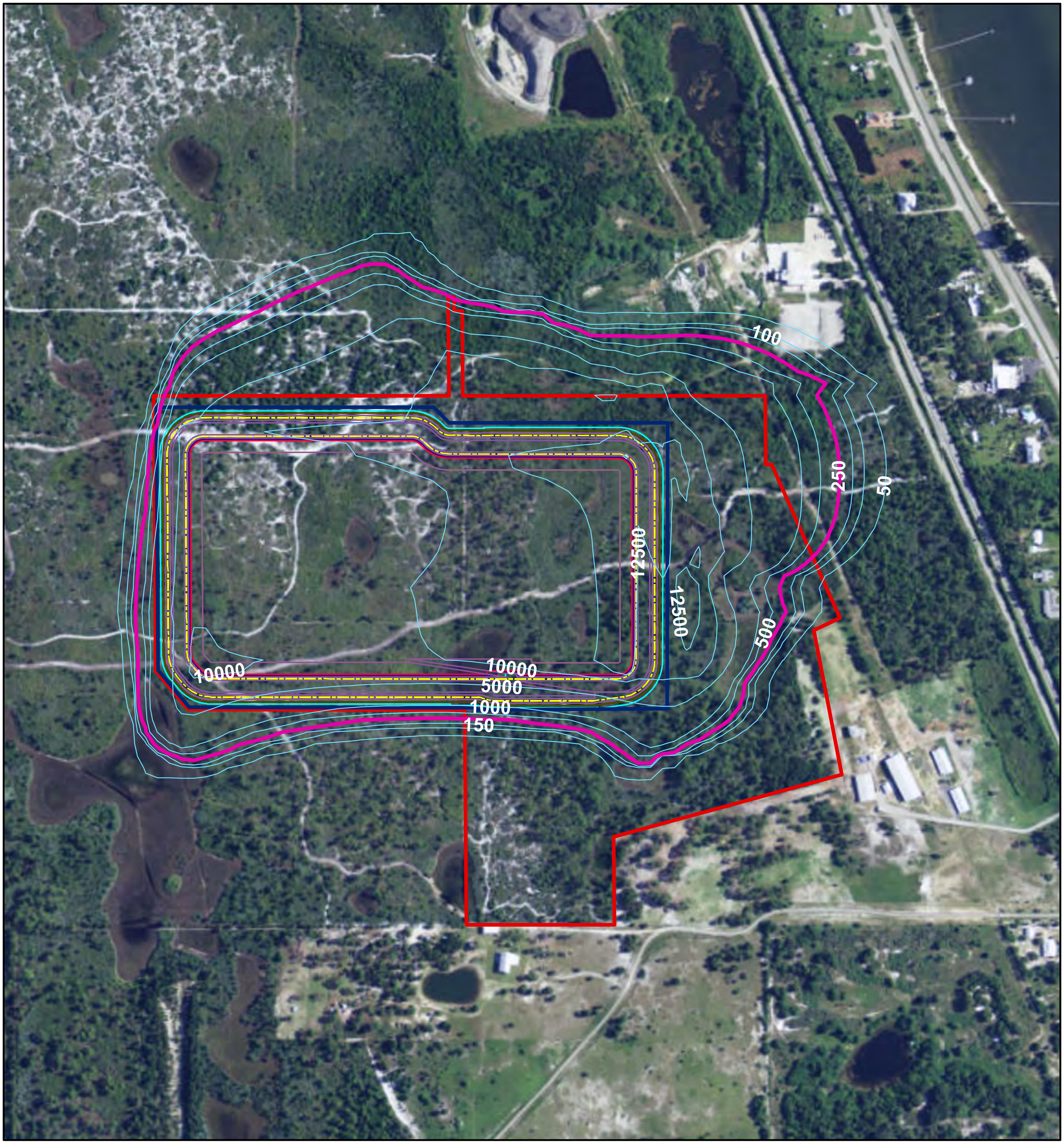
DMMA Boundary

Property Boundary

0 500 1,000 Feet

1 inch = 500 feet

ANDREYEV ENGINEERING, INC.			GROUNDWATER MODELING BV-24A BREVARD COUNTY, FL
APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16 PN:GPGW-16-013	ENGINEER:NA DRAWN BY: DLS	THIRD DREDGE LOADING & RESTING (20-30 YRS) EXHIBIT E-13



N

Legend:

Concentrations at the end of 28-days of dredge loading - Layer 2

DMMA Boundary

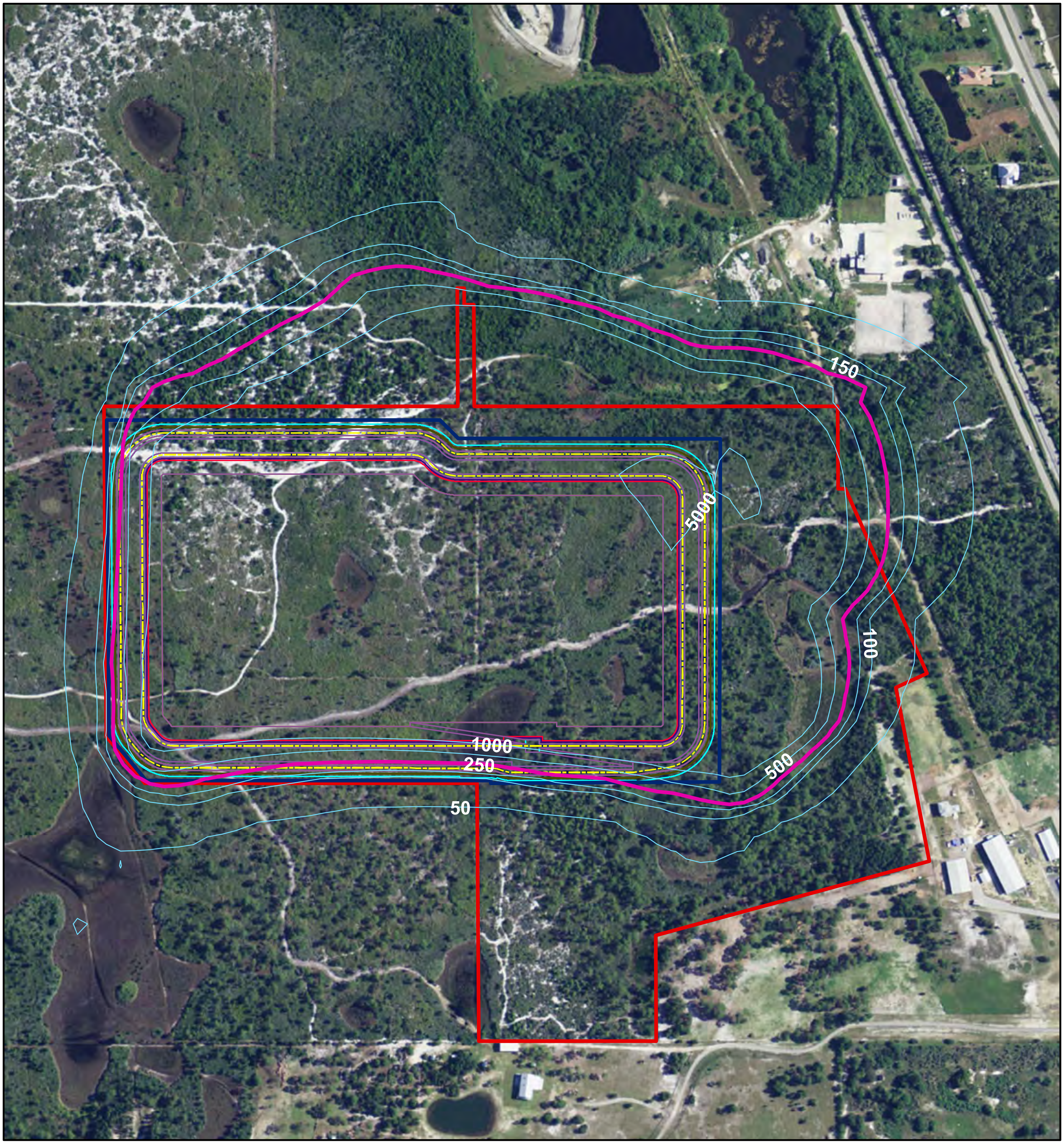
Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA	GROUNDWATER MODELING BV-24A BREVARD COUNTY, FL
	PN:GPGW-16-013	DRAWN BY: DLS	THIRD DREDGE LOADING & RESTING (20-30 YRS) EXHIBIT E-14



N

Legend:

Concentrations at the end of 28-days of dredge loading - Layer 3

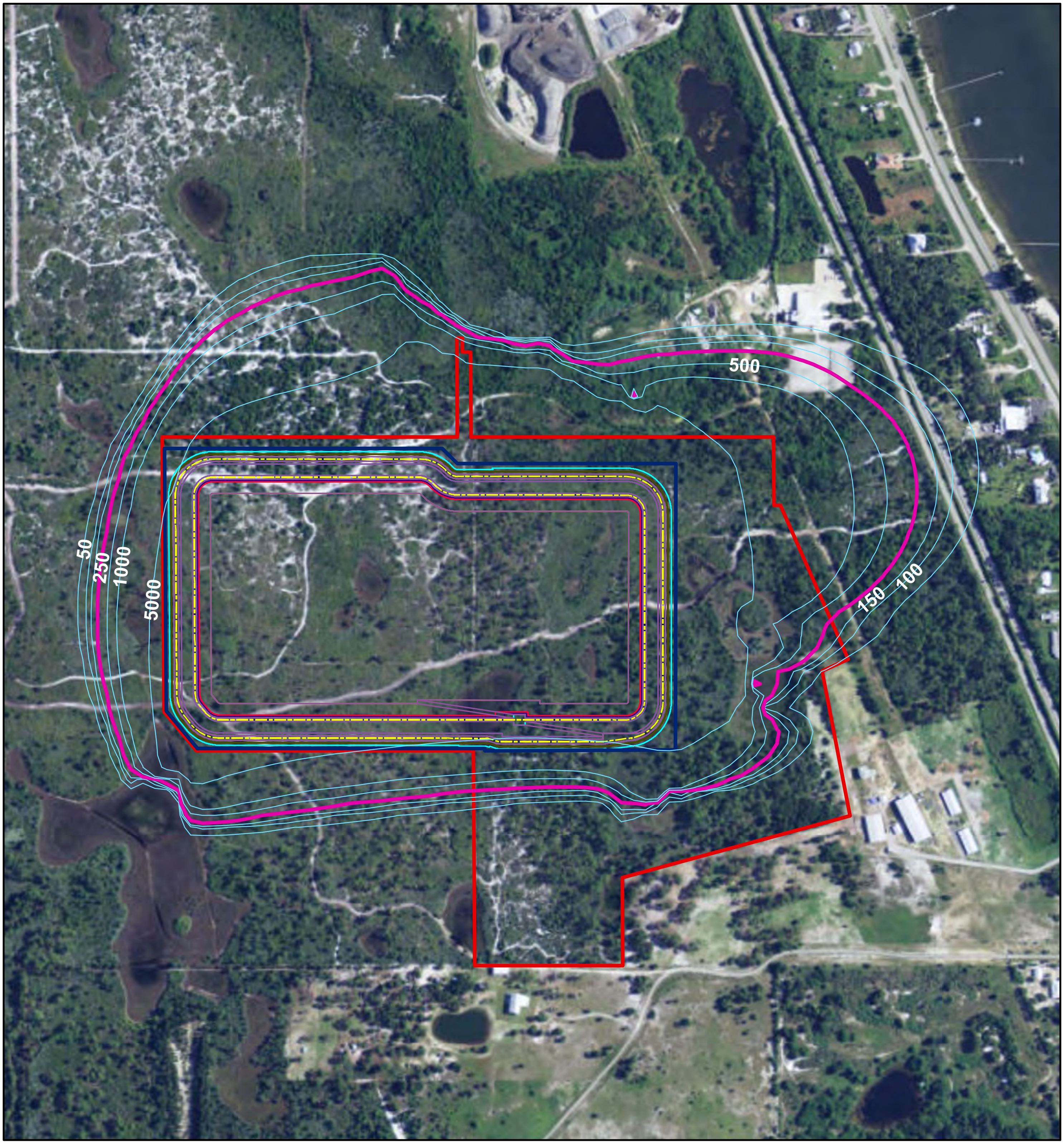
DMMA Boundary

Property Boundary

0 500 1,000 Feet

1 inch = 500 feet

ANDREYEV ENGINEERING, INC.			GROUNDWATER MODELING **BV-24A** BREVARD COUNTY, FL
APPROXIMATE SCALE:	DATE: 05/25/16	ENGINEER:NA	THIRD DREDGE LOADING & RESTING (20-30 YRS)
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS	EXHIBIT E-15



N

Legend:

Concentrations at the end of 10-year resting - Layer 1

DMMA Boundary

Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.

GROUNDWATER MODELING

BV-24A

BREVARD COUNTY, FL

THIRD DREDGE LOADING & RESTING (20-30 YRS)

EXHIBIT E-16

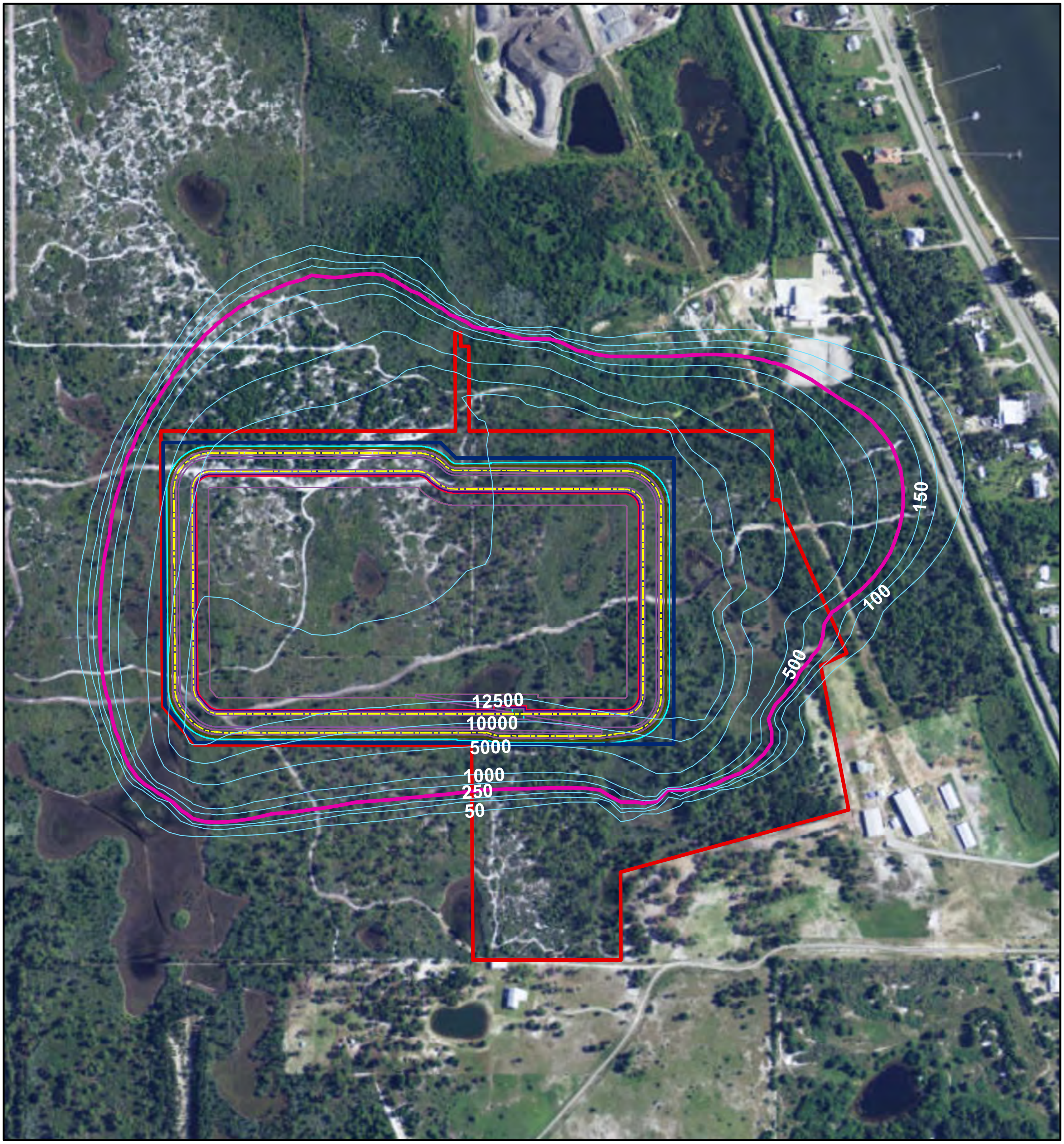
APPROXIMATE SCALE: AS SHOWN

DATE: 05/25/16

ENGINEER:NA

PN:GPGW-16-013

DRAWN BY: DLS



N

Legend:

Concentrations at the end of 10-year resting - Layer 2

DMMA Boundary

Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.

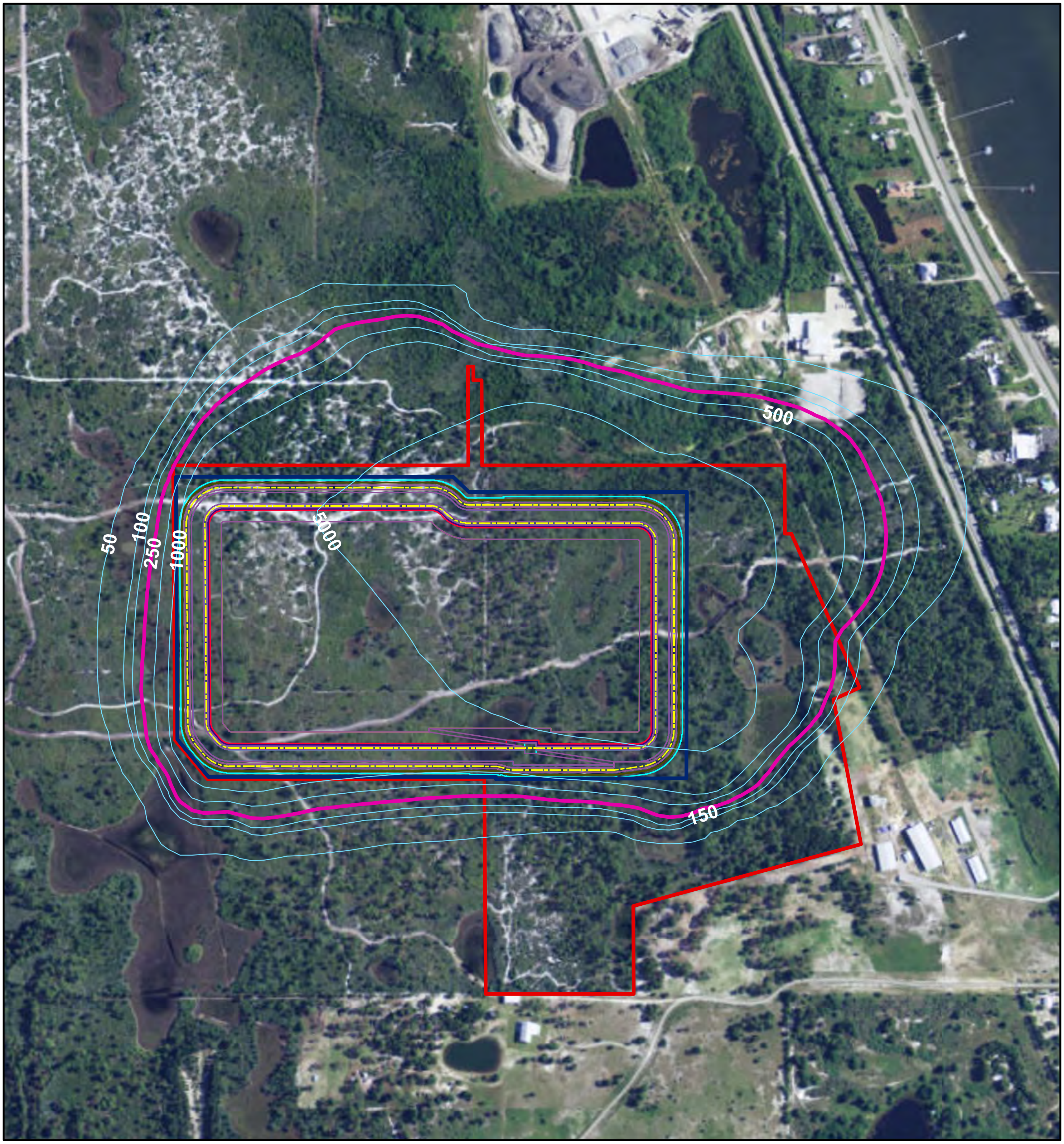
GROUNDWATER MODELING

BV-24A

BREVARD COUNTY, FL

THIRD DREDGE LOADING & RESTING (20-30 YRS)

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA	
	PN:GPGW-16-013	DRAWN BY: DLS	EXHIBIT E-17



N

Legend:

Concentrations at the end of 10-year resting - Layer 3

DMMA Boundary

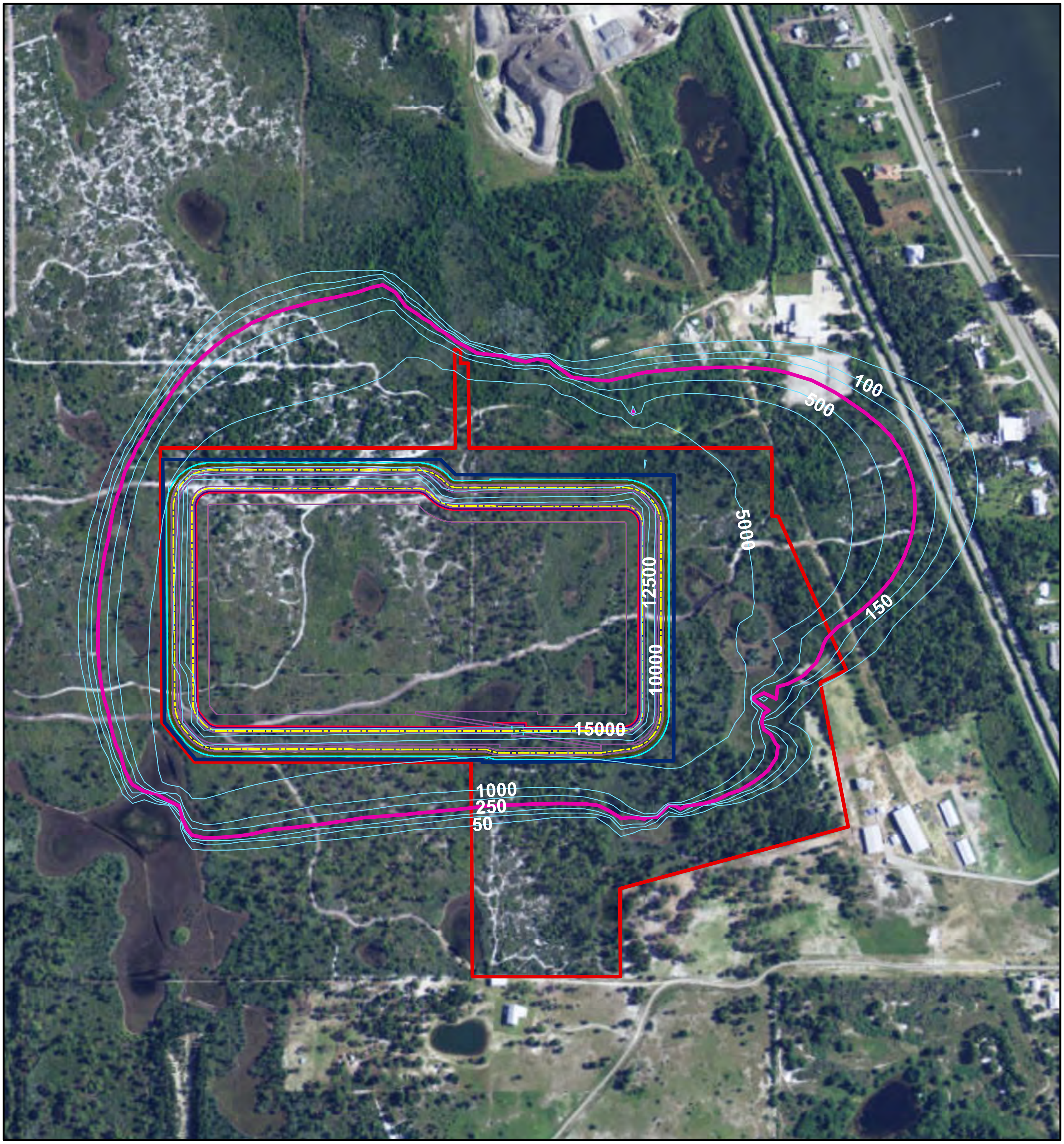
Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA	GROUNDWATER MODELING **BV-24A** BREVARD COUNTY, FL
	PN:GPGW-16-013	DRAWN BY: DLS	THIRD DREDGE LOADING & RESTING (20-30 YRS) EXHIBIT E-18



N

Legend:

Concentrations at the end of 28-days of dredge loading - Layer 1

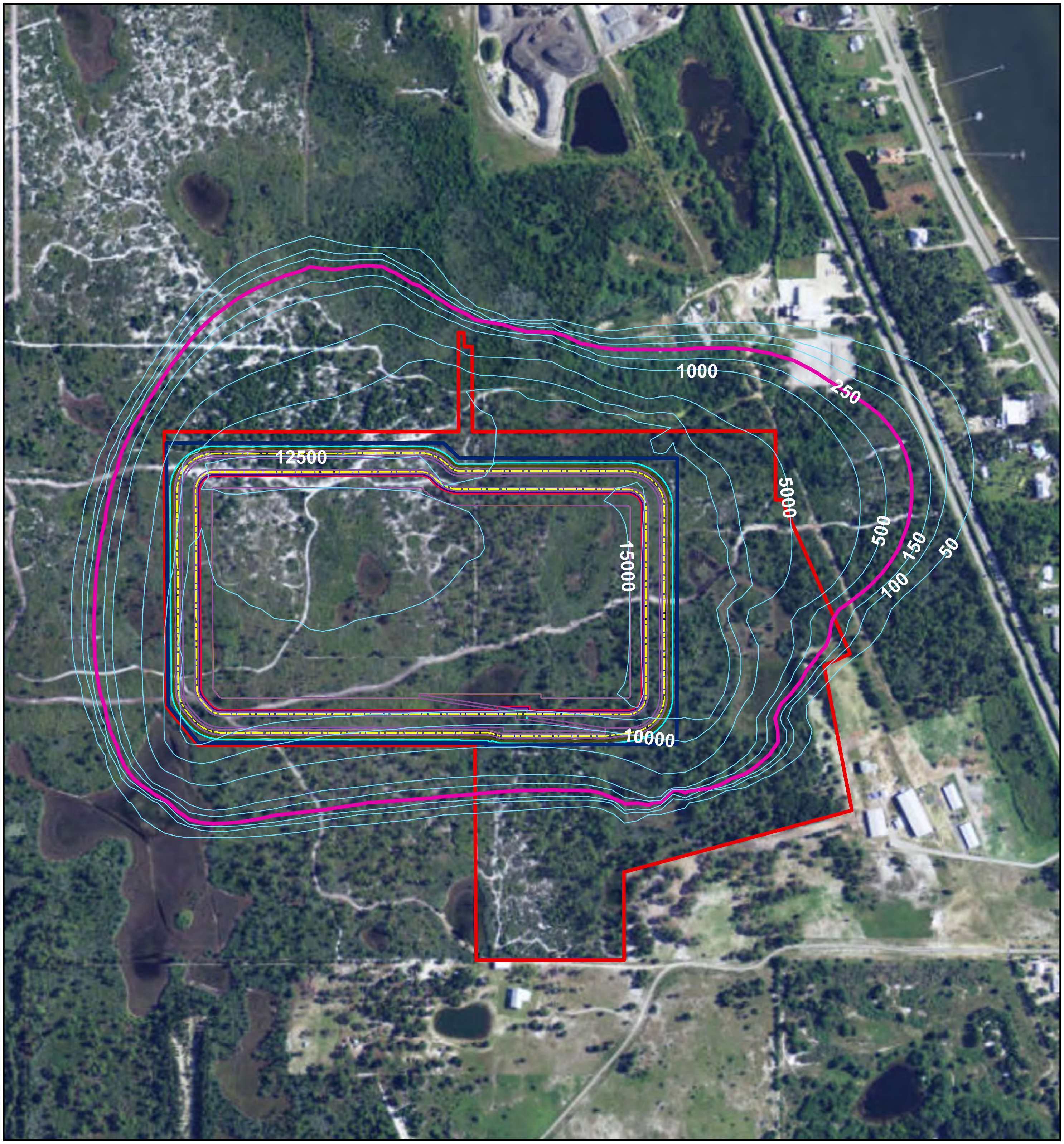
DMMA Boundary

Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.		GROUNDWATER MODELING BV-24A BREVARD COUNTY, FL
APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16 PN:GPGW-16-013	ENGINEER:NA DRAWN BY: DLS
		FOURTH DREDGE LOADING & RESTING (30-40 YRS)
		EXHIBIT E-19



N

Legend:

Concentrations at the end of 28-days of dredge loading - Layer 2

DMMA Boundary

Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.

GROUNDWATER MODELING

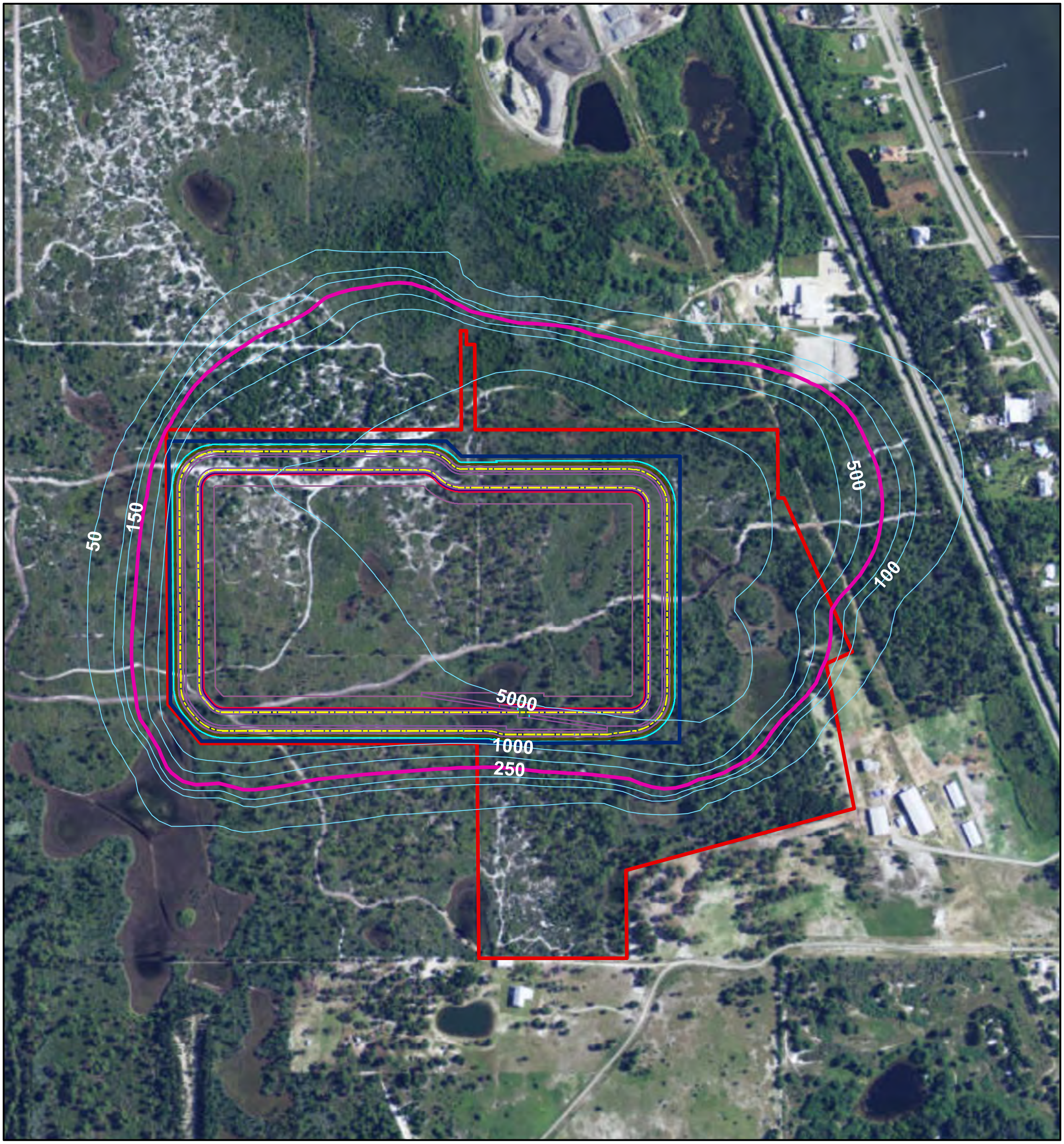
BV-24A

BREVARD COUNTY, FL

FOURTH DREDGE LOADING & RESTING (30-40 YRS)

EXHIBIT E-20

APPROXIMATE SCALE:	DATE: 05/25/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS



N

Legend:

Concentrations at the end of 28-days of dredge loading - Layer 3

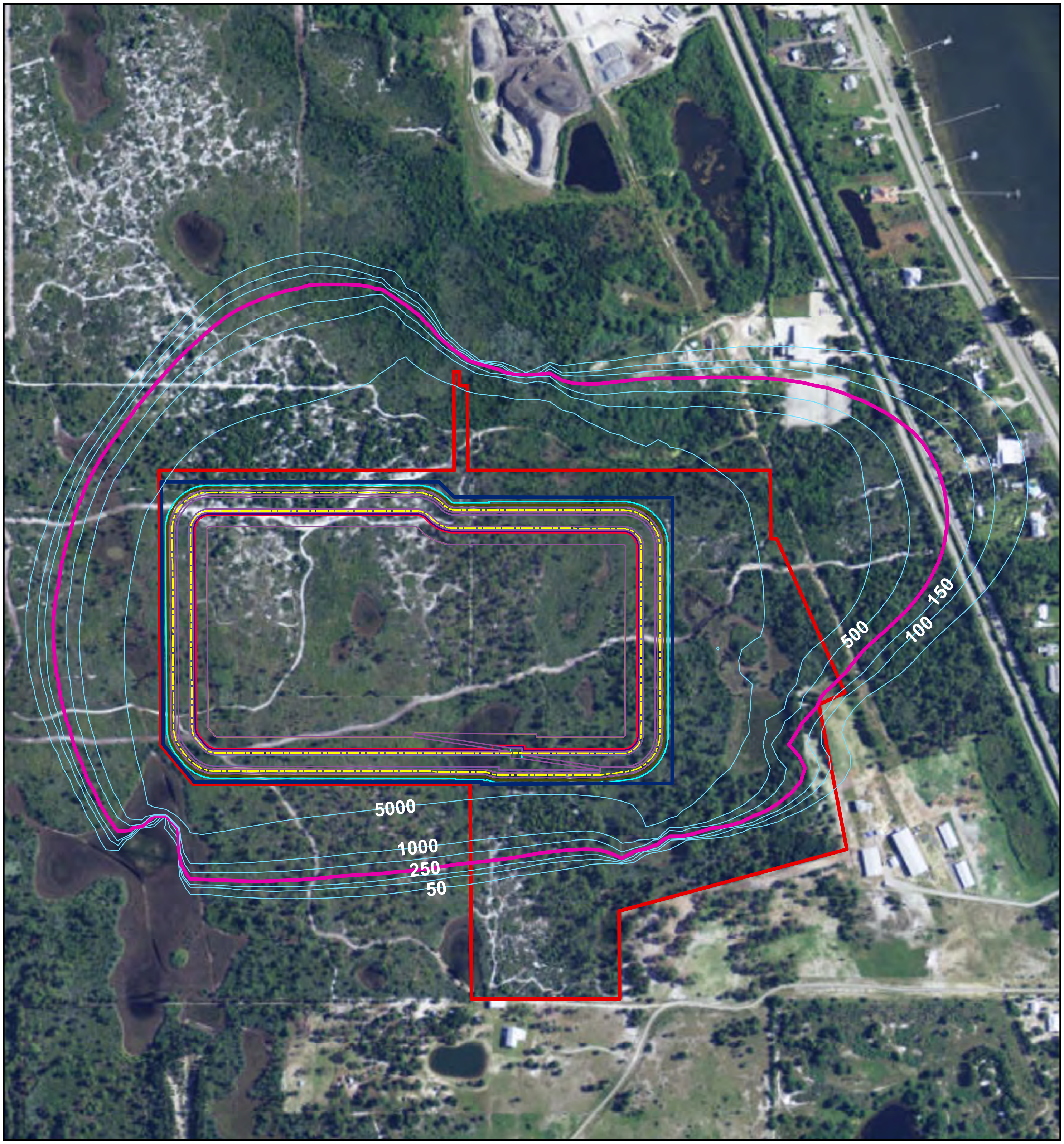
DMMA Boundary

Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.		GROUNDWATER MODELING **BV-24A** BREVARD COUNTY, FL
APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16 PN:GPGW-16-013	ENGINEER:NA DRAWN BY: DLS
		FOURTH DREDGE LOADING & RESTING (30-40 YRS) EXHIBIT E-21



N

Legend:

Concentrations at the end of 10-year resting - Layer 1

DMMA Boundary

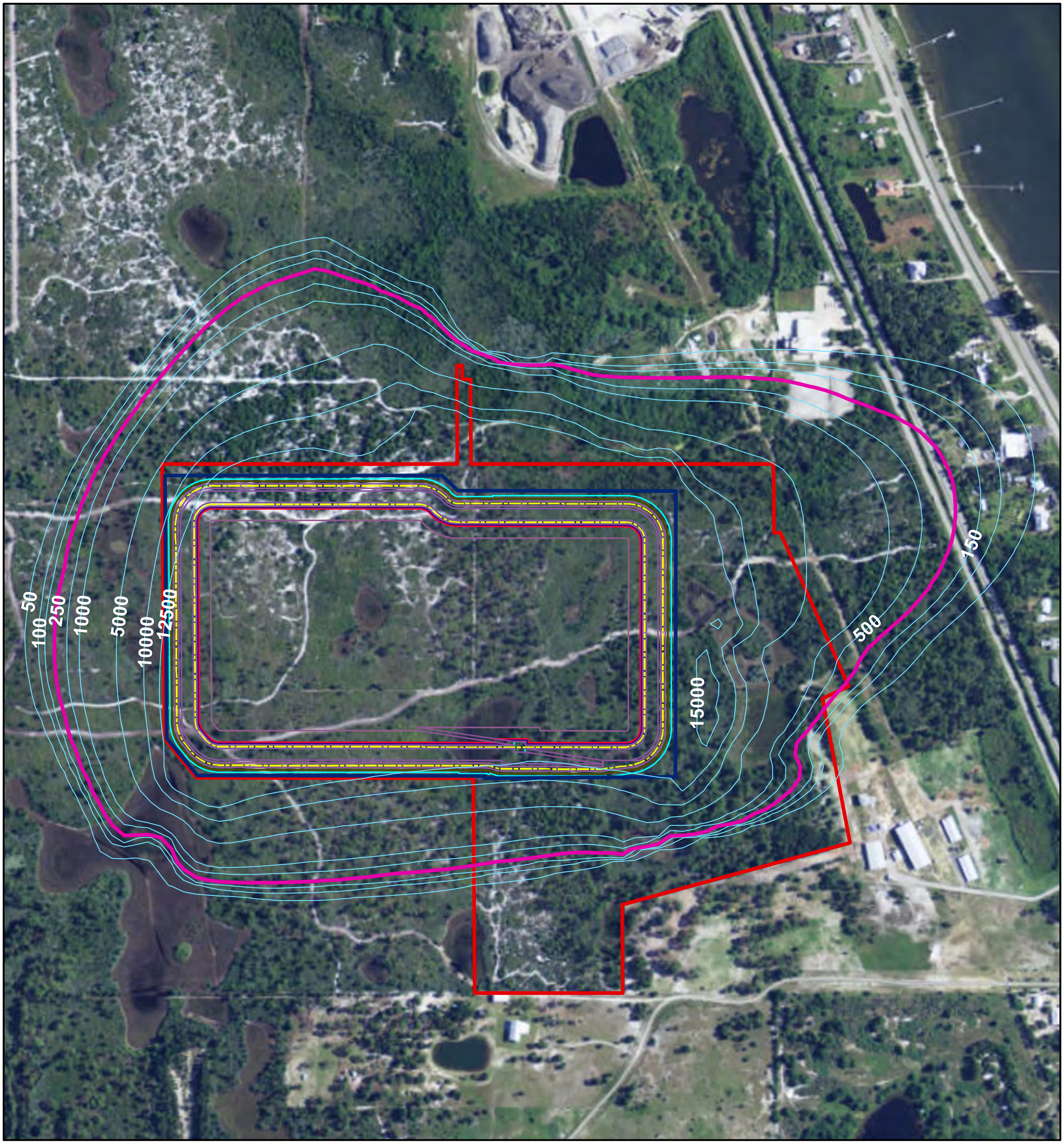
Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA	GROUNDWATER MODELING **BV-24A** BREVARD COUNTY, FL FOURTH DREDGE LOADING & RESTING (30-40 YRS)
	PN:GPGW-16-013	DRAWN BY: DLS	EXHIBIT E-22



N

Legend:

Concentrations at the end of 10-year resting - Layer 2

DMMA Boundary

Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.

GROUNDWATER MODELING

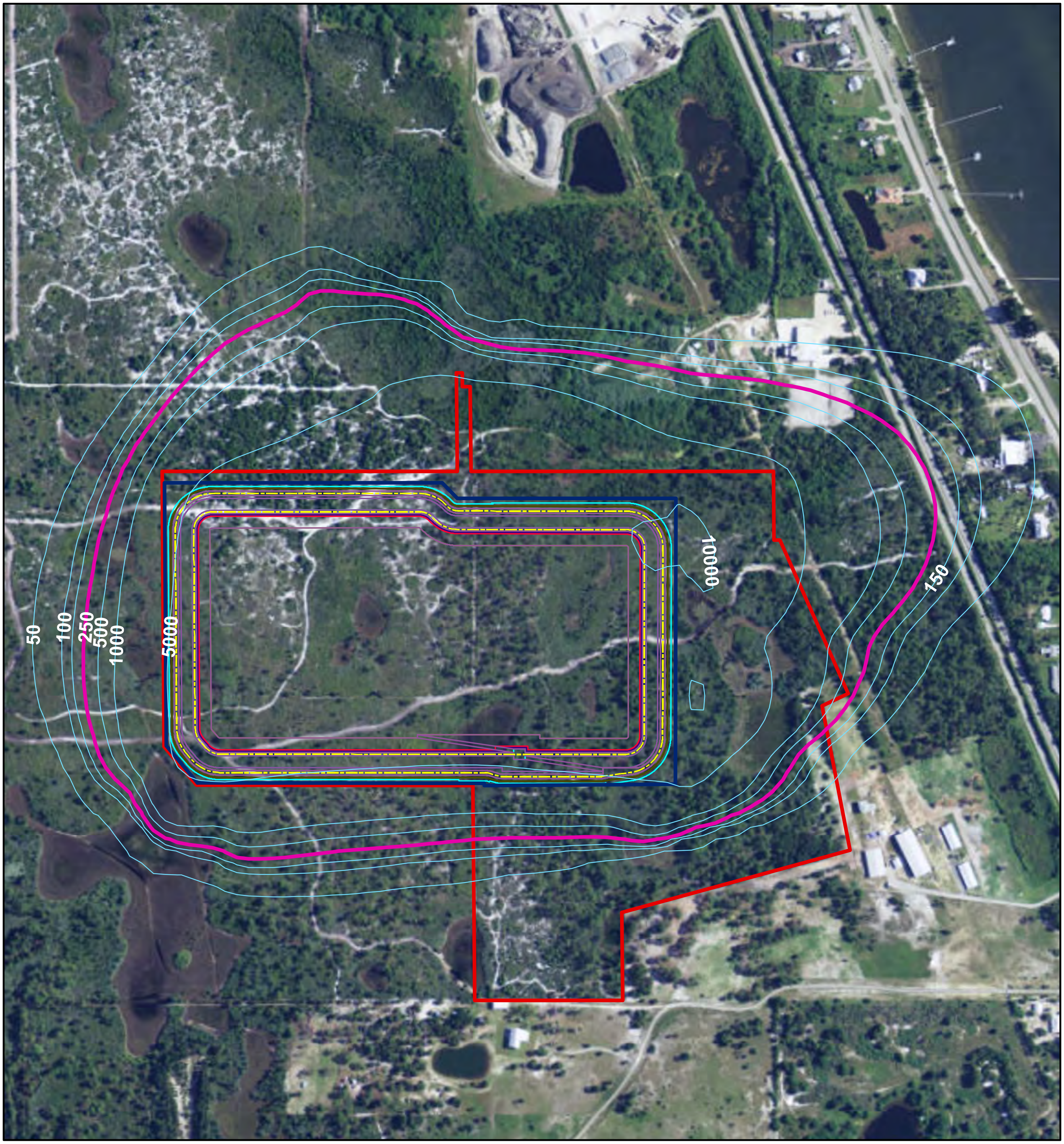
BV-24A

BREVARD COUNTY, FL

FOURTH DREDGE LOADING & RESTING (30-40 YRS)

EXHIBIT E-23

APPROXIMATE SCALE:	DATE: 05/25/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS



N

Legend:

Concentrations at the end of 10-year resting - Layer 3

DMMA Boundary

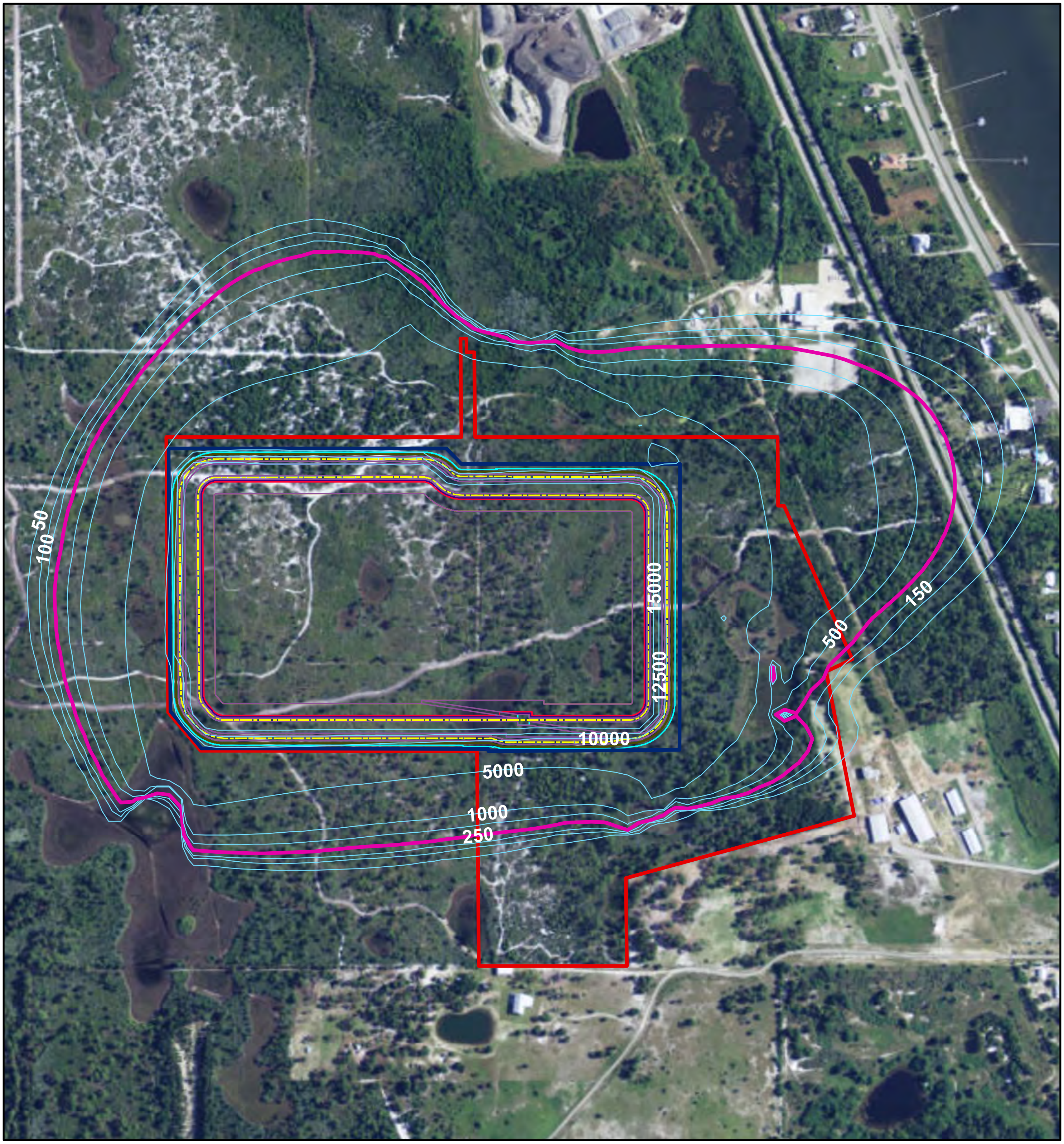
Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA	GROUNDWATER MODELING BV-24A BREVARD COUNTY, FL
	PN:GPGW-16-013	DRAWN BY: DLS	FOURTH DREDGE LOADING & RESTING (30-40 YRS) EXHIBIT E-24



N

Legend:

Concentrations at the end of 28-days of dredge loading - Layer 1

DMMA Boundary

Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.

GROUNDWATER MODELING

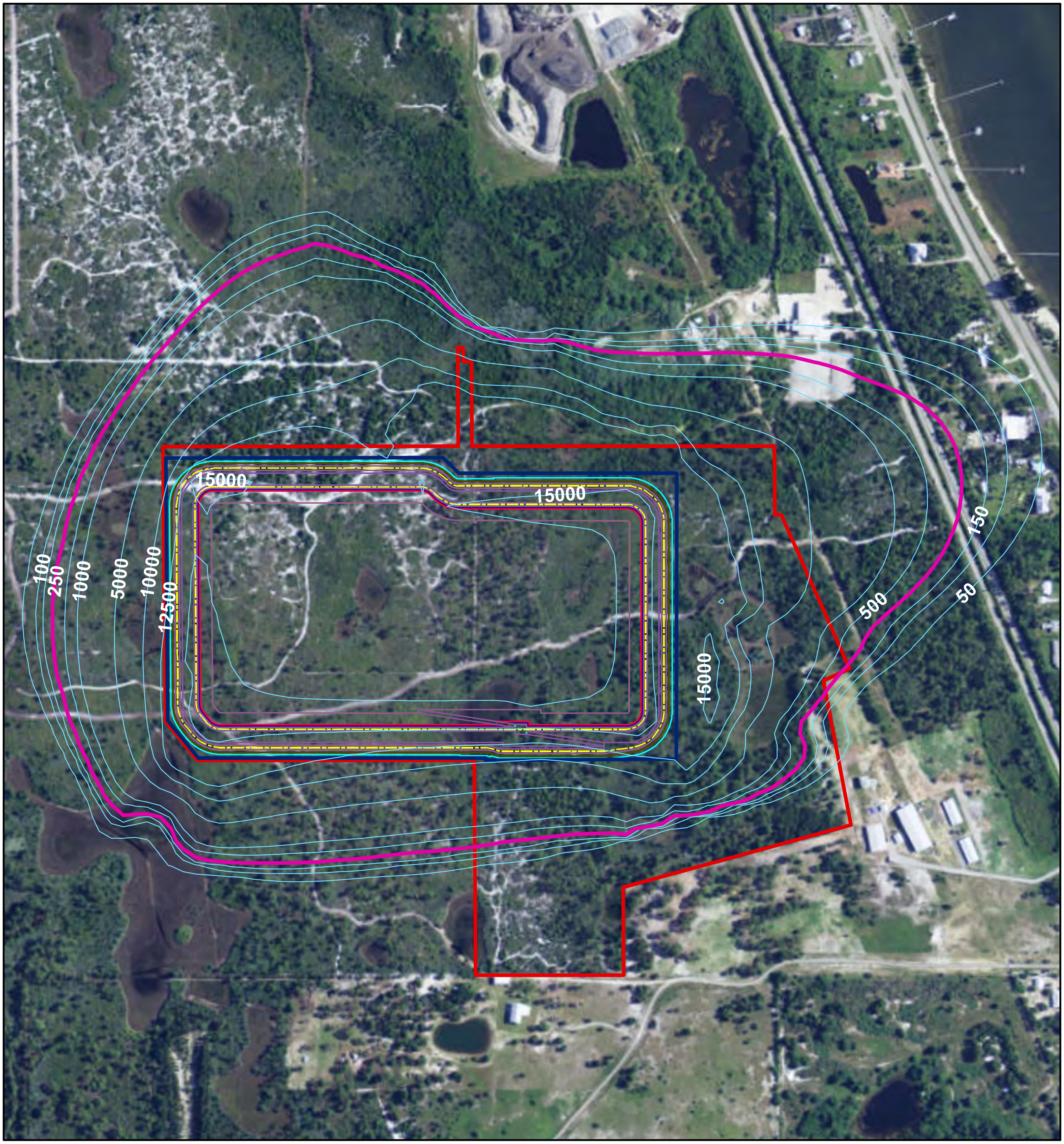
BV-24A

BREVARD COUNTY, FL

FIFTH DREDGE LOADING & RESTING (40-50 YRS)

APPROXIMATE SCALE:	DATE: 05/25/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

EXHIBIT E-25



Legend:

Concentrations at the end of 28-days of dredge loading - Layer 2

DMMA Boundary

Property Boundary

N

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.

GROUNDWATER MODELING

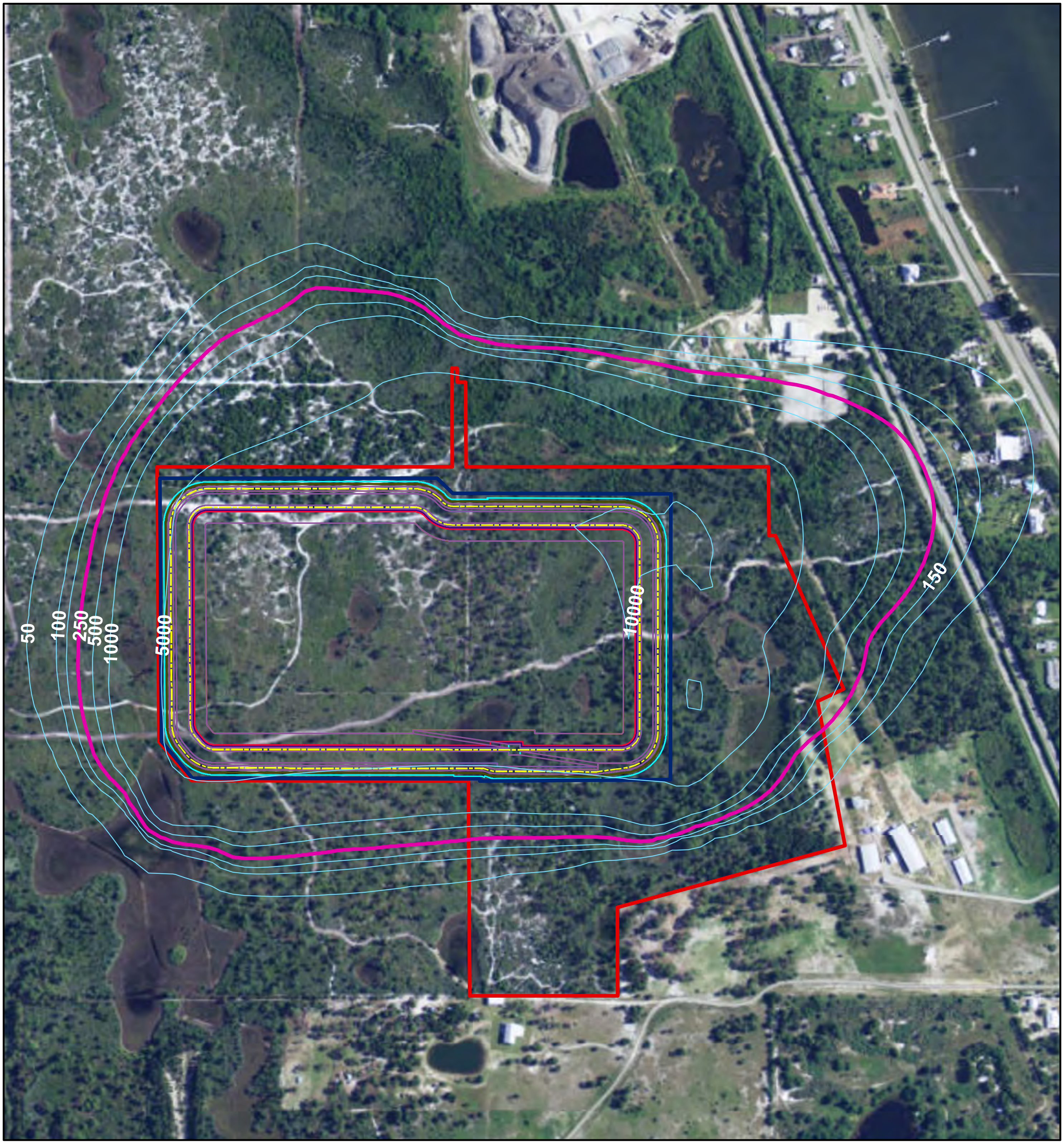
BV-24A

BREVARD COUNTY, FL

FIFTH DREDGE LOADING & RESTING (40-50 YRS)

APPROXIMATE SCALE:	DATE: 05/25/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

EXHIBIT E-26



N

Legend:

Concentrations at the end of 28-days of dredge loading - Layer 3

DMMA Boundary

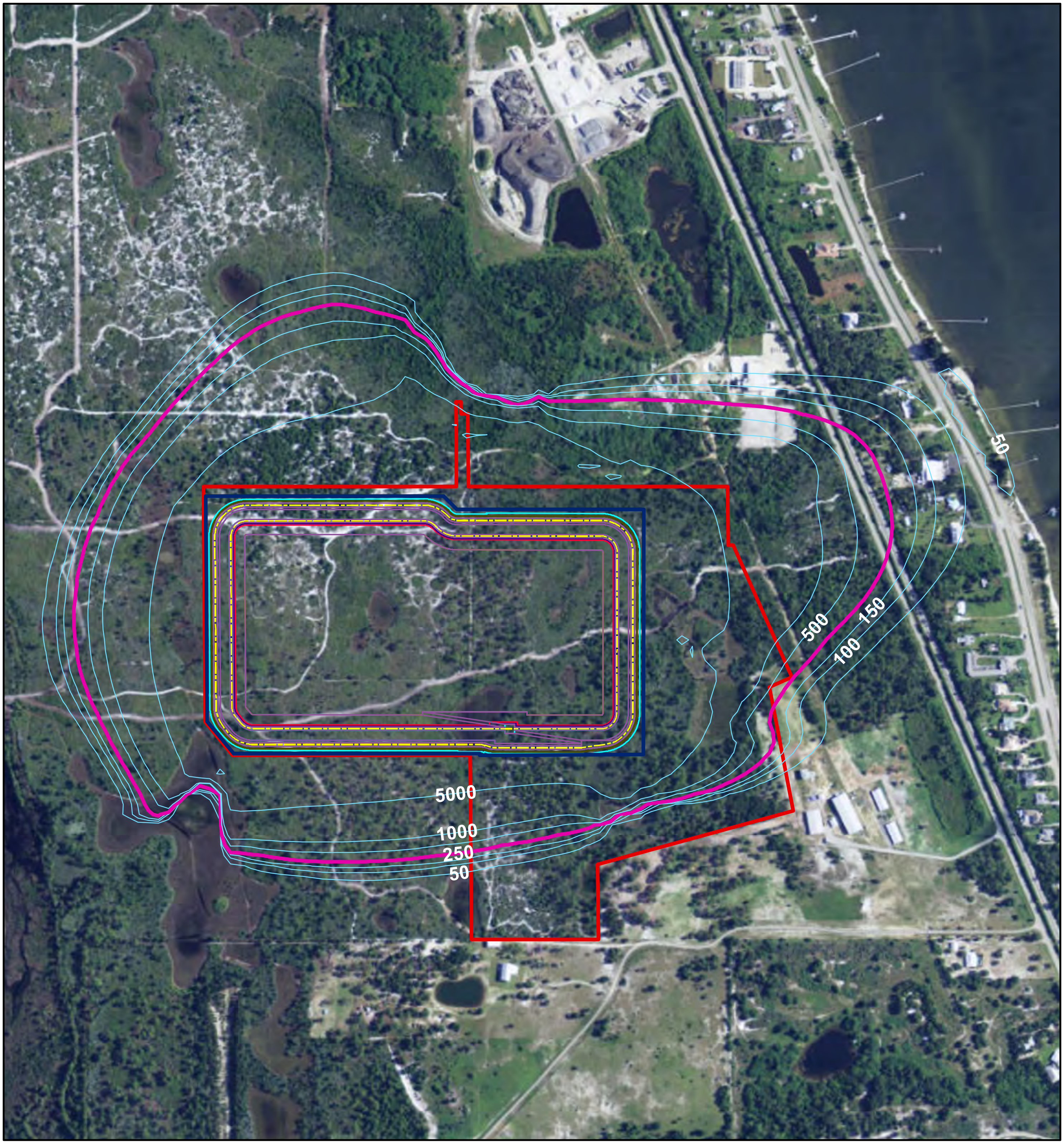
Property Boundary

0 600 1,200 Feet

1 inch = 600 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA	GROUNDWATER MODELING **BV-24A** BREVARD COUNTY, FL FIFTH DREDGE LOADING & RESTING (40-50 YRS)
	PN:GPGW-16-013	DRAWN BY: DLS	EXHIBIT E-27



N

Legend:

Concentrations at the end of 10-year resting - Layer 1

DMMA Boundary

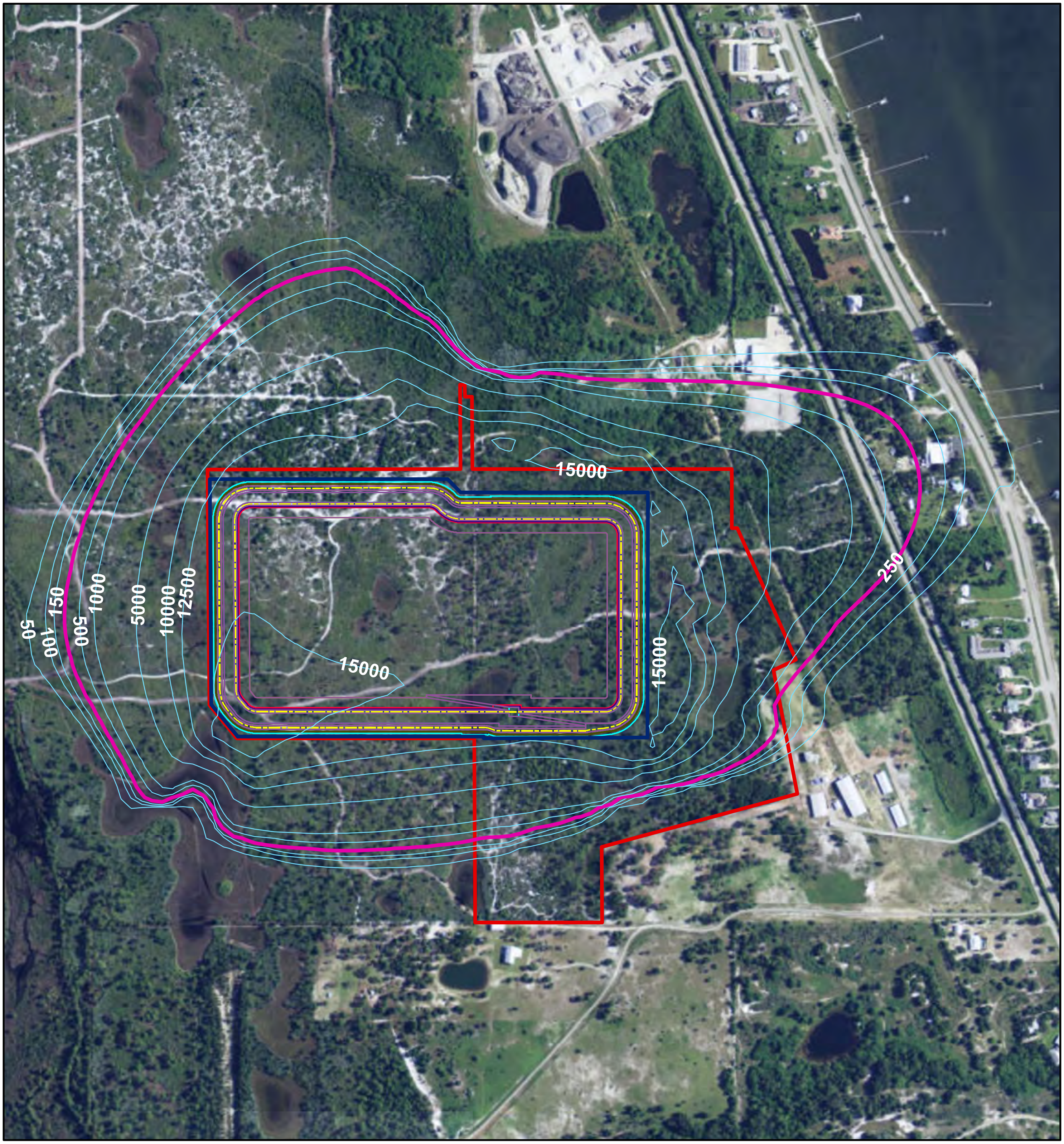
Property Boundary

0 700 1,400 Feet

1 inch = 700 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA	GROUNDWATER MODELING **BV-24A** BREVARD COUNTY, FL
	PN:GPGW-16-013	DRAWN BY: DLS	FIFTH DREDGE LOADING & RESTING (40-50 YRS)
			EXHIBIT E-28



N

Legend:

Concentrations at the end of 10-year resting - Layer 2

DMMA Boundary

Property Boundary

0 700 1,400 Feet

1 inch = 700 feet

ANDREYEV ENGINEERING, INC.

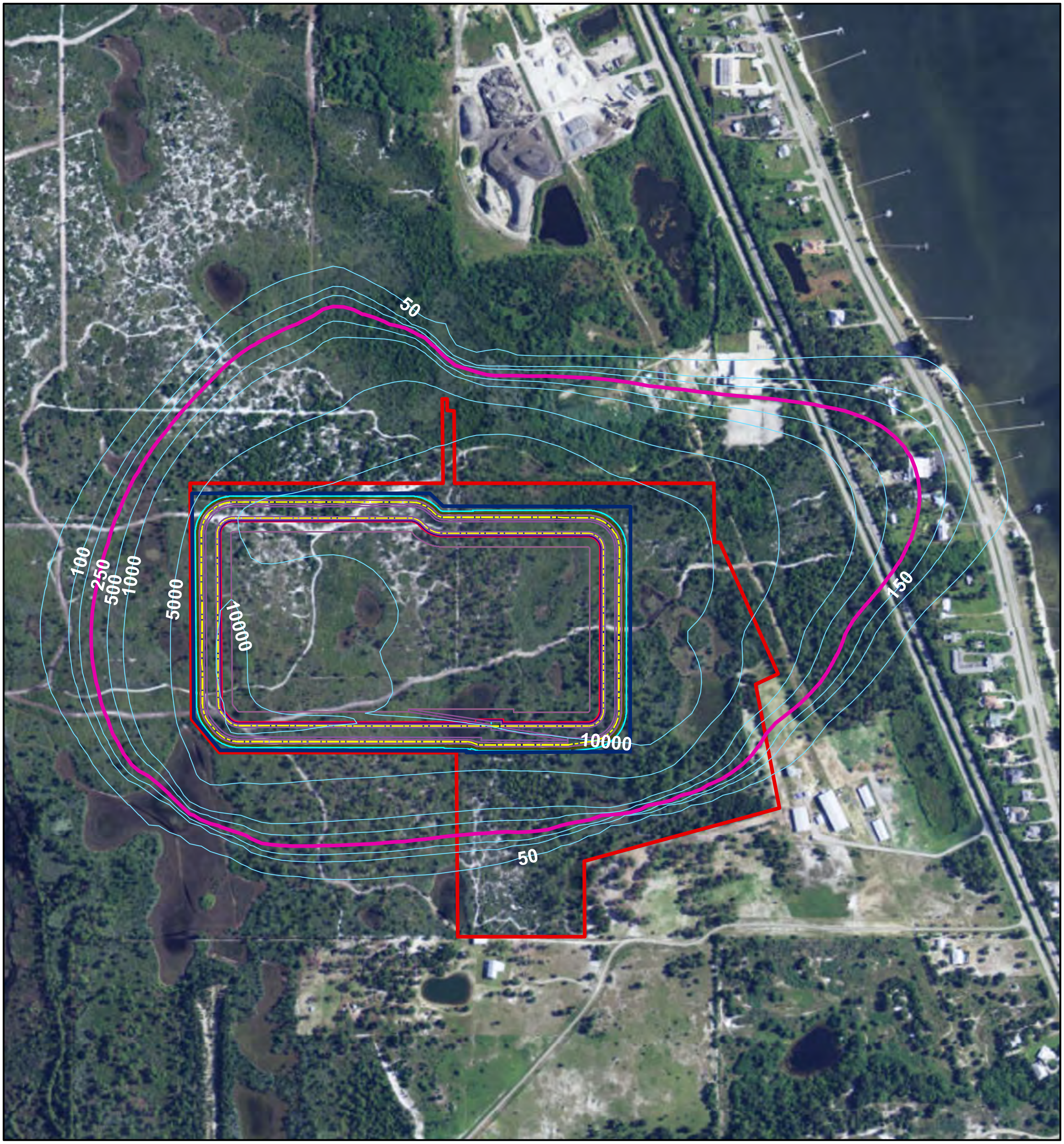
GROUNDWATER MODELING

BV-24A

BREVARD COUNTY, FL

FIFTH DREDGE LOADING & RESTING (40-50 YRS)

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA	EXHIBIT E-29
	PN:GPGW-16-013	DRAWN BY: DLS	



N

Legend:

Concentrations at the end of 10-year resting - Layer 3

DMMA Boundary

Property Boundary

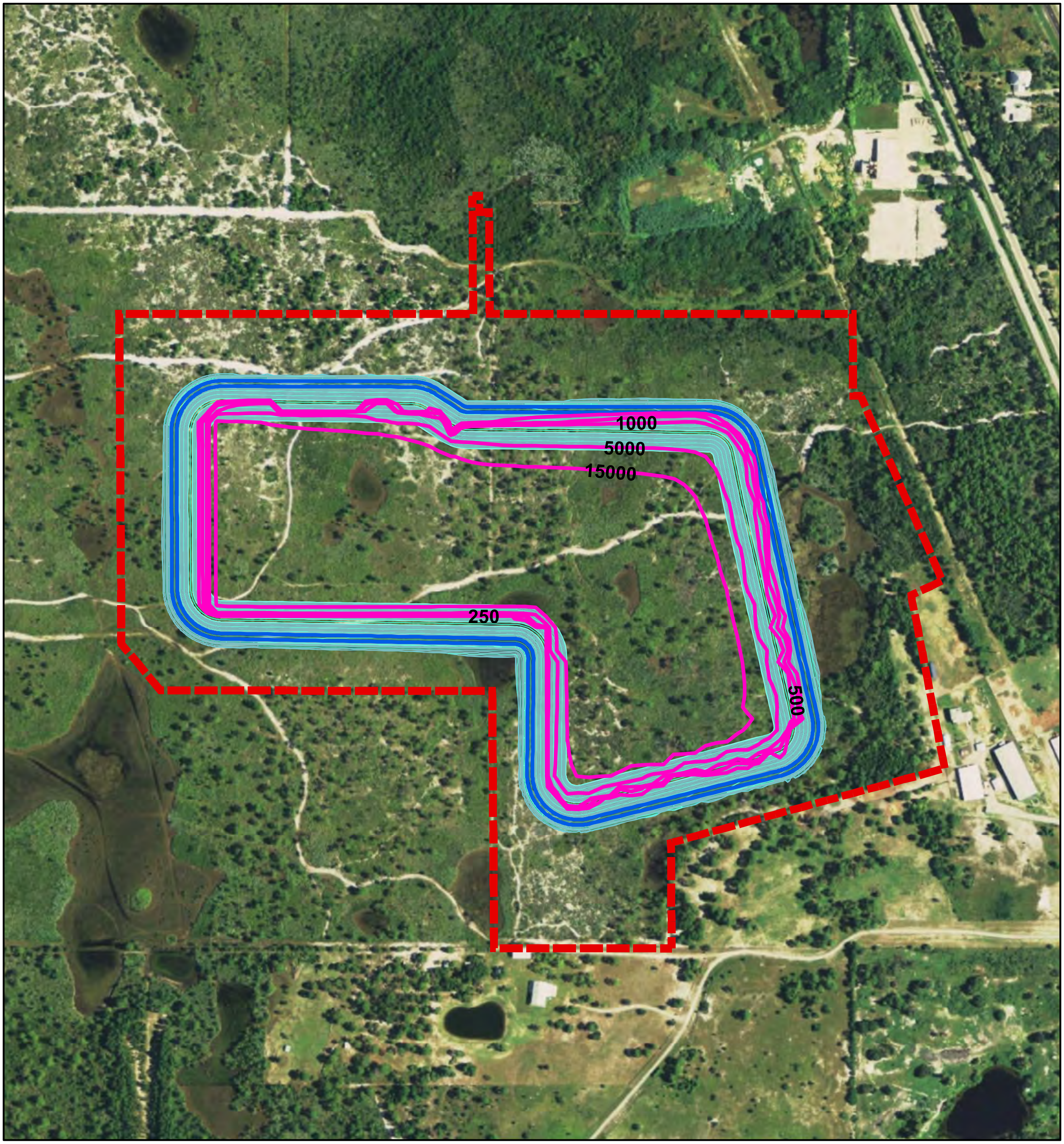
0 700 1,400 Feet

1 inch = 700 feet

ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE: AS SHOWN	DATE: 05/25/16	ENGINEER:NA	GROUNDWATER MODELING
	PN:GPGW-16-013	DRAWN BY: DLS	**BV-24A**
			BREVARD COUNTY, FL
			FIFTH DREDGE LOADING & RESTING (40-50 YRS)
			EXHIBIT E-30

APPENDIX F
GROUNDWATER MODELING – WITH CONTROLS



N

0 500 1,000
Feet
1 " = 500 '

Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 1

ANDREYEV ENGINEERING, INC.

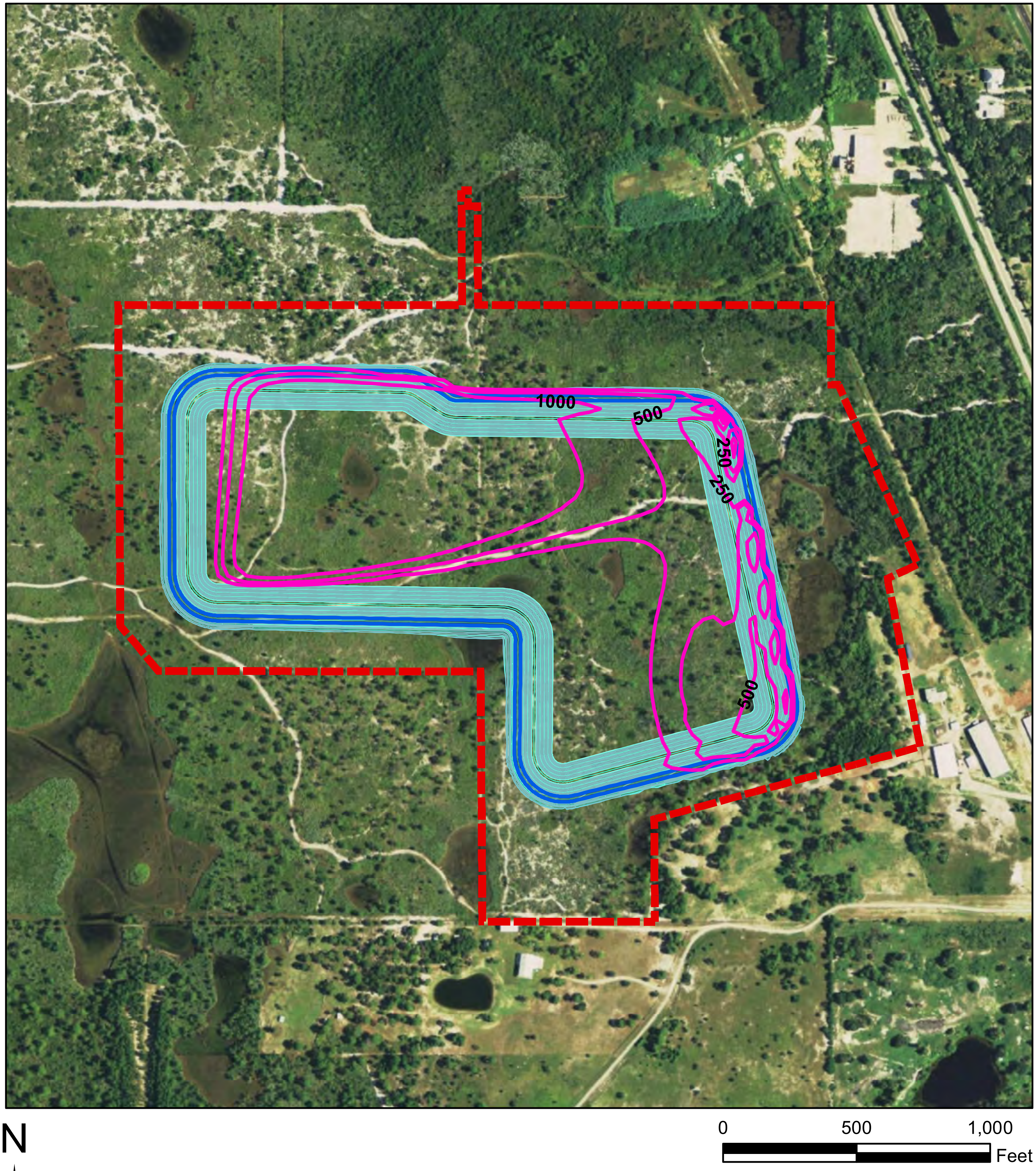
APPROXIMATE SCALE: AS SHOWN	DATE: 11/15/16	ENGINEER:NA
	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 0-10 YEAR CYCLE

Exhibit F-1



Legend:

- Property Boundary
- Perimeter Ditch
- Chloride Contour (mg/L) - Layer 1

ANDREYEV ENGINEERING, INC.

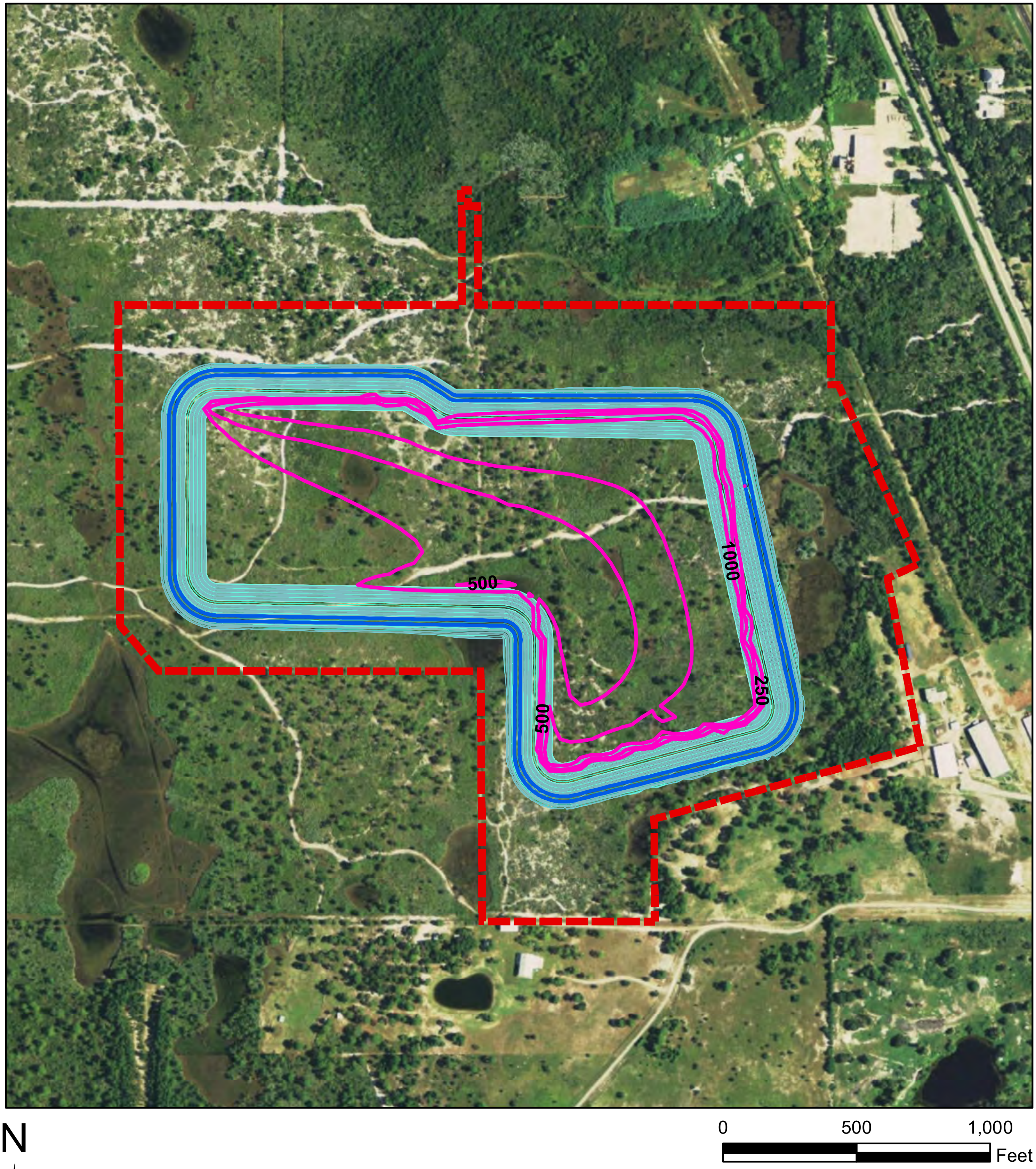
BV-24A

BREVARD COUNTY, FL

APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

CHLORIDE AT END OF 0-10 YEAR CYCLE

Exhibit F-2



Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 2

ANDREYEV ENGINEERING, INC.

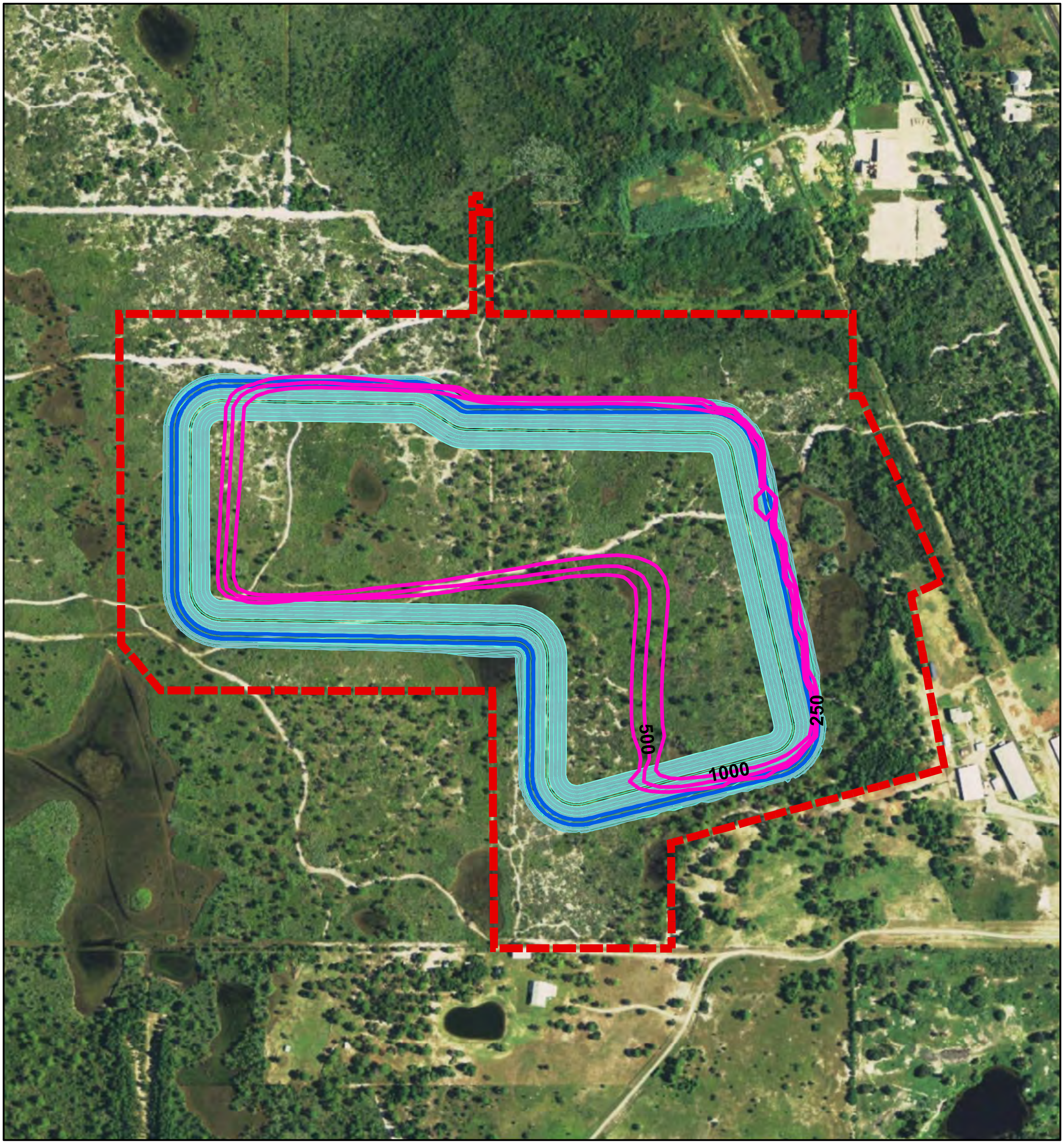
APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 0-10 YEAR CYCLE

Exhibit F-3



N

0 500 1,000

Feet

1 " = 500 '

Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 2

ANDREYEV ENGINEERING, INC.

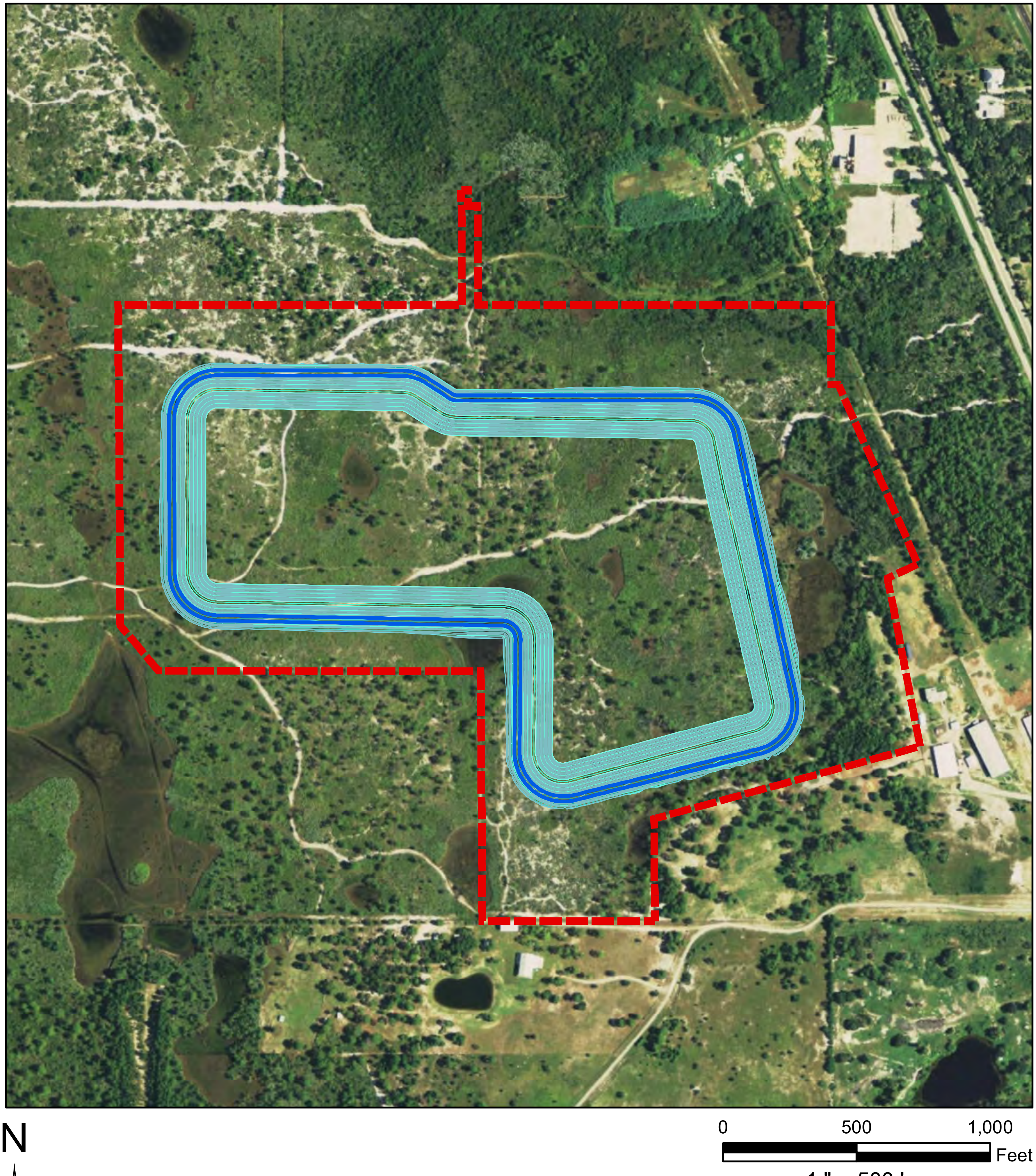
APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT END OF 0-10 YEAR CYCLE

Exhibit F-4



N

Legend:

Property Boundary
Perimeter Ditch
Chloride Contour (mg/L) - Layer 3

ANDREYEV ENGINEERING, INC.

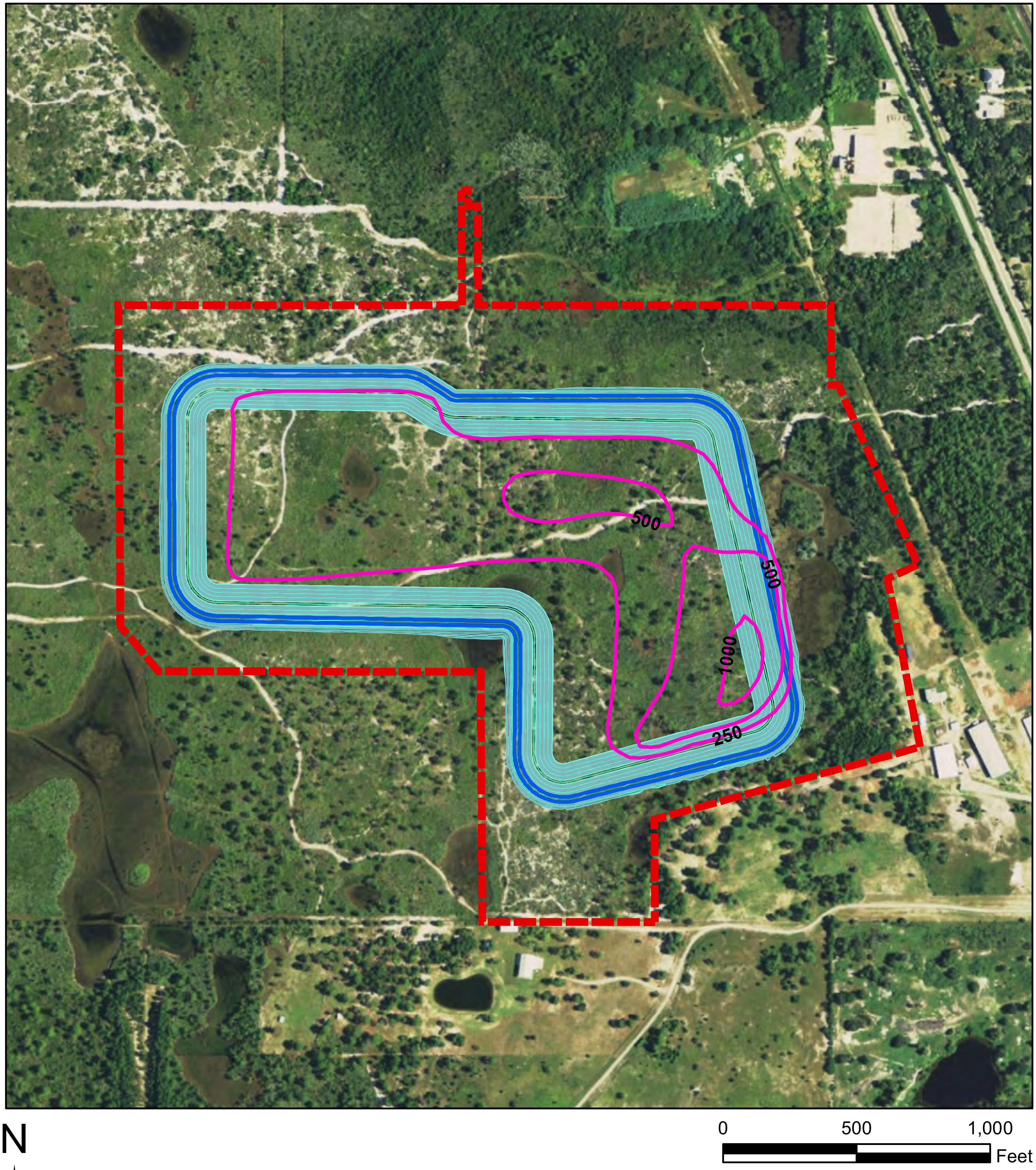
APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 0-10 YEAR CYCLE

Exhibit F-5



Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 3

ANDREYEV ENGINEERING, INC.

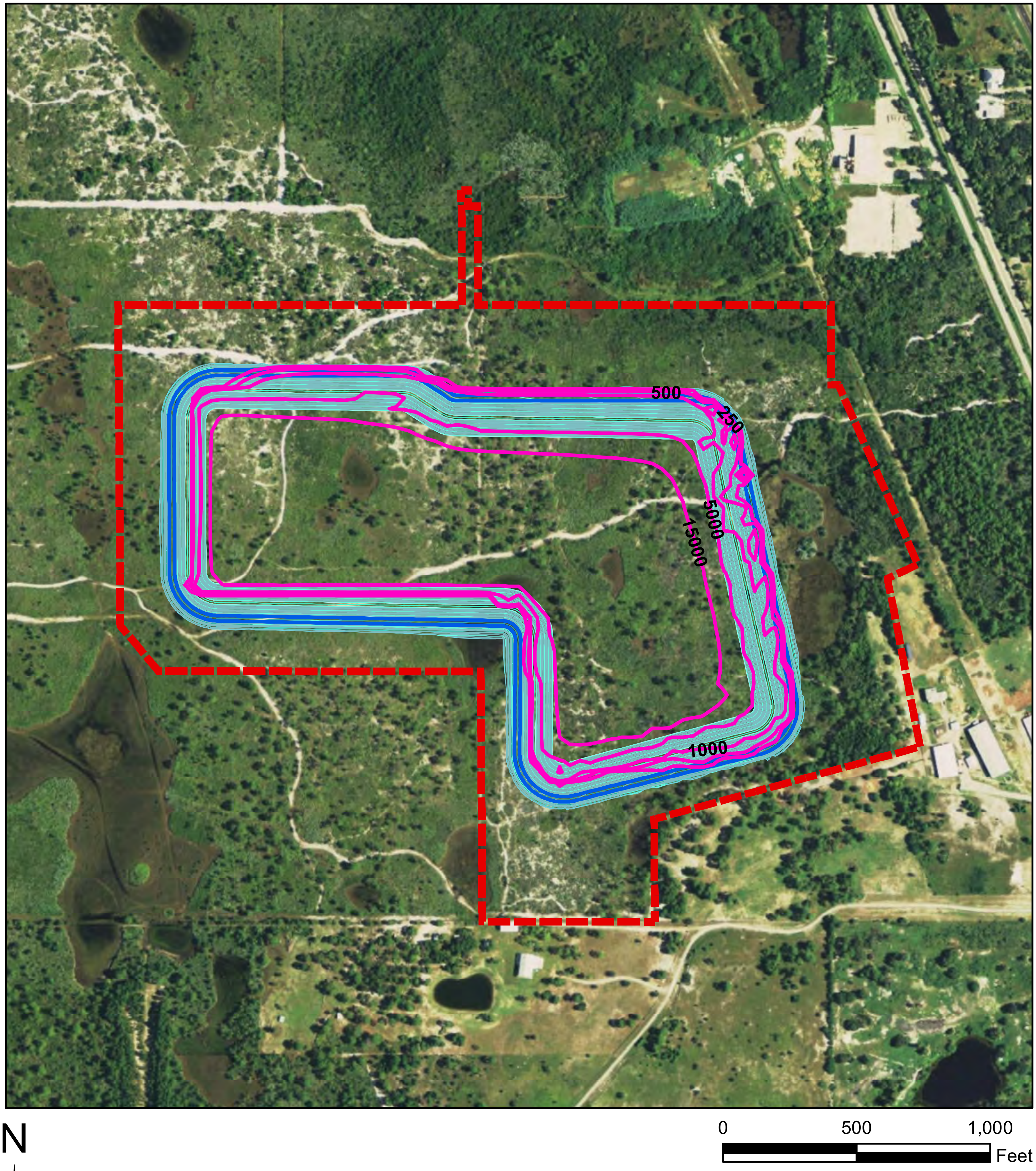
APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT END OF 0-10 YEAR CYCLE

Exhibit F-6



Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 1

ANDREYEV ENGINEERING, INC.

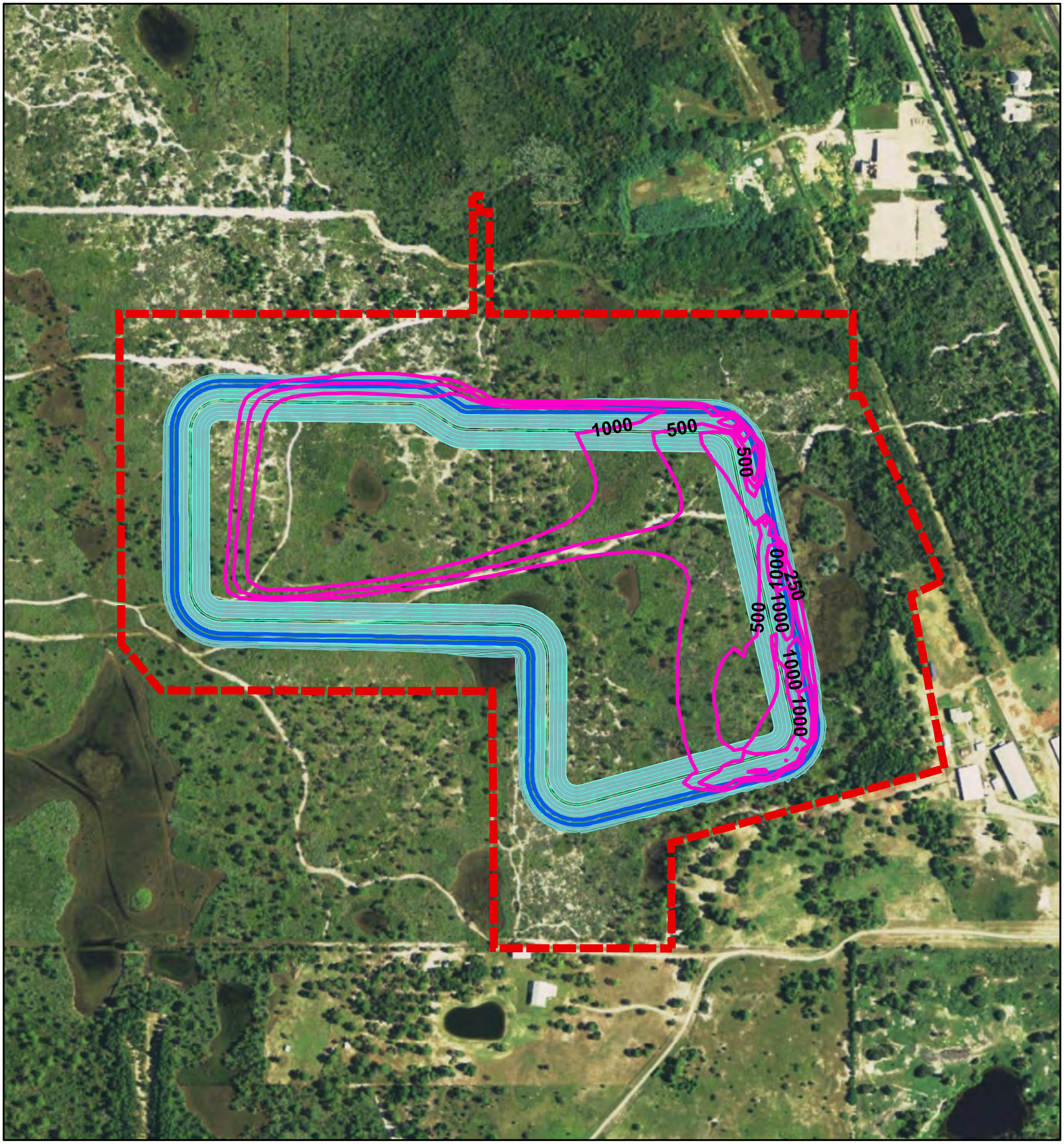
APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 10-20 YEAR CYCLE

Exhibit F-7



N

0 500 1,000

Feet

1 " = 500 '

Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 1

ANDREYEV ENGINEERING, INC.

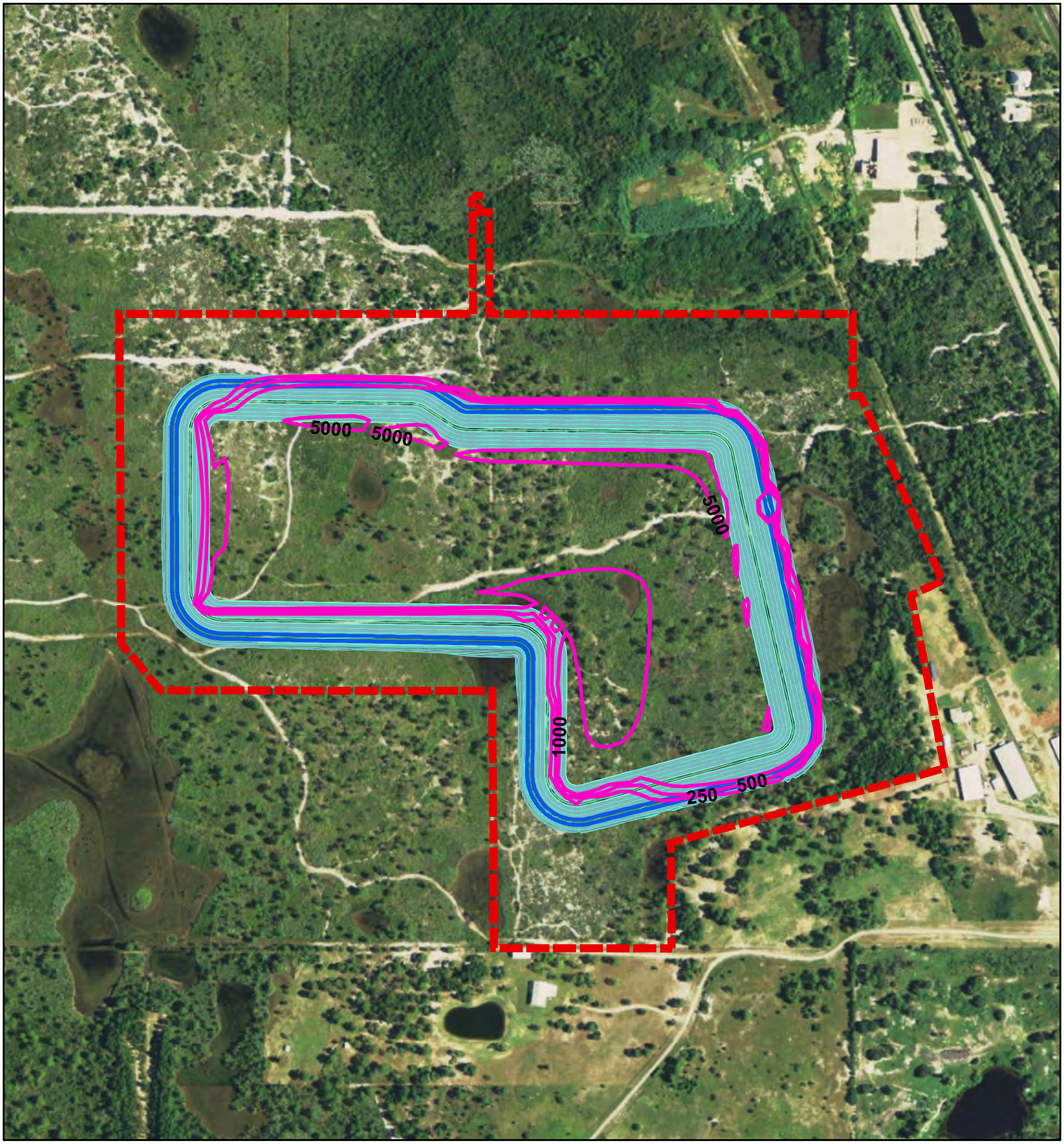
APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT END OF 10-20 YEAR CYCLE

Exhibit F-8



0 500 1,000 Feet

1 " = 500 '

N

Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 2

ANDREYEV ENGINEERING, INC.

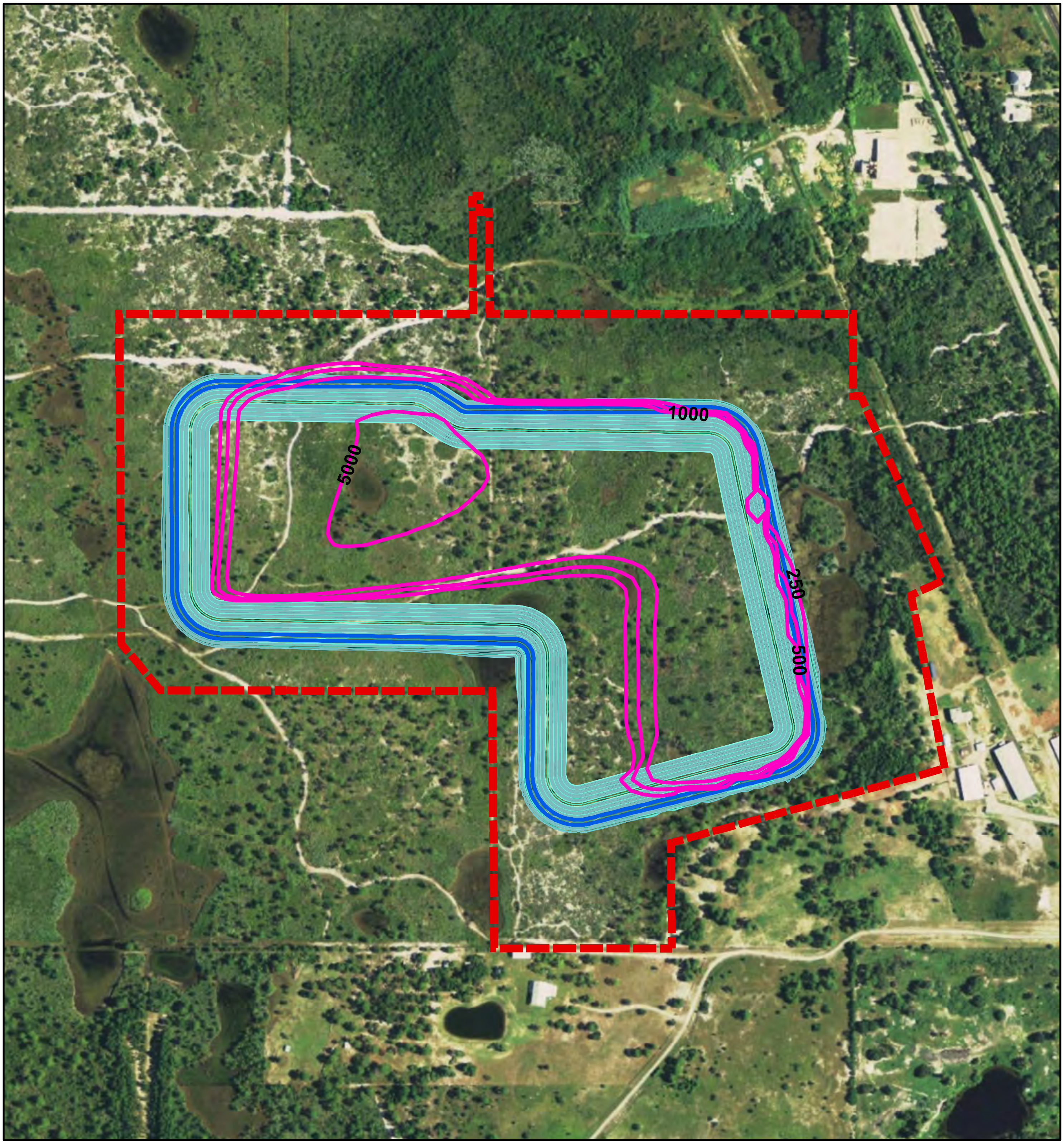
APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 10-20 YEAR CYCLE

Exhibit F-9



N

0 500 1,000
Feet
1 " = 500 '

Legend:
Property Boundary
Perimeter Ditch
Chloride Contour (mg/L) - Layer 2

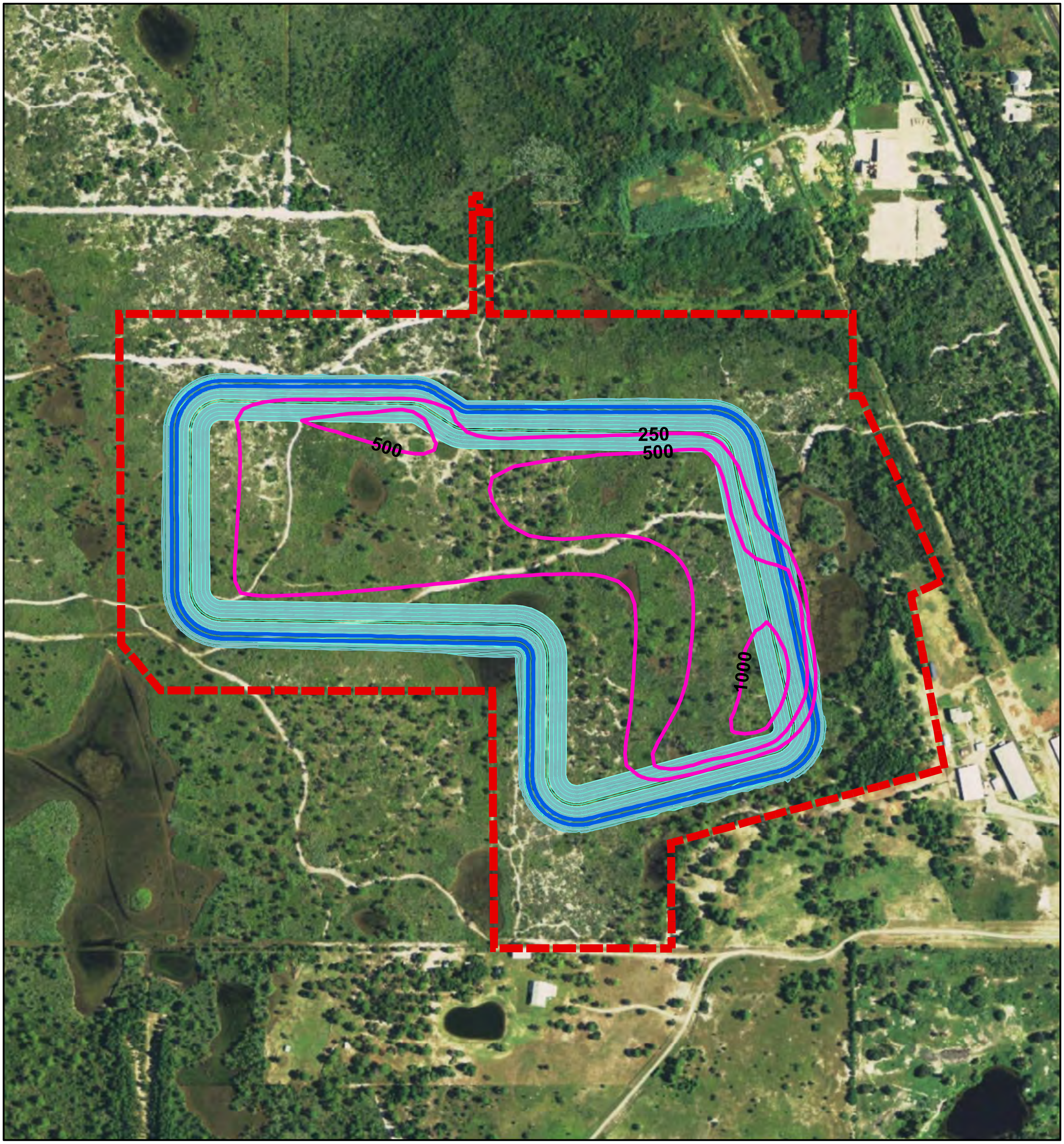
ANDREYEV ENGINEERING, INC.

APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A
BREVARD COUNTY, FL

CHLORIDE AT END OF 10-20 YEAR CYCLE

Exhibit F-10



N

0
500
1,000
Feet

1 " = 500 '

Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 3

ANDREYEV ENGINEERING, INC.

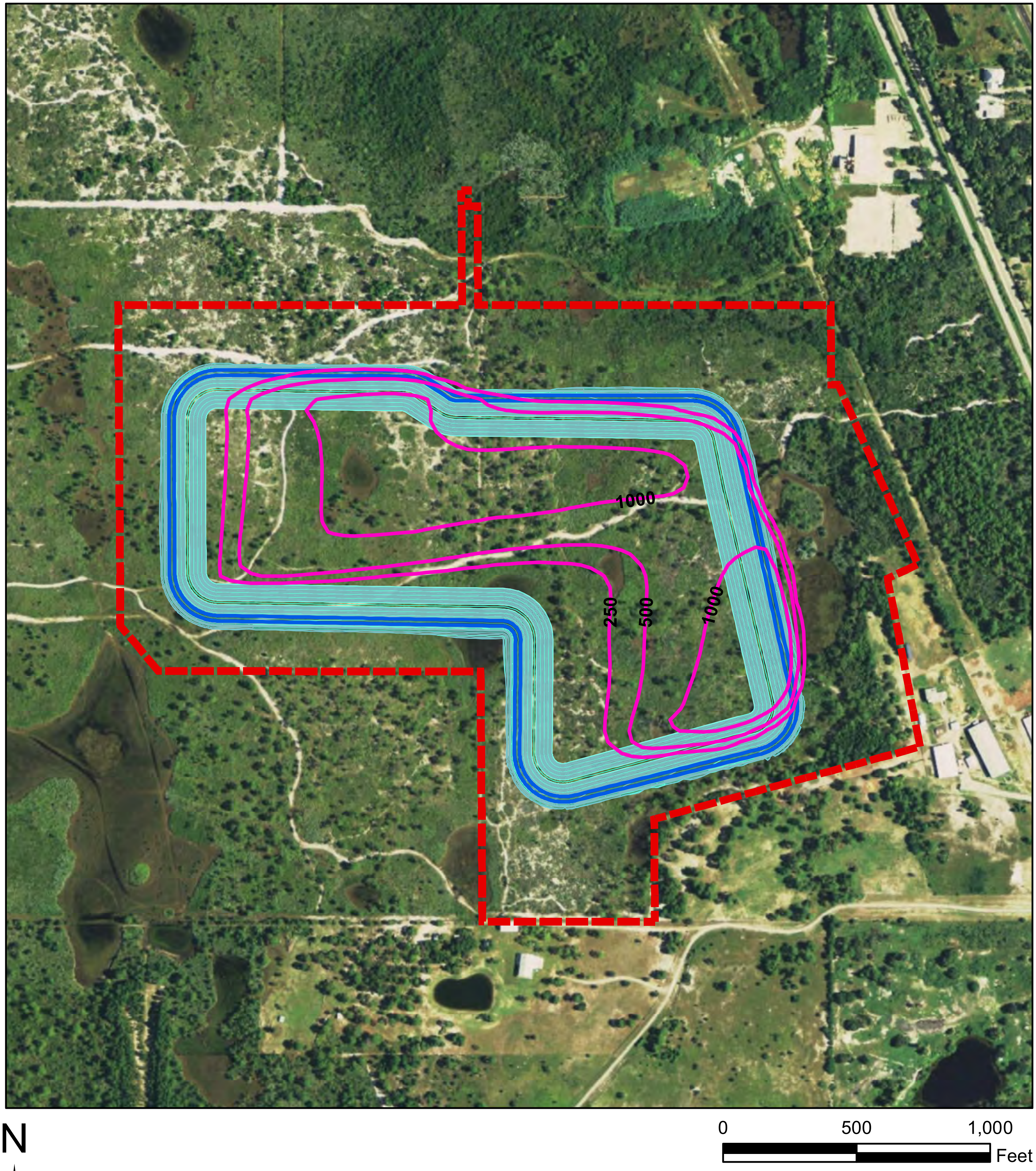
APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 10-20 YEAR CYCLE

Exhibit F-11



Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 3

ANDREYEV ENGINEERING, INC.

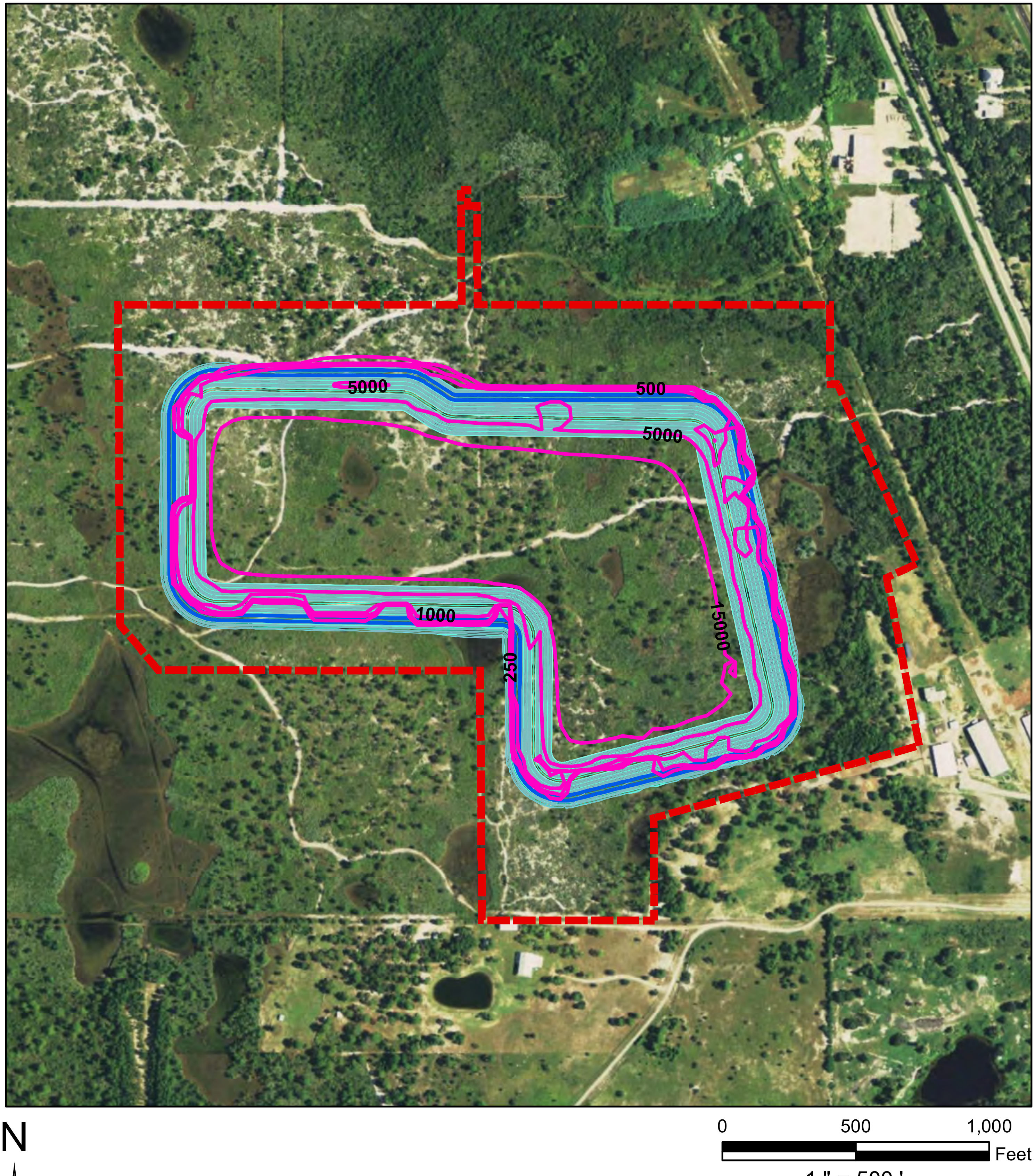
APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT END OF 10-20 YEAR CYCLE

Exhibit F-12



Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 1

ANDREYEV ENGINEERING, INC.

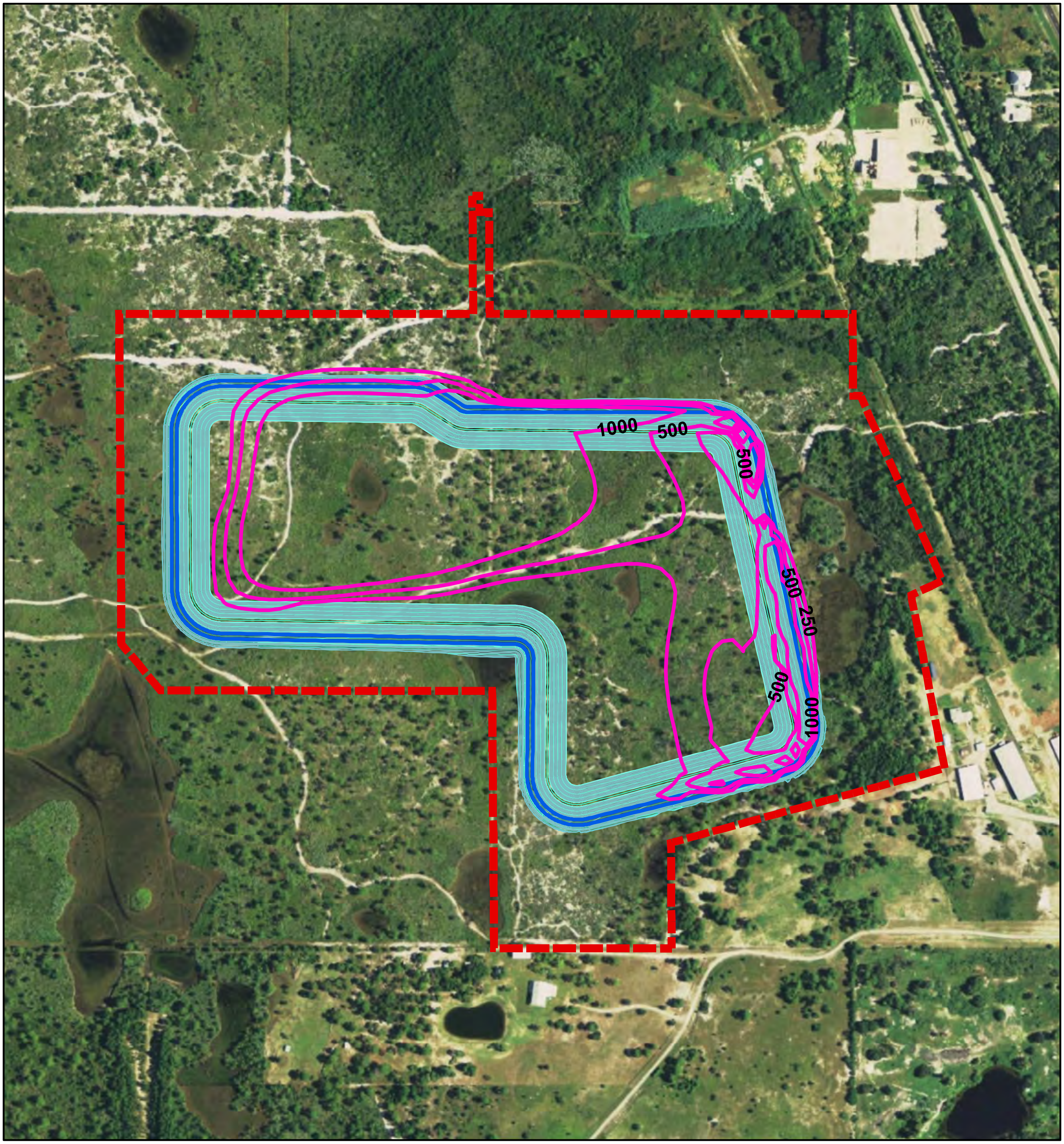
APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 20-30 YEAR CYCLE

Exhibit F-13



0 500 1,000 Feet

1 " = 500 '

N

Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 1

ANDREYEV ENGINEERING, INC.

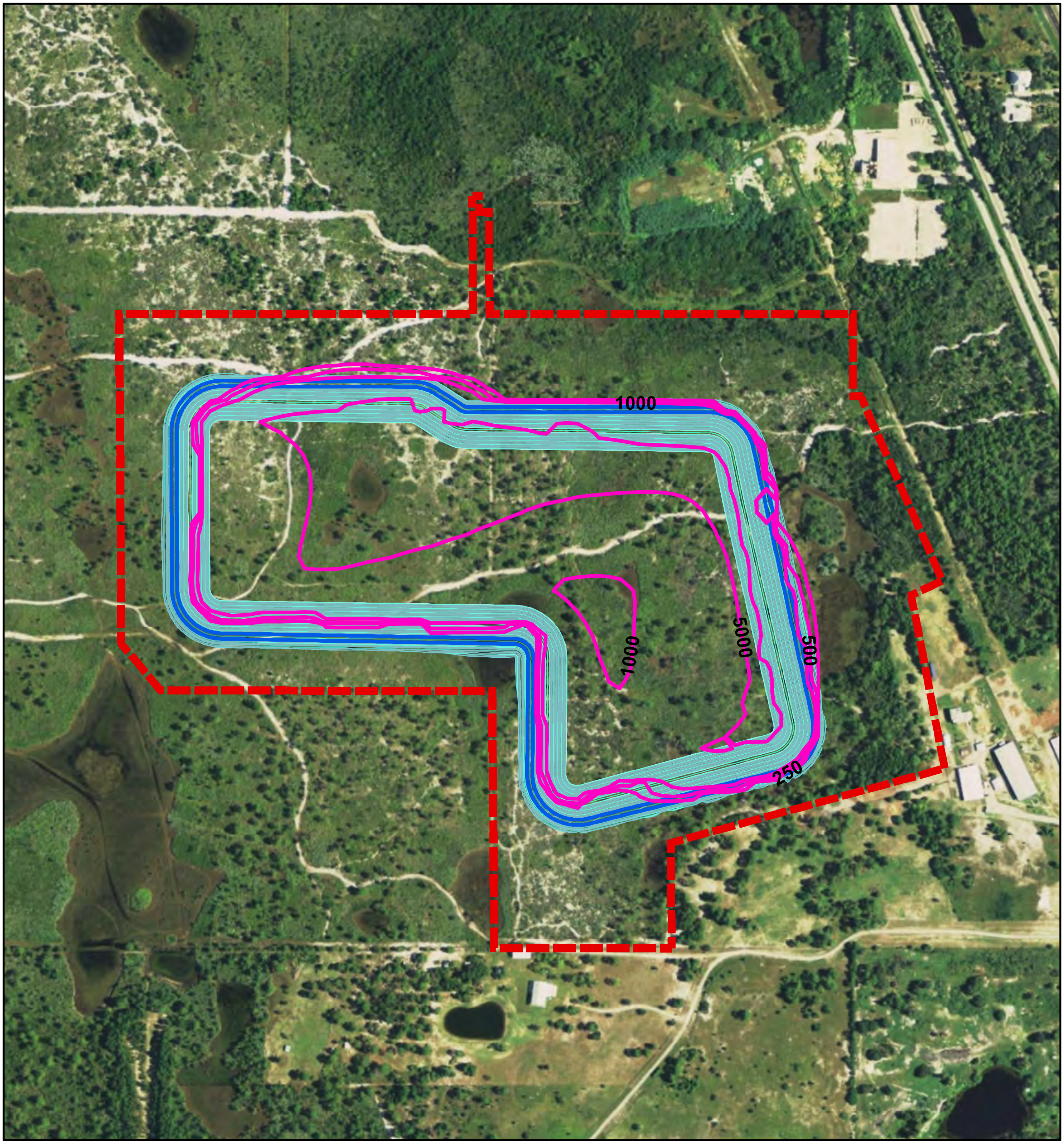
APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT END OF 20-30 YEAR CYCLE

Exhibit F-14



N

0 500 1,000
Feet
1 " = 500 '

Legend:

Property Boundary
Perimeter Ditch
Chloride Contour (mg/L) - Layer 2

ANDREYEV ENGINEERING, INC.

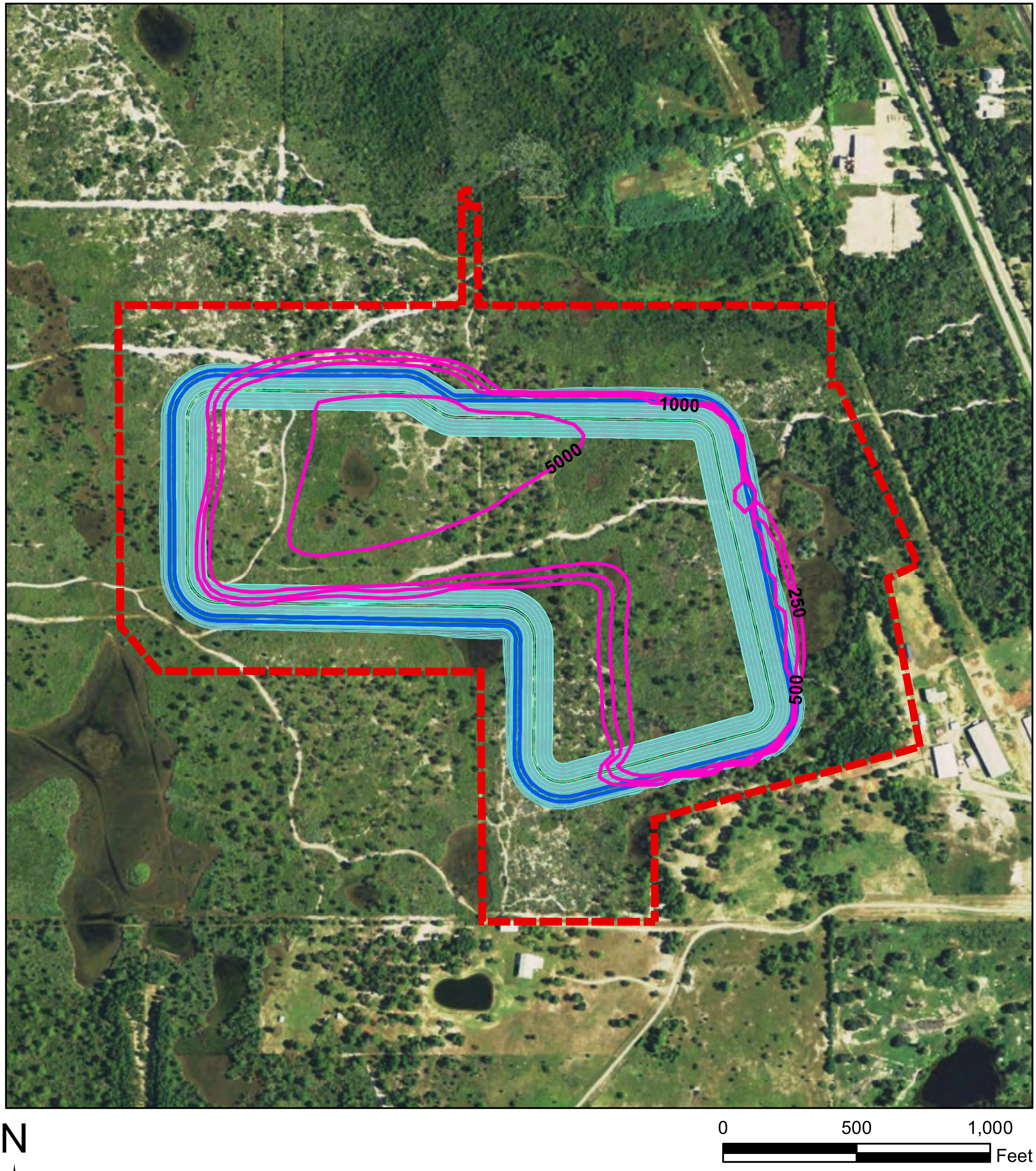
APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 20-30 YEAR CYCLE

Exhibit F-15



Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 2

ANDREYEV ENGINEERING, INC.

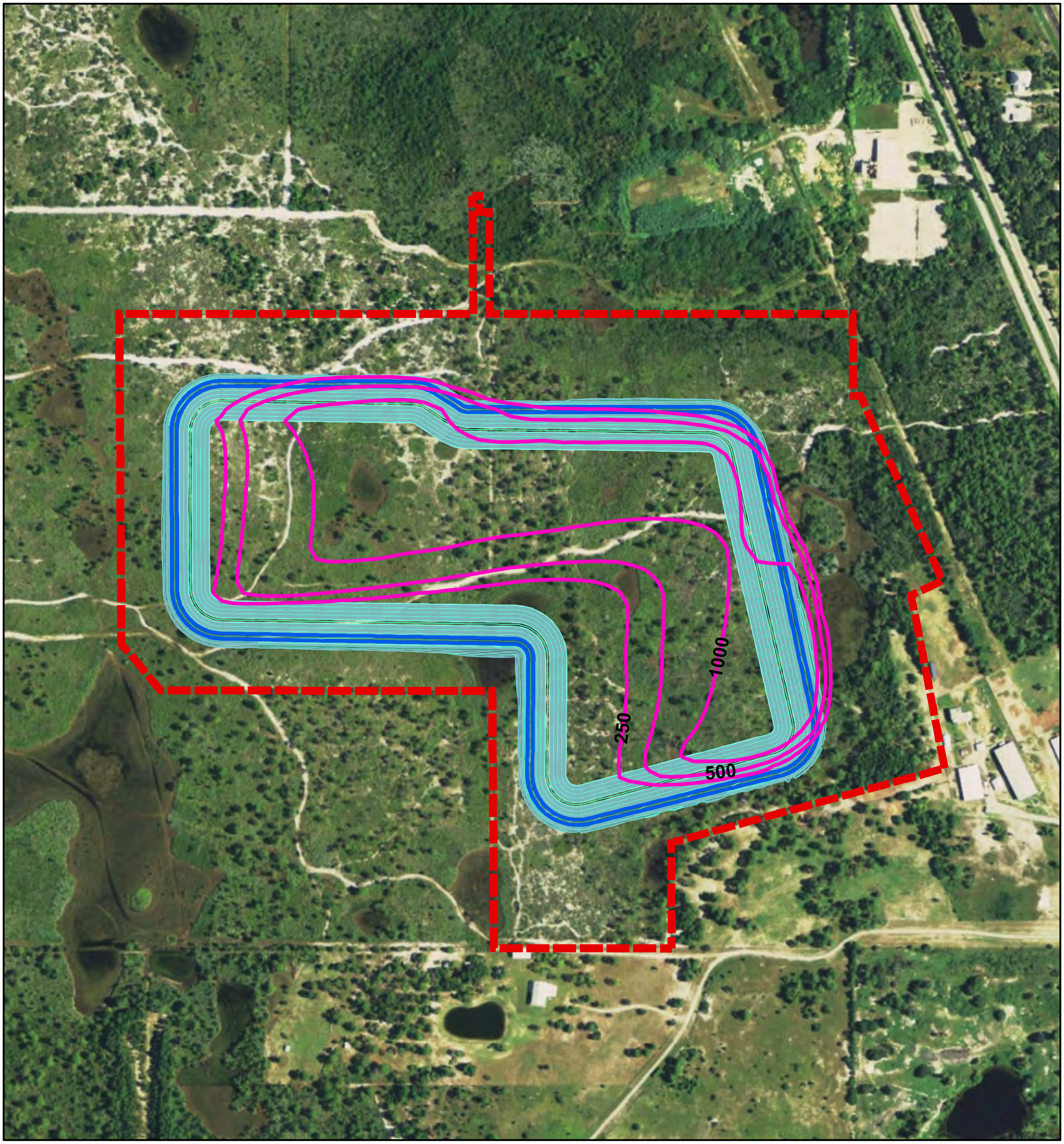
APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT END OF 20-30 YEAR CYCLE

Exhibit F-16



N

0
500
1,000
Feet
1 " = 500 '

Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 3

ANDREYEV ENGINEERING, INC.

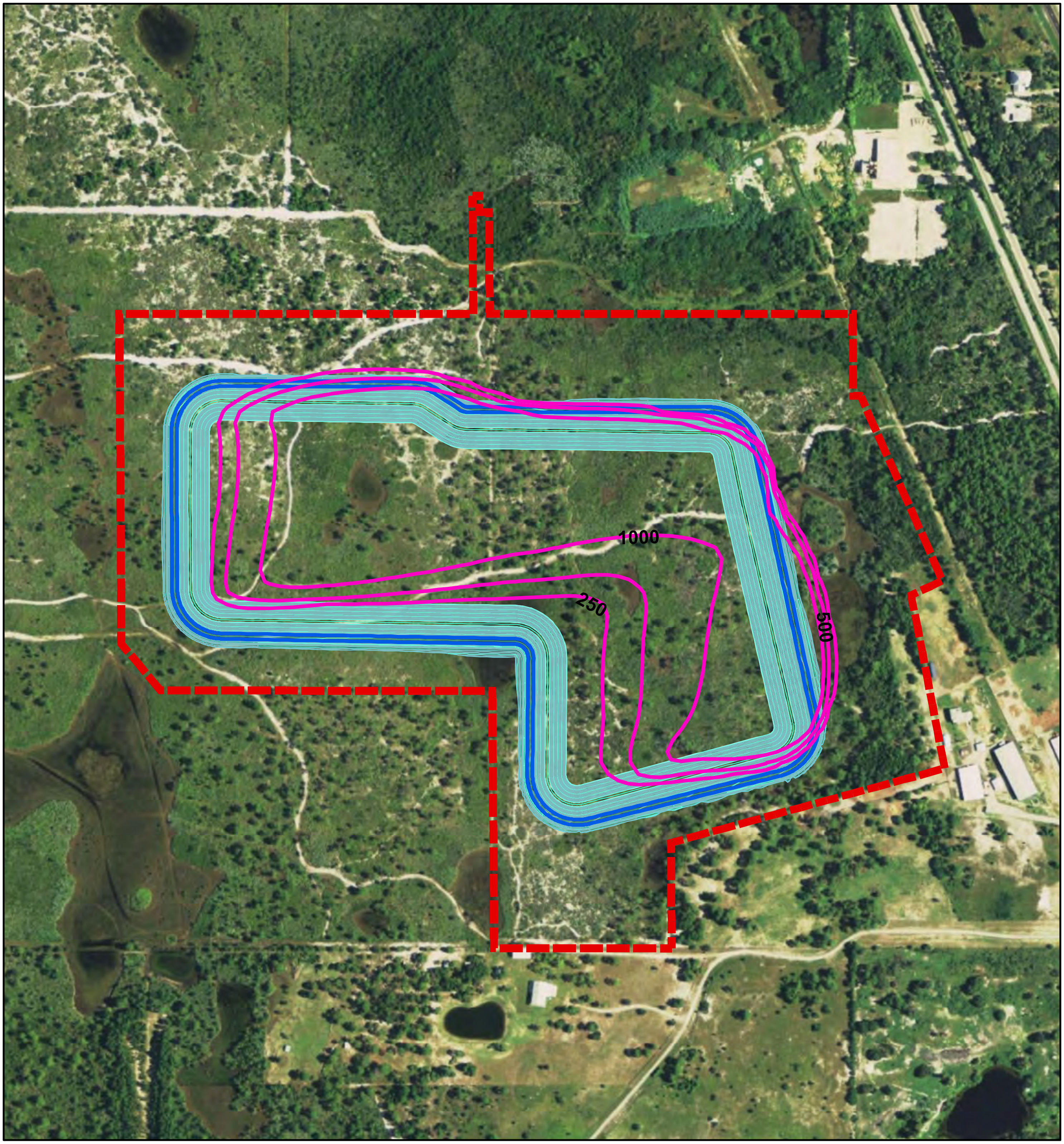
APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 20-30 YEAR CYCLE

Exhibit F-17



N

0 500 1,000
Feet
1 " = 500 '

Legend:

Property Boundary
Perimeter Ditch
Chloride Contour (mg/L) - Layer 3

ANDREYEV ENGINEERING, INC.

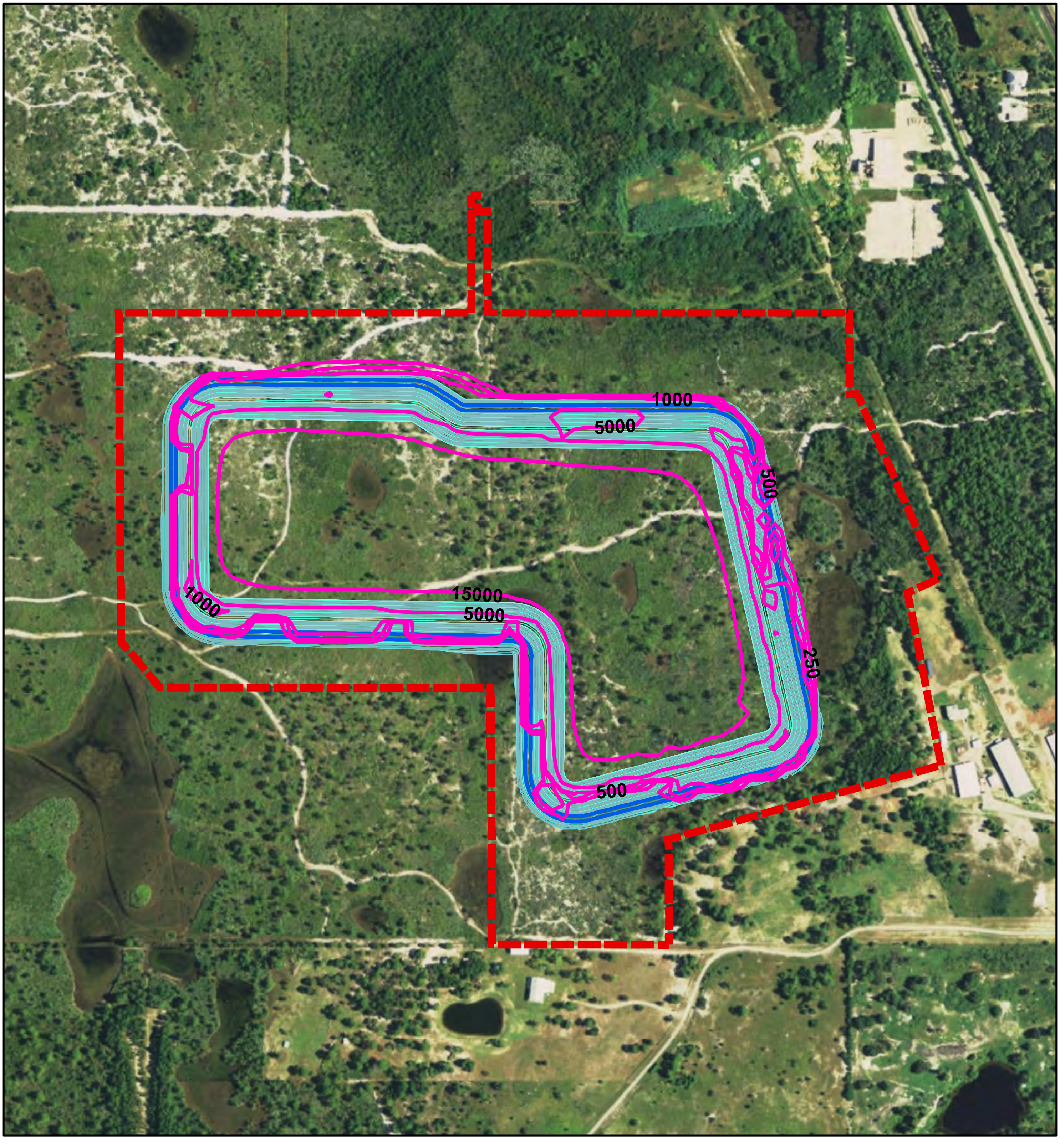
APPROXIMATE SCALE: AS SHOWN	DATE: 11/17/16	ENGINEER:NA
	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT END OF 20-30 YEAR CYCLE

Exhibit F-18



Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 1

ANDREYEV ENGINEERING, INC.

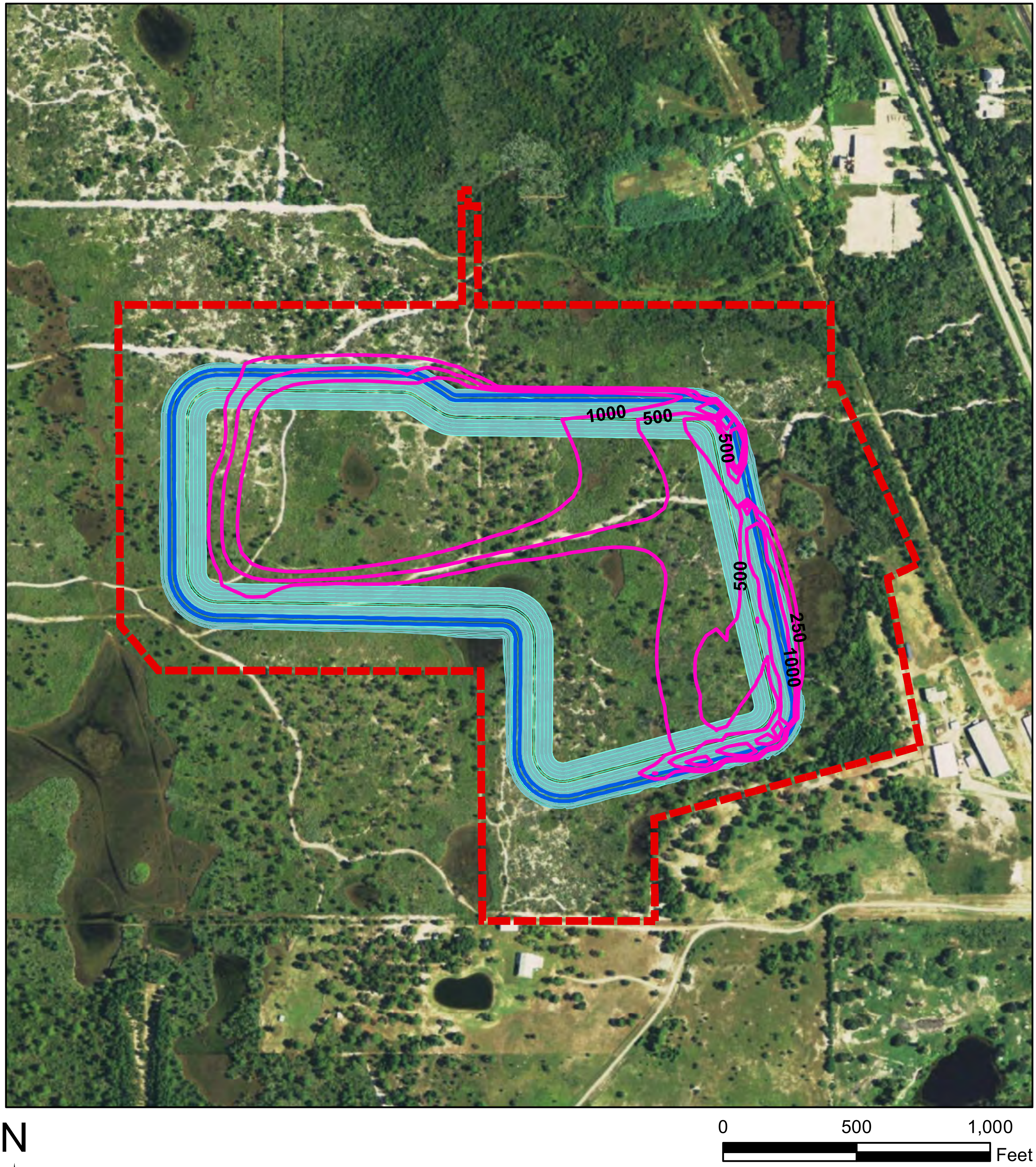
APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 30-40 YEAR CYCLE

Exhibit F-19



Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 1

ANDREYEV ENGINEERING, INC.

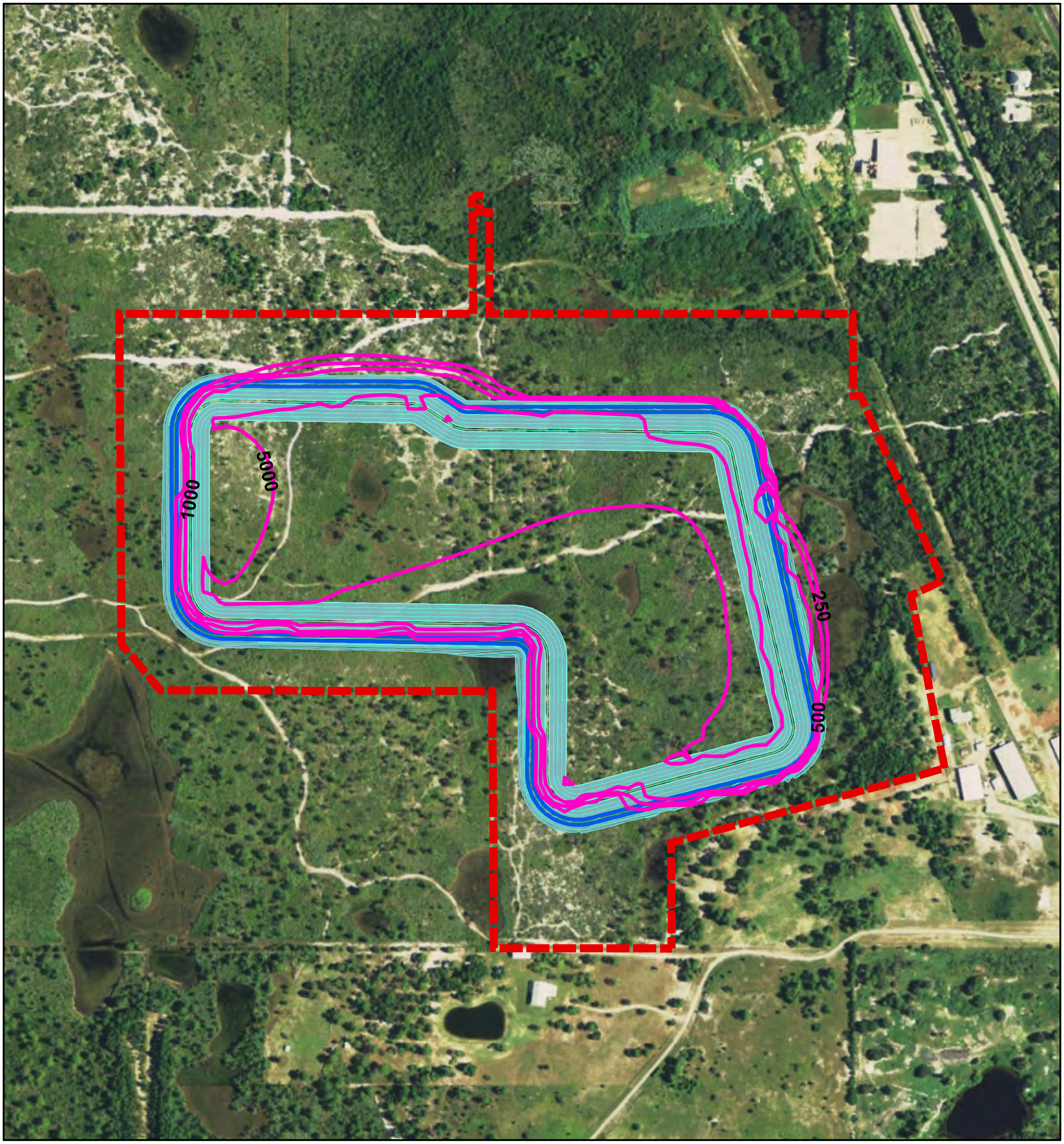
APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT END OF 30-40 YEAR CYCLE

Exhibit F-20



N

0 500 1,000
Feet
1 " = 500 '

Legend:

Property Boundary
Perimeter Ditch
Chloride Contour (mg/L) - Layer 2

ANDREYEV ENGINEERING, INC.

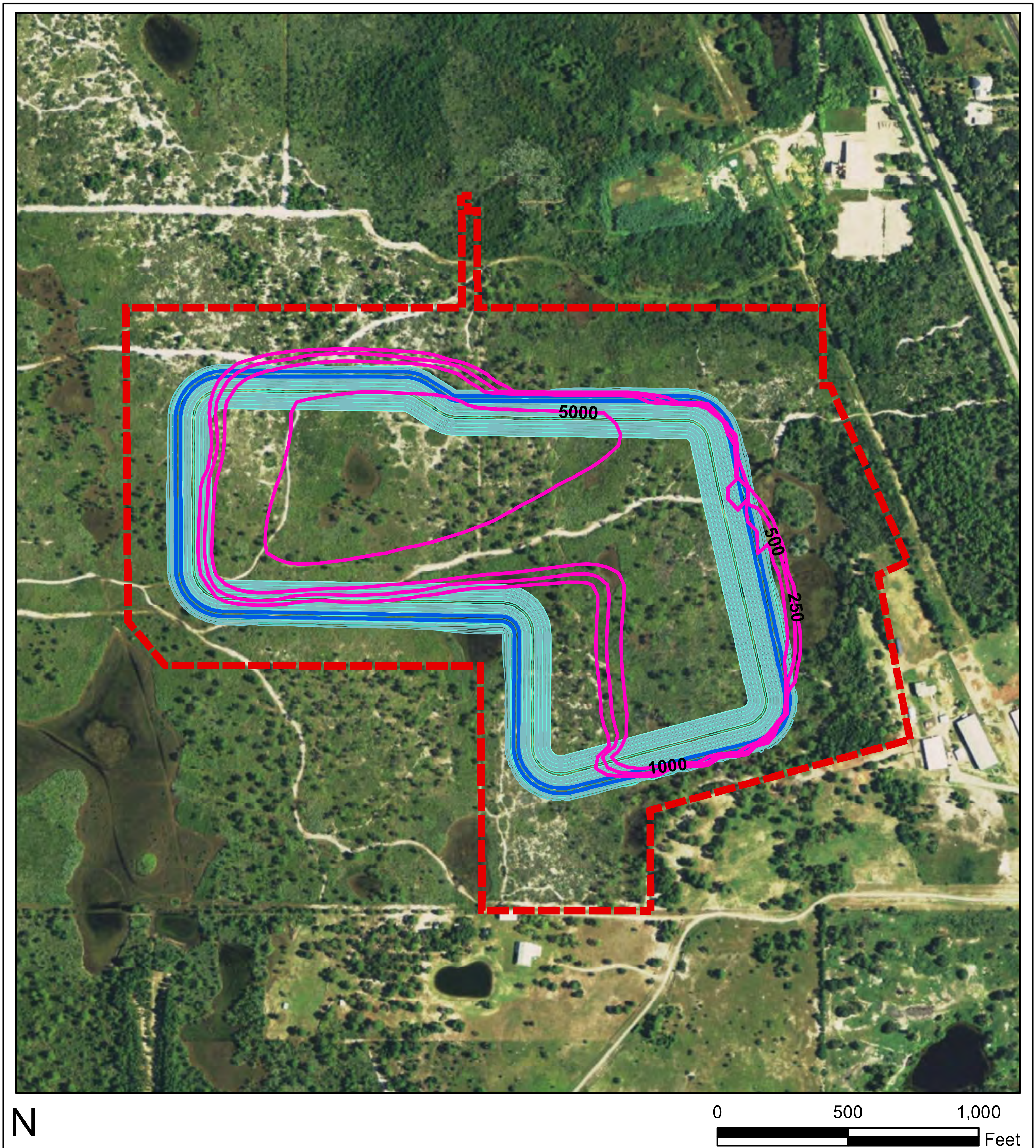
APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 30-40 YEAR CYCLE

Exhibit F-21



Legend:

- Property Boundary
- Perimeter Ditch
- Chloride Contour (mg/L) - Layer 2

ANDREYEV ENGINEERING, INC.

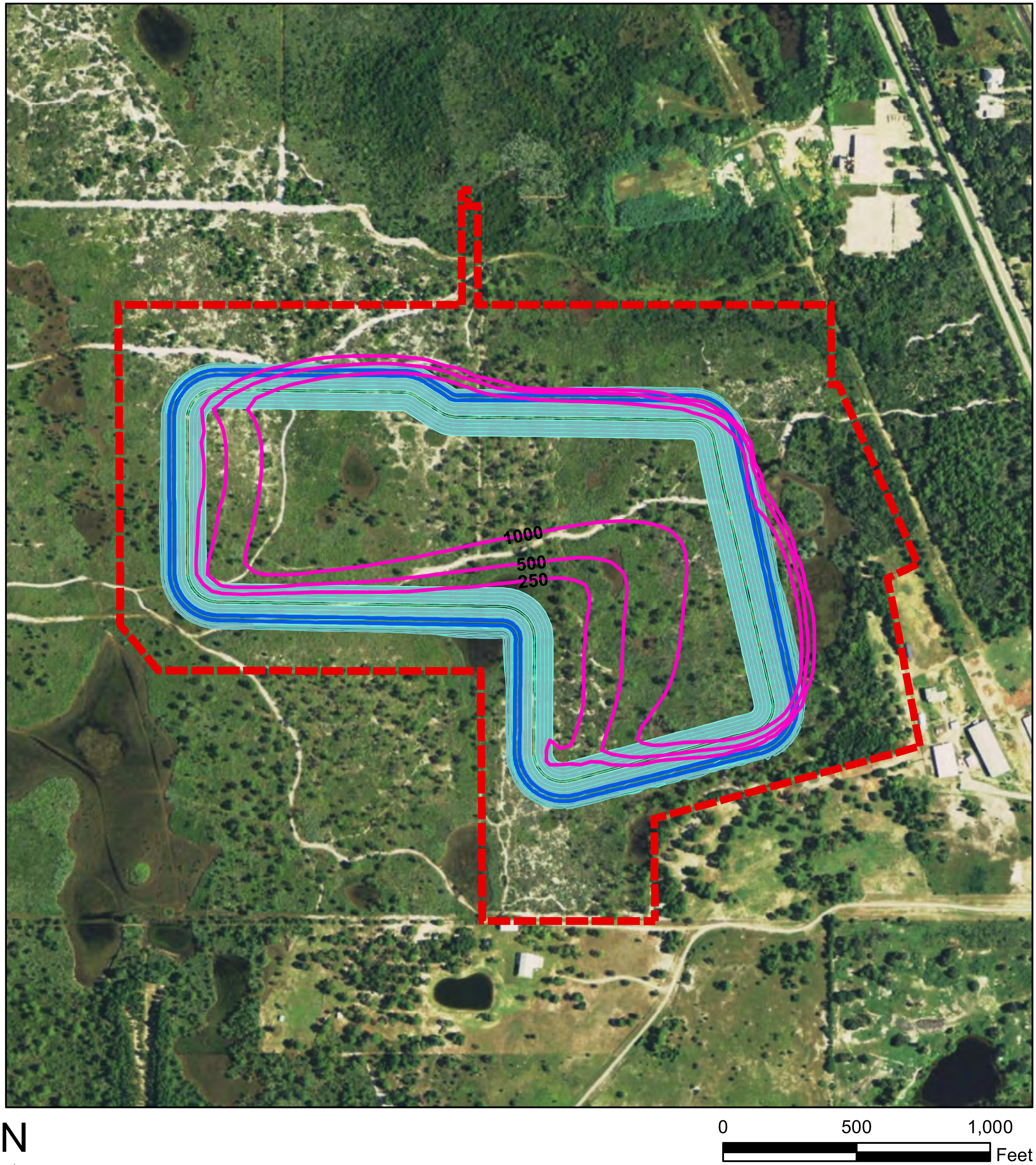
APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT END OF 30-40 YEAR CYCLE

Exhibit F-22



Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 3

ANDREYEV ENGINEERING, INC.

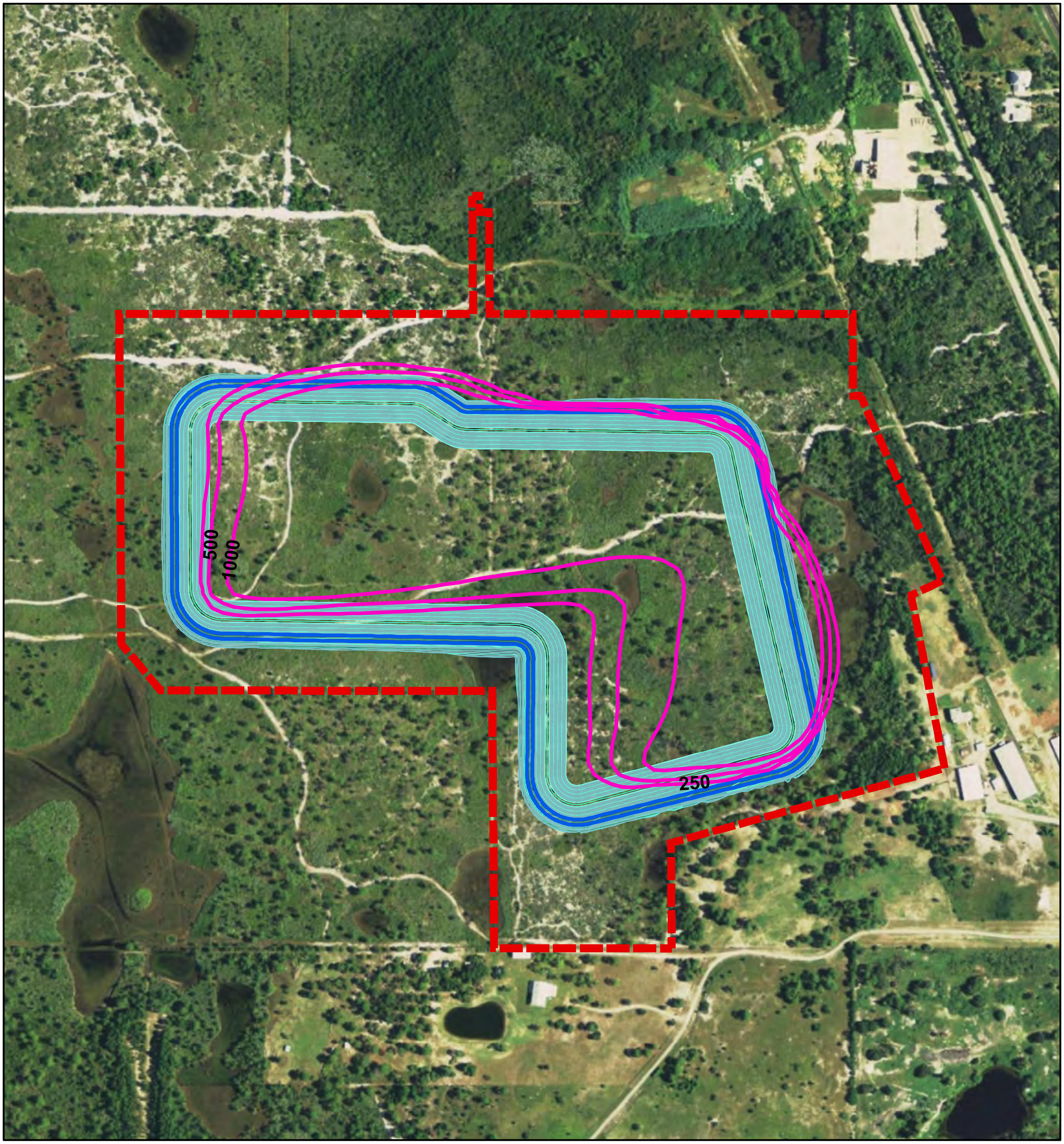
APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 30-40 YEAR CYCLE

Exhibit F-23



Legend:

- Property Boundary
- Perimeter Ditch
- Chloride Contour (mg/L) - Layer 3

ANDREYEV ENGINEERING, INC.

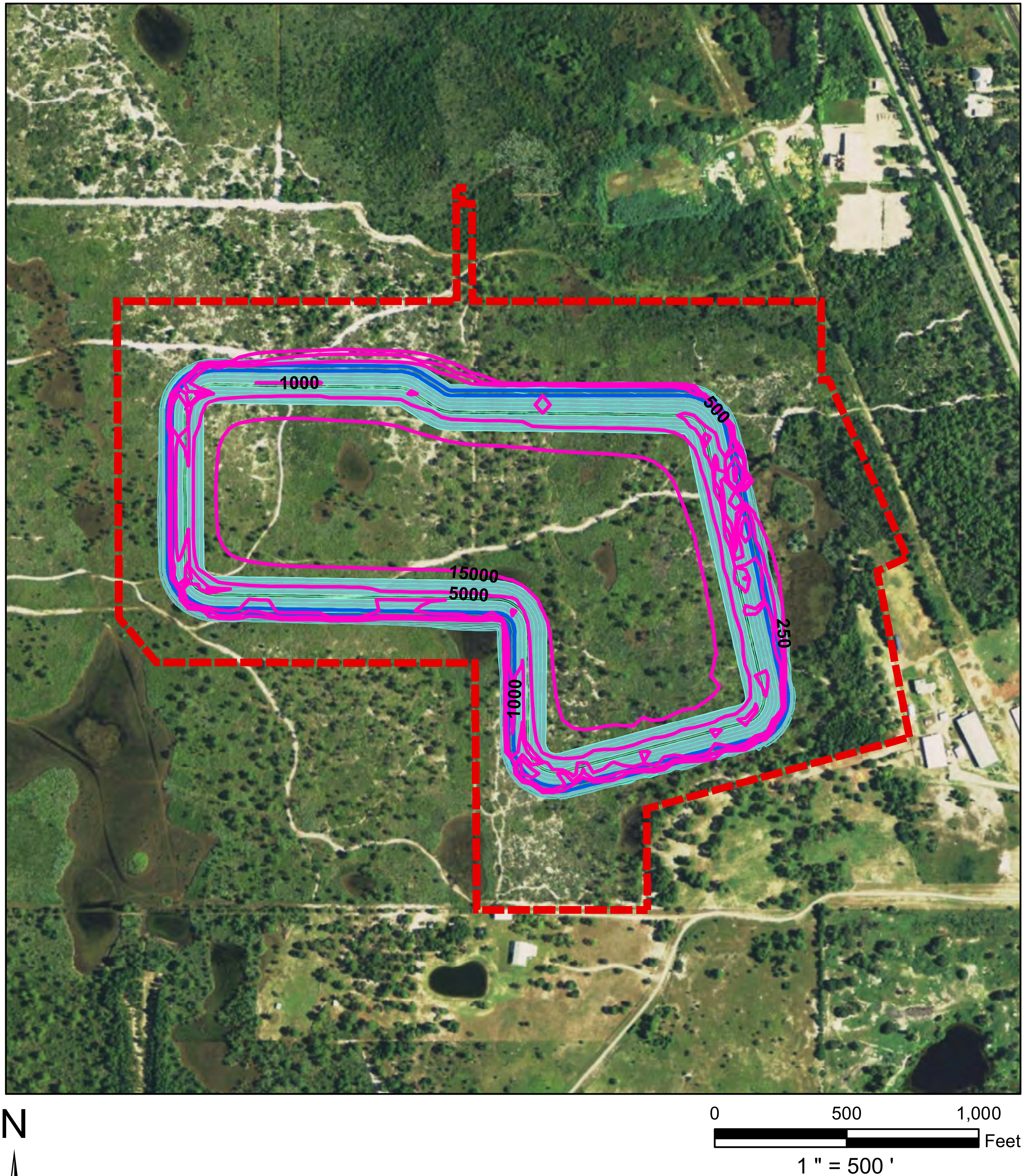
APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT END OF 30-40 YEAR CYCLE

Exhibit F-24



Legend:

Property Boundary
Perimeter Ditch
Chloride Contour (mg/L) - Layer 1

ANDREYEV ENGINEERING, INC.

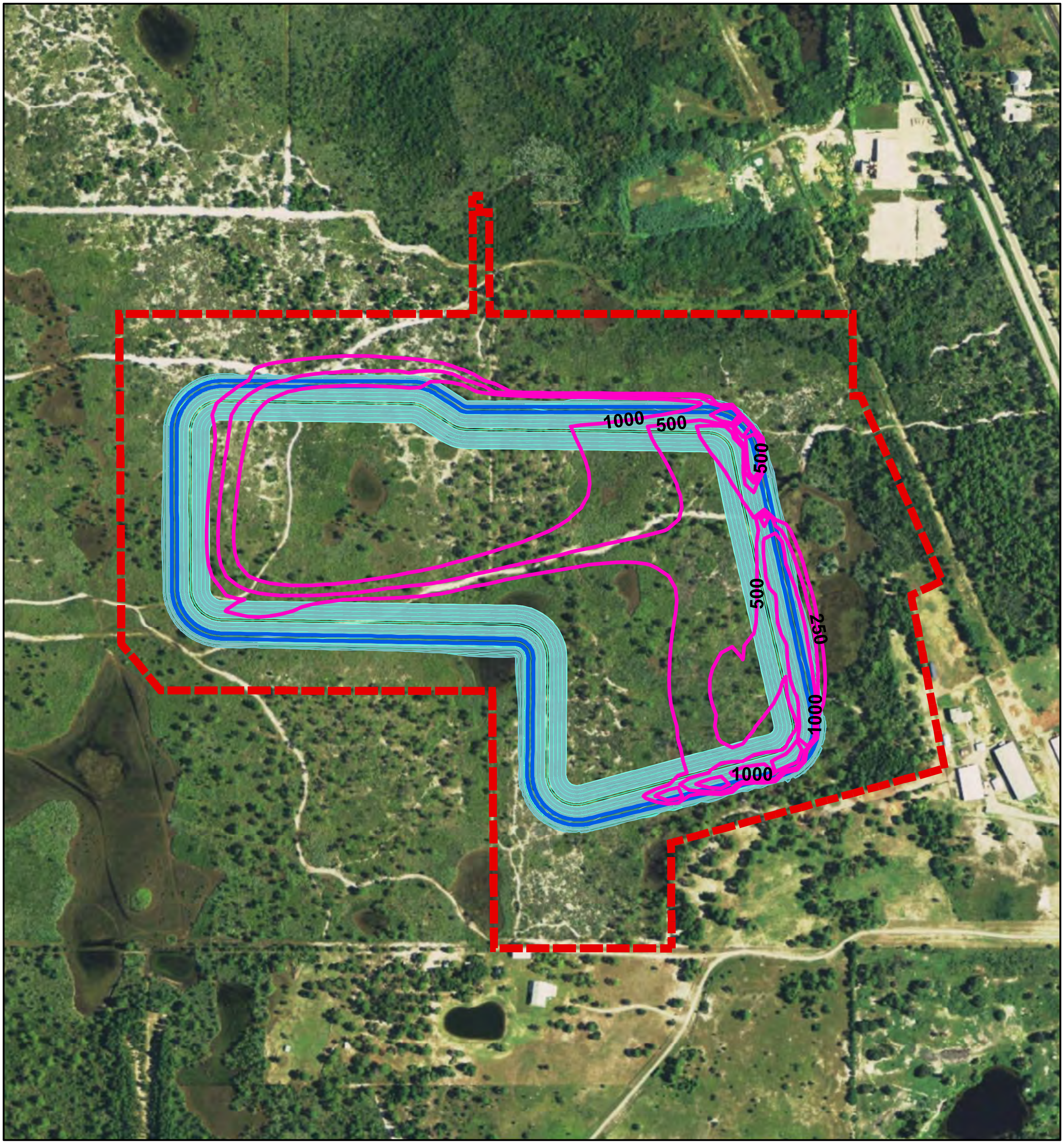
APPROXIMATE SCALE: AS SHOWN	DATE: 11/15/16	ENGINEER:NA
	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 40-50 YEAR CYCLE

Exhibit F-25



0 500 1,000 Feet

1 " = 500 '

N

Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 1

ANDREYEV ENGINEERING, INC.

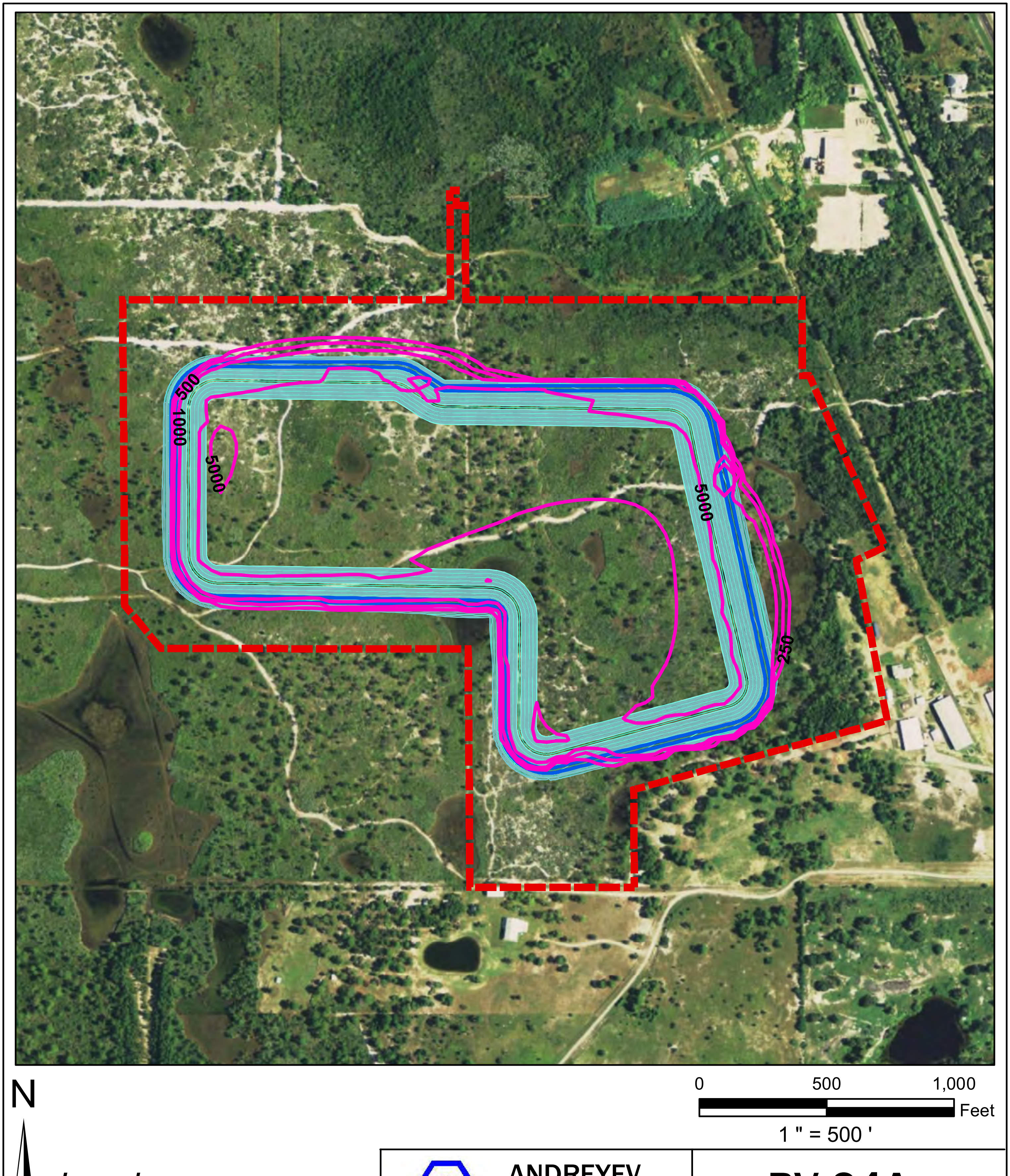
APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT END OF 40-50 YEAR CYCLE

Exhibit F-26



Legend:

Property Boundary
Perimeter Ditch
Chloride Contour (mg/L) - Layer 2

ANDREYEV ENGINEERING, INC.

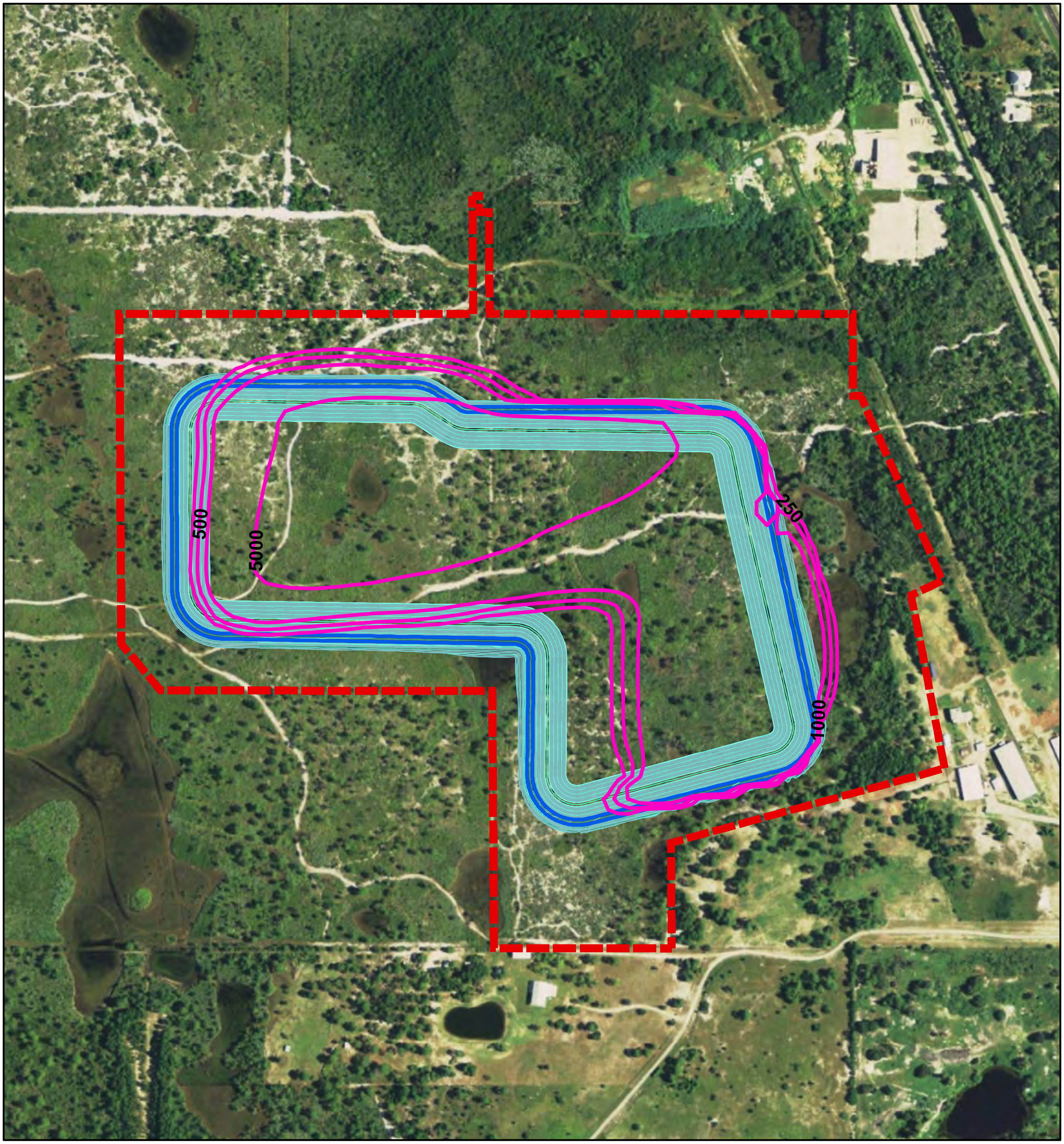
APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 40-50 YEAR CYCLE

Exhibit F-27



N

0 500 1,000
Feet
1 " = 500 '

Legend:

Property Boundary
Perimeter Ditch
Chloride Contour (mg/L) - Layer 2

ANDREYEV ENGINEERING, INC.

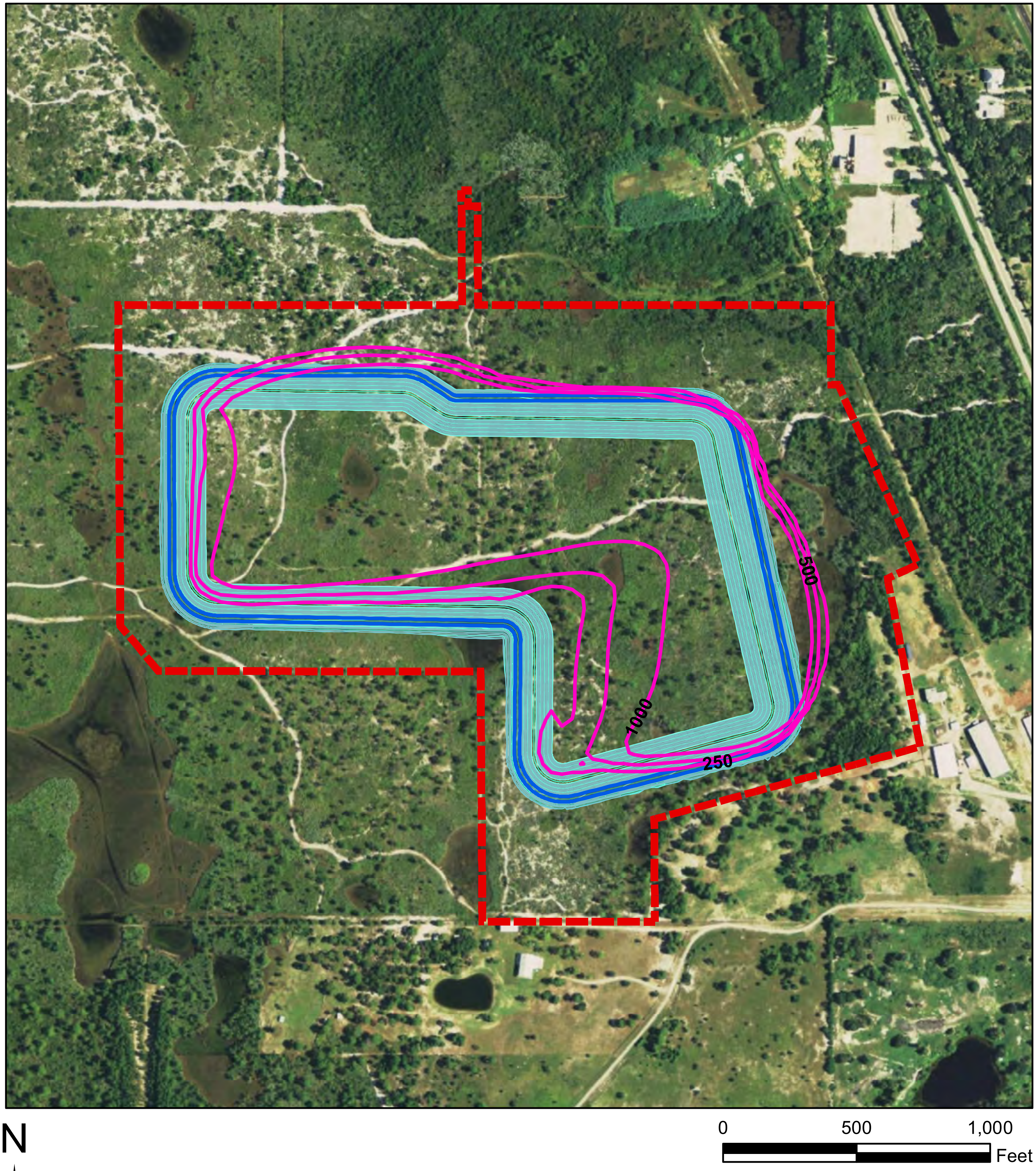
APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT END OF 40-50 YEAR CYCLE

Exhibit F-28



Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 3

ANDREYEV ENGINEERING, INC.

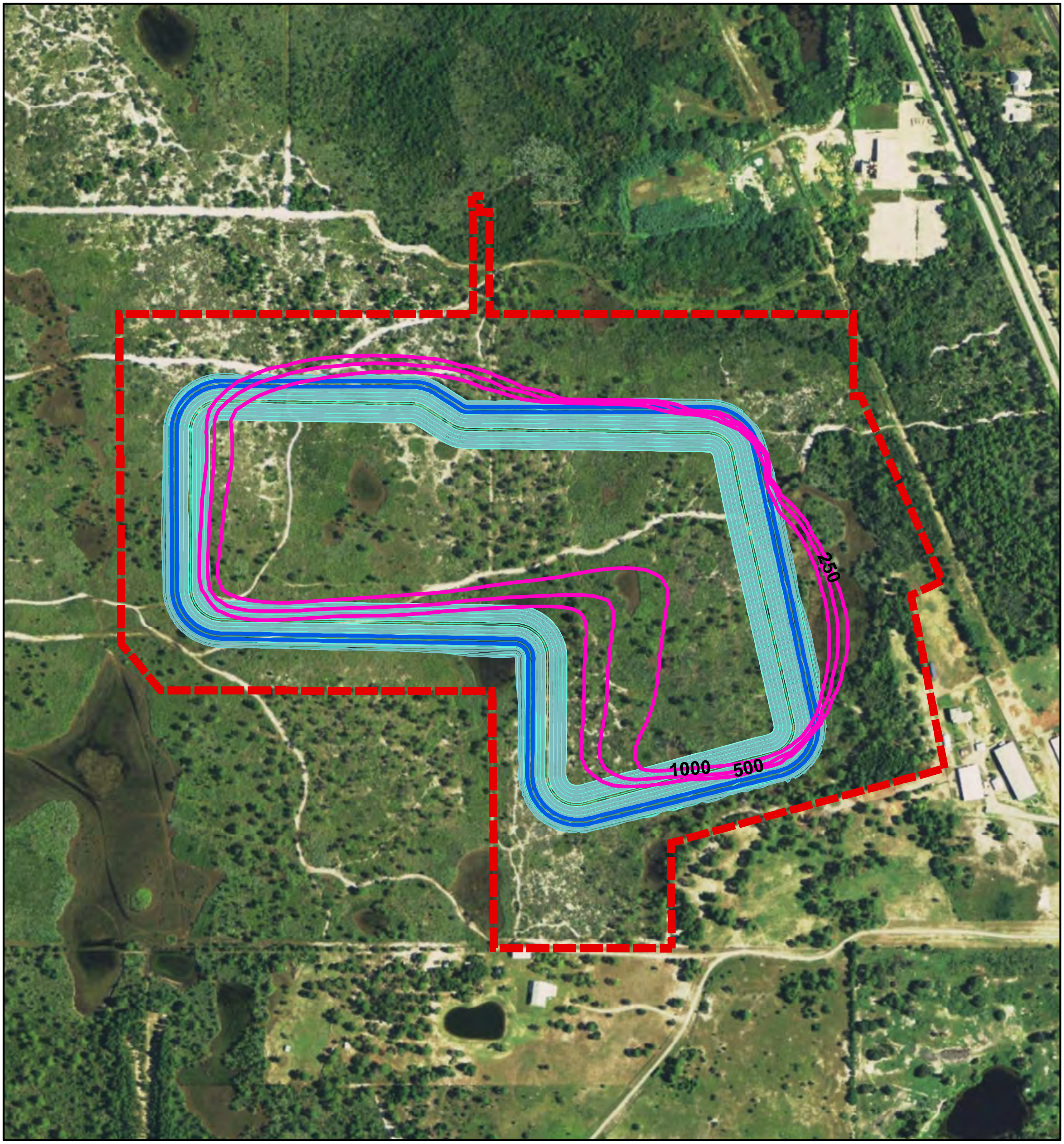
BV-24A

BREVARD COUNTY, FL

CHLORIDE AT 30 DAYS AFTER LOADING FOR 40-50 YEAR CYCLE

APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

Exhibit F-29



N

0 500 1,000 Feet

1 " = 500 '

Legend:

Property Boundary

Perimeter Ditch

Chloride Contour (mg/L) - Layer 3

ANDREYEV ENGINEERING, INC.

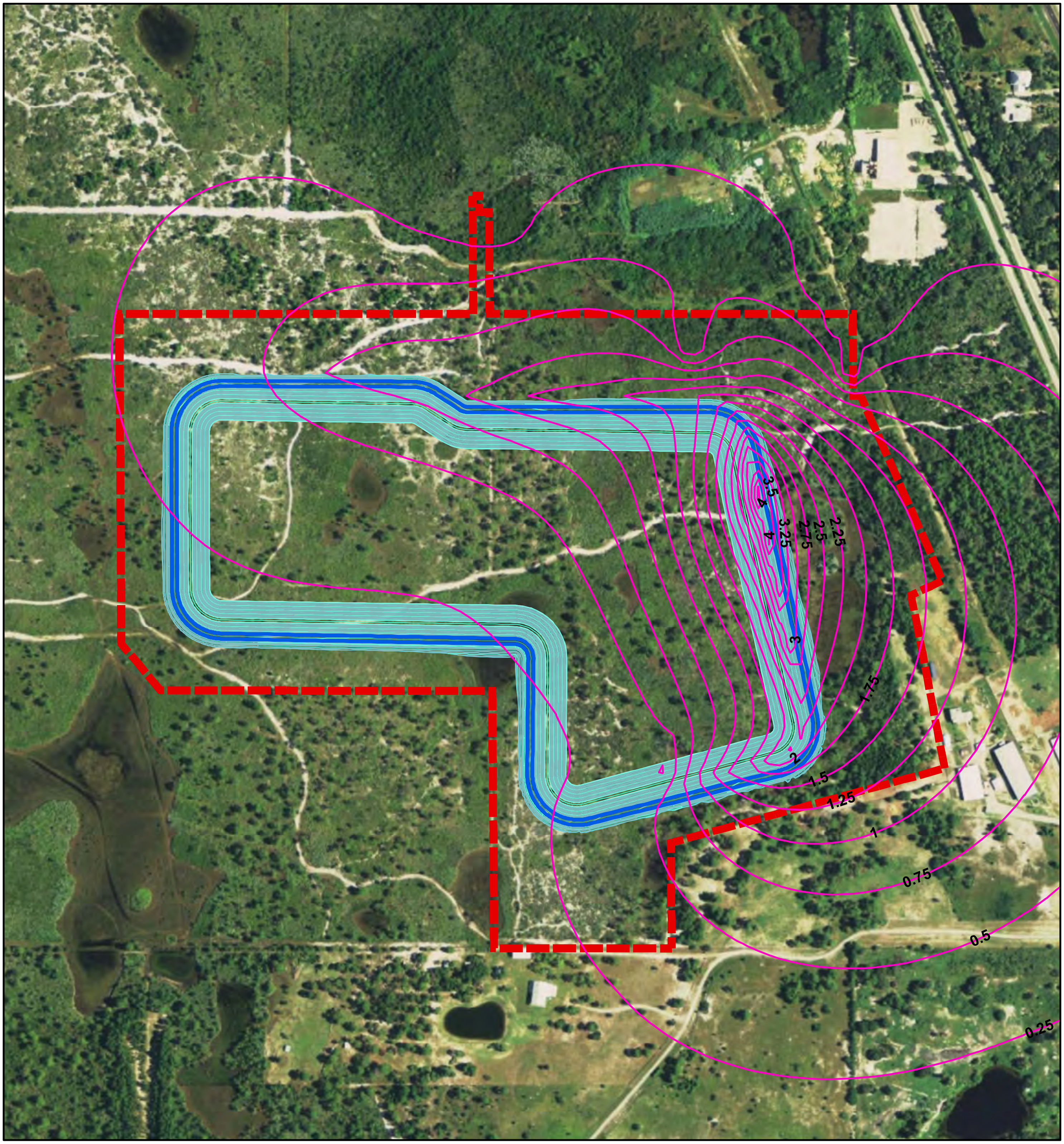
APPROXIMATE SCALE:	DATE: 11/17/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

CHLORIDE AT END OF 40-50 YEAR CYCLE

Exhibit F-30



0 500 1,000
Feet
1 " = 500 '

N

Legend:

Drawdown Contour (ft)
End of 1st 10-year Load/
Rest Cycle - Normal
Dry Season

Property Boundary

Perimeter Ditch

ANDREYEV
ENGINEERING,
INC.

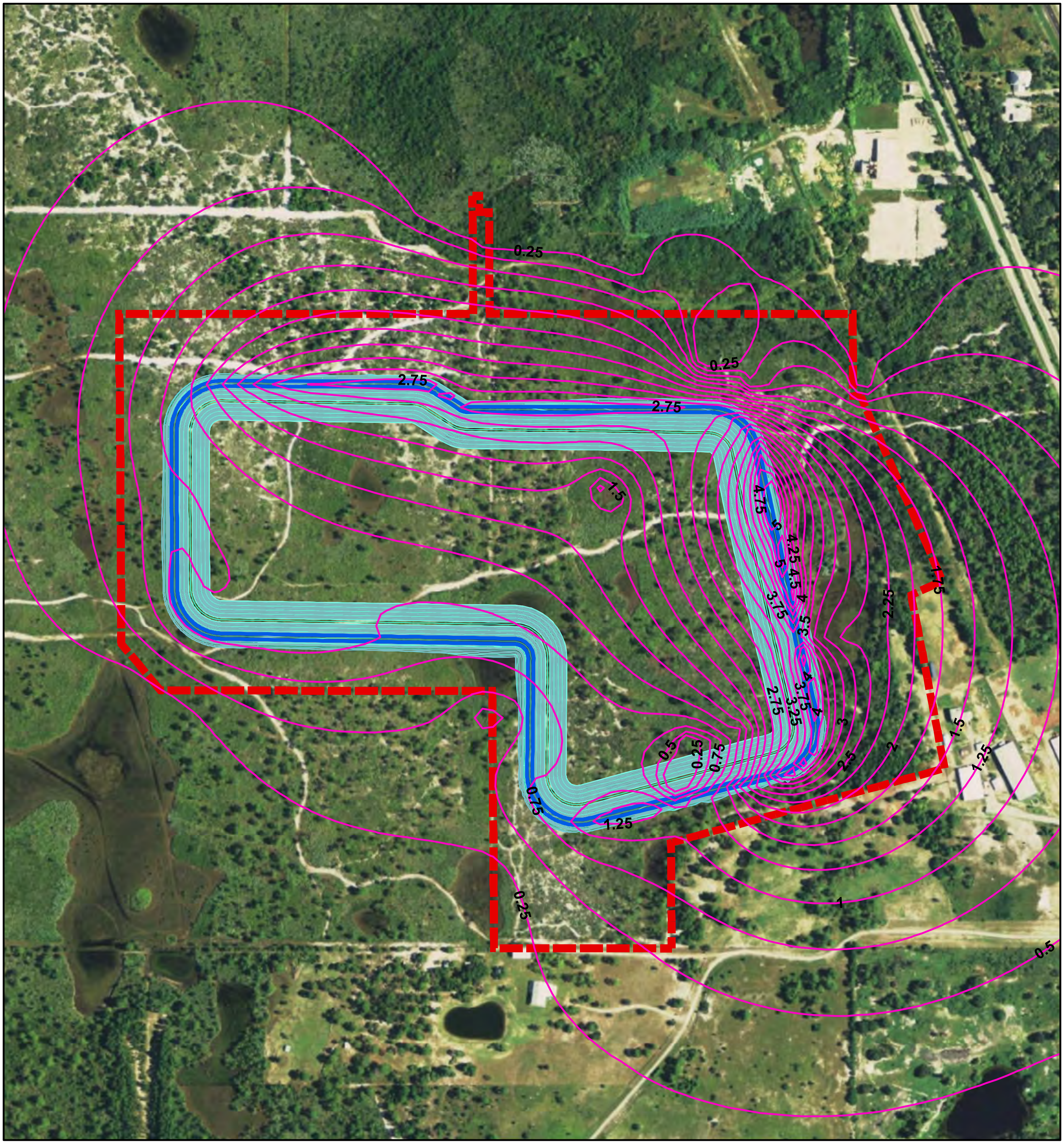
APPROXIMATE SCALE:	DATE: 12/01/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

OFF-SITE WETLAND IMPACT
LAYER 1

Exhibit F-31



Legend:

Drawdown Contour (ft) End of 1st 10-year Load/ Rest Cycle - Normal Wet Season

Property Boundary

Perimeter Ditch

ANDREYEV ENGINEERING, INC.

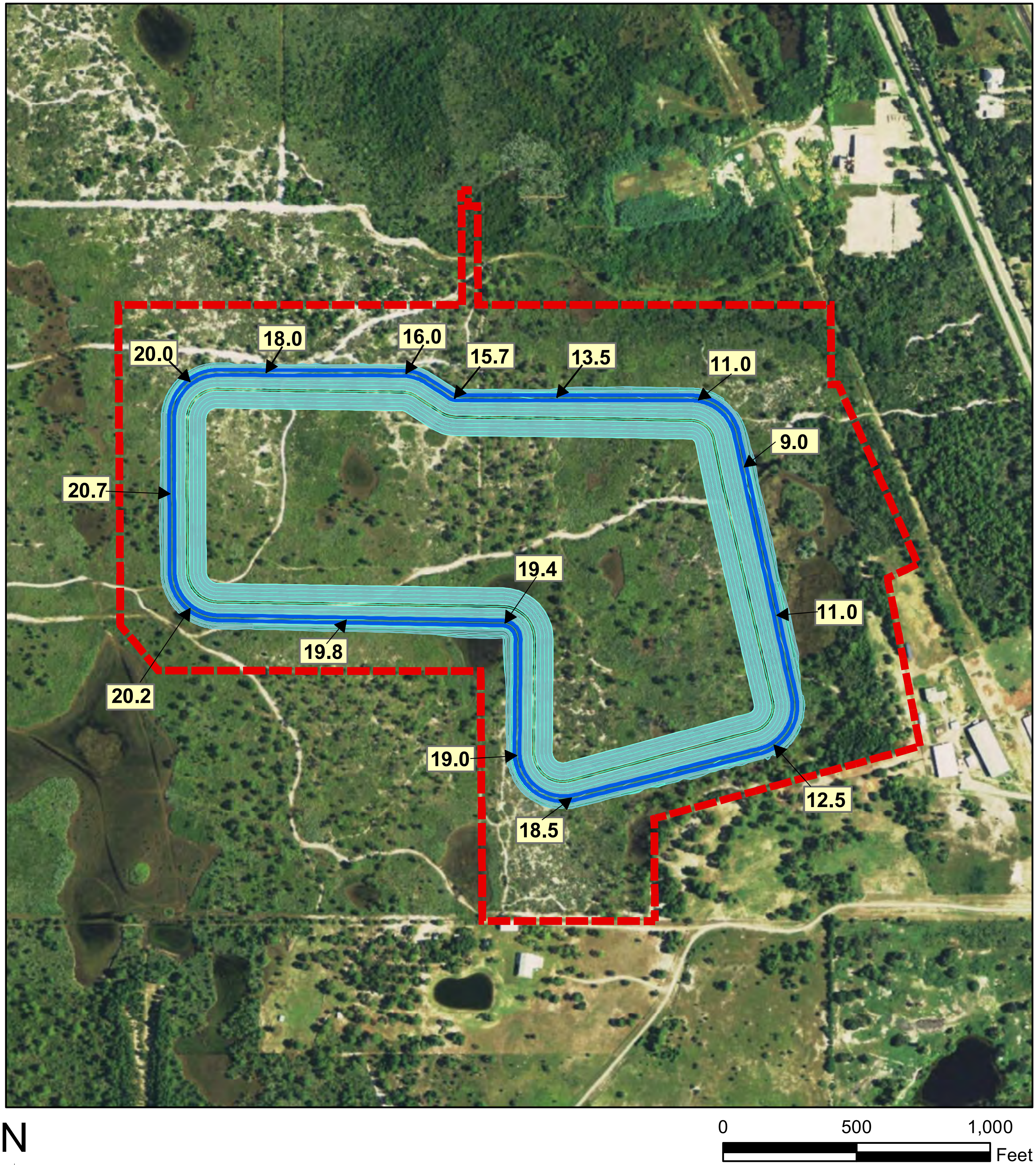
APPROXIMATE SCALE:	DATE: 12/01/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

BV-24A

BREVARD COUNTY, FL

OFF-SITE WETLAND IMPACT LAYER 1

Exhibit F-32



Legend:

Property Boundary

Perimeter Ditch

20.0 Ditch Invert Elevation (ft-NAVD88)

ANDREYEV ENGINEERING, INC.

BV-24A

BREVARD COUNTY, FL

APPROXIMATE SCALE:	DATE: 11/15/16	ENGINEER:NA
AS SHOWN	PN:GPGW-16-013	DRAWN BY: DLS

DITCH INVERT ELEVATION MAP

Exhibit F-33

Geotechnical Engineering Report

Phase III
BV-24A Dredged Material Management Area (DMMA)
Brevard County, Florida
December 19, 2017
Terracon Project No. HB155022

Prepared for:
Taylor Engineering, Inc.
Jacksonville, Florida

Prepared by:
Dunkelberger Engineering & Testing,
A Terracon Company
Port St. Lucie, Florida

December 19, 2017
Revised

Taylor Engineering, Inc.
10151 Deerwood Park Blvd.
Jacksonville, Florida 32256

Attn: Jonathan Armbruster, P.E. … via e-mail (jarmbruster@taylorengineering.com)
Vice President

Re: Geotechnical Engineering Report – Phase III
BV-24A Dredged Material Management Area (DMMA)
Brevard County, Florida
Dunkelberger Project Number: HB155022

Dear Mr. Armbruster:

Dunkelberger Engineering and Testing, A Terracon Company (DUNKELBERGER) has substantially completed the Geotechnical Analysis (Phase III services) for the above referenced project. This study was carried out in general accordance with our subcontract agreement (Taylor Engineering Contract No. C2015-065) dated January 4, 2015.

The findings from the geotechnical analysis are presented in the following report.

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

Sincerely,
Dunkelberger Engineering and Testing, Inc. a Terracon Company

BRENT M. LANGLOIS
LICENSE
No. 81336
STATE OF FLORIDA
PROFESSIONAL ENGINEER
12/21/17

Brent M. Langlois, P.E.
Project Engineer
FL Registration No. 81336

Douglas S. Dunkelberger, P.E.
Principal
FL Registration No. 33317

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GEOTECHNICAL ENGINEERING REPORT
PHASES III
BV-24A DREDGED MATERIAL MANAGEMENT AREA (DMMA)
BREVARD COUNTY, FLORIDA

Terracon Project No. HB155022
December 19, 2017

1.0 PROJECT & SITE DESCRIPTION

The proposed BV-24A Dredged Material Management Area (DMMA) is located east of Grant-Valkaria, Florida in Brevard County. The BV-24A DMMA is one of eight sites selected to provide long-term dredged material containment capacity for the Intracoastal Waterway (ICWW) in Brevard County. It is intended to serve Reach VI located between Turkey Creek and the Brevard County - Indian River County line at Sebastian Inlet. The site is situated about ¼ mile west of the ICWW. A *Site Vicinity Map* is provided as *Sheet 1*. The overall site boundaries surround approximately 112.5 acres of vegetated land. Wetlands are located throughout the site. Several paths traverse through the site which are consistently used as equestrian and all-terrain vehicle trails. Two horse farms lie to the south and southeast of the site and an abandoned Oldcastle Coastal (stone and masonry block) plant lies to the northeast.

2.0 PROPOSED CONSTRUCTION

The purpose of this study phase was to obtain and summarize data characterizing the subsurface conditions within the site to be used for subsequent detailed engineering analyses pertaining to both the design and construction of the DMMA.

Background information concerning the design, construction and operation of the DMMA was provided by Taylor Engineering within the following five documents:

1) *BV-24A DMMA Management Plan (October 2015)*- summary of preliminary design, site preparation, and site management features
2) *BV-24A DMMA Engineering Narrative (October 2015)*- abbreviated summary of the site's key proposed engineering parameters
3) *BV-24A DMMA Environmental Site Documentation (September 2015)*- summary of documented on-site and nearby adjacent vegetation habitats and wildlife habitats
4) *Morgan & Eklund Topographic and Boundary Survey (July 2015)- survey of the topography and boundaries of the site including pipeline easement.*
5) *Morgan & Eklund Core Boring and Monitoring Well Stake Out (January 2016)- survey of boring and monitoring well locations including ground elevations.*

From the document review, initially the proposed DMMA footprint is expected to cover 63.1 acres of the site (including perimeter roads and ditches) with a design capacity of approximately 1,084,100 cubic yards of dredged materials. However, during Phase II of the project, the DMMA footprint was revised, based on groundwater modeling results, to control saline water migration off site. The revised DMMA footprint will cover 64.6 acres and provide a design capacity of approximately 1,035,818 cubic yards of dredged materials. To provide that storage capacity, perimeter earthen dikes will be constructed to a final crest elevation of +35.4 feet (approximately 15 feet above the existing mean site grade of +20.2 feet NAVD) with respect to the North American Vertical Datum of 1988 (NAVD). Preliminary design of the dikes indicates 3:1 (horizontal: vertical) side slopes with a 15-foot wide crest. The interior area of the containment embankment will be excavated to an elevation of +14.6 feet NAVD (about 5 ½ feet below the existing mean site grade) as a borrow source. The borrow fill, with an estimated quantity of 324,816 cubic yards, will be used to construct the dike and access ramps.

Native vegetation covers the majority of the site consisting of palmetto prairies, pine flatwoods, and sand pines. Multiple freshwater marshes (wetlands) were also found throughout the site. Wildlife habitat of significance includes gopher tortoises and scrub jays.

3.0 SCOPE OF WORK

The overall geotechnical work scope consists of: (1) geotechnical field investigation and laboratory analysis; (2) engineering analyses, recommendations, and design; (3) summary report and recommendations; and (4) assistance with construction drawings and specifications. That scope was divided into four separate phases (Phases I through IV). This study, being the third phase, involved design-level geotechnical engineering analyses supported by field and laboratory data collected in preceding phases.

A preliminary geotechnical engineering report was issued on February 27, 2017 encompassing the results of services under Phases I and II. The initial phase involved collection of field and laboratory data as required input to detailed geotechnical engineering analyses and groundwater models. The groundwater modeling, representing the Phase II services, evaluated groundwater impacts (i.e. elevated chloride concentrations) from operation of the DMMA both with and without saline control features (ditches, under drains, and wells). The first five report sections below (**Sections 4.0 through 9.0**) are a re-cap of the Phase I/II data relevant to the Phase III services. The latter sections of this report (**Sections 10.0 and 11.0**) present the results of the detailed geotechnical engineering analyses pertaining to the design and the construction of the DMMA dike and its associated features.

Additionally, a draft geotechnical engineering report was issued on August 19, 2016 which provided the results of our geotechnical exploration along the originally planned permanent discharge pipeline easement. This report summarizes the subsurface conditions found in the easement as well as provides recommendations concerning design and construction aspects of the pipeline including unsuitable soil removal and replacement, excavations, bedding support, and backfill.

4.0 REVIEW OF AVAILABLE DATA

4.1 USGS Topographic Map

A copy of the USGS Topographic Map is provided as *Sheet 2* of this report. Reference to the map shows the site area with a west to east downward slope ranging in elevation from approximately +25 feet to +15 feet with respect to the National Geodetic Vertical Datum of 1929 (NGVD '29). The elevation at the central area of the site is about +20 (ft.-NGVD). The median elevation of the site based on the ground surface elevations obtained at the boring and monitoring well locations (provided by Morgan and Eklund, Inc.) is about +20 feet as referenced to the North American Vertical Datum of 1988 (NAVD88).

The map also depicts the site surface as vegetated land with green shading and containing multiple wetlands.

4.2 Brevard County Soil Conservation Survey

The Soil Survey of Brevard County, Florida as prepared by the United States Department of Agriculture (USDA), Soil Conservation Service (SCS; later renamed the Natural Resource Conservation Service – NRCS) identifies the majority of soil types in the proposed DMMA footprint area of the site as Immokalee Sand (Map Unit 28) and Pomello Sand (Map Unit 49) with a localized area of Myakka Sand, Depressional (Map Unit 38).

The Immokalee Sand and Pomello Sand soil types which cover about 95% of the proposed DMMA footprint are generally sandy and devoid of organic (muck) soils, clay/silt soils, and rock at shallow depths. As an exception, the Myakka Sand, Depressional soil type occurs in a circular-shaped, wetland feature on the south side of the proposed dike alignment. This area is of importance due to surficial layers of muck (unsuitable soil) commonly found in wetland areas. More detailed descriptions of the primary soil classifications are provided below.

28 – Immokalee Sand. This soil type has 0 to 2 percent slopes and is poorly drained. Under natural conditions, this soil type has a depth to water table of 6 to 18 inches. This soil type consists of relatively clean sands to a depth of 35 inches. A layer of black weakly cemented fine sand with organic coating, locally known as hardpan, is indicated from 35 to 54 inches. Thereafter, to the maximum defined depth of 80 inches, the soil profile consists of loamy sands.

49 – Pomello Sand. This soil type has 0 to 2 percent slopes and is moderately well drained. Under natural conditions, this soil type has a depth to water table of 24 to 42 inches. This soil type consists of relatively clean sands to a depth of 42 inches. A layer of black weakly cemented sand with organic coating, locally known as hardpan, is indicated from 42 to 54 inches. Thereafter, to the maximum defined depth of 80 inches, the soil profile consists of additional clean sands.

38 – Myakka Sand, depressional. This soil type has 0 to 2 percent slopes and is very poorly drained. Under natural conditions, this soil type has a water table at the ground surface. This soil type consists of relatively clean sands to a depth of 20 inches. A layer of black, weakly-cemented sand with organic coating, locally known as hardpan, is indicated from 20 to 36 inches. Thereafter, to the maximum defined depth of 85 inches, the soil profile consists of additional clean sands.

The Soil Survey is not intended as a substitute for site-specific geotechnical exploration; rather it is a useful tool in planning a project scope in that it provides information on soil types likely to be found. Boundaries between adjacent soils types on the Soil Survey maps are approximate. The Soil Survey is included as *Sheet 3*.

4.3 Regional Geology

The geology at the site (Reference Florida Geologic Survey: Geologic Map of Florida, dated 2002, revised in 2006) is mapped with the Anastasia Formation. The Anastasia Formation generally is recognized near the coast, generally composed of sands and coquinoid limestones. The most recognized materials found within the Anastasia Formation are coquina of whole or fragmented shells in a matrix of sand which is often cemented. The Anastasia Formation forms part of the surficial aquifer system. Below the surficial aquifer lies the Hawthorn Formation which is considered an intermediate confining unit. The Hawthorn Formation begins at approximately Elevation -85 feet NAVD and separates the surficial aquifer from the Upper Floridan Aquifer at about -300 feet NAVD. The Upper Floridan Aquifer is made up of a Limestone Formation referred to as Basal Hawthorne/ Suwanee and Ocala Limestone.

4.4 Historical Aerial Review

Historical aerial photographs from Years 1943, 1951, 1958, 1994, 1999, 2004, 2005, 2007, 2009, 2013, and 2014 were reviewed for features of geotechnical significance. The noted items are listed below in chronological order.

- 1943: the site is vacant, wooded (vegetated) land
- 1994: the site has meandering ATV/equestrian paths; otherwise unchanged
- 1999: the western half of the site appears to have been cleared of tall trees; possibly a controlled burning operation
- 2014: the site appears similar to its current condition

According to available historic aerial photographs and with the exceptions noted above, the site appears to have been relatively undisturbed from 1943 to date.

4.5 Nearby Well, Septic Tank and Pond Information

Given the planned disposal of dredged material within the relatively large DMMA footprint and the proximity of surrounding properties, we compiled an inventory of wells, septic tanks, and ponds within an approximately ½ mile radius of the site. Records for wells less than 6 inches in diameter were obtained from St. Johns River Water Management District (SJRWMD) data bases. Larger well (greater than 6 inches in diameter) and septic tank records were obtained from Brevard County Florida Department of Health data bases. Pond locations were primarily identified using Google Earth aerial images. The compiled data is mapped on *Sheet 4* and summarized in the table below.

Table 4.1 - Nearby Well, Septic Tank, and Pond Information

Item	No. of Items	Type
Wells	66	Potable / Irrigation
Septic Tanks	23	Sewage Disposal
Ponds	10	Retention/Borrow

5.0 DETAILED SITE DESCRIPTION

Over the course of our field exploration, we made observations pertaining to the site terrain, vegetation, soil conditions and drainage patterns. A detailed site description with photos is provided herein.

The terrain was mostly flat with overall gradual topographic relief sloping downward from west to east. Several all-terrain vehicle and equestrian paths traversed throughout the site and exposed loose, white “sugar” sands.

Figure 5.1 – Photo of "Sugar" sand covered all-terrain vehicle / equestrian paths

The remaining areas consisted of natural vegetation including wetland features. The vegetation primarily consisted of short saw palmettos and scattered tall pine trees.

Figure 5.2 – Photo of Typical vegetation

The wetlands found at the site were low lying, topographically-closed areas with tall grasses. Wetland bottom conditions ranged from saturated (soggy) to holding several feet of standing water.

Figure 5.3 – Photo of Typical wetland

The surficial soils found at the site were light gray clean sands and white “sugar sands” found along the paths described above. Consistent with the topographic relief across the site, surface drainage flow was from west to east. The site experienced significant rainfall during our field exploration causing many of the paths, wetlands, and other low lying areas to contain standing water.

Figure 5.4 – Photo of Standing water after heavy rains

Figure 5.5 – Photo of Standing water in wetland after heavy rains

Wildlife found during our site visits was minimal. Although tracks were found consistently for deer and raccoons, gopher tortoises were the only species found in addition to their burrows. The presence of gopher tortoises is significant with respect to an earthen dike project given their propensity to burrow through soil.

Figure 5.6 – Photo of Gopher tortoise burrow

6.0 FIELD EXPLORATION PROGRAM AND METHODS

The layout of the field exploration program (i.e. test hole locations and monitoring well locations) is shown in *Sheet 5*. Prior to our field exploration, Morgan and Eklund field staked and provided ground elevations for the test hole and monitoring well locations. Ground elevations at each field test location are included on *Sheet 5*. Descriptions of the exploratory program are provided in the following report sections.

6.1 Standard Penetration Test (SPT) Borings

Subsurface conditions within the DMMA footprint were explored with twenty-five (25) Standard Penetration Test (SPT) borings. The borings were drilled 15 feet deep in the proposed interior borrow area and 45 to 100 feet in depth along the proposed perimeter dike alignment. The SPT borings were drilled with an ATV-mounted drill rig employing mud-rotary procedures. The drilling involved use of a standard split-barrel driven with a 140-pound automatic hammer (slide hammer) freely falling 30 inches (the Standard Penetration Test per ASTM D 1586). Samples of the in-place materials were recovered continuously to a depth of 10 feet, and then taken at 5-foot vertical intervals to the termination depth of the borehole. SPT "N-values" were recorded at 2-foot vertical intervals within the first 10 feet of the boring and at 5-foot vertical intervals thereafter. Samples recovered from the borings were placed in moisture-proof containers, labeled, and returned to our laboratory for visual-manual classification by a geotechnical engineer. The deep boreholes were subsequently sealed with neat cement grout and the shallow boreholes were sealed with bentonite chips. Subsurface profiles are presented as *Sheets 6 through 12*.

6.2 Cone Penetration Test (CPT) Soundings

Cone Penetrometer Test (CPT) soundings were advanced at seven (7) locations in lieu of SPT borings as a cost effective means to complete the field exploration. The CPT soundings were completed to depths of 35 to 75 feet along the proposed perimeter dike alignment. The CPT method provides continuous readings of soil resistance by use of a track-mounted, mechanical cone penetrometer equipped with a friction mantle (ASTM D 3441). CPT cone bearing resistances and friction sleeve readings were recorded as the penetrometer was pushed into the ground with a hydraulic ram. Detailed graphical logs and correlative parameters are presented in *Appendix A* as *Exhibits A-1* through *A-14*.

6.3 Bulk Samples

Bulk samples were obtained at fifteen (15) locations from the interior borrow area. The samples were obtained from auger borings drilled to depths up to about seven feet using a continuous flight auger (CFA). During the drilling, soil cuttings were raised and expelled at the surface where they were recovered, placed in large bags, labeled, and transported to our laboratory for testing.

6.4 Groundwater Monitoring Wells

Eleven (11) locations were selected for the installation of wells to measure groundwater quality and levels. Nine wells were constructed along the perimeter of the site and two were installed at the center of the site. The two wells at the center of the site, MW-4 and MW-5, were installed close to one another and at depths of 40 feet and 15 feet, respectively. The objective of these wells was to assess any influence of potential confining (clay and/or silt) layers. A difference in hydrostatic head between the companion shallow and deep wells would suggest the presence of a confining layer which could impact deep foundation, groundwater flow (seepage), and construction dewatering aspects of the project. The perimeter wells were installed to a depth of 15 feet.

The wells consisted of a 5-foot length by 2-inch diameter machine slotted PVC pipe (0.010-inch slot width) screen that was coupled to solid riser pipe of similar composition which rose to about 3 feet above the ground. The deep (40 foot) well, MW-4, consisted of the same dimensions with the exception of a 10-foot screen length. The sand pack surrounding the well screen consisted of clean 6/20 silica sand. Bentonite chips were placed above the piezometer screen up to the ground surface. Finally, an aluminum casing with pad lock was placed over the pipe stick-up and a concrete pad was constructed on the ground surface for protection.

6.5 Field Permeability Tests

Two (2) constant head field permeability tests were run in monitoring wells MW-4 and MW-5. The tests generally consisted of pumping water at a fixed volumetric flow to maintain a constant head near the top of the well pipe. The time was measured for multiple test runs.

Additionally, a shallow temporary piezometer was installed near MW-4 and MW-5 to a depth of 5 feet bls and a third permeability test was performed using procedures described in the South Florida Water Management District (SFWMD) Usual Open Hole test method. The test method consists of installing a 2-inch diameter, full-length, perforated PVC pipe with a clean 6/20 sand pack. Similarly, the test was run with a constant head maintained at the ground surface.

6.6 Intracoastal Waterway (ICWW) Vibracores

Dredged sediment samples were recovered by our subcontractor, Athena Technologies, Inc., from Reach VI of the Intracoastal Waterway (ICWW) using the Vibracore method. In general, this method consisted of vibrating a thin walled 6-inch diameter steel casing down to the target elevation of -17 feet with respect to Mean Lower Low Water which corresponds to 5 feet below the Federally authorized depth of 12 feet. The casing was then extracted and the sample emptied into containers. The process was repeated until approximately 5 gallons of sediment was recovered at each test location. Dredged sediment sampling was obtained at eleven (11) locations from the proposed dredge areas. The bulk samples, placed in large containers, were labeled by location with State-Plane coordinates and transported back to our laboratory where they were laid out for visual-manual classification by a geotechnical engineer. A layout of the Vibracore locations is shown on *Sheet 13*.

7.0 GENERAL SUBSURFACE CONDITIONS

7.1 Subsoil Conditions

The soil samples collected from the SPT and auger borings were visually-manually classified in accordance with the Unified Soil Classification System (USCS). Subsurface profiles are presented graphically in Sheets 6 through 12. The generalized soil stratification is shown in the following table.

Table 7.1 - Generalized Soil Stratification

Stratum	Material Description	Unified Soil Classification System (USCS)
1	Gray or brown medium to fine SAND	SP
2	Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan)	SP-SM, SM
3	Light brown slightly silty medium to fine SAND	SP-SM
4	Dark gray to green sandy SILT	ML
5	Gray shelly SAND with varying amounts of silt	SP, SP-SM, SM
6	Green or light gray CLAY, traces of shell	CL, CH
7	Gray to green slightly silty to silty fine SAND	SP-SM, SM

In general, the borings/soundings found about 40 feet of relatively clean to silty, medium to fine sands (SP, SP-SM, SM; Strata 1, 2, 3, and 7) with some test areas indicating isolated 5 +/- foot thick layers of silt between Elevations 0 and -15 feet NAVD. Underlying the sands were typically clays and silts (Strata 4 and 6) with highly variable thicknesses ranging from 5 to 40 feet. Below the silts and clays were typically shelly sands with varying amounts of silt (Stratum 5) extending to the respective boring termination depths.

The SPT N-values, and CPT cone tip readings, indicate that the predominately sandy subsoils beneath the DMMA footprint range from very loose to medium dense in terms of relative density. The deeper shelly sands are typically dense to very dense. With respect to the fine-grained layers (i.e. silts/clays, Strata 4 and 6), the isolated upper layers of silt are very soft to soft, while the deeper clay and silt layers are medium stiff to stiff in terms of relative consistency.

Hydraulic conductivity of the sands measured by field permeability tests were 43.5 feet per day in the upper 5 feet, 7.0 feet per day from 10 to 15 feet bls, and 9.4 feet per day from 35 to 40 feet bls.

7.2 Groundwater Conditions

At the time of our field exploration, groundwater was found in each drilled test hole. At these locations, the groundwater level was measured during drilling at elevations between about +22.5 and +14.6 (feet-NAVD). The groundwater depth ranged from at the ground surface to 3.0 feet bls. Additionally, groundwater level readings were taken periodically in the monitoring wells. Those groundwater measurements are shown in the following table.

Table 7.2 - Groundwater Elevations

Date	Groundwater Elevations (Feet - NAVD)										
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11
2/24/16	-	-	+8.3	-	-	+13.3	-	-	+16.8	+17.6	+20.2
2/26/16	+22.5	+17.1	+8.9	+18.2	+19.6	-	+21.7	+19.9	-	-	+20.8
4/12/16	+20.1	+15.9	+7.9	+17.0	+17.0	+12.7	+20.2	+18.8	+15.4	+16.2	+18.7
4/22/16	+20.0	+16.5	+8.7	+17.0	+17.3	+12.6	+20.1	+18.6	+14.9	+16.1	+18.6
6/10/16	+22.6	+18.2	+10.0	+18.9	+19.3	+14.6	+22.1	+20.5	+17.6	+18.1	+20.7
7/11/16	-	-	+8.6	+17.6	+18.0	+12.9	-	-	-	-	-
8/1/16	+19.6	+15.5	+7.3	+16.6	+16.9	+12.3	+19.6	+18	+14.7	+15.5	+18.1
9/28/16	+20.9	+16.9	+9.0	+17.9	+18.4	+13.4	+21.0	+19.8	+16.6	+17.3	+19.7

Similar to the trend of topographic relief across the site, the groundwater flow gradient is from west to east dropping in elevation from about +22 to +12 (feet- NAVD). Comparison of the MW-4 (shallow) and MW-5 (deep) data indicates no significant head differential that may be caused by a confining soil layer.

8.0 LABORATORY TESTING PROGRAM: ON-SITE SOILS

Samples from the borings were reviewed by a geotechnical engineer and classified in accordance with the Unified Soil Classification System (ASTM D 2487) and appropriate geologic nomenclature. Representative samples of the subsurface strata were tested for soil properties as follows.

- Moisture Content (102 Tests)
- Organic Content (3)
- Fines Content (97)
- Gradation (37)
- Atterberg Limits (8)
- Modified Proctor Compaction (5)
- Limerock Bearing Ratio (LBR) (3)
- Hydraulic Conductivity (8)
- Triaxial Shear Strength (3)
- Consolidation (4)

The laboratory test results are discussed below and summarized in Tables A through G following *Sheet 13*.

8.1 Index Properties

Representative samples of the soils recovered from the borings were tested for index properties including moisture content (ASTM D2216), organic content (ASTM D2974), Atterberg Limits (ASTM D4318), fines content (ASTM D1140), and grain size distribution (ASTM D422). A complete summary of the index properties and grain size distribution results are presented in Tables A and B. Grain size distribution curves are provided in *Appendix B* as *Exhibits B-1* through *B-5*. Average values of the test results are summarized in the following table.

Table 8.1 - Index Property Laboratory Test Results (On-Site Soils)

Stratum No.	Soil Type	MC (%)	Atterberg Limits		OC (%)	Amount of Material Passing Sieve Size (%)					
			LL	PI		#4	#10	#40	#60	#100	#200
1	SP	24.6	-	-	-	100	100	94.3	70.2	29.4	3.0
2	SP-SM	21.5	-	-	7.4	100	99.1	91.3	61.8	29.0	10.2
3	SP-SM	23.9	-	-	-	100	100	99.4	97.2	82.1	6.9
4	ML	51.5	45.0	17.3	-	-	-	-	-	-	69.2
5	SP, SP-SM, SM	20.0	-	-	-	97.2	93.1	78.9	60.1	34.2	9.3
6	CL, CH	42.4	35.2	14.3	-	-	-	-	-	-	82.9
7	SP-SM, SM	26.8	NP	NP	-	100	100	90.5	84.8	61.0	9.9

Notes: 1. Soil Type refers to the Unified Soil Classification System Group Symbol (ASTM D2487).
2. MC, LL, PI, and OC indicates moisture content, Liquid Limit, Plasticity Index and organic content, respectively.
3. NP - Not plastic

8.2 Modified Proctor Compaction

Bulk soil samples obtained from the proposed interior borrow area at five (5) locations, from depths of 0 to 7 feet bls, were tested for their compacted moisture/dry density relationship in accordance with the Modified Proctor Compaction Test (ASTM D 1557). The optimum moisture content of the compacted soils ranged between 10.4 and 14.3 percent, and the maximum dry density ranged from 101.9 to 103.1 pounds per cubic foot (pcf). A summary of the test data is provided in Table C.

8.3 Limerock Bearing Ratio (LBR)

Bulk soil samples at three (3) selected locations within the interior borrow area were tested for Limerock Bearing Ratio (LBR). The optimum moisture content of the compacted soils ranged between 12.8 and 13.6 percent, and the maximum dry density ranged from 103.3 to 104.9 pounds per cubic foot (pcf). The LBR values ranged from 41.9 to 59.6. A summary of the test data is provided in Table D.

8.4 Hydraulic Conductivity

Two (2) undisturbed (Shelby tube) samples of the clay (Stratum 6) were extruded and tested for hydraulic conductivity in a triaxial flexible wall permeameter (ASTM D 5084). The hydraulic conductivity of the clay was measured at 4.87×10^{-8} cm/sec and 5.57×10^{-8} cm/sec.

Additionally, three (3) bulk samples of near-surface soils in the proposed interior borrow area were remolded to specific moisture-dry density conditions and tested in the laboratory for hydraulic conductivity. Each sample was remolded to two moisture-density conditions: one near the approximate dry density of the in-situ conditions; and one at approximately 95 percent of its maximum dry density as determined by the Modified Proctor Compaction Test. The hydraulic conductivity of the samples was determined in a rigid-walled permeameter using the constant head method (ASTM D 2434). The hydraulic conductivity of the material at in-situ density ranged from 1.70×10^{-2} cm/sec to 2.61×10^{-2} cm/sec (48.1 to 74.0 feet per day). At 95 percent of its maximum dry density, the hydraulic conductivity ranged from 1.21×10^{-2} cm/sec to 2.02×10^{-2} cm/sec (34.3 to 57.3 feet per day).

Results of the hydraulic conductivity testing are summarized in Tables E.1, E.2, and E.3. Detailed test reports are provided in *Appendix B* as *Exhibits B-6 to B-13*.

8.5 Triaxial Shear Strength

Consolidated Drained (CD) triaxial shear strength tests were completed on two (2) remolded bulk samples of near-surface sandy soils (depths of 0 to 7 feet bls) representative of those that will be foundation soils or a source of borrow for the dike embankment fill. The soil specimens were prepared at approximately 95 percent of their maximum dry density and ±2 percent of their optimum moisture content as determined by the Modified Proctor Compaction Test. A Consolidated Undrained (CU) test with pore pressure measurements was completed on an undisturbed clay sample obtained from a depth of about 33 feet bls. The specimens were run at consolidation pressures varying for each point.

The effective angle of internal friction (ϕ') for the sand borrow soils was measured at 31.0 and 33.1 degrees. Sandy soils such as these have zero cohesion, although some apparent cohesion was measured which is normal. The total strength values for angle of internal friction (ϕ) and cohesion (c) from the triaxial shear strength tests for the clay sample were 8.2 degrees and 562 pounds per square foot (psf), respectively. The effective strength values for angle of internal friction (ϕ) and cohesion (c) for the same sample was 15 degrees and 605 psf. The effective strength value above for cohesion is referred to as apparent cohesion.

A summary of the triaxial shear strength test results and test parameters are summarized in Table F. Detailed reports of the test results are provided in *Appendix B* as *Exhibits B-14 to B-17*.

8.6 Consolidation

Four (4) undisturbed (Shelby tube) samples of silt (Stratum 4) and clay (Stratum 6) were extruded and tested for one-dimensional consolidation. The tests were conducted at multiple load increments to a maximum load of 16 tons per square foot (tsf). Sample compression was measured using a ½ inch stroke dial gage. Compression index (C_c) values for the four tests ranged from 0.29 to 0.70 on a strain basis. Recompression index (C_r) values for the same four tests ranged from 0.03 to 0.09 on a strain basis. The pre-consolidation pressures ranged from 4.0 ksf to 6.2 ksf. This data, as well as the correlative CPT data, suggests that the silts and clays are slightly to moderately over-consolidated with OCRs ranging from 1.6 to 3.3.

A summary of the consolidation test results is summarized in Table G. Detailed reports of the test results are provided in *Appendix B* as *Exhibits B-18 to B-21*.

9.0 LABORATORY TESTING PROGRAM: DREDGED MATERIALS

Dredged sediment samples from the eleven (11) vibracores were reviewed by a geotechnical engineer and classified in accordance with the Unified Soil Classification System (ASTM D2487) and appropriate geologic nomenclature. Each Vibracore sample was tested for the following properties:

- Gradation
- Leachability

9.1 Index Properties

Representative samples of the soils recovered from the vibracores were tested for grain size distribution (ASTM D422). The Vibracore samples were visually inspected to estimate the amount of muck (organic matter) compared to the total sample volume. A summary of the index properties is presented in the following table. Grain size distribution curves are provided in *Appendix C* as *Exhibit C-1*. The test results are summarized in the following table.

Table 9.1 - Index Property Laboratory Test Results (Dredged Materials)

Vibracore Number	Soil Type	Muck %	Amount of Material Passing Sieve Size (%)									
			1”	¾”	½ “	#4	#10	#20	#40	#60	#100	#200
V-1	SC	20	100	93.2	92.9	85.9	78.1	70.5	63.9	55.0	38.8	18.1
V-2	SC	75	100	100	99.0	92.6	79.8	66.4	54.5	44.6	37.2	28.8
V-3	SC	30	100	100	99.0	91.7	79.0	64.3	56.0	46.1	33.7	15.7
V-4	SP-SC	15	100	100	98.4	85.8	64.2	46.8	36.2	27.4	21.5	10.4
V-5	SP-SC	10	100	100	99.9	95.9	86.3	78.3	69.3	57.5	39.1	10.9
V-6	SP	0	100	100	99.5	95.8	86.2	70.7	58.6	39.7	25.1	3.4
V-7	SP	0	100	100	100	96.8	87.9	80.5	70.5	53.7	42.4	3.2
V-8	SP	10	100	100	100	94.3	82.8	67.9	56.6	45.3	34.3	2.9
V-9	SP-SC	50	100	100	100	90.1	77.8	65.8	55.9	25.4	13.3	7.1
V-10	SP	5	100	100	100	90.8	76.9	58.3	50.7	37.9	23.2	2.7
V-11	SP-SC	80	100	100	100	97.2	93.0	87.2	77.6	50.4	27.5	6.7
AVG	**SP-SC**	**30**	**100**	**99.4**	**99.0**	**97.8**	**92.5**	**81.1**	**68.8**	**59.1**	**43.9**	**10.0**

Notes: 1. Soil Type refers to the Unified Soil Classification System Group Symbol (ASTM D2487).
2. Muck % indicates approximate percentage of muck mixed with the Vibracore sample based on visual observation

9.2 Chloride Leachability Testing

Representative soil samples from each of the eleven (11) vibracore locations were used for our in-house chloride leachability tests. The purpose of the laboratory testing was to simulate an operational condition of the DMMA to evaluate the leaching potential of a 2-foot thick layer (column) of dredged material when subjected to 52 inches of influent. The procedure generally consisted of a PVC pipe setup including two 3-inch diameter pipes, one at 2 feet in length to hold the soil specimen, and the second at 5 feet to hold 52 inches of water. A PVC pipe reducer and ball valve were fastened to the bottom of the pipes to allow pausing of the test. A filter stone was placed in the bottom of each pipe. Containers were placed under each ball valve to capture the leached extract. Two feet of sample was loaded into the tubes and water was subsequently added to saturate the sample. Once the samples were saturated, 52 inches of water (modeling annual rainfall) was loaded onto each sample and the ball valves were opened to begin the test. Chloride and pH tests were run on the liquid extract on an incremental basis after 9 inches of water had passed through the sample. After the complete 52 inches of water had fully passed through, a final set of chloride and pH tests were run.

In addition to our in-house testing, other portions of the eleven (11) vibracore samples were sent to Pace Analytical Services Inc. to test for pH, total chloride of soil, and Synthetic Precipitation Leaching Procedure (SPLP, EPA SW-846 Method 1312) testing. For a previous DMMA project, Toxicity Characteristic Leaching Procedure (TCLP, EPA SW-846, Method 1311) was used to test the vibracore samples. The TCLP generally applies to material sitting in a landfill whereas the SPLP was designed to simulate material sitting in-situ and therefore adopted for this study as the better of the two methods to assess chemical mobility in the open environment.

Results of the in-house soil column leaching tests showed relatively high concentrations of chlorides in the extracted liquid. For 11 column tests, the maximum and average chloride contents of the first 9 inches of percolated liquid extract were 18,750 mg/L and 13,000 mg/L, respectively. Four of the eleven tests were not fully completed due to the low permeability of the vibracore material. The incomplete data was not considered in our analyses. The average final chloride content based on the seven completed tests for the entire 52 inches of liquid extract was 2,800 mg/L. The commercial laboratory SPLP test results, for all 11 samples, averaged 234 mg/L. It is noted as a point of reference that seawater has a chloride concentration of 19,400 mg/L.

The reason for the order-of-magnitude difference between the SPLP and the column leaching is likely attributed to the latter test being larger scale and it is more representative physically of actual field conditions. Therefore, the column leaching data was adopted for use in the groundwater (transient solute transport) model. More specifically, the test data for Sample V-11 represented the highest leaching potential and was used as a conservative basis for both analysis and design which we believe is appropriate given the inherent variability of dredged material consistency.

Referencing the State’s Secondary Drinking Water Standard at 250 mg/L, the column leaching test results indicate significant potential for leaching of chlorides particularly during first flushing of newly placed dredged materials.

Detailed results of the leachability testing are presented in *Appendix C* as *Exhibits C-2* through *C-7*.

10.0 ENGINEERING ANALYSIS

10.1 Design Sections

Four (4) typical dike sections were each analyzed for stability, settlement, and seepage. The following text provides details regarding the existing topography, foundation soil stratigraphy, and typical dike features followed by discussion of the results of the analyses.

10.1.1 Common Features

We have assumed that the following design features, typical of previous DMMA projects, will be incorporated into the dike and are included on the design cross-sections used in our analyses.

Crest
The final design elevation of the dike crest is to be at +35.4 feet NAVD. The dike will have a 15-foot wide crest for ease of construction and to provide suitable access for post-construction vehicle traffic.

Dike Slopes
The dike cross sections will have inside (upstream) slopes and outside (downstream) slopes of 3 horizontal to 1 vertical (3H:1V).

Dike Toe Swale
The dike cross sections will have a shallow swale located at the toe of the embankment to collect storm water runoff. The invert elevations will range from +10.7 to +22.4 feet NAVD. The side slopes will be consistent with the dike embankment (3H:1V).

Perimeter Ditch
The dike cross sections each have a downstream perimeter ditch for the collection of storm water runoff and seepage from the impoundment. The ditch bottom width is 2 feet and at elevations ranging from about +9 feet NAVD to +21 feet NAVD. The ditch bottom drops in elevation from west to east. The side slopes of the perimeter ditch are 3H:1V.

Toe Drain
Each design cross-section includes a toe drain feature beneath the downstream embankment slope. The drain will outfall to the perimeter ditch.

Weir Structure
The outlet structure will be located near the northeast corner of the dike and will consist of three weir-controlled drop inlets with a 36-inch diameter minimum high density polyethylene (HDPE) discharge pipes penetrating through the dike to outfall in the perimeter ditch. The steel weir box structure will be supported by a concrete slab foundation system and a timber walkway will span from the top of the structure to the dike crest. The elevated walkway will be supported by shallow foundation footings.

10.1.2 East Section

The design "Cross-Section: East" represents a high embankment fill reaching about 22 ½ feet above the topographical low area of the site.

The stratigraphy beneath the east section is represented by the conditions found in SPT Boring B-102 as well as CPT sounding CPT-205. In general, the subsurface profile consists of very loose to medium dense fine sands, sand with silt, and silty sands (SP, SP-SM, SM) that extend to an elevation of about -12 feet NAVD. These sands are followed by about 5 feet of very soft silt (ML) and 5 feet of very soft clay (CL). The clay layer is underlain by very loose to dense fine sands, sand with silt, silty sands intermixed with shell and shell fragments extending to an elevation of about -72 feet NAVD. Below these sands was a stiff clay layer (CL) which extended to the B-102 boring termination depth of about -85 feet NAVD.

The typical section adopted for analysis of the east section is presented below.

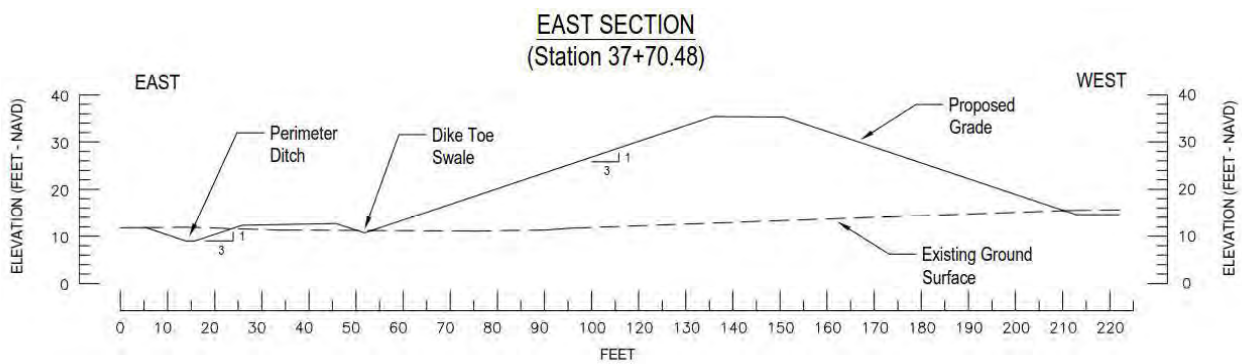


Figure 10.1.2 – Design Section: East

10.1.3 North Section

The design "Cross-Section: North" represents a medium embankment fill height of about 18 ½ feet for the north side of the dike.

The stratigraphy beneath the north section is represented by the conditions found in SPT Borings B-102 and B-203 as well as CPT soundings CPT-202 and CPT-302. In general, the subsurface profile consists of very loose to medium dense fine sands, sand with silt, and silty sands (SP, SP-SM, SM) that extend to an elevation of about -1.5 feet NAVD. A thin 2-foot layer of very soft silt (ML) was disclosed followed by additional very loose to medium dense fine sands, sand with silt, and silty sands (SP, SP-SM, SM) to an elevation of -25 feet NAVD. These sands are followed by very soft clay (CL) extending to an elevation of about -55 feet NAVD. The clay layer is underlain by dense fine sands, sand with silt, silty sands intermixed with shell and shell fragments extending to an elevation of about -72 feet NAVD. Below these sands was a stiff clay layer (CL) which extended to the B-102 boring termination depth of about -85 feet NAVD.

The typical section with foundation soil profile adopted for analysis of the north section is presented below.

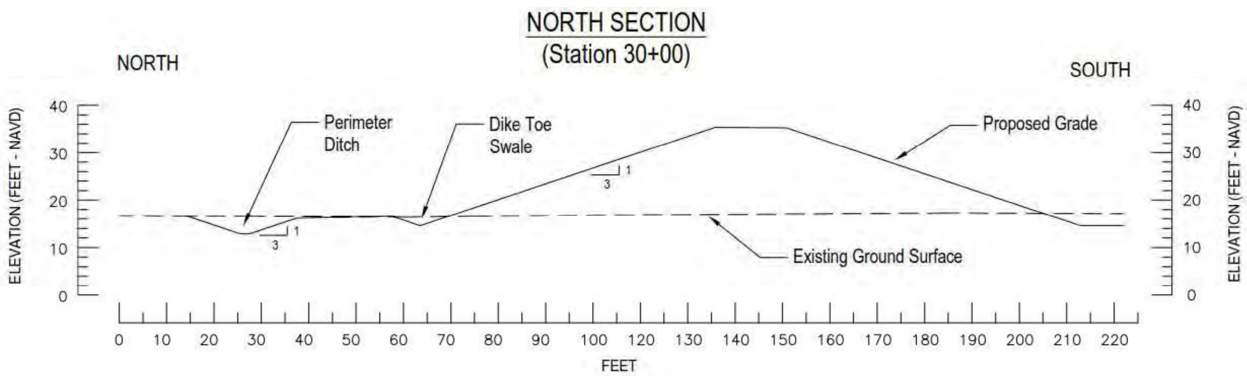


Figure 10.1.3 – Design Section: North

10.1.4 South Section

The southern dike alignment was divided into two design sections. The design "Cross-Section: Southeast" and "Cross Section: Southwest" represent medium embankment fill heights of about 15 and 19 ½ feet for the south side of the dike.

The stratigraphy beneath the southeast section is represented by the conditions found in SPT Borings B-102 and B-103 as well as CPT sounding CPT-303. In general, the subsurface profile consists of very loose to medium dense fine sands, sand with silt, and silty sands (SP, SP-SM, SM) that extend to an elevation of about +1 feet NAVD. A thin 2-foot layer of very soft silt (ML) was disclosed followed by additional very loose to medium dense fine sands, sand with silt, and silty sands (SP, SP-SM, SM) to an elevation of about -25 feet NAVD. These sands are followed by very soft silt (ML) extending to an elevation of about -30 feet NAVD. The clay layer is underlain by dense fine sands, sand with silt, silty sands intermixed with shell and shell fragments extending to the B-103 boring termination depth of about -83 feet NAVD.

The typical section with foundation soil profile adopted for analysis of the southeast section is presented below.

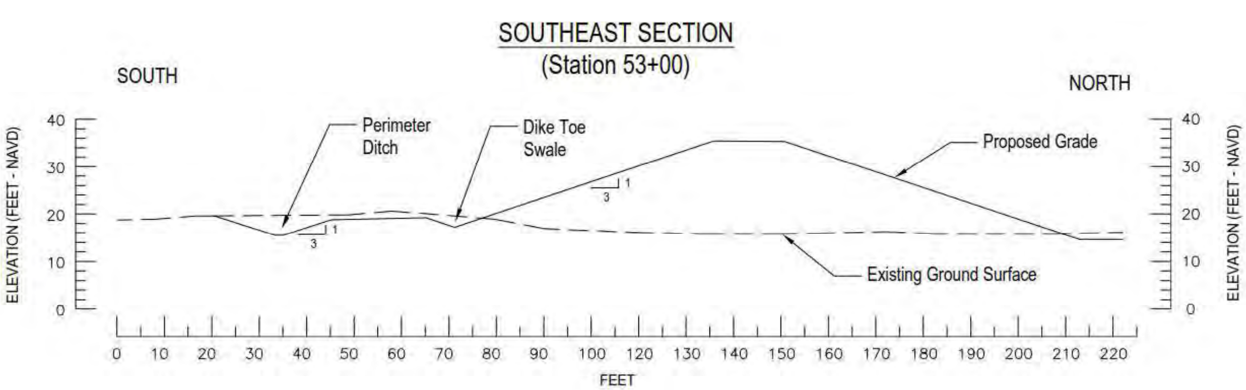


Figure 10.1.4-1 – Design Section: Southeast

The stratigraphy beneath the southwest section is represented by the conditions found in SPT Borings B-104 and B-206 as well as CPT sounding CPT-207. In general, the subsurface profile consists of very loose to medium dense fine sands, sand with silt, and silty sands (SP, SP-SM, SM) that extend to an elevation of about 0 feet NAVD. A 6-foot layer of very soft silt (ML) was disclosed followed by a thin 2 ½ foot layer of medium dense fine sands (SP) and then a 2-foot layer of very soft clay to an elevation of about -10.5 feet NAVD. The clay layer is underlain by medium dense fine sands, sand with silt, and silty sands to an elevation of -30 feet NAVD. The boring found very soft to stiff clay and silt to an elevation of -60 feet NAVD. The clay/silt layer is underlain by dense fine sands, sand with silt, silty sands intermixed with shell and shell fragments extending to the B-104 boring termination depth of about -77 feet NAVD.

The typical section with foundation soil profile adopted for analysis of the southwest section is presented below.

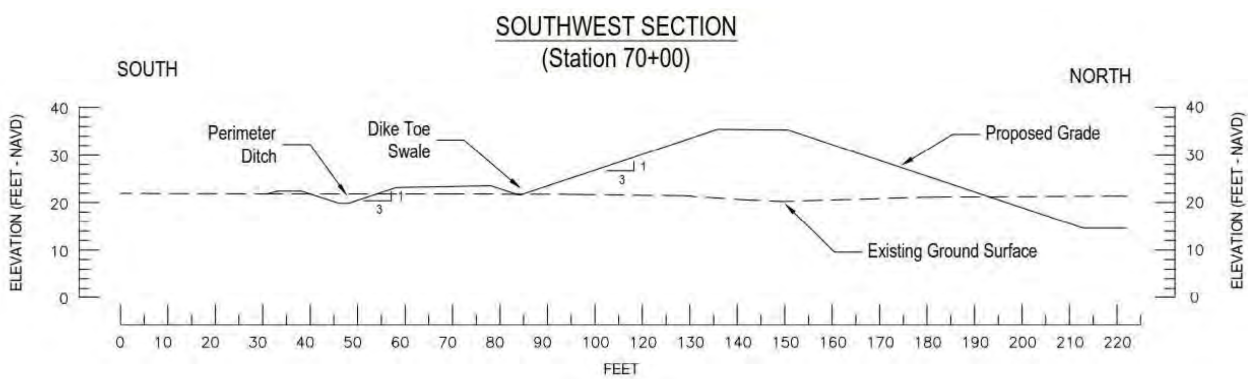


Figure 10.1.4-2 – Design Section: Southwest

10.1.5 West Section

The design "Cross-Section: West" represents a relatively low embankment fill height of about 12 ½ feet for the west side of the dike.

The stratigraphy beneath the west section is represented by the conditions found in SPT Borings B-101 and B-208 as well as CPT soundings CPT-208 and CPT-209. In general, the subsurface profile consists of very loose to medium dense fine sands, sand with silt, and silty sands (SP, SP-SM, SM) that extend to an elevation of about -7 feet NAVD. A thin 3-foot layer of very soft silt (ML) was disclosed followed by additional very loose to medium dense fine sands, sand with silt, and silty sands (SP, SP-SM, SM) to an elevation of about -17 feet NAVD. These sands are followed by 3 ½ feet of very soft silt (ML) to an elevation of about -20.5 feet NAVD. The profile then shows additional very loose to medium dense fine sands, sand with silt, and silty sands (SP, SP-SM, SM) extending to an elevation of about -27 feet NAVD. A layer combined with silt and clay was found under the sands to an elevation of -57 feet NAVD followed by dense fine sands, sand with silt, silty sands intermixed with shell and shell fragments extending to the B-101 boring termination depth of about -77 feet NAVD.

The typical section with foundation soil profile, including engineering properties, adopted for analysis of the west section is presented below.

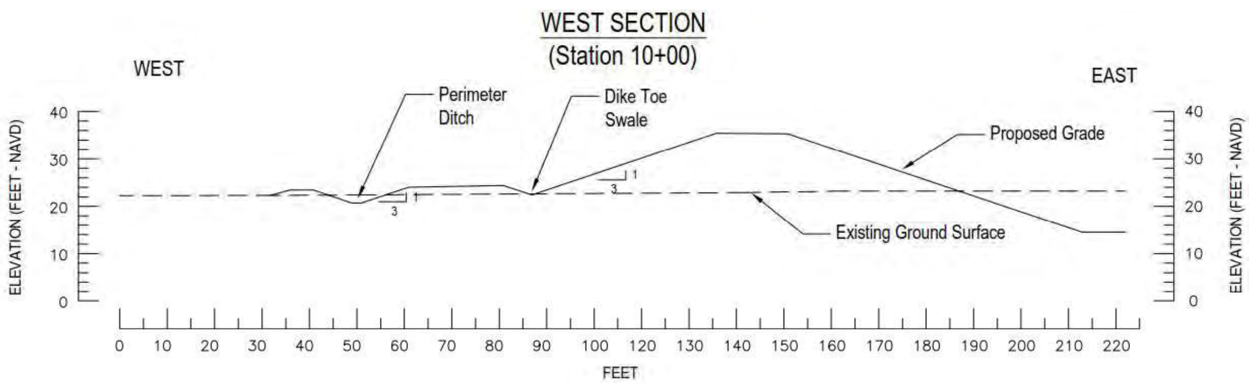


Figure 10.1.5 – Design Section: West

10.2 Dike Settlement Analysis

10.2.1 Settlement Analysis Design Assumptions

The immediate (elastic) and long-term (consolidation) settlement was evaluated at the five design dike sections. Each design section was represented by a trapezoidal stress diagram with a top (crest) width of 15 feet and a base width equal to that of each typical section. Each diagram was tapered from the crest to the base on a 3H:1V slope. Embankment load was calculated based on unit weight of the embankment fill soils and the height above the existing ground surface. Stress distribution to each stratified layer was based on equations by Boussinesq for a trapezoidal load. The soil compressibility parameters, used for both elastic and consolidation settlement analyses, are shown for each design section in Appendix. D

10.2.2 Initial Settlement

Settlement within the sand layers (identified as Strata Numbers 1, 2, 3, 5, and 7 on the subsurface profiles (provided in Sheets 6 through 12) is expected to occur almost immediately as the weight of the embankment fill is applied (i.e. during construction). The elastic settlement of these soils under dike loading was estimated using elastic compression theory based on an estimated elastic modulus. The elastic modulus was calculated from empirical equations based on SPT blow counts (N-values) and CPT cone tip resistance values. Settlement within soils at depths greater than about 100 feet below the base of the embankment was assumed to be negligible.

A summary of the estimated immediate settlement, beneath the dike crest, for each design section is summarized in the table below.

Table 10.2.1 Estimated Immediate Settlement

Design Section	Estimated Sand Settlement (inches)
East	2.1
North	2.4
Southeast	3.7
Southwest	2.2
West	1.4

These settlements are expected to occur during placement of the dike fill and post-construction settlement of the dike crest, associated with the sand layers, should be minimal.

10.2.3 Consolidation Settlement

The consolidation settlement within the fine-grained (clay and silt) soils (identified as Strata Numbers 4 and 6 on the *Subsurface Profiles* provided on Sheets 6 through 12) was calculated based upon the following design parameters:

Table 10.2.3-1 Silt/Clay Soil Index Properties

USCS Classification	Void Ratio	C_C	C_R	OCR
CL	1.27	0.47	0.08	3.3
ML	1.10	0.29	0.03	1.6
CH	1.65	0.70	0.09	2.5
CL	0.96	0.31	0.04	2.0

The compressibility parameters for the fine-grained soils were derived from laboratory consolidation tests (refer to **Section 8.6** of this report). The fine-grained soils were over consolidated within the range of anticipated embankment loads based on those test results.

We calculated the approximate increase in vertical effective stress ($\Delta\sigma'_v$) below the center of the embankment section based equations by Boussinesq for a trapezoidal load.

A summary of consolidation settlement estimates of the dike crest for each of the five sections is provided in the table below.

Table 10.2.3-2 Estimated Consolidation Settlement

Design Section	Estimated Consolidation Settlement (inches)
East	2.3
North	2.9
Southeast	1.5
Southwest	2.1
West	1.1

The values reflect settlements beneath the dike crest due to consolidation of the silt and clay layers. Consolidation settlement generally occurs over the long-term, in contrast to the immediate settlement of the sand layers, and therefore will continue after dike construction. It's important to note that the clay and silt layers located at the site are over-consolidated and the consolidation anticipated will occur as recompression. The rate of recompression occurs significantly faster than virgin consolidation. The time rate of the consolidation is discussed in the following section. If it is critical to maintain the design crest elevation of the dike, it should be over-built with a camber to account for the estimated magnitude of consolidation settlement.

10.2.4 Time Rate of Settlement

The time rate of consolidation settlement will vary across the site due to differences in both fine-grained soil layer and embankment fill thicknesses. The estimated time to reach various percentages of consolidation are summarized in the following table. The coefficient of compressibility (C_v) was based on the laboratory consolidation tests and calculated increases in vertical effective stress in the fine-grained layers due to embankment fill loads.

Table 10.2.4 Estimated Time Rate of Consolidation

Cross Section	Coefficient of Compressibility (C_v) (ft^2/day)	Consolidation (%)	Time
East	0.50 to 1.50	30	4 days
		50	10 days
		90	2 months
North	0.44 to 1.60	30	7 days
		50	1 month
		90	3 months
Southeast	0.39 to 0.50	30	0 days
		50	1 day
		90	4 days

Cross Section	Coefficient of Compressibility (C_v) (ft²/day)	Consolidation (%)	Time
Southwest	0.32 to 1.60	30	3 days
		50	8 days
		90	2 months
West	0.32 to 1.90	30	2 days
		50	6 days
		90	1 month

The time required for 90% consolidation is estimated to be approximately 3 months or less across each section.

The actual magnitude and time rate of settlement of the dike should be monitored during construction through the use of settlement plates as discussed in **Section 11** of this report. If actual settlements vary significantly from our estimated settlements, then the dike overbuild should be adjusted accordingly.

10.2.5 Settlement at Dike Toe

In addition to the estimated settlement beneath the dike crest, there will be some post-construction settlement experienced beneath the toe of the dike embankment. The following table provides an estimate of the total consolidation settlement beneath the dike toe at each of the analyzed sections.

Table 10.2.5 Estimated Dike Toe Consolidation Settlement

Design Section	Estimated Dike Toe Consolidation Settlement (inches)
East	0.6
North	1.2
Southeast	0.3
Southwest	0.9
West	0.5

Based on the above estimated settlement under the toe and centerline of the dike, the anticipated differential settlement between these two areas can be expected to range from about 1 to 2 inches.

10.2.6 Operational Settlement (Dredge Material Load)

In addition to the settlement imposed by the newly constructed dike embankment, we anticipate "operational settlement" which will occur during loading of the dike's upstream slope with dredged materials. The dredged material load will cause additional total and differential settlement at the upstream toe of the dike, in addition to that indicated in **Section 10.2.5.** The operational settlement will also impact the weir structure and walkway. The following table provides an estimate of the total settlement (elastic and consolidation) beneath the dike's upstream toe at each of the analyzed sections based on fill heights representing the DMMA at full capacity.

Table 10.2.6 Estimated Operational Settlement

Design Section	Estimated Operational Settlement (inches)
East	3.1
North	4.3
Southeast	3.9
Southwest	4.7
West	3.5

Typical operational plans of the DMMA are to load dredge materials incrementally every 10 years for 50 years resulting in five loading events. The settlement will therefore occur incrementally.

10.3 Dike Seepage and Stability Analysis

10.3.1 Analysis Methodology

Field and laboratory test data were utilized to assign engineering properties for each of the subsoil layers in the east, north, southeast, and west typical sections. The southeast section was analyzed for the dike seepage and stability analysis. Both southern sections represent similar foundation materials, therefore only one was analyzed. Geotechnical computer software was then used to determine the slope stability factors of safety at each cross-section location under each operational scenario: End-of-Construction and Steady State Seepage.

The pore water pressure in the soil layers must be defined within the computer software for each slope stability analysis. A steady-state seepage analysis was used to determine the pore water pressure for the end-of-construction and steady state scenarios. The phreatic surface was manually defined for the rapid draw down scenario. The transient seepage analysis uses initial pore pressures calculated from a steady state seepage analysis or user defined phreatic surface, and incorporates the time required for the pool (impounded water) to recede in calculating the transient phreatic surface and pore water pressures.

The seepage and stability analyses were run using the computer programs SEEP/W and SLOPE/W, respectively. These programs are part of the GeoStudio two-dimensional finite element software suite developed by GEO-SLOPE International Ltd. SEEP/W uses a hydrogeologic model to determine seepage paths, seepage flow rates, phreatic surfaces, pore water pressures and exit gradients for steady state and transient seepage problems. SLOPE/W runs limit-equilibrium slope stability analyses using a method-of-slices search routine to determine a safety factor for multiple potential failure surfaces. SLOPE/W can use pore water pressures calculated from a phreatic surface that is manually defined by the user or it can use pore water pressures generated by SEEP/W.

The seepage exit gradients obtained from SEEP/W were compared with the exit gradients considered to be safe for major impoundments. For sandy soils, the factor of safety against piping (i.e. seepage induced soil erosion) is simply expressed as the reciprocal of the exit gradient.

For the stability analyses, the circular failure surface search routine using Morgenstern-Price's Method of Slices was used to find the minimum factor of safety failure surface. The Engineering Manual for Slope Stability published by the USACE, EM 1110-2-1902, Table 3-1 indicates that the required minimum factor of safety is 1.5 for downstream slopes under long-term conditions with steady-state seepage, 1.3 for upstream and downstream slopes at the end of construction, and 1.3 for upstream slopes during rapid drawdown from the Maximum Storage Pool. However, for DMMA dikes, rapid drawdown at the upstream slope is not an expected scenario since dredged materials will occupy the impoundment. The embankment stability analysis results were compared to these minimum factors of safety.

10.4 Slope Stability Analysis

10.4.1 Geotechnical Design Parameters

The slope stability geotechnical design parameters utilized in our evaluation included moist and saturated unit weights, angles of internal friction and cohesion. The soil unit weight and strength parameters were based on standard correlations with SPT N-values and laboratory triaxial shear test data. The raw data received from the triaxial shear tests was adjusted to reflect post-peak residual strength values which will account for any strain softening. Additionally, due to the curved nature of the shear failure envelope for drained clay/silt layers, the drained stability analysis considered a fitted bi-linear strength envelope. The model, using the bi-linear strength envelope, selected soil strength parameters based on the normal stress for each slice. The ranges of the soil parameters used for the four design sections are provided in the following table and shown the exhibits in Appendix D for each design section.

Table 10.4.1 Geotechnical Design Parameters

Material Description	Saturated Unit Weight (pcf)	Drained Parameters		Undrained Parameters		Permeability (K_X) (feet/day)	K_Y/ K_X
		Friction Angle (deg)	Cohesion (psf)	Friction Angle (deg)	Cohesion (psf)		
Dredged Material	90	20	0	-	-	5	1
Embankment	103	31	0	-	-	40	0.5
Sand (Upper)	100	30	0	-	-	60	0.5
Sand (Lower)	100	30	0	-	-	7	0.5
Shelly Sand	110	32	0	-	-	10	0.5
Silt/Clay	90	14 to 24	250	8	400	0.00015	1

The following sections of the report summarize the results of the long-term seepage and slope stability analyses for the four design cross-sections (east, north, south and west). The results are also shown graphically on the attached Exhibits E-1 through E-28 and F-1 through F-8 in Appendices E and F. Each cross-section includes figures to show each of the seepage and stability scenarios: end-of-construction and steady-state seepage.

The rapid drawdown scenario was not considered for the dike embankment due to the dredged materials occupying the impoundment. It was not considered in the ditches due to the high permeability of the embankment and foundation soils which would quickly relieve pore water pressures. The transient seepage scenario was also not considered for the same reason.

The failure planes and corresponding factors of safety for the stability analyses presented herein represent the worst case scenario for each condition and section. Deeper failure planes from the dike crest to the ditch toe were also analyzed but are not shown because they do not represent the worst case scenario (i.e. lowest factor of safety).

10.4.2 Dike Stability Analysis Results

The results of the slope stability analyses of the four dike design cross-sections are summarized in the following table.

Table 10.4.2 Dike Slope Stability Analysis Results

Cross Section	Analysis Condition	Minimum Factor of Safety, F.S. (USACE)	Calculated Factor of Safety, F.S.	
			Upstream Slope	Downstream Slope
East	End-of-Construction	1.3	1.71	1.80
	Steady State	1.5	-	1.60
North	End-of-Construction	1.3	1.66	1.79
	Steady State	1.5	-	1.66
South	End-of-Construction	1.3	1.64	1.80
	Steady State	1.5	-	1.57
West	End-of-Construction	1.3	1.55	1.80
	Steady State	1.5	-	1.70

The calculated safety factors are all above the USACE minimum values.

10.4.3 Ditch Stability Analysis

The results of the slope stability analyses for the four perimeter ditch cross-sections are summarized in the table below.

Table 10.4.3 Ditch Slope Stability Analysis Results

Cross Section	Analysis Condition	Minimum Factor of Safety, F.S. (USACE)	Calculated Factor of Safety, F.S.			
			Inside (Sand)	Outside (Sand)	Inside (Gravel Bed)	Outside (Gravel Bed)
East	End-of-Construction	1.3	1.47	1.48	-	-
	Steady State	1.5	1.37	1.43	1.76	1.74
North	End-of-Construction	1.3	1.39	1.39	-	-
	Steady State	1.5	1.24	1.31	1.75	1.75
South	End-of-Construction	1.3	1.44	1.44	-	-
	Steady State	1.5	0.92	1.08	1.75	1.78
West	End-of-Construction	1.3	1.76	1.72	-	-
	Steady State	1.5	1.42	1.46	1.77	1.73

The calculated factors of safety fell slightly below the USACE minimum values in all four design cross-sections under the steady-state seepage (Year 50 maximum impoundment operating level) as indicated above.

Ditch slope stability is significantly less critical than dike stability and may warrant a risk-based approach by dealing with ditch slope issues, should they occur, through routine post-construction inspection and maintenance. However, the inside slopes are of greater importance since they support the outfall piping from the weir and toe drain.

The ditch stability analyses under steady state conditions were re-run with a 1-foot gravel bed placed on the slopes and bottom of the ditch. The gravel bed improves the stability factor of safety by providing a filtered seepage exit which will reduce seepage gradients moving into the ditch as well as provide an increased friction angle. The gravel may be Number 57 stone or similar which we anticipate will be used for construction of the dike toe drain. As indicated in **Table 10.4.3** the gravel bed increased the factors of safety above the minimum required values.

10.5 Dike Seepage Analysis

10.5.1 Seepage Analysis Soil Properties

The principal soil property required for seepage analysis is hydraulic conductivity. Hydraulic conductivity values for the various soil layers were estimated using the laboratory permeability test results and our experience with similar soil types.

The hydraulic conductivity values used in the seepage analyses are provided in Table 10.4.1 in **Section 10.4.1**.

10.5.2 Boundary Conditions

All seepage analyses used constant head boundary conditions to represent the inside pool (impounded water) and outside water features (i.e. perimeter ditch). Exit-face boundary conditions were used on all outside slopes to allow the SEEP/W model to identify locations where the phreatic surface would exit the slope.

Constant head and no-flow boundary conditions were utilized on the vertical faces at the inside and outside limits of the model. The horizontal distance for each model was 340 feet from the left and right extents. This results in horizontal distances to the model extent of about 110 feet from the ditch and 30 feet from the upstream toe. The constant head boundary conditions for the water features in each design section are summarized in the following tables:

Table 10.5.2-1 East Cross-Section Boundary Conditions

Analyses	Pool Elevation (feet-NAVD)	Toe Drain Invert Elevation (feet-NAVD)	Ditch Water Elevation (feet-NAVD)	Groundwater Elevation (feet-NAVD)
End-of-Construction	+16.6	+11.2	-	+11
Steady State	+33.3	+11.2	-	+11

Table 10.5.2-2 North Cross-Section Boundary Conditions

Analyses	Pool Elevation (feet-NAVD)	Toe Drain Elevation (feet-NAVD)	Ditch Water Elevation (feet-NAVD)	Groundwater Elevation (feet-NAVD)
End-of-Construction	+16.6	+15.1	-	+16
Steady State	+33.3	+15.1	-	+16

Table 10.5.2-3 South Cross-Section Boundary Conditions

Analyses	Pool Elevation (feet-NAVD)	Toe Drain Elevation (feet-NAVD)	Ditch Water Elevation (feet-NAVD)	Groundwater Elevation (feet-NAVD)
End-of-Construction	+16.6	+17.7	-	+18
Steady State	+33.3	+17.7	-	+18

Table 10.5.2-4 West Cross-Section Boundary Conditions

Analyses	Pool Elevation (feet-NAVD)	Toe Drain Elevation (feet-NAVD)	Ditch Water Elevation (feet-NAVD)	Groundwater Elevation (feet-NAVD)
End-of-Construction	+16.6	+22.7	-	+22
Steady State	+33.3	+22.7	-	+22

10.5.3 Seepage Flow Rates

The seepage analysis indicated that the dike's downstream slope will be wet at its toe under steady-state seepage conditions. To avoid a wet toe, we recommend that a toe drain be installed beneath the entire length of the dike's downstream slope. The toe drain was modeled by inserting a circular region with a potential seepage face boundary condition along the perimeter. The toe drain was offset about 35 feet from the dike toe swale invert into the downstream embankment. This offset adequately controlled the phreatic surface at each analyzed section. The following table presents the seepage flow rates into the drain under steady-state seepage conditions for the three cross-sections.

Table 10.5.3 Seepage Flow Rate into Toe-Drain

Cross Section	Seepage Flow Rates per foot of dike (ft^3/day)	Seepage Flow Rates per foot of dike (gpm)
East	238.2	1.2
North	179.5	0.9
South	236.9	1.2
West	187.1	1.0

The water flowing to the drain will need to be routed to the perimeter ditch via an outfall pipe with positive gravity flow. The total maximum (i.e. Year 50) seepage flow rate into the perimeter ditch under steady-state seepage conditions is estimated to be 1,785,000 cubic feet per day or about 9,300 gallons per minute. This rate is a combination of piped outfall from the toe drain as well as seepage that passes below the drain and flows directly into the ditch. The rate is based on 7,147 lineal feet of dike.

10.5.4 Seepage Exit Gradients

The quantitative results of the seepage analyses for the end-of-construction and steady-state seepage scenarios are provided on Exhibits F-1 through F-8 in Appendix F. The seepage results indicate that most seepage lost from the DMMA will flow through the dike and within the upper sands above the clay and/or silt strata. The SEEP/W results also show that the phreatic surface does not exit on the face of the downstream slope, but instead passes through the toe drain.

The exit gradients into the perimeter ditch and dike toe swale under steady-state seepage conditions were determined for each design section. The phreatic surface exit gradient into the perimeter ditch for each dike section is presented in the following table.

Table 10.5.4-1 Perimeter Ditch Seepage Exit Gradients

Cross Section	Perimeter Ditch Surface Exit Gradient	Corresponding Piping Safety Factor
East	0.24	4.17
North	0.35	2.86
South	0.53	1.89
West	0.26	3.85

Table 10.5.4-2 Dike Toe Swale Seepage Exit Gradients

Cross Section	Dike Toe Swale Surface Exit Gradient	Corresponding Piping Safety Factor
East	0.18	5.56
North	0.24	4.17
South	0.42	2.38
West	0.10	10.00

The U.S. Army Corps of Engineers (USACE) Engineering Manual EM 1110-2-5027 – Confined Disposal of Dredged Material does not provide specific guidance for minimum factor of safety against a seepage piping failure. The USACE Engineering Manual EM 1110-2-1901 – Seepage Analysis and Control for Dams indicates a minimum factor of safety against piping between 2.5 and 3. DUNKELBERGER considers the factor of safety against piping at the dike toe swale (minimum of 2.38) adequate for the design provided that project specifications require routine visual observations along the southern dike toe while in use during dredging. If the observations indicate the presence of seepage along the dike toe, Taylor Engineering should be contacted immediately for recommendations. The factor of safety against piping at the perimeter ditch (minimum of 1.86) is lower than that at the toe swale and significantly lower than the USACE range above at locations along the southern perimeter ditch. The factor of safety could be increased by placing a filter along the southern ditch. However, we understand that Taylor Engineering considers a piping failure to be less critical as the distance from the dike increases. If the southern ditch is not filtered, project specifications should require the same routine visual observations along the southern perimeter ditch as for the dike toe stated above.

The exit gradients shown in the above tables may be decreased by adding a filter at the seepage exit points. The filter should provide sufficient permeability to reduce the pressure (gradient) at the exit point as well as meet gradation requirements to prevent particle migration (piping).

10.6 Weir Structure Foundations

Substantial settlements caused by the weight of the dredged spoils (i.e. operational settlement) as well as the structure itself are anticipated at the location of the weir structure when employing a shallow foundation system. The operational settlement alone at this location is estimated up to about 4.3 inches. The settlement of the weir slab under the weight of the structure is estimated at about 0.8 inches with the consolidation component being 0.5 inches and the other 0.3 inches as immediate (elastic) movement. Consolidation settlement of the weir structure could influence differential settlement of the elevated walkway depending on construction timing as explained further below.

The weir slab and elevated walkway may be supported by shallow foundations bearing on native soil or structural embankment soils (i.e. dike fill). Foundations based in these densified materials may be proportioned for a net allowable bearing pressure of 500 pounds per square foot (psf). To provide an adequate factor of safety against a bearing capacity failure: 1) all foundation components should be based at least 18 inches below the lowest adjacent grade; and 2) footings should be at least 48 inches wide. The footing concrete should be cast upon granular materials compacted to a firm and stable condition, and at least 95% of the ASTM D1557 maximum dry density.

The amount of settlement that the weir structure walkway experiences will be partially dependent on the construction schedule. If the walkway is constructed immediately after the dike is constructed, then the walkway will experience consolidation settlement in addition to operational settlement. If walkway construction is delayed approximately 3 months to allow consolidation underneath the dike to complete, then the walkway will experience only operational settlement.

Consolidation settlement of the walkway near the crest is estimated at about 2.9 inches over a period of 3 months while the walkway at the upstream toe of the dike may experience about 1.2 inches of consolidation. The walkway at its connection to the weir structure will experience 0.5 inches of consolidation settlement plus additional settlement of about 4.3 inches caused by operational loads from the dredge spoils. The following figures illustrate the estimated settlement of the walkway for each scenario described above.

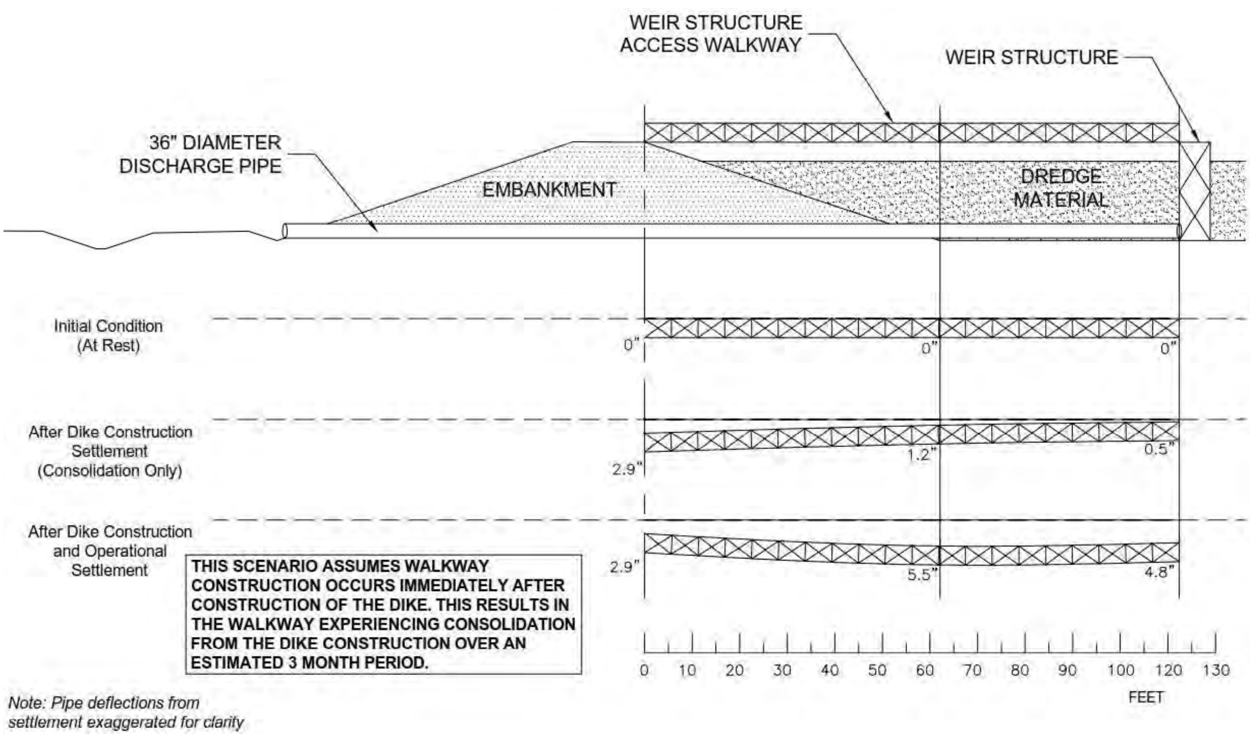


Figure 10.6.1 – Walkway Settlement (Scenario 1)

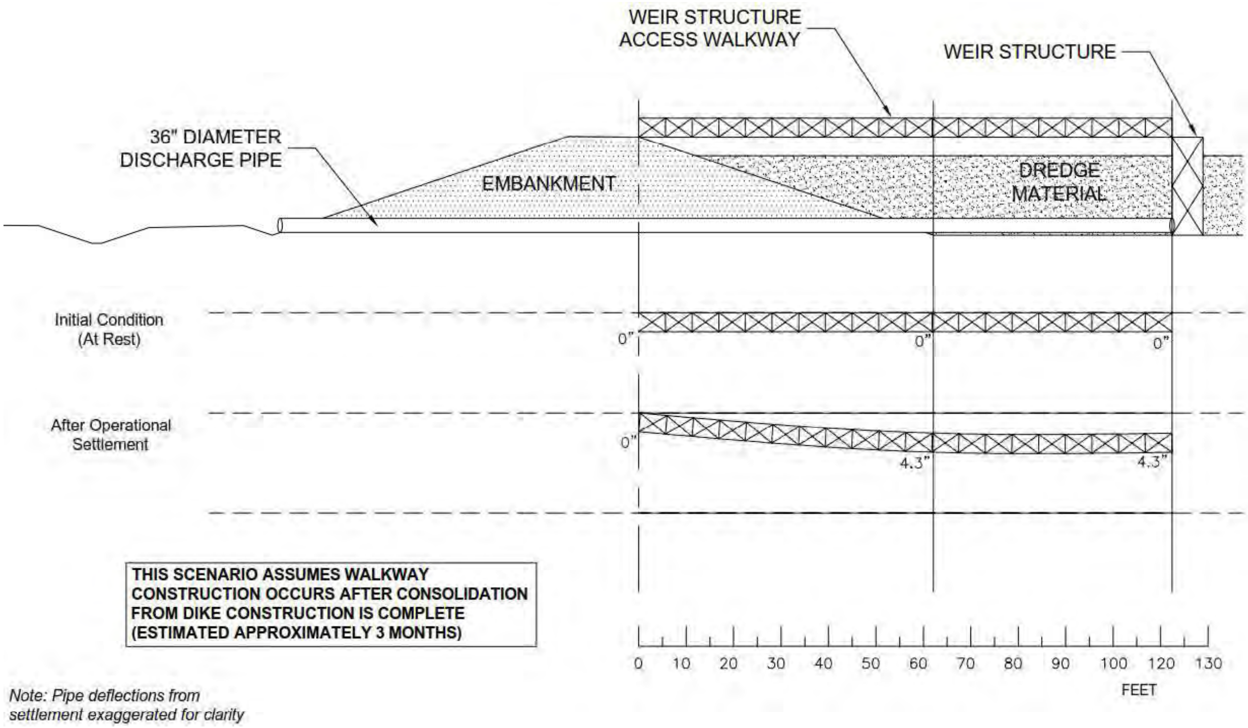


Figure 10.6.2 – Walkway Settlement (Scenario 2)

The walkway structure should be designed to accommodate the total settlement and also the differential settlement between the footings as well as the weir structure.

If these settlements cannot be tolerated by the weir structure or walkway, the Engineer should refer to **Section 11.4** as an alternative to limit post-construction settlement to the weir system.

10.7 Weir Discharge Pipe

Similar total and differential settlements are anticipated for the weir discharge pipe. The pipe will first undergo settlement impacts from construction of the dike embankment. The total settlement (elastic and consolidation) at the centerline and toe of the embankment is estimated at 5.3 inches and 1.5 inches, respectively. Operational settlement from the dredged spoils will also add settlement to both the upstream toe and the location of the pipe connection to the weir structure. The following figure illustrates the estimated settlement of the discharge pipe. Consolidation settlement of the weir structure could influence differential settlement of the discharge pipe depending on construction timing as explained further below.

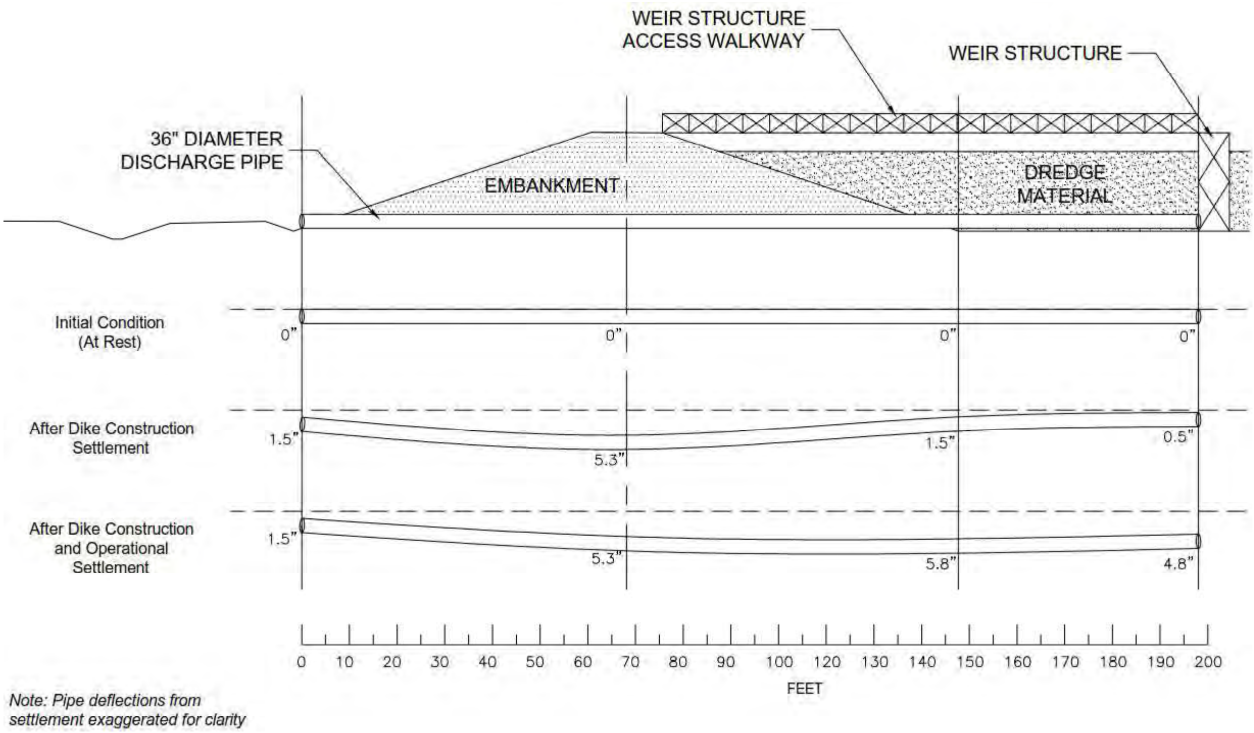


Figure 10.7 – Discharge Pipe Settlement

If these settlements cannot be tolerated by the weir discharge pipe, the Engineer should refer to **Section 11.4** as an alternative to limit post-construction settlement to the pipe.

11.0 CONSTRUCTION RECOMMENDATIONS

11.1 Dikes

11.1.1 Foundation Preparation

Earthwork operations should begin with the stripping of any surficial organic soil (topsoil) from the planned limits of the DMMA. The stripped topsoil should be removed from the construction areas. Wet or dry material should either be removed or moisture conditioned and re-compacted. After stripping, the exposed surface should be proof-rolled to aid in locating loose or soft areas. Proof-rolling should be performed with a vibratory roller with a minimum static weight of 20,000 pounds. The roller should make a minimum of eight overlapping passes over all areas of the site, the latter four passes at right angles to previous passes. The soils should be compacted sufficiently to obtain a minimum compaction of 95 percent of the maximum density at moisture content within 2 percent of the optimum moisture content as determined by ASTM D1557 to a minimum depth of 12 inches prior to fill placement.

11.1.2 Settlement Monitoring

Settlement platforms should be installed prior to fill placement. We recommend placing settlement platforms along the dike centerline at a minimum of one platform per analyzed section (5 total). The settlement platforms should be installed at the ground surface after it has been cleared, grubbed, and proof-rolled prior to dike fill placement.

11.1.3 Fill Placement

The fill borrow soil is anticipated to be near-surface clean sand and sand with silt (SP and SP-SM). Silty or clayey sand (SM, SC) with fines contents up to 25 percent may be used on the inside portion (not within 5 feet measured normal to the slope face) of the dike section. The fill should be free of roots, vegetation, and other deleterious materials. It should have an organic content no greater than 2 percent by weight.

Fill should be placed parallel to centerline of the dikes. Each lift of fill should extend across the entire dike section. If silty or clayey sands (SM, SC) are used as fill, the compacted surface of each lift should be scarified by light disking, or by any other approved method, before the succeeding layer is placed. After dumping the succeeding lift, materials should be spread by bulldozers or other approved means in approximately horizontal layers over the entire fill area. The fill should be placed in maximum 12-inch thick loose lifts.

The gradation and distribution of materials throughout the compacted earth fill section of the dike shall be such that the dike will be free from lenses, pockets, streaks, and layers of material differing substantially in texture or gradation from surrounding material. The fill should be disked or harrowed to blend.

The materials in each layer of the fill should be within ±2 percent of the soil's optimum moisture content, as determined by ASTM D1557, during placement. The moisture content after compaction should be as uniform as practical throughout any one layer. Harrowing, disking, or other approved methods will be required to work the moisture into the material until a uniform distribution of moisture is obtained.

The materials in each layer of the fill should be compacted as required to obtain a minimum of 95 percent of the soil's maximum dry density determined by ASTM D1557.

11.1.4 Seepage Toe Drains

The seepage toe drain should consist of a perforated, corrugated high density polyethylene (HDPE) pipe embedded in inert fine gravel which is also encased with C33 concrete sand to facilitate filter compatibility. The drain should outfall to the perimeter ditch via gravity flow through an outlet pipe with a minimum positive slope of 1%.

The predicted maximum, post-construction settlements along both the crest and upstream toe are less than 6 inches. Accordingly, we believe that there is relatively low risk of significant embankment cracking due to differential movement. An option, however, to further lessen that risk is extension of the toe drain upward on a 2H:1V incline as a blanket drain.

11.2 Groundwater Control

Where groundwater is expected to be encountered during excavation, a dewatering system should be installed to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations and fill material to be placed in the dry, and to maintain stable excavation side slopes. Groundwater should be maintained at least 3 feet below the bottom of any excavation.

Dewatering systems for structures should be kept in operation until the dead load of the structure exceeds possible buoyant uplift force on the structure. Dewatering systems should be shut off at such a rate as to prevent a quick upsurge of water that might weaken the subgrade, or cause instability in excavation side slopes.

11.3 Structures

Subgrade to receive fill or backfill should be free of organic material, roots, stumps or other undesirable material. It should be scarified to a depth of 6 inches and compacted to a minimum of 95 percent of the soil’s maximum dry density as determined by ASTM D1557.

Fill and backfill adjacent to structures should be placed in 12-inch maximum loose lifts and compacted as necessary to obtain a minimum of 95 percent of the soil’s maximum dry density determined by ASTM D1557. Fill material should be compacted with equipment of proper type and size to obtain the density specified. Hand-operated equipment should be used for filling and backfilling within 3 feet of walls and retaining walls. When hand-held equipment is used, fill should be placed in 6-inch maximum loose lifts. Fill or backfill material should not be placed when the air temperature is less than 40 degrees Fahrenheit and when the subgrade to receive the material is wet, loose, or soft.

Backfill should not be placed around any part of concrete structures until each part has reached its specified 28-day compressive strength. Backfilling should not commence until stripping of concrete forms, trash removal from excavations, concrete finishing, damp-proofing and waterproofing have been completed.

Fill should not be placed against walls until slabs at the top, bottom and intermediate levels of walls are in place and have reached 28-day required compressive strength to prevent wall movement.

Fill and backfill should be brought up uniformly around the structures and individual walls, piers, or columns.

11.4 Weir Structure and Discharge Pipe

If the settlements discussed in **Sections 10.6 and 10.7** cannot be tolerated by the weir structure, walkway, or discharge pipe, we recommend placing the full dike section in this area early in the construction schedule to limit the settlement impacts. When consolidation settlement is nearly complete, a portion of the dike would then be removed to expose a minimum 15-foot wide work area along the pipe alignment. After the pipe is installed, the dike fill should be replaced. The excavation slopes should be no steeper than 4H:1V, and each lift of the new fill should be bench-cut into the existing fill a minimum horizontal distance of 2 feet. The pipe alignment between the upstream embankment toe and the weir structure should also be pre-loaded with a temporary fill. The pre-load, if compacted, should be the same height as the dike embankment. If the preload is constructed “loose”, then the height should be increased by 5 feet.

Seepage control should be placed along the pipe where it penetrates the dike to avoid the potential for piping of soils along the outside of the pipe. The seepage control should utilize a filter diaphragm or collar placed around the pipe at the location of the toe drain. The filter diaphragm should tie directly into the toe drain for controlled routing of the seepage. If the filter diaphragm cannot be tied into the toe drain system, then the filter should extend across the entire downstream third of the pipe and be routed into the perimeter ditch by controlled outfall. Concrete seepage collars should not be used due to the difficulty associated with compaction around them creating potential for internal erosion. Concrete collars should not be confused with filter diaphragms (or filter collars).

12.0 SUMMARY AND RECOMMENDATIONS

The proposed DMMA footprint area is underlain by a thick (100 feet +/-) deposit of mostly granular soils consisting of relatively clean to silty sands containing broken shell. The profile also includes generally three layers of fine-grained (silt or clay) layers, referred to as upper, middle, and deep layers. The sands are generally loose in the upper part of the profile transitioning to dense at deeper depths in terms of relative density. The upper silt/clay layer is soft while the middle and deep layers are medium stiff to stiff.

A large wetland lies along the southern dike centerline. Surficial muck (unsuitable foundation materials) is commonly found in these wetlands. If found, the muck would require full removal and replacement. The area of this wetland is 76,500 square feet. With an assumed typical depth of 12 inches, the required excavation volume would be roughly 3,000 to 4,000 cubic yards.

The presence of the fine-grained layers is beneficial with respect to management of seepage from the impoundment. Seepage of impounded waters will predominately move laterally in the shallow sand layers above the clay/silt and allow for effective capture in a perimeter ditch system. Conversely, these materials are soft in areas and also locally thick which will cause significant dike and weir structure settlement.

Five design dike sections (east, north, southeast, southwest, and west) were used for engineering analysis to account for the variability in both topography and subsoil conditions from east to west across the site. Maximum dike (embankment fill) heights ranged from of 12 ½ feet on the west to 22 ½ feet on the east.

Slope stability analyses indicated sufficient stability in the dike sections, based on USACE criteria, for end-of-construction, steady-state seepage, and transient seepage conditions. Placement of a toe drain beneath the dike’s downstream slope is required to maintain sufficient stability under steady-state seepage conditions. The perimeter ditch stability fell below UASCE required minimum factors of safety for steady-state seepage conditions. Placement of a gravel lining on the ditch slopes would maintain sufficient stability throughout the 50-year life span of the DMMA.

Estimated dike crest settlements from elastic compression of the sand strata added to consolidation of the fine-grained layers are summarized in the following table.

Table 12 Summary of Crest Settlement Estimates

Design Section	Estimated Sand Settlement (inches)	Estimated Consolidation Settlement (inches)	Total Estimated Settlement (inches)
East	2.1	2.3	4.4
North	2.4	2.9	5.3
Southeast	3.7	1.5	5.2
Southwest	2.2	2.1	4.3
West	1.4	1.1	2.5

The estimated combined settlement values should be considered for earthwork volume estimates and to establish crest over-build elevations. Operational settlements, resulting from the weight of dredge materials, near the upstream toe should also be considered.

The sand settlement will be immediate occurring simultaneously with placement of the dike fill. Fine-grained material consolidation is estimated to take about 3 months following the end of dike construction.

The magnitude and duration of fine-grained material consolidation will impact both design and construction of the weir structure and its components. The Engineer should review the estimated total and differential settlements associated with the weir structure, elevated walkway, and discharge pipe to determine if they are tolerable. If any component of the weir system cannot tolerate these settlements, then preloading will be required. Following preloading of the weir system, or in the case that the total and differential settlements are deemed acceptable by the Engineer, the weir structure and elevated walkway may be supported on shallow foundations consisting of concrete footings for the walkway and a heavily-reinforced concrete slab for the weir structure.

The groundwater flow gradient mimics the topographic decline from west to east across the site. Depths to groundwater measured in on-site monitoring wells during the study period (i.e. dry season although significant rain was experienced) ranged from 1 ½ to 3 ½ feet below the existing ground surface or elevations from +8.3 to +22.5 feet NAVD. Groundwater control (dewatering) will likely be needed to accomplish fill placement at lower elevations and borrow excavation in the dry.

Borrow excavations up to 5 ½ feet bls, as presently planned, should produce relatively clean fine sands that would meet the engineering properties adopted for analysis and therefore be suitable for general embankment fill. These clean, uniformly fine sands are, however, very high in permeability, even when compacted, and therefore will result in significant flow rates in the dike toe drain system.

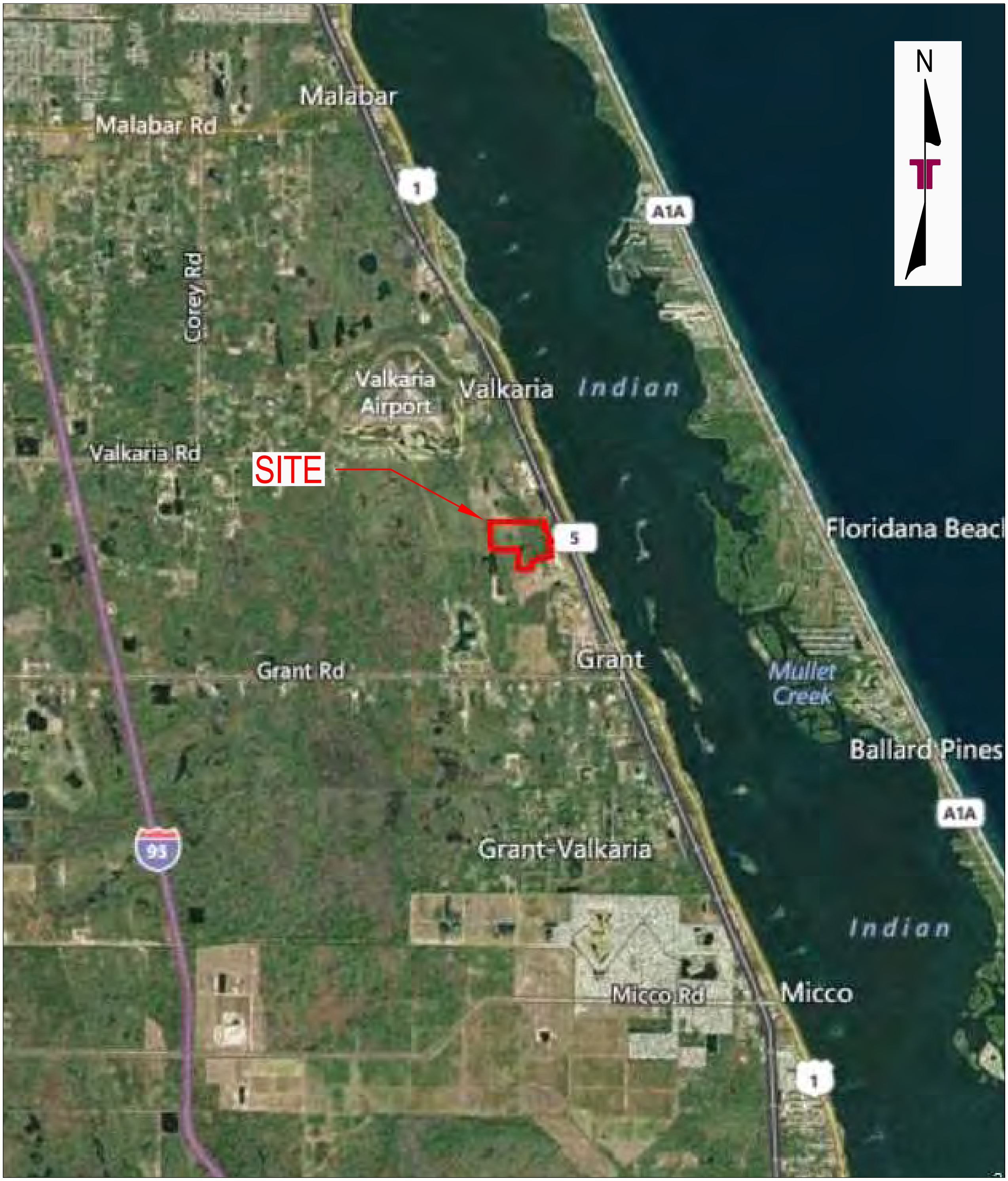
13.0 ADDITIONAL STUDY

The revised DMMA footprint, required for groundwater (i.e. chloride plume movement) control, represents an approximately 500-foot shift of the southeasterly stretch of the perimeter dike as compared to the original position. The exploratory borings completed during an earlier phase (Phase I) of study were aligned with the original footprint. Thus, a significant gap of exploratory data now exits along the southeasterly segment of the revised DMMA footprint. We recommend the drilling of supplemental borings in this area to confirm consistency with the earlier borings and current assumptions being used for Phase III design-level geotechnical analyses.

14.0 GENERAL COMMENTS

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.



SCALE 1 : 90000

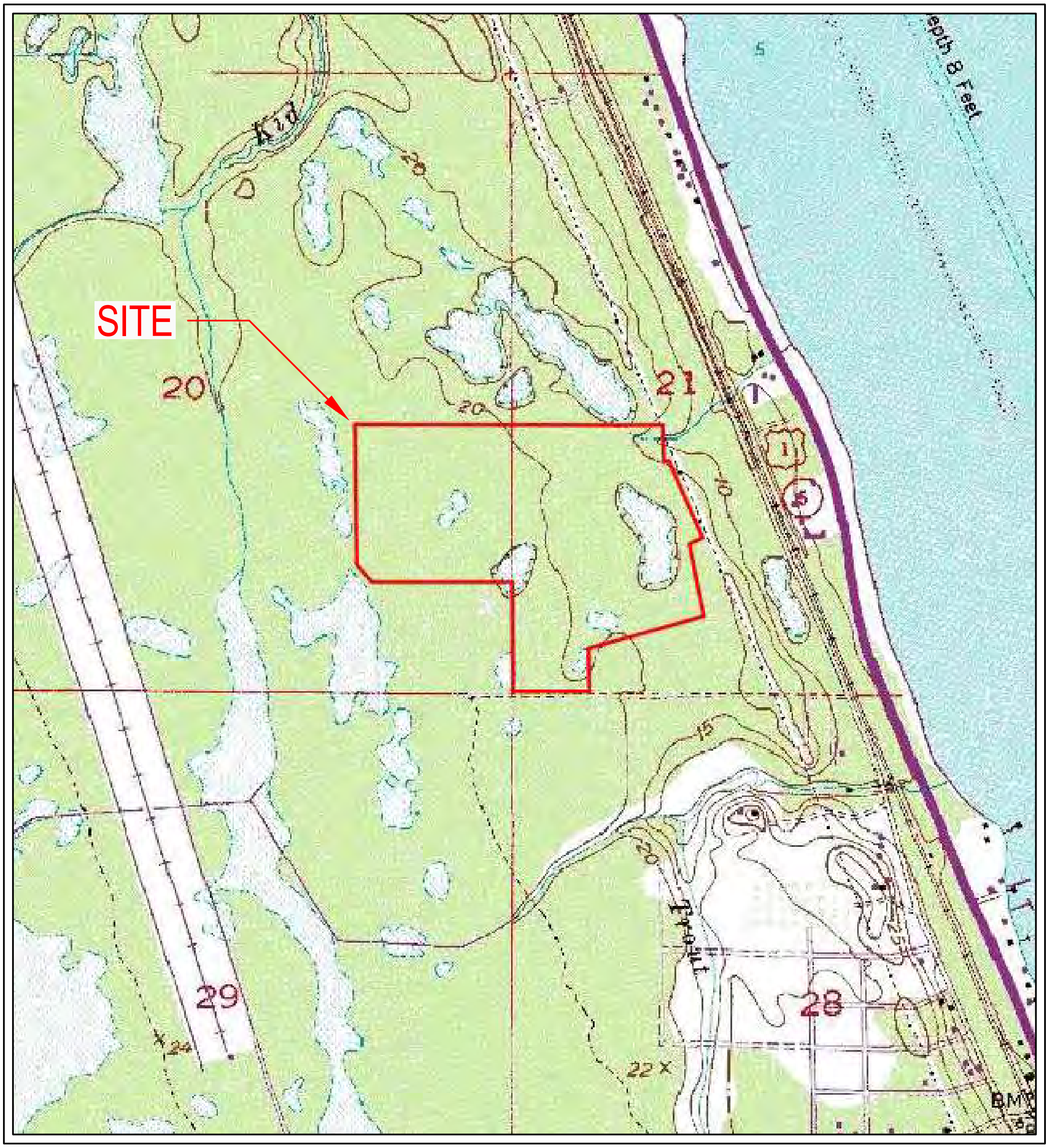
1 0 1 2 3 4 5

MILES

Project Mngr: DD	Project No. HB155022	**DUNKELBERGER** engineering & testing, inc. A Terracon COMPANY	SITE VICINITY MAP
Drawn By: BL	Scale: AS SHOWN	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION
Checked By: DD	File No. -	PH. (772) 343-9787 FAX. (772) 343-9404	TAYLOR ENGINEERING, INC.
Approved By: KA	Date: 5/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida

SHEET 1

UNITED STATES — DEPARTMENT OF THE INTERIOR — GEOLOGICAL SURVEY



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1000 0 1000 2000 3000 4000 5000

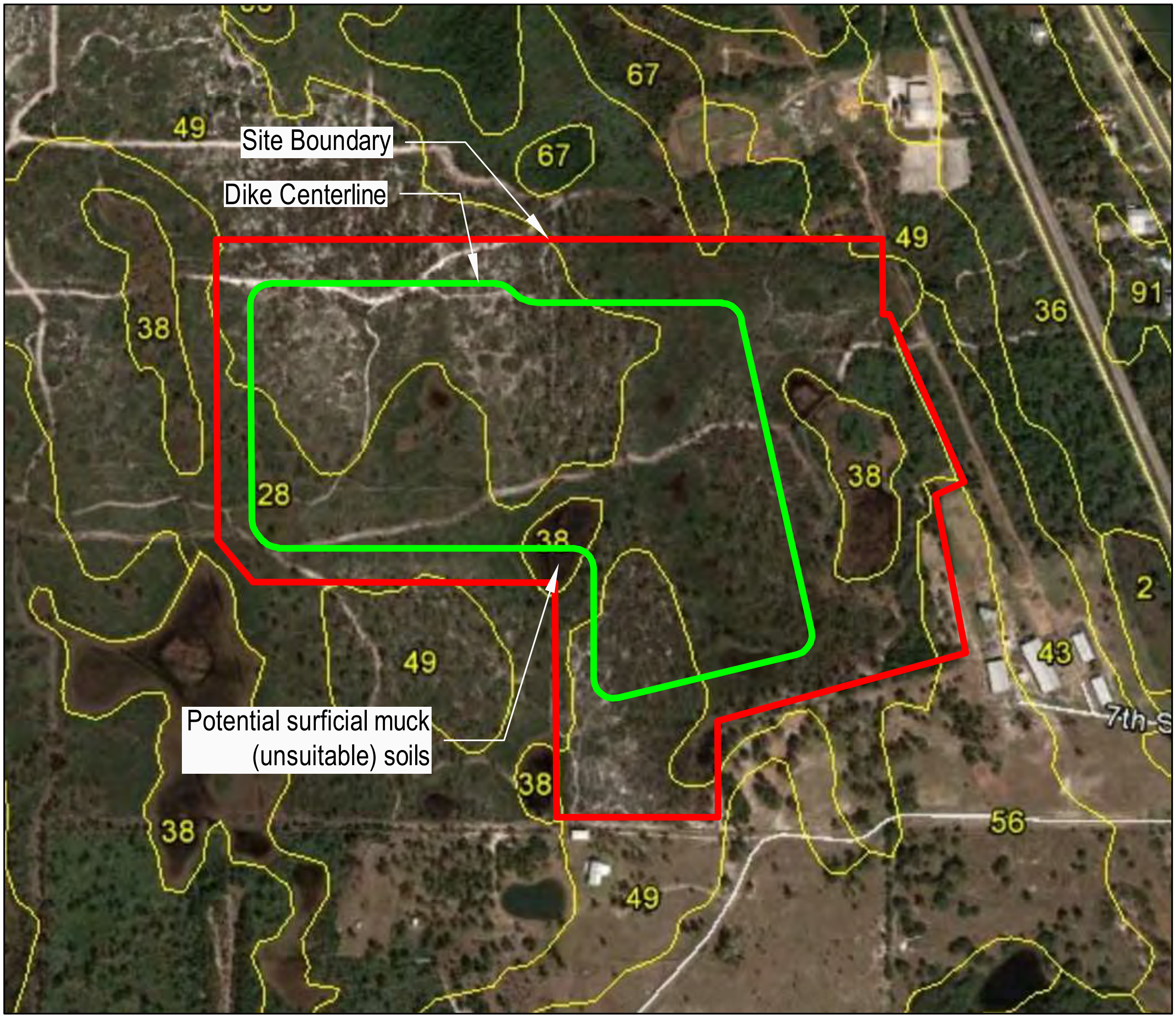
FEET

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

GRANT, FLORIDA
1949; PHOTO REVISED 1970
7.5 MINUTE SERIES (TOPOGRAPHIC)

N

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	TOPOGRAPHIC VICINITY MAP	SHEET
Drawn By: BL	Scale: AS SHOWN		GEOTECHNICAL SITE EXPLORATION	
Checked By: DD	File No. -		TAYLOR ENGINEERING, INC.	2
Approved By: KA	Date: 5/26/16	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986 PH. (772) 343-9787 FAX. (772) 343-9404	DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida	



SCALE 1 : 2600

400 0 400 800 1200 1600 2000
FEET

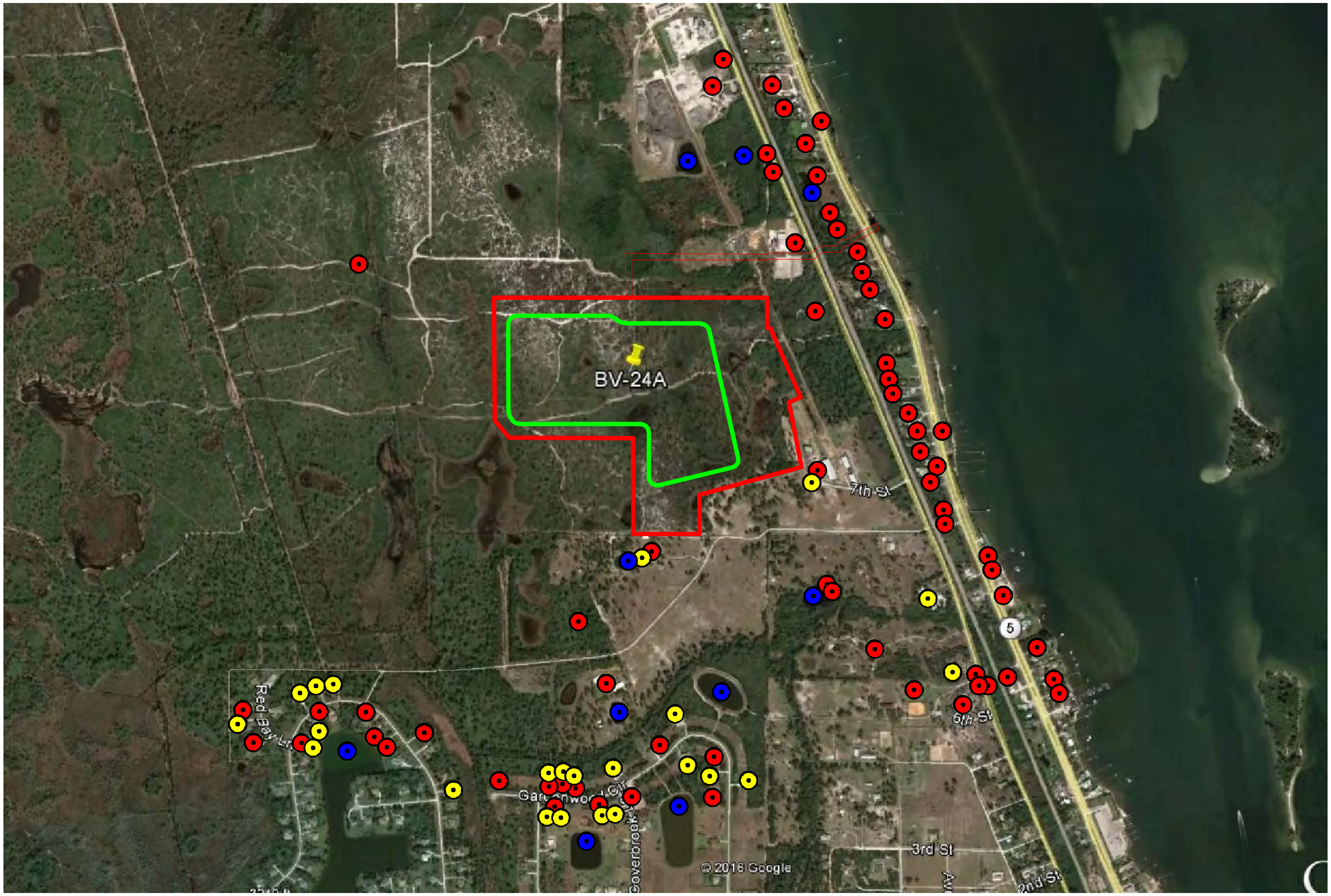
SOIL LEGEND

28	IMMOKALEE SAND
38	MYAKKA SAND, DEPRESSIONAL
49	POMELLO SAND
56	ST. LUCIE FINE SANDS, 0 TO 5 PERCENT SLOPES
67	TOMOKA MUCK, UNDRAINED

N

U.S.D.A. SOIL SURVEY FOR BREVARD COUNTY, FLORIDA
ISSUED: JANUARY 1987

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	SOIL SURVEY MAP	SHEET
Drawn By: BL	Scale: AS SHOWN		GEOTECHNICAL SITE EXPLORATION	3
Checked By: DD	File No. -		TAYLOR ENGINEERING, INC.	
Approved By: KA	Date: 5/26/16	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986 PH. (772) 343-9787 FAX. (772) 343-9404	DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida	



SOURCE: GOOGLE EARTH PRO

LEGEND

●	-	WELL
●	-	SEPTIC TANK
●	-	POND

Locations are approximate

N

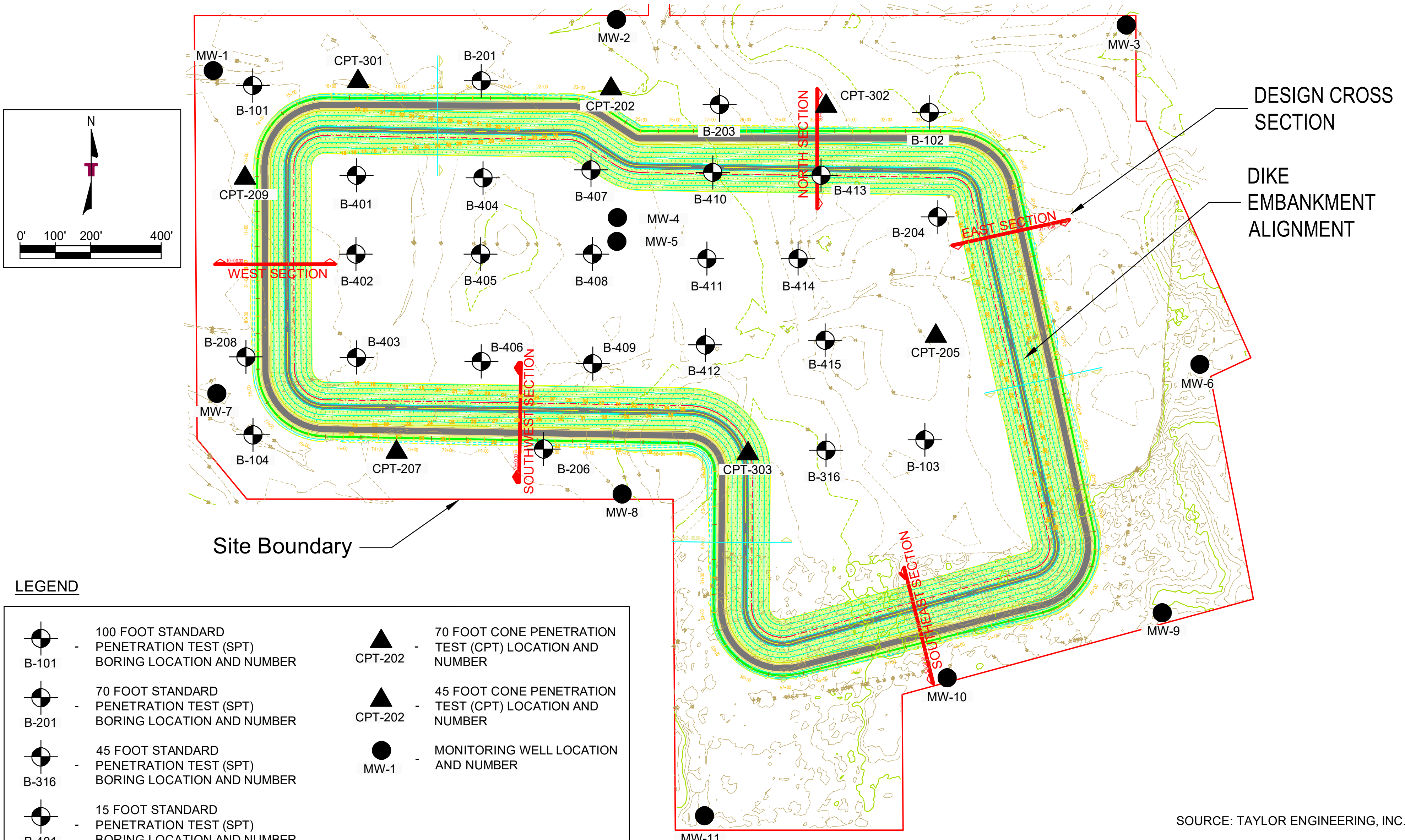
0 ¼ ½

MILES

Project Mngr: DD	Project No. HB155022	**DUNKELBERGER** engineering & testing, inc. A Terracon COMPANY 607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986 PH. (772) 343-9787 FAX. (772) 343-9404	HYDROLOGICAL DATA INVENTORY MAP
Drawn By: BL	Scale: AS SHOWN		GEOTECHNICAL SITE EXPLORATION TAYLOR ENGINEERING, INC.
Checked By: DD	File No. -		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A
Approved By: KA	Date: 5/26/16		Brevard County Florida

SHEET

4



LEGEND

B-101	- 100 FOOT STANDARD PENETRATION TEST (SPT) BORING LOCATION AND NUMBER	CPT-202	- 70 FOOT CONE PENETRATION TEST (CPT) LOCATION AND NUMBER
B-201	- 70 FOOT STANDARD PENETRATION TEST (SPT) BORING LOCATION AND NUMBER	CPT-202	- 45 FOOT CONE PENETRATION TEST (CPT) LOCATION AND NUMBER
B-316	- 45 FOOT STANDARD PENETRATION TEST (SPT) BORING LOCATION AND NUMBER	MW-1	- MONITORING WELL LOCATION AND NUMBER
B-401	- 15 FOOT STANDARD PENETRATION TEST (SPT) BORING LOCATION AND NUMBER		

Locations are approximate

SOURCE: TAYLOR ENGINEERING, INC.

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	TEST LOCATION PLAN	SHEET
Drawn By: BL	Scale: AS SHOWN	645 NW ENTERPRISE DR., STE 107 PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION	5
Checked By: DD	File No. -	PH. (772) 343-9787 FAX. (772) 343-9404	TAYLOR ENGINEERING, INC.	
Approved By: KA	Date: 8/16/17		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A	
			Brevard County Florida	

LEGEND

① Gray or brown medium to fine SAND. (SP)

② Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan). (SP-SM, SM)

③ Light brown slightly silty medium to fine SAND. (SP-SM)

④ Dark gray to green sandy SILT. (ML)

⑤ Gray shelly SAND with varying amounts of silt. (SP, SP-SM, SM)

⑥ Green or light gray CLAY, traces of shell. (CL, CH)

⑦ Gray to green slightly silty to silty fine SAND. (SP-SM, SM)

SP - Unified Soil Classification System Group Symbol (ASTM D 2487)

N - Indicates the number of blows of a 140 pound hammer, freely falling a distance of 30 inches, required to drive a 2-inch diameter sampler 12 inches (ASTM D 1586

B-101 - Standard Penetration Test (SPT) boring and number

MC - Moisture Content (%)

OC - Organic Content (%)

-200 - Amount finer than the U.S. No. 200 Sieve (%)

+22.9' ▼ 2-17-16 - Elevation of groundwater (feet-NAVD) and date measured

WOH - Indicates sampler advanced due to weight of hammer

50/1 - Indicates fifty blows required to drive sampler 1 inch

LL - Liquid Limit (%)

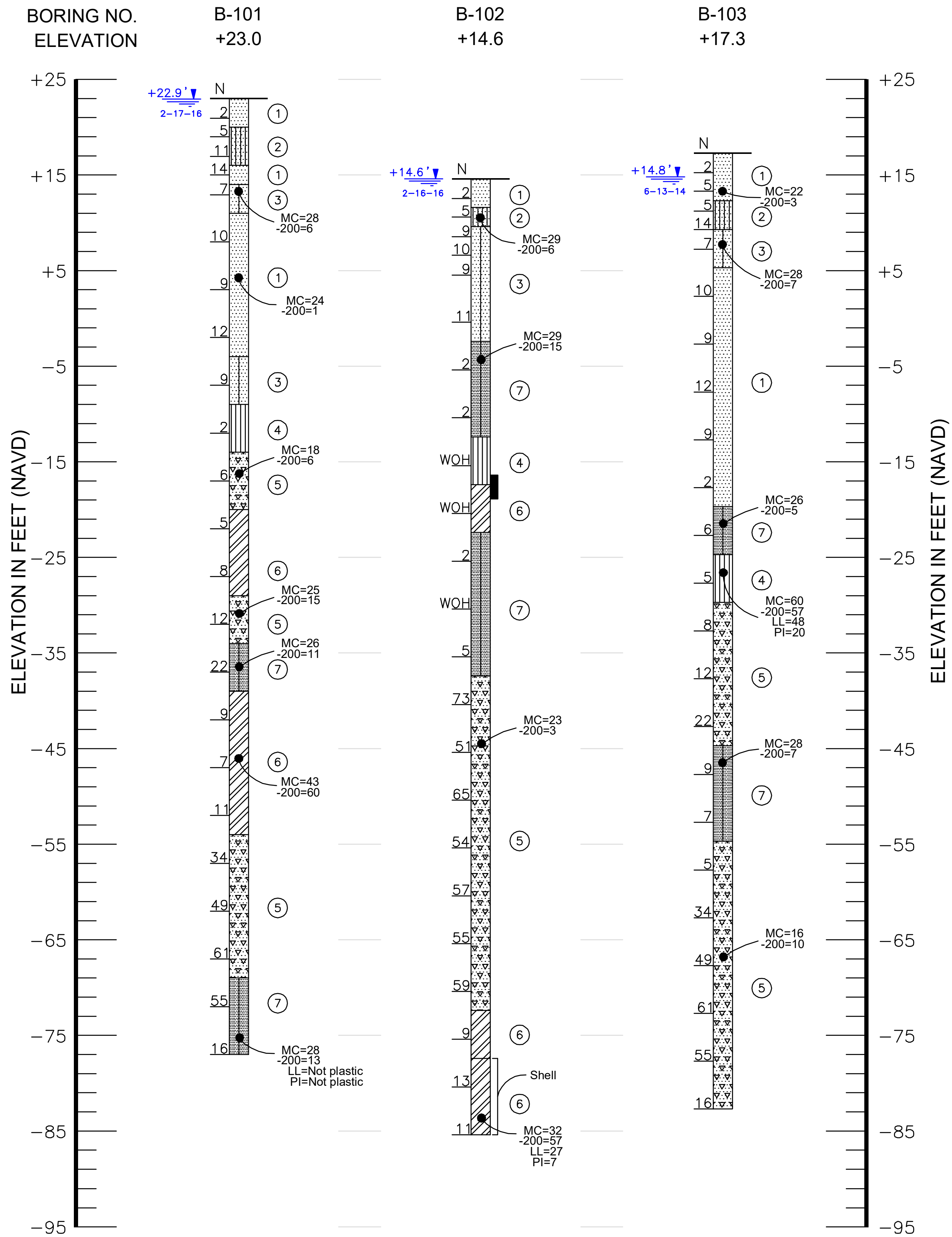
PI - Plasticity Index (%)

▌ - Indicated location of undisturbed (Shelby tube) sample collection

NOTES

1. Borings were drilled February 15, 2016 through February 26, 2016 using an ATV mounted Deidrich 50 (D-50) drill rig.
2. Strata boundaries are approximate and represent soil strata at each test hole location only. Soil transitions may be more gradual than implied.
3. Groundwater elevations shown on the subsurface profiles represent groundwater surfaces on the dates shown. Groundwater level fluctuations should be anticipated throughout the year.

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	LEGEND	SHEET
Drawn By: BL	Scale: AS-SHOWN		GEOTECHNICAL SITE EXPLORATION	6
Checked By: BL	File No. -		TAYLOR ENGINEERING, INC.	
Approved By: KA	Date: 5/26/16	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986 PH. (772) 343-9787 FAX. (772) 343-9404	DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida	



LEGEND

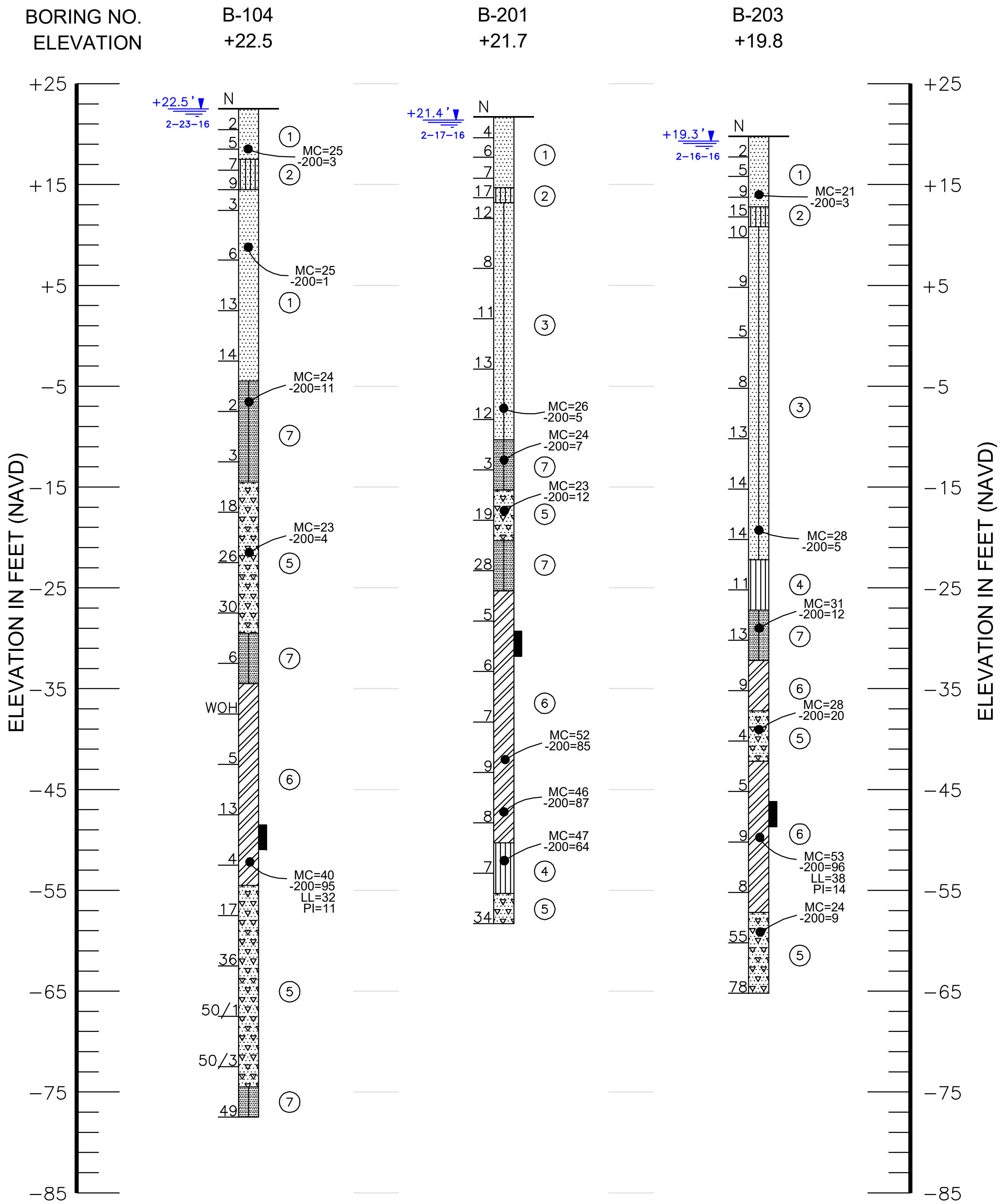
1	Gray or brown medium to fine SAND. (SP)
2	Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan). (SP-SM, SM)
3	Light brown slightly silty medium to fine SAND. (SP-SM)
4	Dark gray to green sandy SILT. (ML)
5	Gray shelly SAND with varying amounts of silt. (SP, SP-SM, SM)
6	Green or light gray CLAY, traces of shell. (CL, CH)
7	Gray to green slightly silty fine to silty SAND. (SP-SM, SM)

Project Mngr: DD	Project No. HB155022
Drawn By: BL	Scale: 1" = 10'
Checked By: DD	File No. -
Approved By: KA	Date: 3/26/16

DUNKELBERGER engineering & testing, inc.
A Terracon COMPANY
607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986
PH. (772) 343-9787 FAX. (772) 343-9404

SUBSURFACE PROFILES
GEOTECHNICAL SITE EXPLORATION
TAYLOR ENGINEERING, INC.
DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A
Brevard County Florida

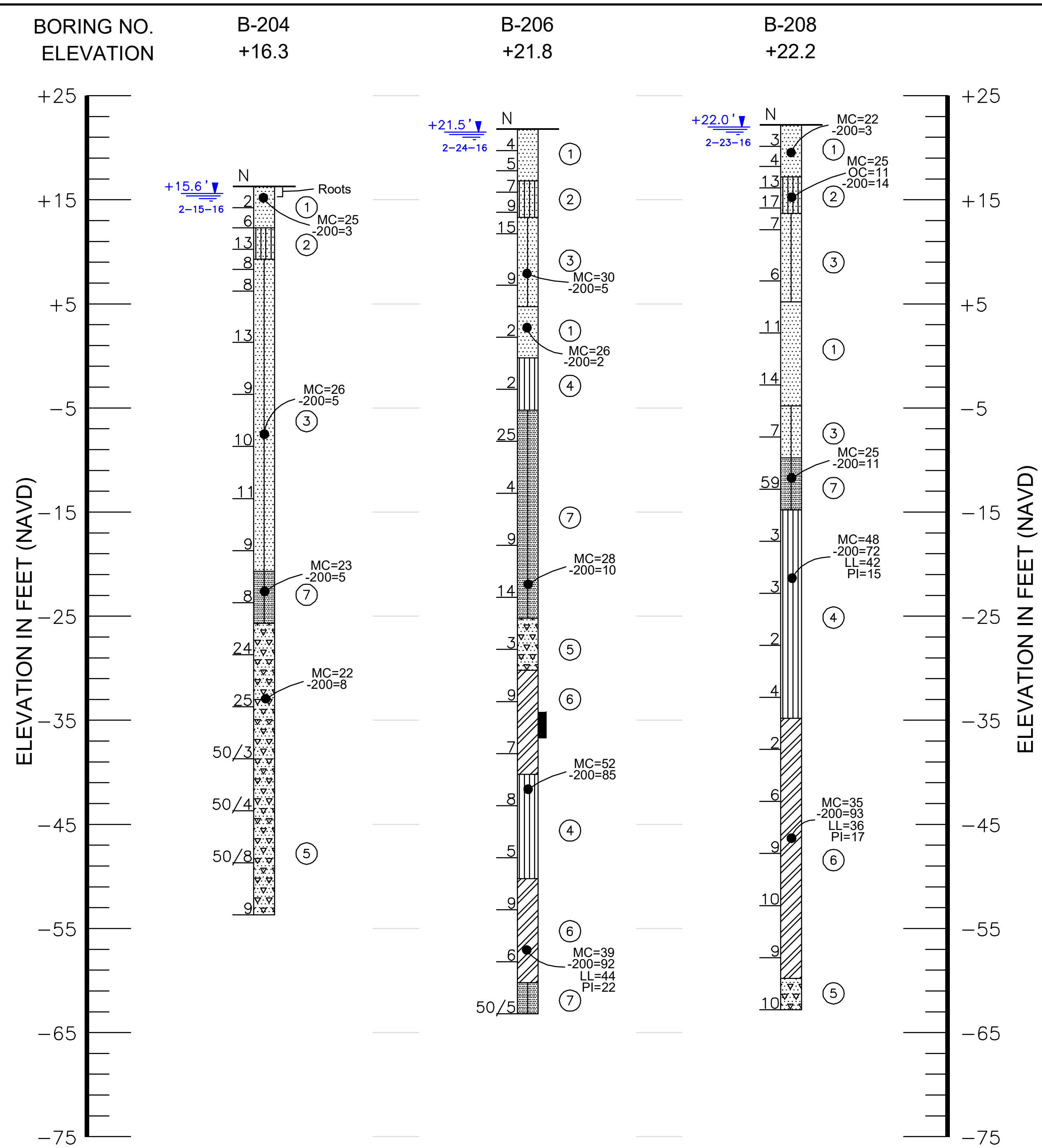
SHEET
7



LEGEND

1 Gray or brown medium to fine SAND. (SP)	5 Gray shelly SAND with varying amounts of silt. (SP, SP-SM, SM)
2 Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan). (SP-SM, SM)	6 Green or light gray CLAY, traces of shell. (CL, CH)
3 Light brown slightly silty medium to fine SAND. (SP-SM)	7 Gray to green slightly silty fine to silty SAND. (SP-SM, SM)
4 Dark gray to green sandy SILT. (ML)	

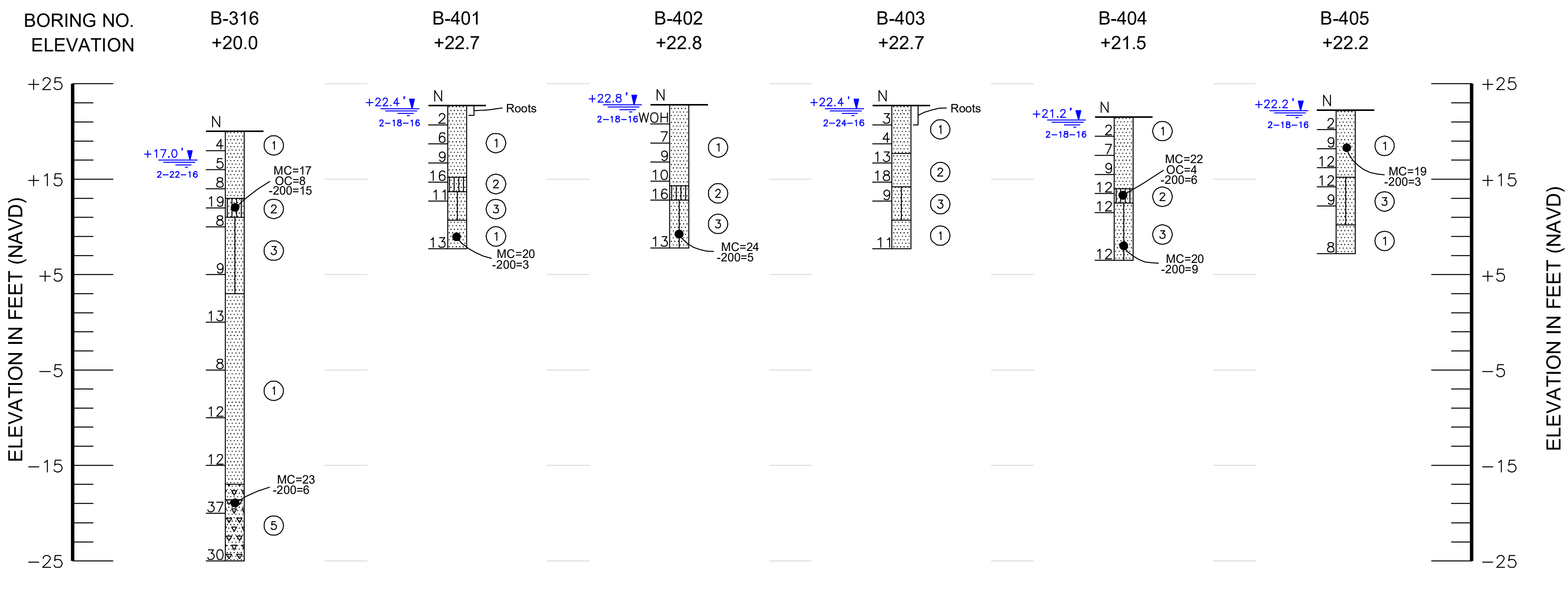
Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	SUBSURFACE PROFILES	SHEET
Drawn By: BL	Scale: 1" = 10'	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION	8
Checked By: DD	File No. -	PH. (772) 343-9787 FAX (772) 343-9404	TAYLOR ENGINEERING, INC.	
Approved By: KA	Date: 3/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida	



LEGEND

1. Gray or brown medium to fine SAND. (SP)
2. Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan). (SP-SM, SM)
3. Light brown slightly silty medium to fine SAND. (SP-SM)
4. Dark gray to green sandy SILT. (ML)
5. Gray shelly SAND with varying amounts of silt. (SP, SP-SM, SM)
6. Green or light gray CLAY, traces of shell. (CL, CH)
7. Gray to green slightly silty fine to silty SAND. (SP-SM, SM)

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	SUBSURFACE PROFILES	SHEET
Drawn By: BL	Scale: 1" = 10'	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION	9
Checked By: DD	File No. -	PH. (772) 343-9787 FAX. (772) 343-9404	TAYLOR ENGINEERING, INC.	
Approved By: KA	Date: 3/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A	
			Brevard County Florida	



LEGEND

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② Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan). (SP-SM, SM)

③ Light brown slightly silty medium to fine SAND. (SP-SM)

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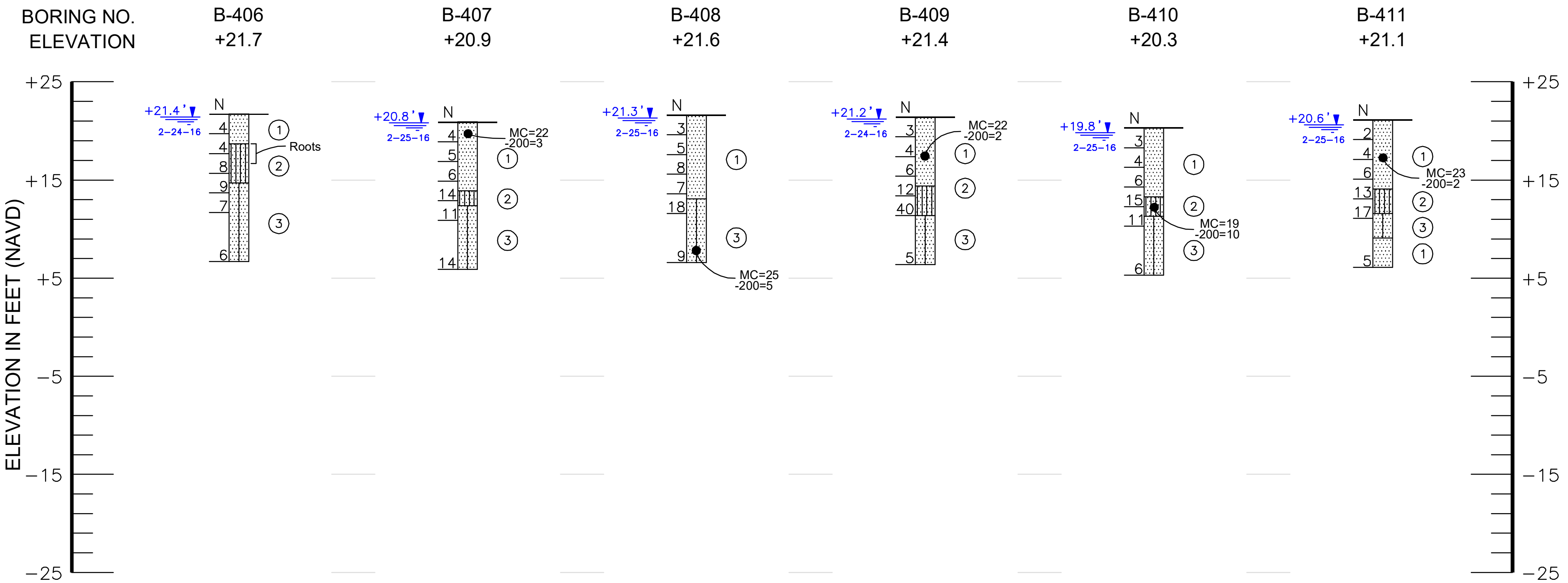
⑤ Gray shelly SAND with varying amounts of silt. (SP, SP-SM, SM)

⑥ Green or light gray CLAY, traces of shell. (CL, CH)

⑦ Gray to green slightly silty fine to silty SAND. (SP-SM, SM)

Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	SUBSURFACE PROFILES
Drawn By: BL	Scale: 1" = 10'	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION
Checked By: DD	File No. -	PH. (772) 343-9787 FAX. (772) 343-9404	TAYLOR ENGINEERING, INC.
Approved By: KA	Date: 3/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A
			Brevard County Florida

SHEET 10

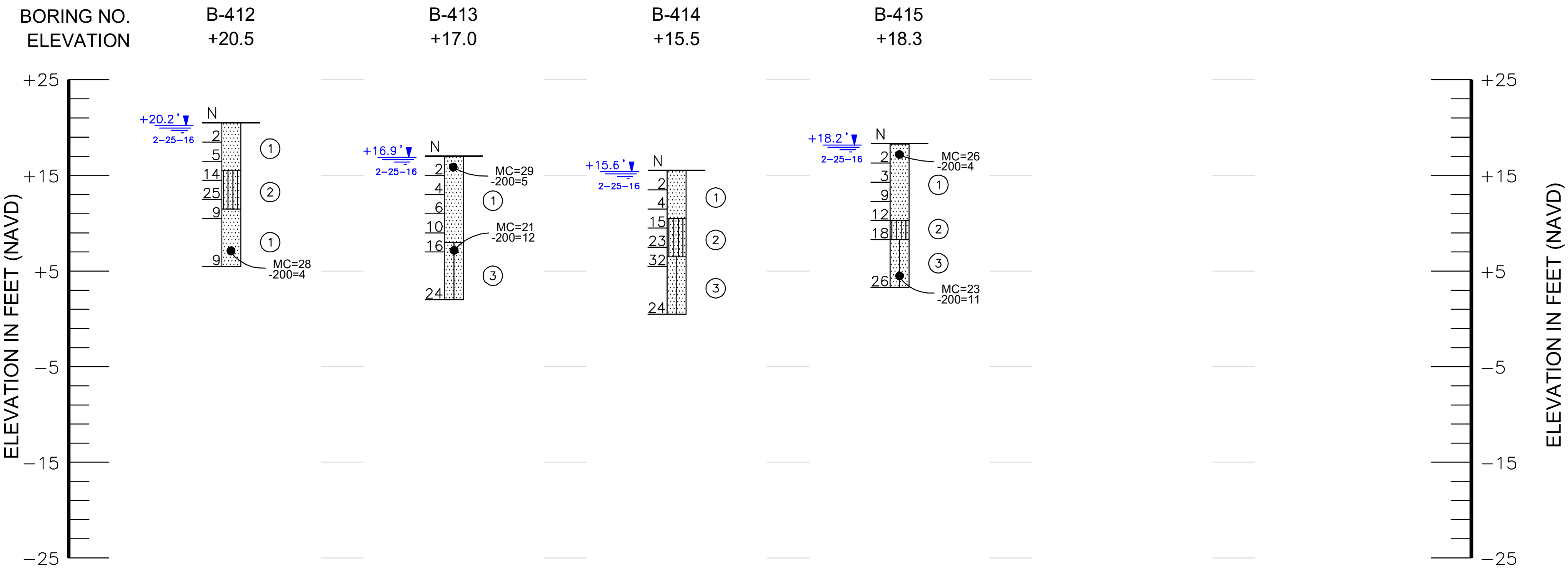


LEGEND

(1) Gray or brown medium to fine SAND. (SP)	(5) Gray shelly SAND with varying amounts of silt. (SP, SP-SM, SM)
(2) Black slightly silty to silty fine SAND, weakly cemented with an organic stain (Hardpan). (SP-SM, SM)	(6) Green or light gray CLAY, traces of shell. (CL, CH)
(3) Light brown slightly silty medium to fine SAND. (SP-SM)	(7) Gray to green slightly silty fine to silty SAND. (SP-SM, SM)
(4) Dark gray to green sandy SILT. (ML)	

Project Mngr: DD	Project No. HB155022	**DUNKELBERGER** engineering & testing, inc. A Terracon COMPANY	SUBSURFACE PROFILES
Drawn By: BL	Scale: 1" = 10'	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION
Checked By: DD	File No. -	PH. (772) 343-9787 FAX. (772) 343-9404	TAYLOR ENGINEERING, INC.
Approved By: KA	Date: 3/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A
			Brevard County Florida

SHEET
11



LEGEND

1. Gray or brown medium to fine SAND. (SP)
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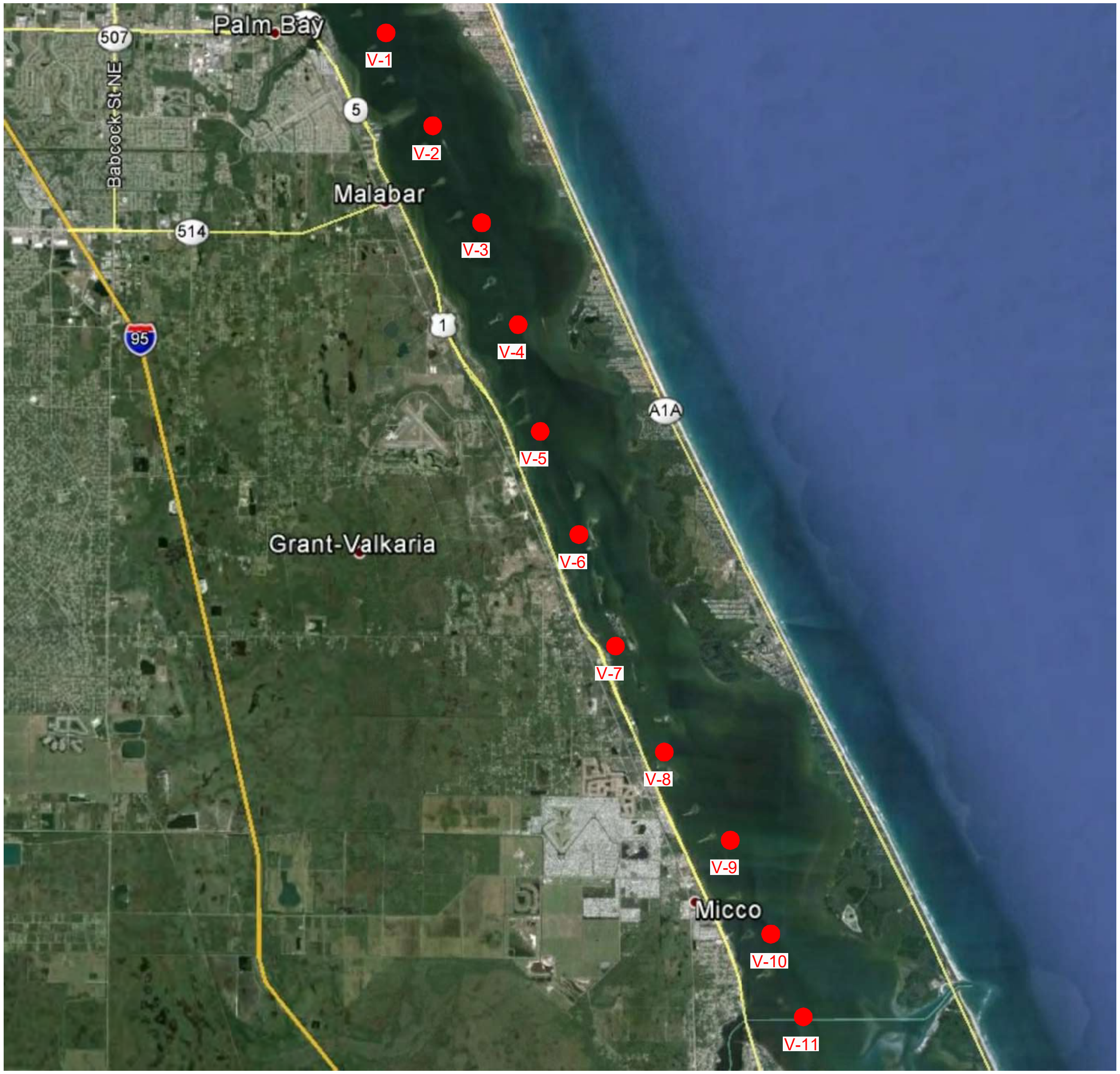
7. Gray to green slightly silty fine to silty SAND. (SP-SM, SM)

Project Mngr: DD	Project No. HB155022	**DUNKELBERGER** engineering & testing, inc. A Terracon COMPANY	SUBSURFACE PROFILES
Drawn By: BL	Scale: 1" = 10'	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION
Checked By: DD	File No. -	PH. (772) 343-9787 FAX (772) 343-9404	TAYLOR ENGINEERING, INC.
Approved By: KA	Date: 3/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A Brevard County Florida

SHEET 12



SOURCE: GOOGLE EARTH PRO

STATE-PLANE COORDINATES

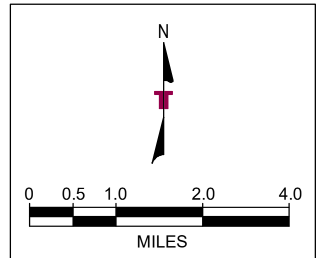
VIBRACORE NO.	NORTHING	EASTING
V-1	796408.32	1345623.44
V-2	799587.99	1339442.26
V-3	802904.71	1332943.36
V-4	805319.46	1326244.75
V-5	806869.92	1319150.80
V-6	809477.04	1312317.33
V-7	811849.13	1304957.15
V-8	815128.46	1297939.66
V-9	819627.28	1292100.20
V-10	822348.58	1285885.45
V-11	824503.59	1280396.94

Coordinates recorded in NAD83 State Plane, Florida East (Zone 0901), U.S. Survey Feet by Athena Technologies, Inc.

LEGEND

V-1 - VIBRACORE LOCATION AND NUMBER

Locations are approximate



Project Mngr: DD	Project No. HB155022	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	VIBRACORE LOCATION PLAN	SHEET
Drawn By: BL	Scale: AS SHOWN	607 NW COMMODITY COVE PORT ST. LUCIE, FL 34986	GEOTECHNICAL SITE EXPLORATION	13
Checked By: DD	File No. -	PH. (772) 343-9787 FAX (772) 343-9404	TAYLOR ENGINEERING, INC.	
Approved By: KA	Date: 5/26/16		DREDGED MATERIAL MANAGEMENT AREA (DMMA) BV-24A	
			Brevard County Florida	

Table A
Summary of Site Soil Index Properties
BV-24A DMMA, Brevard County, Florida

Stratum Number	Sample Location	Sample Depth (ft)	Moisture Content (%)	Amount Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Organic Content (%)
1	B-103	3 - 5	27.5	4.9	-	-	-
1	B-104	3 - 5	25.3	2.8	-	-	-
1	B-204	0 - 2	25.2	3.0	-	-	-
1	B-208	2 - 4	22.0	2.7	-	-	-
1	B-401	13 - 15	20.2	3.3	-	-	-
1	B-407	0 - 2	22.1	3.2	-	-	-
1	B-409	3 - 5	21.6	2.0	-	-	-
1	B-412	13 - 15	27.9	3.7	-	-	-
1	B-413	0 - 2	28.5	4.8	-	-	-
1	B-415	0 - 2	25.9	3.8	-	-	-
1	MIN		20.2	2.0	-	-	-
1	MAX		28.5	4.9	-	-	-
1	AVERAGE		24.6	3.4	-	-	-
2	B-208	6 - 8	25.1	13.5	-	-	11.0
2	B-316	7 - 9	17.4	14.8	-	-	7.7
2	B-404	7 - 9	22.1	6.1	-	-	3.6
2	MIN		17.4	6.1	-	-	3.6
2	MAX		25.1	14.8	-	-	11.0
2	AVERAGE		21.5	11.5	-	-	7.4
3	B-103	9 - 11	27.5	7.0	-	-	-
3	B-201	28 - 30	26.4	5.1	-	-	-
3	B-204	23 - 25	25.6	5.2	-	-	-
3	B-402	13 - 15	23.5	5.2	-	-	-
3	B-404	13 - 15	20.2	8.6	-	-	-
3	B-413	9 - 11	20.7	12.4	-	-	-
3	B-415	13 - 15	23.4	10.9	-	-	-
3	MIN		20.2	5.1	-	-	-
3	MAX		27.5	12.4	-	-	-
3	AVERAGE		23.9	7.8	-	-	-
4	B-103	43 - 45	59.5	56.5	47.8	19.8	-
4	B-201	73 - 75	46.7	63.5	-	-	-
4	B-206	63 - 65	51.9	84.6	-	-	-
4	B-208	43 - 45	47.8	72.2	42.1	14.8	-
4	MIN		46.7	56.5	42.1	14.8	-
4	MAX		59.5	84.6	47.8	19.8	-
4	AVERAGE		51.5	69.2	45.0	17.3	-

Table A (continued)
Summary of Site Soil Index Properties
BV-24A DMMA, Brevard County, Florida

Stratum Number	Sample Location	Sample Depth (ft)	Moisture Content (%)	Amount Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index	Organic Content (%)
5	B-101	38 - 40	18.3	6.4	-	-	-
5	B-103	83 - 85	16.0	9.9	-	-	-
5	B-201	38 - 40	23.4	12.4	-	-	-
5	B-204	48 - 50	22.2	7.8	-	-	-
5	MIN		16.0	6.4	-	-	-
5	MAX		23.4	12.4	-	-	-
5	AVERAGE		20.0	9.1	-	-	-
6	B-101	68 - 70	43.1	59.6	-	-	-
6	B-102	98 - 100	31.9	56.5	26.8	6.7	-
6	B-104	73 - 75	39.8	94.8	31.8	11.3	-
6	B-201	63 - 65	51.9	84.6	-	-	-
6	B-201	68 - 70	45.8	87.4	-	-	-
6	B-203	68 - 70	53.3	96.4	37.5	14.4	-
6	B-206	78 - 80	38.7	91.5	44.0	22.0	-
6	B-208	68 - 70	34.7	92.6	36.0	16.9	-
6	MIN		31.9	56.5	26.8	6.7	-
6	MAX		53.3	96.4	44.0	22.0	-
6	AVERAGE		42.4	82.9	35.2	14.3	-
7	B-101	58 - 60	25.8	11.1	-	-	-
7	B-101	98 - 100	28.4	13.3	Non-plastic	Non-plastic	-
7	B-102	18 - 20	28.8	14.7	-	-	-
7	B-103	63 - 65	27.5	7.0	-	-	-
7	B-104	28 - 30	23.7	11.4	-	-	-
7	B-201	33 - 35	23.8	7.3	-	-	-
7	B-203	48 - 50	30.6	12.3	-	-	-
7	B-206	43 - 45	27.9	10.0	-	-	-
7	B-208	33 - 35	24.9	11.3	-	-	-
7	MIN		23.7	7.0	-	-	-
7	MAX		30.6	14.7	-	-	-
7	AVERAGE		26.8	10.9	-	-	-

Table B
Summary of Sieve Analysis
BV-24A DMMA, Brevard County, Florida

Stratum Number	Sample Location	Sample Depth (ft)	USCS	Amount Passing Sieve Size (%)							
				3/8"	#4	#10	#20	#40	#60	#100	#200
1	B-101	18 - 20	SP	100.0	100.0	100.0	99.7	96.0	78.7	24.5	0.8
1	B-103	3 - 5	SP	100.0	100.0	100.0	99.7	92.3	63.2	29.8	2.7
1	B-104	13 - 15	SP	100.0	100.0	100.0	100.0	96.9	75.1	21.9	1.4
1	B-203	5 - 7	SP	100.0	100.0	100.0	99.8	93.0	64.6	31.1	3.2
1	B-206	18 - 20	SP	100.0	100.0	100.0	99.9	94.6	83.7	39.5	1.9
1	B-405	3 - 5	SP	100.0	100.0	100.0	99.7	93.9	65.7	33.3	3.0
1	B-411	3 - 5	SP	100.0	100.0	100.0	99.8	93.4	60.5	25.7	2.2
2	B-102	3 - 5	SP-SM	100.0	100.0	98.4	98.1	90.9	60.3	26.2	6.4
2	B-410	7 - 9	SP-SM	100.0	100.0	99.8	99.2	91.7	63.2	31.8	10.1
3	B-101	9 - 11	SP-SM	100.0	100.0	100.0	99.9	99.5	96.7	84.7	6.3
3	B-203	38 - 40	SP-SM	100.0	100.0	100.0	99.9	98.7	97.6	89.4	5.2
3	B-206	13 - 15	SP	100.0	100.0	100.0	100.0	99.9	99.5	88.9	4.9
3	B-408	13 - 15	SP-SM	100.0	100.0	100.0	100.0	99.3	94.9	65.4	5.1
5	B-101	53 - 55	SM	100.0	100.0	99.0	96.3	90.4	78.6	50.3	15.4
5	B-102	58 - 60	SP	100.0	100.0	100.0	100.0	98.7	49.5	10.1	3.0
5	B-104	43 - 45	SP	100.0	98.9	95.9	89.7	83.8	66.4	18.1	3.7
5	B-203	58 - 60	SM	100.0	91.1	84.5	77.3	73.0	70.2	66.6	20.4
5	B-203	78 - 80	SP-SM	100.0	95.8	88.6	76.6	60.7	41.3	21.5	8.5
5	B-316	38 - 40	SP-SM	100.0	97.7	90.5	76.4	66.6	54.7	38.4	5.5
7	B-103	38 - 40	SP-SM	100.0	100.0	100.0	99.5	98.0	94.9	62.7	5.4
7	B-204	38 - 40	SP-SM	100.0	100.0	100.0	94.9	83.0	74.8	59.3	5.2
1	Borrow[1]	0 - 7	SP	100.0	100.0	100.0	99.8	94.3	62.3	26.8	2.8
1	Borrow[1]	0 - 7	SP	100.0	100.0	100.0	99.8	94.5	64.6	30.0	4.9
1	Borrow[1]	0 - 7	SP	100.0	100.0	100.0	99.8	92.1	59.4	26.6	3.0
1	Borrow[1]	0 - 7	SP	100.0	100.0	99.9	99.7	93.7	62.3	28.4	3.3
1	Borrow[1]	0 - 7	SP	100.0	100.0	99.5	99.0	90.7	52.7	20.7	2.5

(1) Samples collected in bulk using a continuous flight auger from proposed interior borrow area

Table C
Modified Proctor (ASTM D1557) Compaction Results
BV-24A DMMA, Brevard County, Florida

Sample Location	Sample Depth (ft)	USCS	Fines Content (%)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)
B-401 / B-402	0 - 7	SP	2.8	14.3	101.9
B-405 / B-406	0 - 7	SP	4.9	11.9	101.9
B-407 / B-408	0 - 7	SP	3.0	13.1	103.1
B-411 / B-412	0 - 7	SP	3.3	10.8	102.7
B-413 / B-414	0 - 7	SP	2.5	10.4	102.7

Samples collected in bulk using a continuous flight auger from proposed interior borrow area
Fines content refers to amount passing No. 200 Sieve

Table D
Limerock Bearing Ratio (LBR) Results
BV-24A DMMA, Brevard County, Florida

Sample Location	Sample Depth (ft)	USCS	Fines Content (%)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)	LBR
B-403 / B-404	0 - 7	SP	4.1	13.3	103.3	41.9
B-409 / B-410	0 - 7	SP	2.4	12.8	104.9	54.5
B-413 / B-414	0 - 7	SP	2.2	13.6	103.4	59.6

Samples collected in bulk using a continuous flight auger from proposed interior borrow area
Fines content refers to amount passing No. 200 Sieve
Optimum moisture content and maximum dry unit weight determined in accordance with Modified Proctor test

Table E.1
Summary of Hydraulic Conductivity Test Results
BV-24A DMMA, Brevard County, Florida
Sand Samples

Sample Location	Sample Depth (ft)	USCS	Sample Type	Fines Content (%)	Initial Conditions			Confining Stress (psi)	Hydraulic Conductivity	
					Moisture Content (%)	Dry Unit Weight (pcf)	Estimated Relative Compaction (%)		cm/sec	ft/day
B-401	0 - 7	SP	Remolded	< 5	12.8	103.3	101.4	-	1.24E-02	35.2
B-401	0 - 7	SP	Remolded	< 5	12.3	94.9	93.1	-	2.48E-02	70.3
B-408	0 - 7	SP	Remolded	< 5	13.3	101.3	98.3	-	1.21E-02	34.3
B-408	0 - 7	SP	Remolded	< 5	13.2	94.7	91.9	-	1.70E-02	48.1
B-415	0 - 7	SP	Remolded	< 5	13.1	102.6	99.9	-	2.02E-02	57.3
B-415	0 - 7	SP	Remolded	< 5	13.1	94.7	92.2	-	2.38E-02	67.6

Samples collected in bulk using a continuous flight auger from proposed interior borrow area
Fines content refers to amount passing No. 200 Sieve

Table E.2
Summary of Hydraulic Conductivity Test Results
BV-24A DMMA, Brevard County, Florida
Fine Grained Samples

Sample Location	Sample Depth (ft)	USCS	Sample Type	Fines Content (%)	Initial Conditions		Confining Stress (psi)	Hydraulic Conductivity	
					Moisture Content (%)	Dry Unit Weight (pcf)		cm/sec	ft/day
B-102	31 - 33	CL	Undisturbed	85.0	51.6	68.7	3.0	4.87E-08	1.38E-04
B-203	66 - 68	CH	Undisturbed	98.7	53.6	67.4	3.0	5.57E-08	1.58E-04

Fines content refers to amount passing No. 200 Sieve

Table E.3
Summary of Hydraulic Conductivity Test Results
BV-24A DMMA, Brevard County, Florida
Field Tests

Sample Location	Screen Interval (ft)	USCS	Sample Type	Hydraulic Conductivity	
				cm/sec	ft/day
PZ-1	0 - 5	SP	Insitu	1.53E-02	43.5
MW-4	10 - 15	SP-SM	Insitu	2.47E-03	7.0
MW-5	35 - 40	SP-SM	Insitu	3.32E-03	9.4

PZ-1 located near MW-4 and MW-5

Table F
Summary of Triaxial Shear Test Results
BV-24A DMMA, Brevard County, Florida

Sample Location	Test Method	Representative Area	Sample Type	Sample Depth (ft)	USCS	Total Strength Parameters		Effective Strength Parameters	
						Cohesion (C, psf)	Internal Friction Angle (φ, deg)	Cohesion (C', psf)	Internal Friction Angle (φ', deg)
Borrow[1]	Consolidated Drained	Embankment Soils	Remolded[2]	0 - 7	SP	-	-	274	31.0
Borrow[1]	Consolidated Drained	Foundation Soils	Remolded[2]	0 - 7	SP	-	-	389	33.1
B-102	Consolidated Undrained	Foundation Soils	Undisturbed	31 - 33	CL	562	8.2	605	15.0

(1) Samples collected in bulk using a continuous flight auger from proposed interior borrow area

(2) Samples remolded to 95% of their Modified Proctor determined maximum dry density

Table G
Summary Consolidation Test Results
BV-24A DMMA, Brevard County, Florida

Sample Location	Sample Depth (ft)	USCS	Moisture Content (%)	Dry Unit Weight (pcf)	Fines Content (%)	Liquid Limit	Plasticity Index	Coefficient of Compression	Coefficient of Recompression	Void Ratio	Pre-Consolidation Pressure (ksf)	Over-Consolidation Ratio
B-102	31 - 33	CL	48.0	74.2	85.0	34.0	16.7	0.47	0.08	1.27	4.0	3.3
B-104	71 - 73	ML	39.5	80.9	87.2	38.0	11.0	0.29	0.03	1.10	4.2	1.6
B-203	66 - 68	CH	61.6	63.5	98.7	67.8	43.0	0.70	0.09	1.65	6.2	2.5
B-206	56 - 58	CL	27.7	86.5	82.4	43.0	23.0	0.31	0.04	0.96	4.4	2.0

Fines content refers to amount passing No. 200 Sieve

APPENDIX A
CONE PENETROMETER TEST (CPT) LOGS

CPT LOG NO. CPT-202

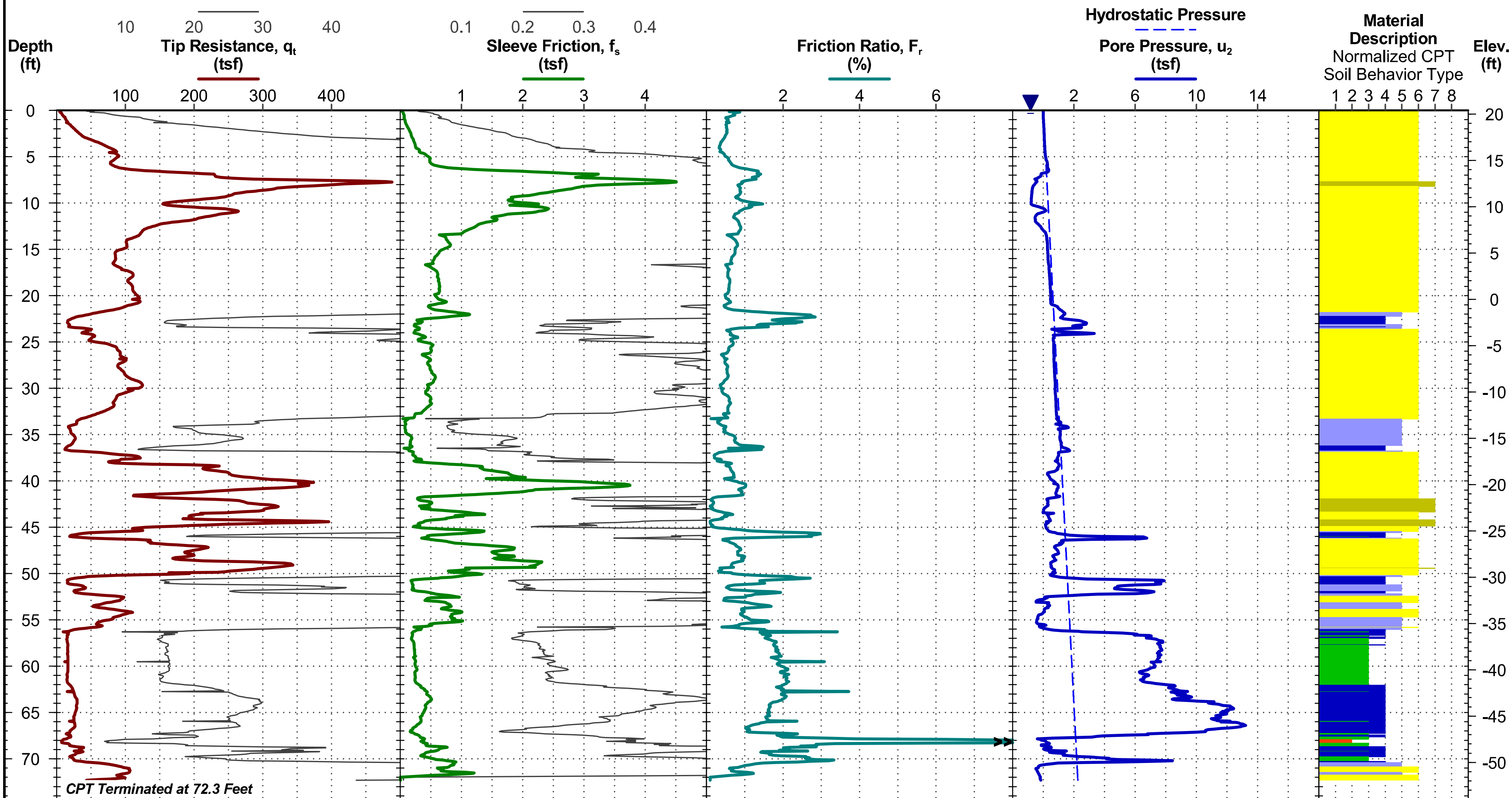
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 20.4 ft

SITE: Brevard County, FL



See CPT General Notes for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

0 ft estimated water depth
(used in normalizations and correlations; see CPT General Notes)

Probe no. DPG1228 with net area ratio of 0.8
U2 pore pressure transducer location
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER engineering & testing, inc.
A Terracon COMPANY

CPT Started: 2/18/2016	CPT Completed: 2/18/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-1

CPT LOG NO. CPT-205

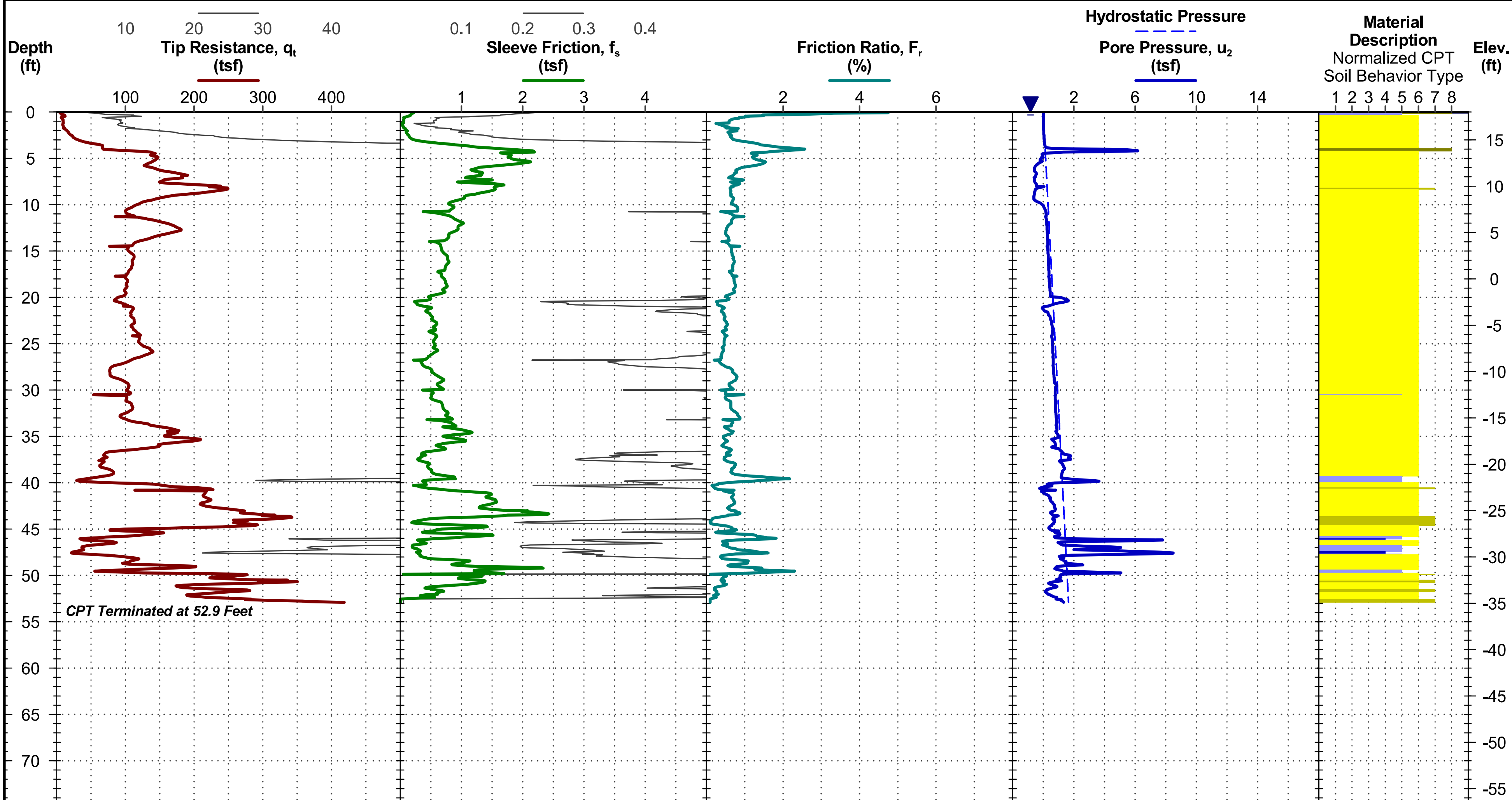
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 18.0 ft

SITE: Brevard County, FL



See CPT General Notes for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

0 ft estimated water depth
(used in normalizations and correlations; see CPT General Notes)

Probe no. DPG1228 with net area ratio of 0.8
U2 pore pressure transducer location
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER
engineering & testing, inc.
A Terracon COMPANY

CPT Started: 2/19/2016	CPT Completed: 2/19/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-2

CPT LOG NO. CPT-207

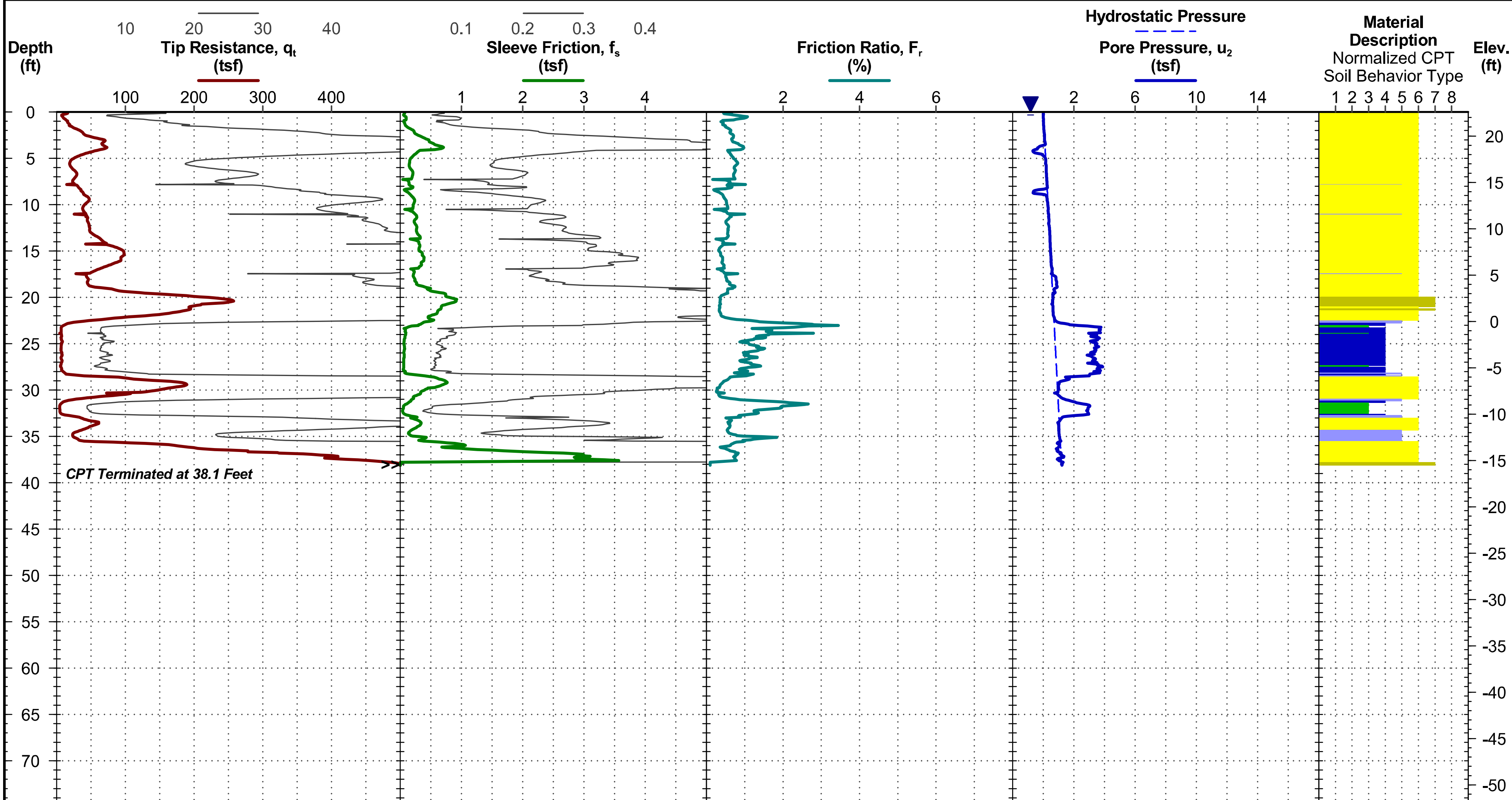
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 22.6 ft

SITE: Brevard County, FL



See CPT General Notes for explanation of symbols and abbreviations.

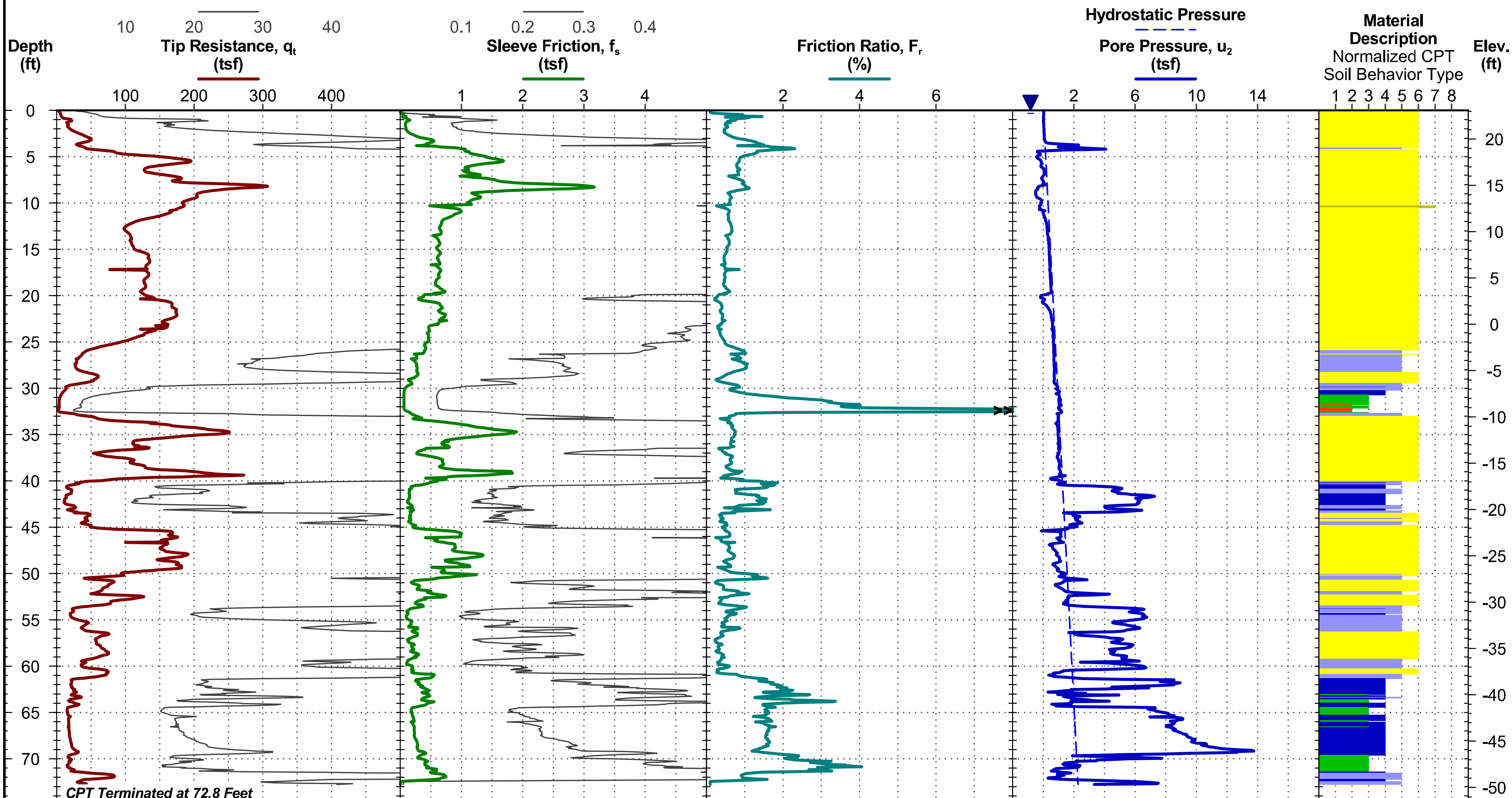
Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION	Probe no. DPG1228 with net area ratio of 0.8 U2 pore pressure transducer location Manufactured by Vertek; calibrated 12/27/2014 Tip and sleeve areas of 15 cm² and 225 cm² Ring friction reducer with O.D. of 2 in	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	CPT Started: 2/18/2016	CPT Completed: 2/18/2016
0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)			Rig: 735	Operator: Tony Antonatos
			Project No.: HB155022	Exhibit: A-3

CPT LOG NO. CPT-209

PROJECT: BV-24A DMMA	**CLIENT:** Taylor Engineering, Inc.	**TEST LOCATION:** See Sheet 5 Surface Elev.: 23.1 ft
SITE: Brevard County, FL		



See CPT General Notes for explanation of symbols and abbreviations.

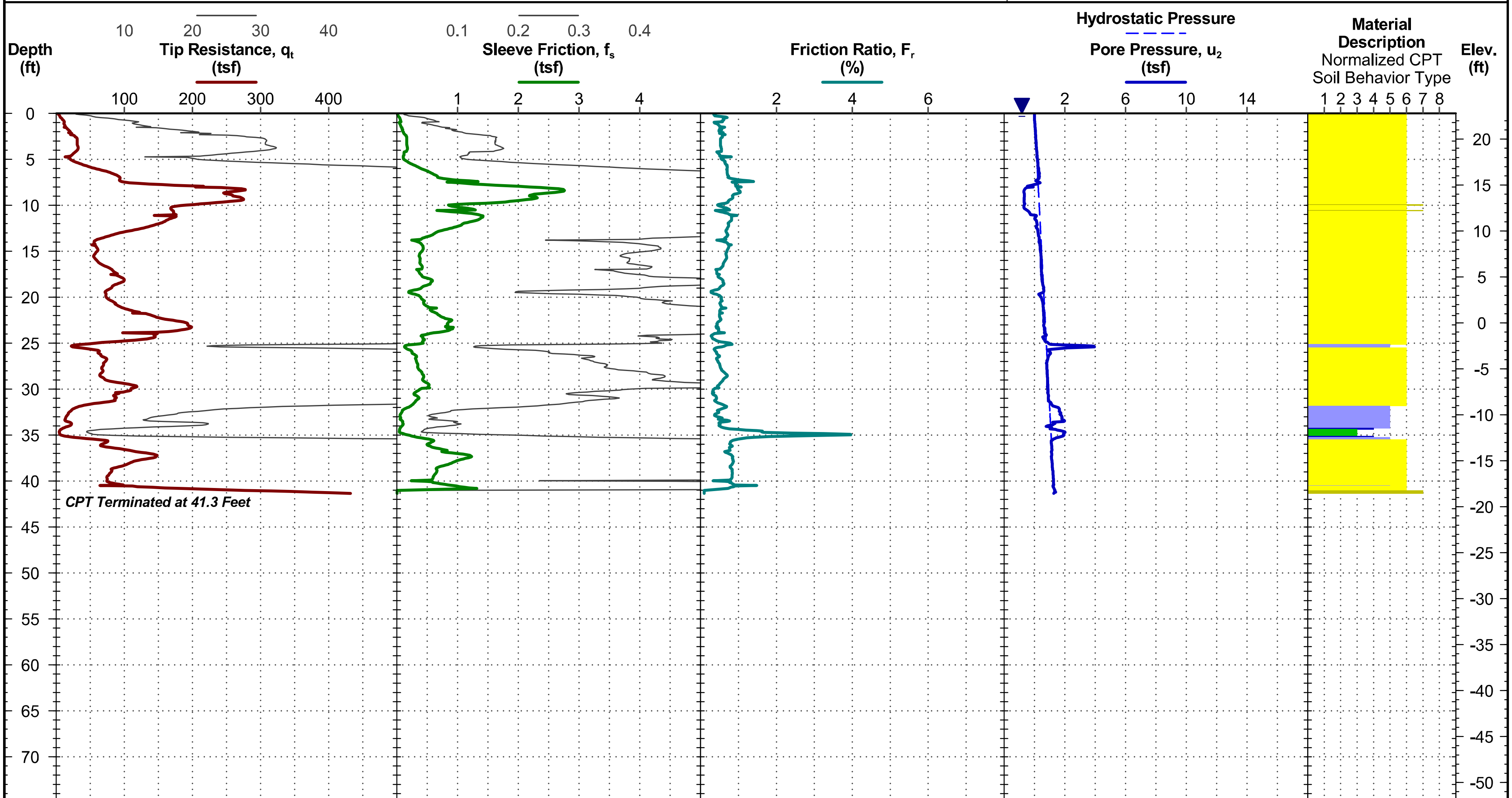
Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION 0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)	Probe no. DPG1228 with net area ratio of 0.8 U2 pore pressure transducer location Manufactured by Vertek; calibrated 12/27/2014 Tip and sleeve areas of 15 cm^2 and 225 cm^2 Ring friction reducer with O.D. of 2 in	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	CPT Started: 2/18/2016 Rig: 735 Project No.: HB155022	CPT Completed: 2/18/2016 Operator: Tony Antonatos Exhibit: A-4

CPT LOG NO. CPT-301

PROJECT: BV-24A DMMA	**CLIENT:** Taylor Engineering, Inc.	**TEST LOCATION:** See Sheet 5 Surface Elev.: 22.8 ft
SITE: Brevard County, FL		



See CPT General Notes for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

0 ft estimated water depth
(used in normalizations and correlations; see CPT General Notes)

Probe no. DPG1228 with net area ratio of 0.8
U2 pore pressure transducer location
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER engineering & testing, inc.
A Terracon COMPANY

CPT Started: 2/17/2016	CPT Completed: 2/17/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-5

CPT LOG NO. CPT-302

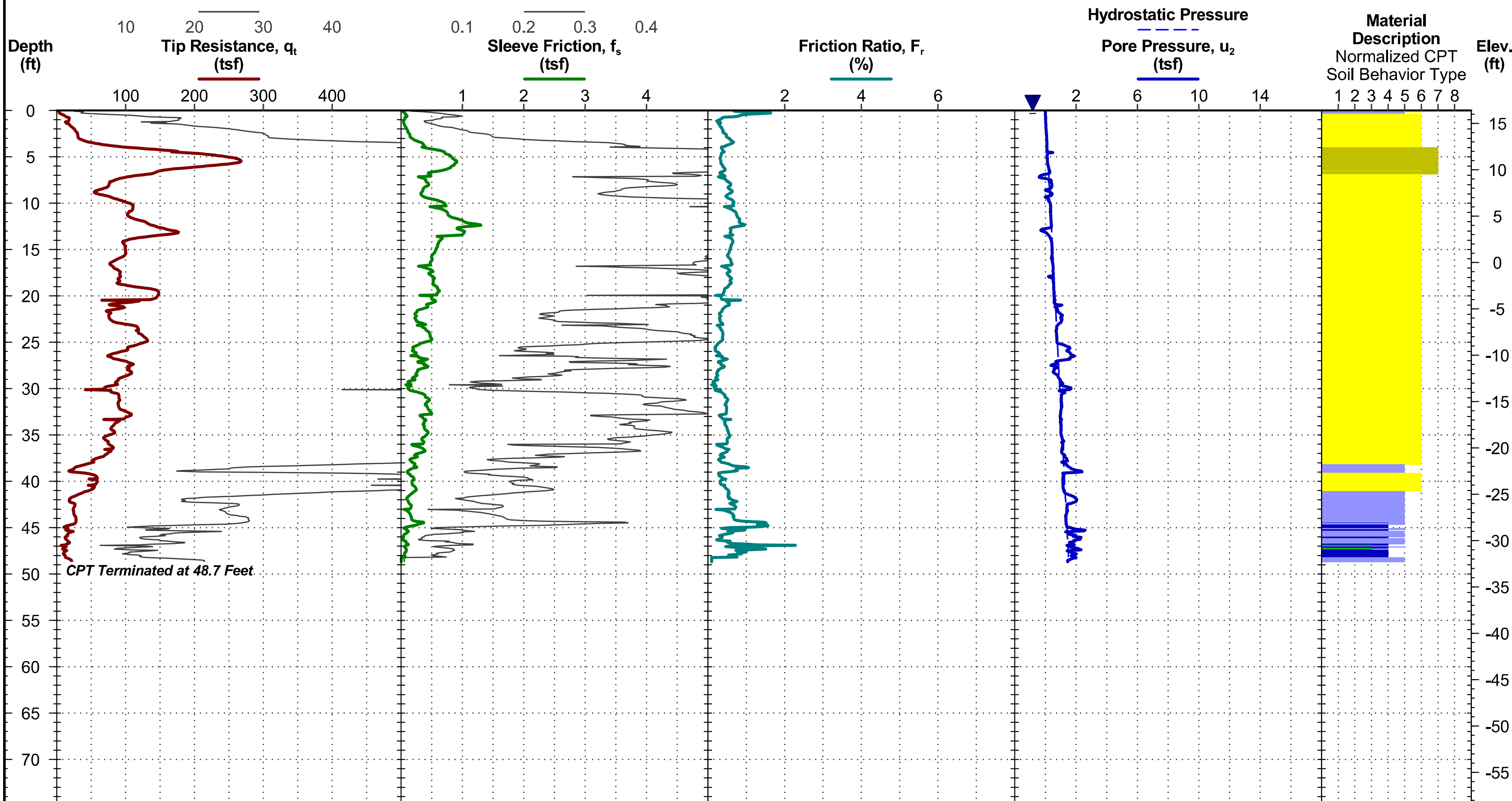
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 16.4 ft

SITE: Brevard County, FL



See CPT General Notes for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

0 ft estimated water depth
(used in normalizations and correlations; see CPT General Notes)

Probe no. DPG1228 with net area ratio of 0.8
U2 pore pressure transducer location
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER
engineering & testing, inc.
A Terracon COMPANY

CPT Started: 2/18/2016	CPT Completed: 2/18/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-6

CPT LOG NO. CPT-303

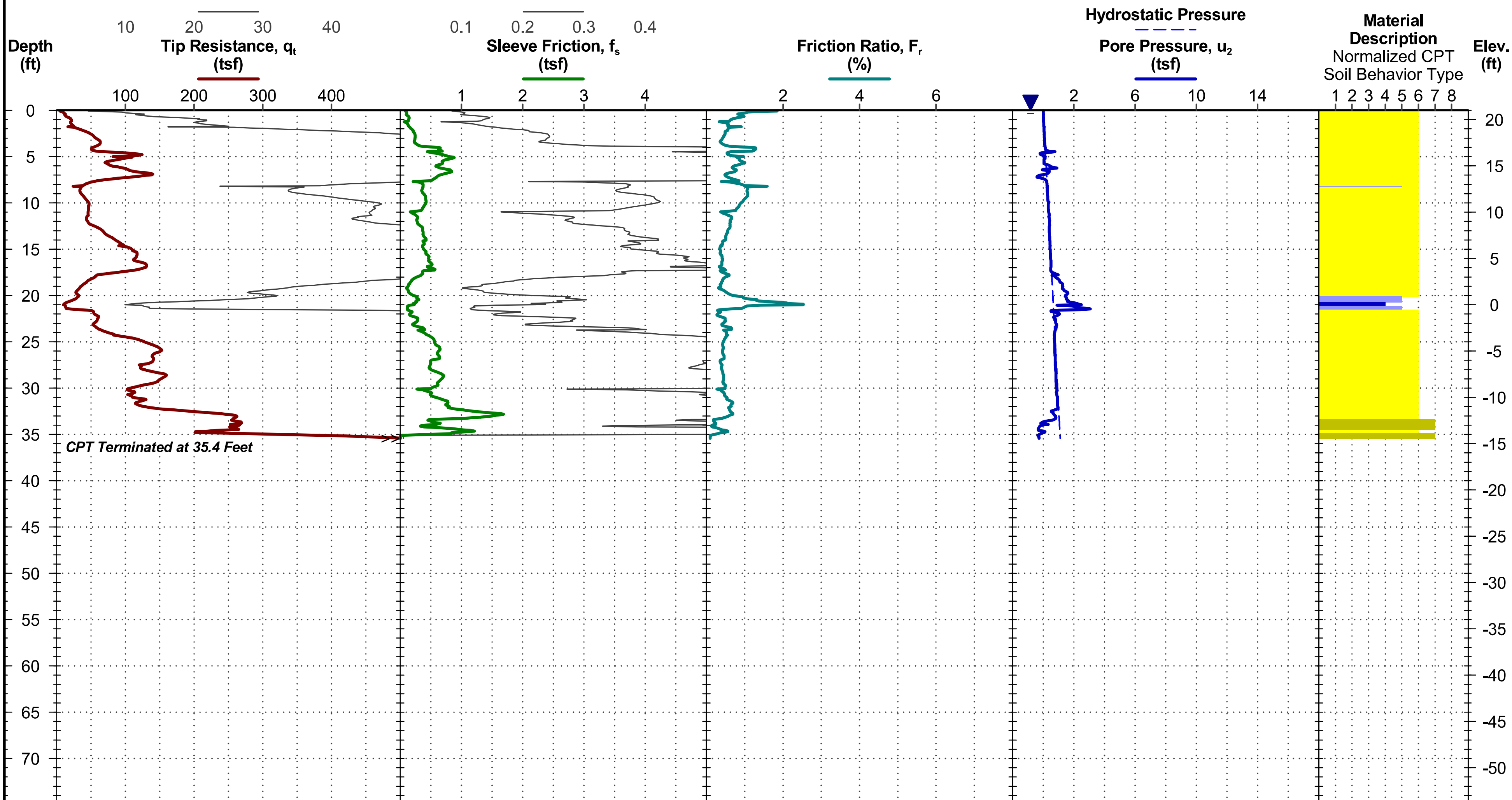
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 21.0 ft

SITE: Brevard County, FL



See CPT General Notes for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

0 ft estimated water depth
(used in normalizations and correlations; see CPT General Notes)

Probe no. DPG1228 with net area ratio of 0.8
U2 pore pressure transducer location
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER
engineering & testing, inc.
A Terracon COMPANY

CPT Started: 2/19/2016	CPT Completed: 2/19/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-7

CPT CORRELATIVE PARAMETER LOG NO. CPT-202

SEE CPT LOG NO. CPT-202 FOR DETAILED TEST RESULTS

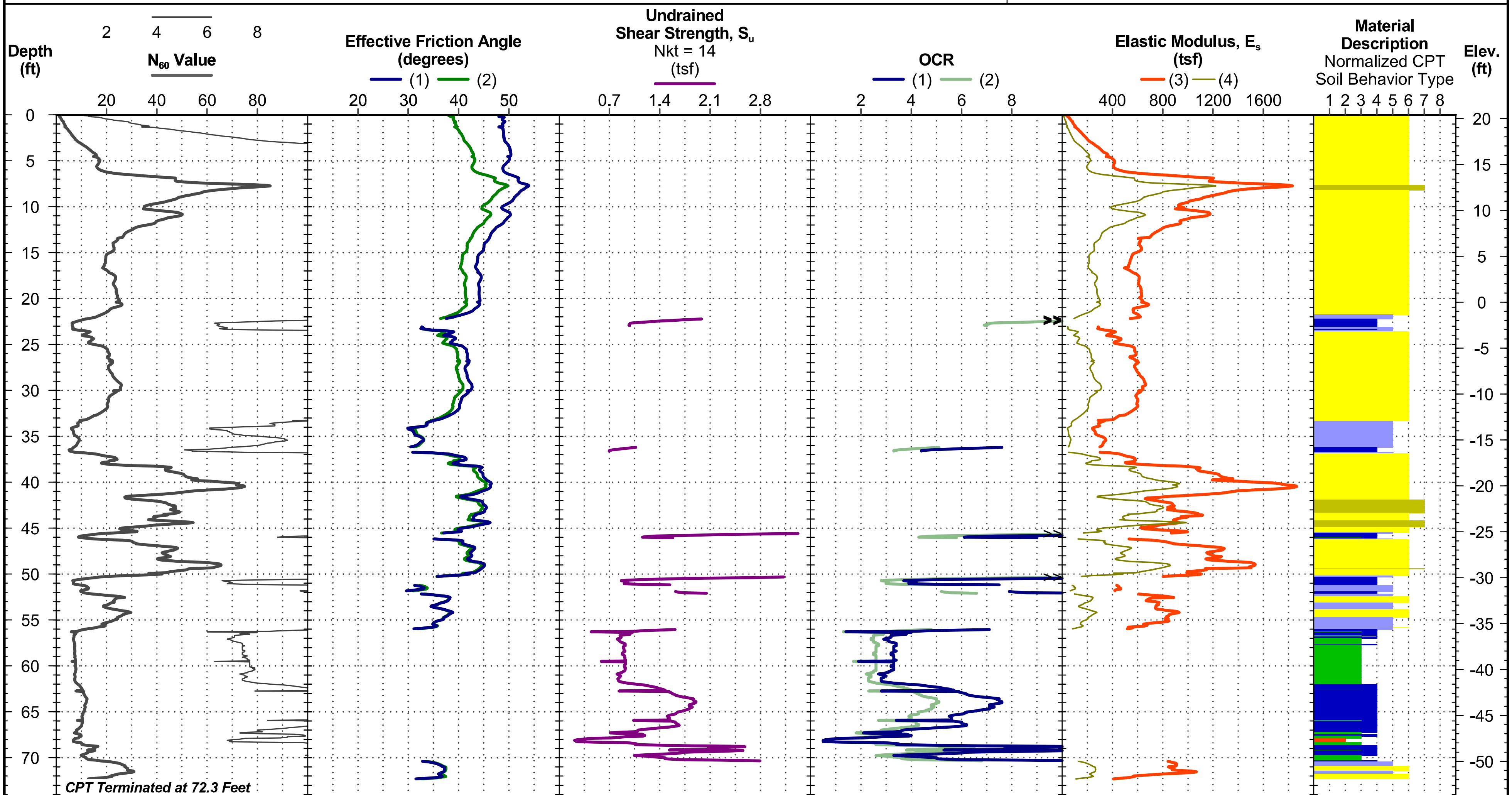
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 20.4 ft

SITE: Brevard County, FL



Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION

0 ft estimated water depth
(used in normalizations and correlations; see CPT General Notes)

Notes:
Probe no. DPG1228 with net area ratio of 0.8
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER engineering & testing, inc.
A Terracon COMPANY

CPT Started: 2/18/2016	CPT Completed: 2/18/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-8

CPT CORRELATIVE PARAMETER LOG NO. CPT-205

SEE CPT LOG NO. CPT-205 FOR DETAILED TEST RESULTS

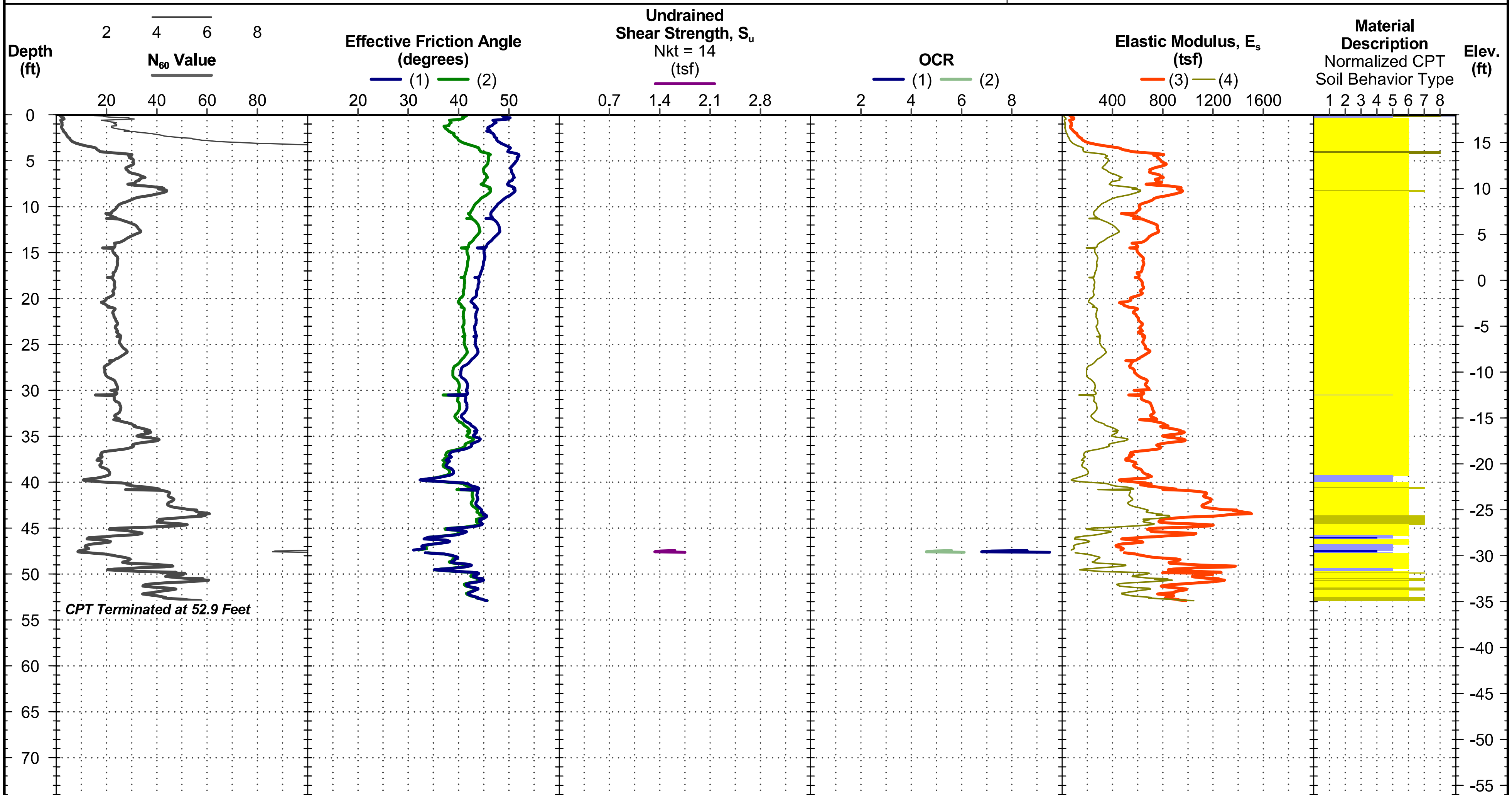
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 18.0 ft

SITE: Brevard County, FL



Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION

0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)

Notes:
Probe no. DPG1228 with net area ratio of 0.8
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER engineering & testing, inc.
A Terracon COMPANY

CPT Started: 2/19/2016	CPT Completed: 2/19/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-9

CPT CORRELATIVE PARAMETER LOG NO. CPT-207

SEE CPT LOG NO. CPT-207 FOR DETAILED TEST RESULTS

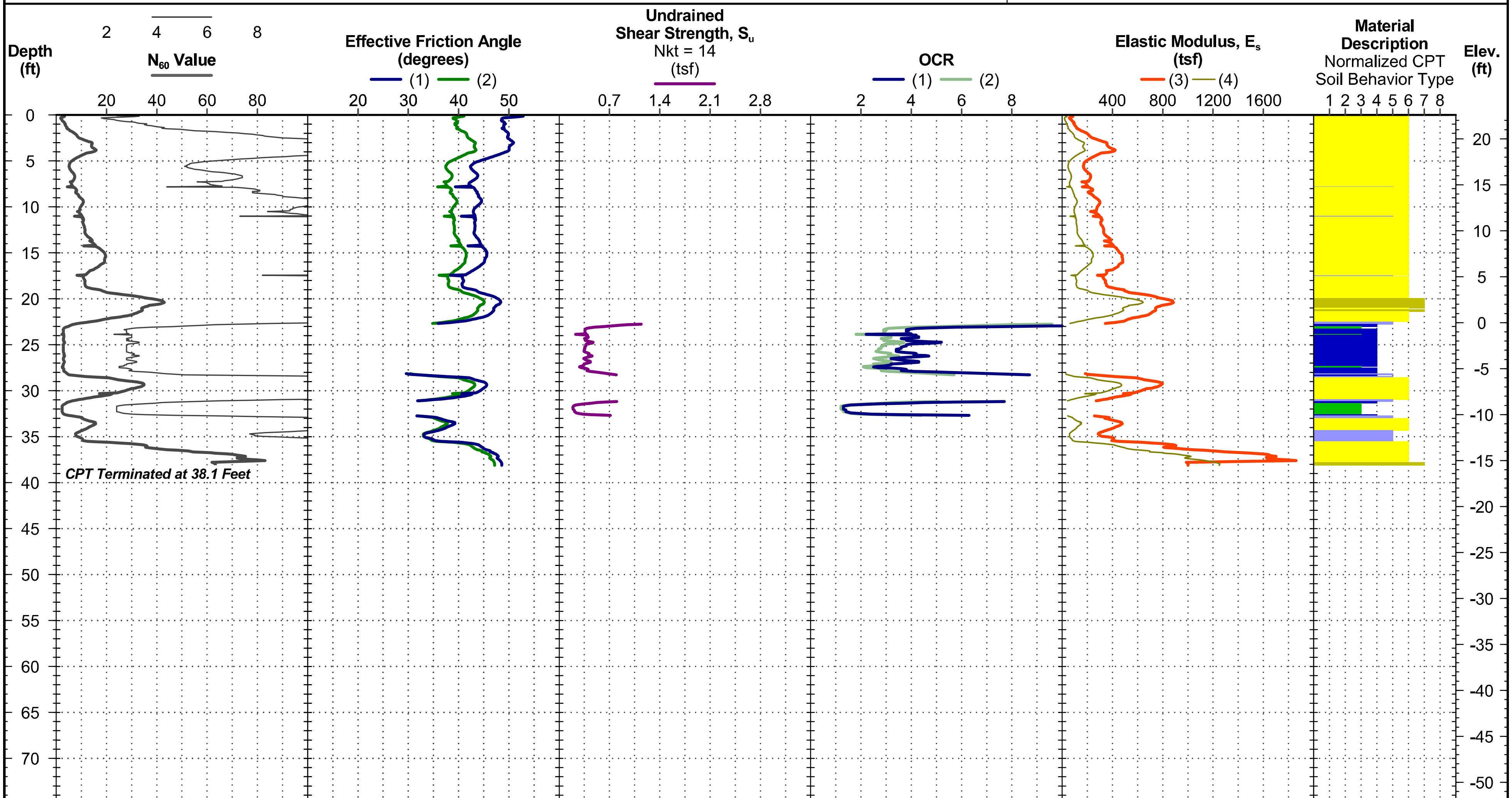
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 22.6 ft

SITE: Brevard County, FL



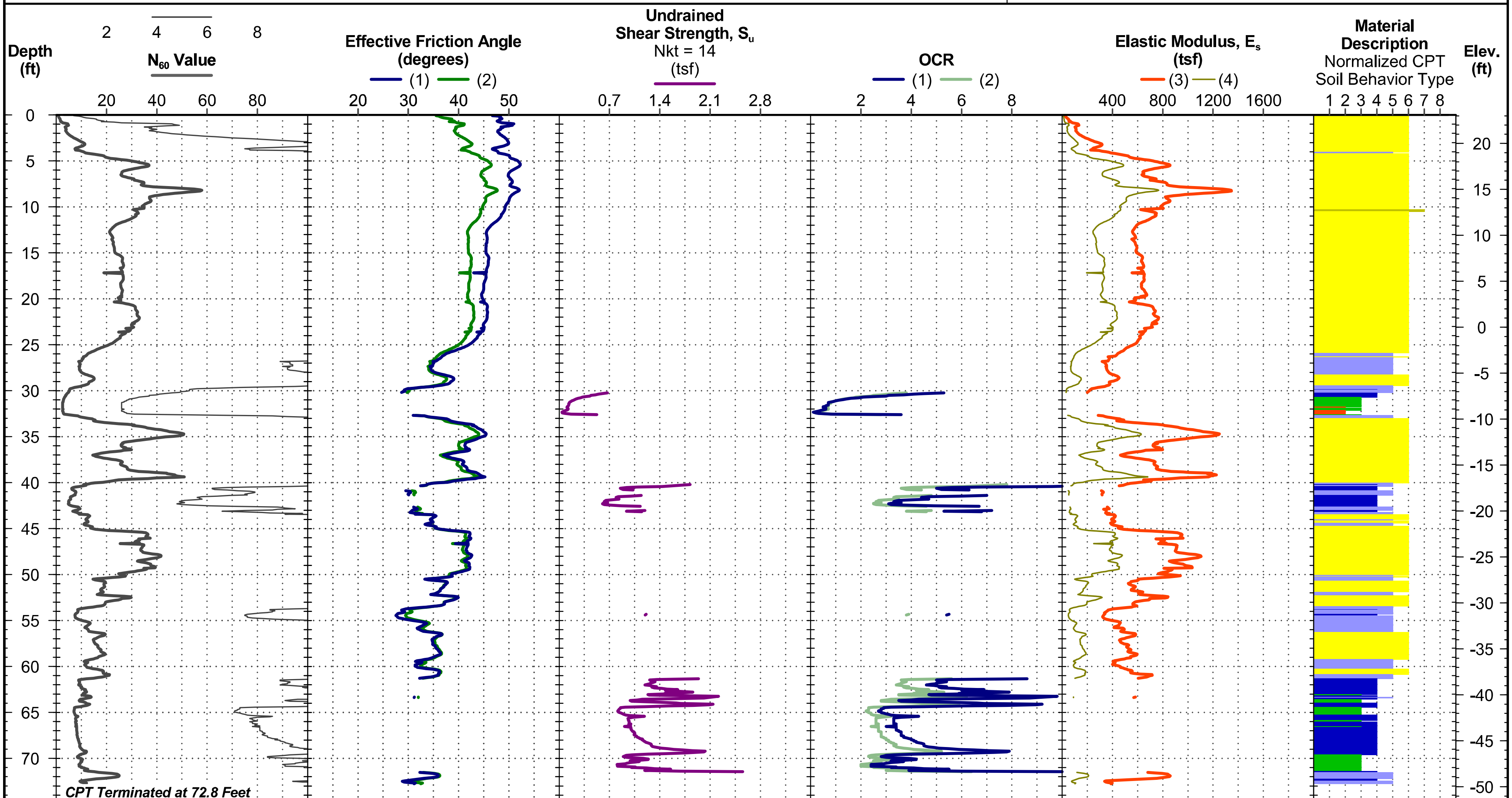
Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION	Notes:	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	CPT Started: 2/18/2016	CPT Completed: 2/18/2016
0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)	Probe no. DPG1228 with net area ratio of 0.8 Manufactured by Vertek; calibrated 12/27/2014 Tip and sleeve areas of 15 cm^2 and 225 cm^2 Ring friction reducer with O.D. of 2 in		Rig: 735	Operator: Tony Antonatos
			Project No.: HB155022	Exhibit: A-10

CPT CORRELATIVE PARAMETER LOG NO. CPT-209

SEE CPT LOG NO. CPT-209 FOR DETAILED TEST RESULTS

PROJECT: BV-24A DMMA	**CLIENT:** Taylor Engineering, Inc.	**TEST LOCATION:** See Sheet 5 Surface Elev.: 23.1 ft
SITE: Brevard County, FL		



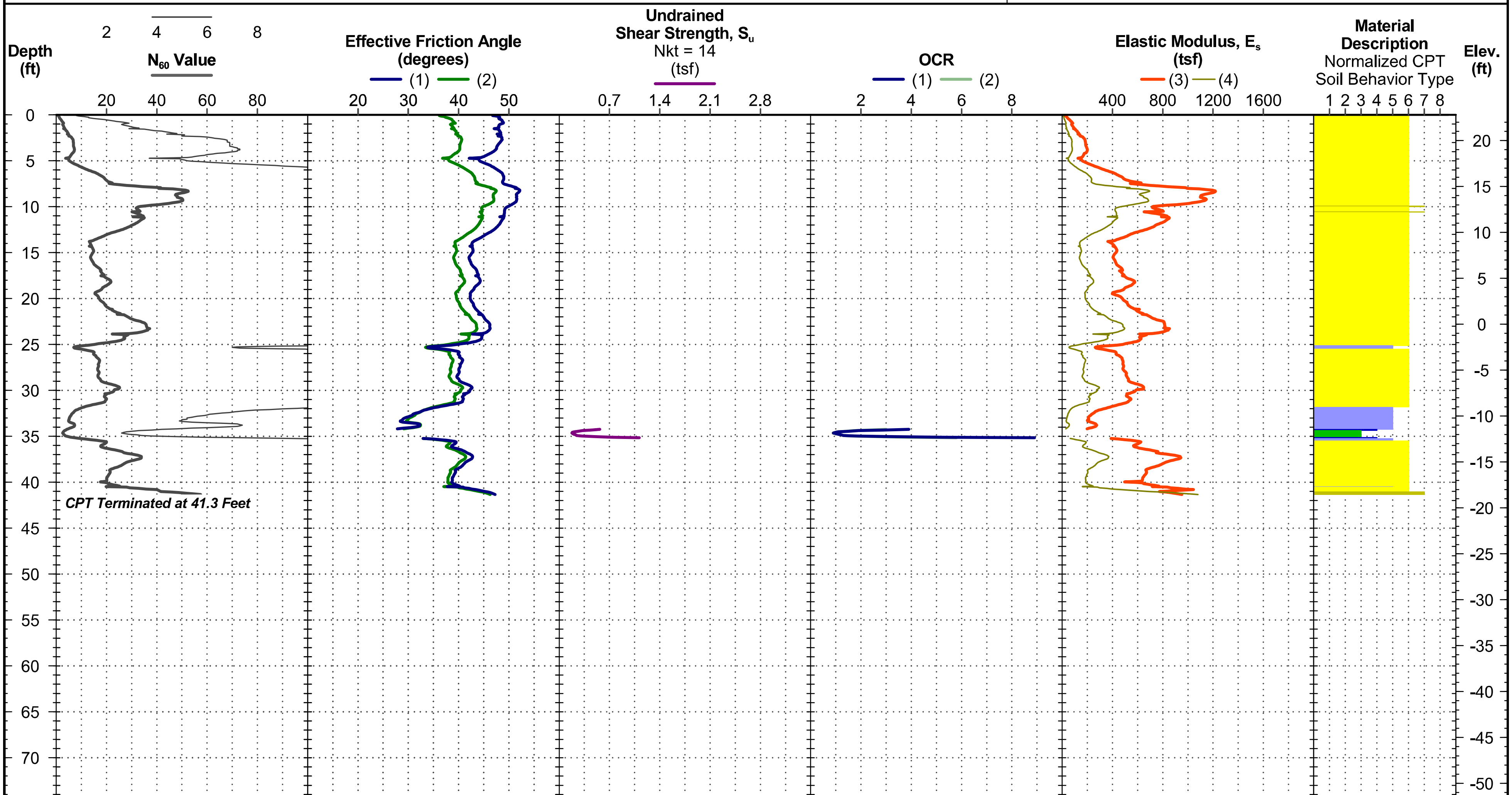
Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION	Notes:	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	CPT Started: 2/18/2016	CPT Completed: 2/18/2016
0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)	Probe no. DPG1228 with net area ratio of 0.8 Manufactured by Vertek; calibrated 12/27/2014 Tip and sleeve areas of 15 cm^2 and 225 cm^2 Ring friction reducer with O.D. of 2 in		Rig: 735	Operator: Tony Antonatos
			Project No.: HB155022	Exhibit: A-11

CPT CORRELATIVE PARAMETER LOG NO. CPT-301

SEE CPT LOG NO. CPT-301 FOR DETAILED TEST RESULTS

PROJECT: BV-24A DMMA	**CLIENT:** Taylor Engineering, Inc.	**TEST LOCATION:** See Sheet 5 Surface Elev.: 22.8 ft
SITE: Brevard County, FL		



Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION

0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)

Notes:
Probe no. DPG1228 with net area ratio of 0.8
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER engineering & testing, inc. A Terracon COMPANY

CPT Started: 2/17/2016	CPT Completed: 2/17/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-12

CPT CORRELATIVE PARAMETER LOG NO. CPT-302

SEE CPT LOG NO. CPT-302 FOR DETAILED TEST RESULTS

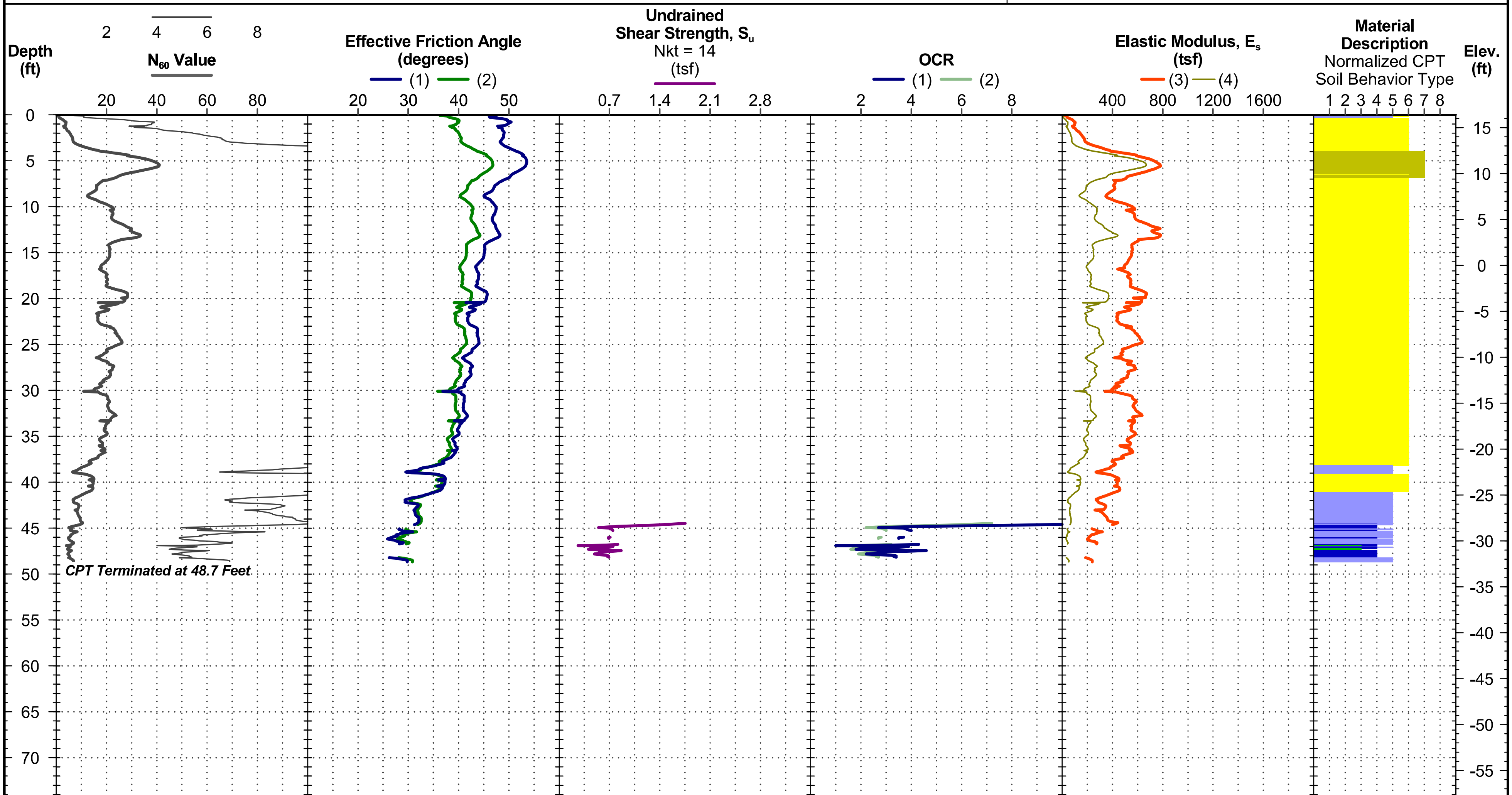
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 16.4 ft

SITE: Brevard County, FL



Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION

0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)

Notes:
Probe no. DPG1228 with net area ratio of 0.8
Manufactured by Vertek; calibrated 12/27/2014
Tip and sleeve areas of 15 cm^2 and 225 cm^2
Ring friction reducer with O.D. of 2 in

DUNKELBERGER engineering & testing, inc. A Terracon COMPANY

CPT Started: 2/18/2016	CPT Completed: 2/18/2016
Rig: 735	Operator: Tony Antonatos
Project No.: HB155022	Exhibit: A-13

CPT CORRELATIVE PARAMETER LOG NO. CPT-303

SEE CPT LOG NO. CPT-303 FOR DETAILED TEST RESULTS

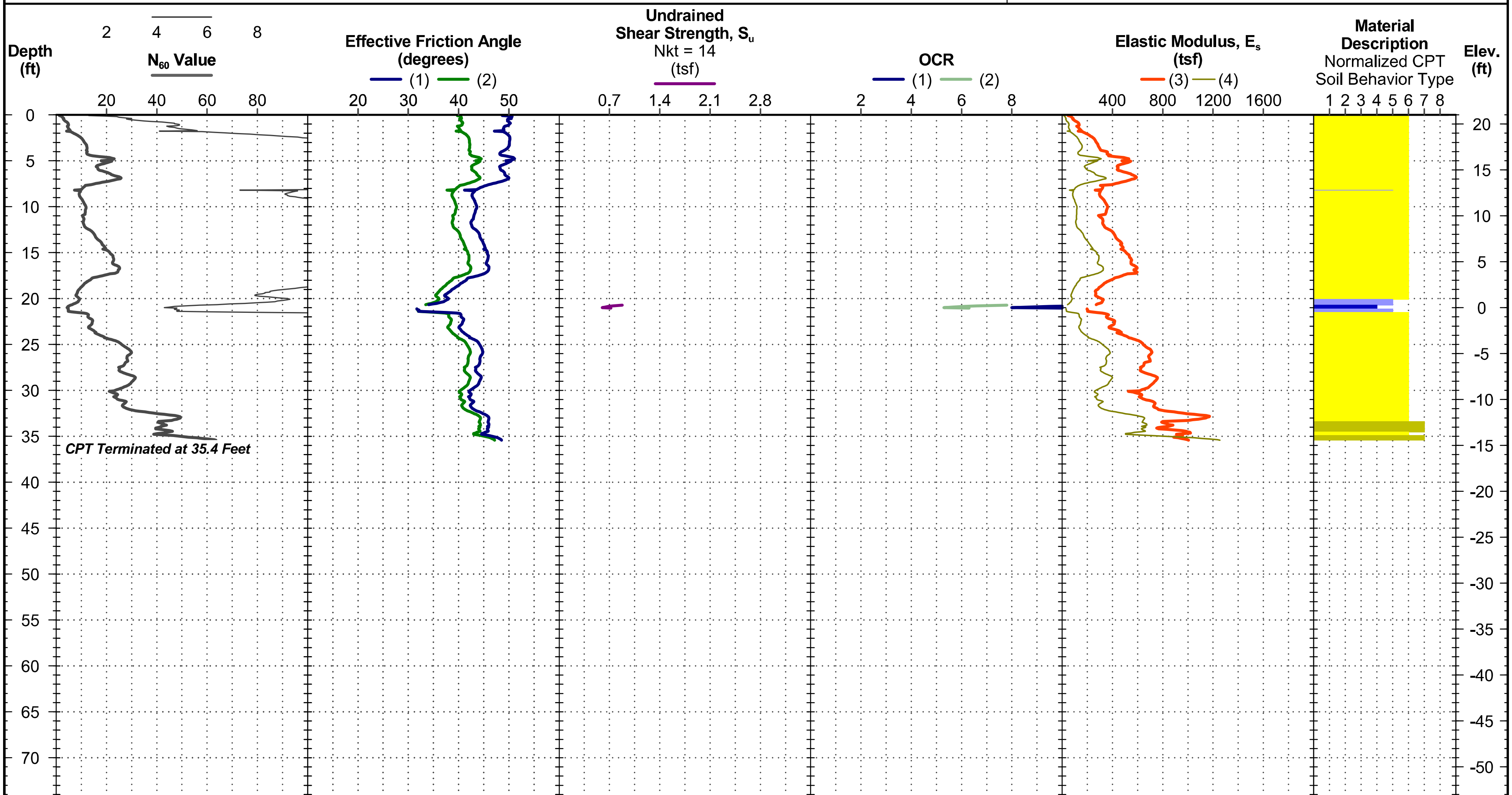
PROJECT: BV-24A DMMA

CLIENT: Taylor Engineering, Inc.

TEST LOCATION: See Sheet 5

Surface Elev.: 21.0 ft

SITE: Brevard County, FL



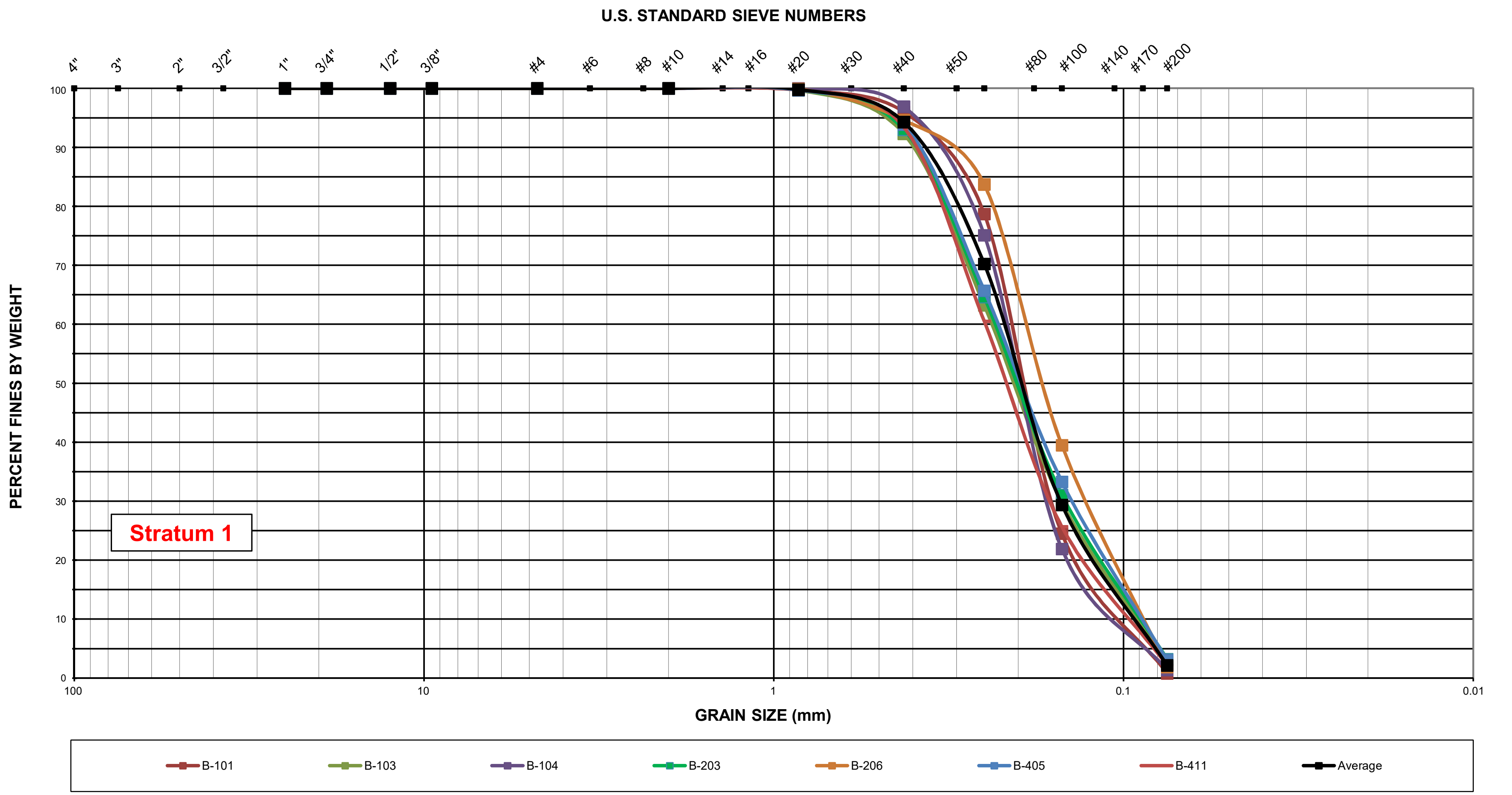
Tip resistance, sleeve resistance, porewater pressure, and tilt angle are measured. Other parameters presented are derived from interpretations of the measured data, based upon published correlations, but do not necessarily represent actual values that would be derived from direct testing. Appendix CPT General Notes provides the formulas used for these correlations and presents estimates of the relative reliability associated with the correlated parameters.

WATER LEVEL OBSERVATION	Notes:	DUNKELBERGER engineering & testing, inc. A Terracon COMPANY	CPT Started: 2/19/2016	CPT Completed: 2/19/2016
0 ft estimated water depth (used in normalizations and correlations; see CPT General Notes)	Probe no. DPG1228 with net area ratio of 0.8 Manufactured by Vertek; calibrated 12/27/2014 Tip and sleeve areas of 15 cm^2 and 225 cm^2 Ring friction reducer with O.D. of 2 in		Rig: 735	Operator: Tony Antonatos
			Project No.: HB155022	Exhibit: A-14

APPENDIX B
LABORATORY TESTING REPORTS

DUNKELBERGER
engineering & testing, inc.
A Terracon COMPANY

Particle Size Analysis of Soil

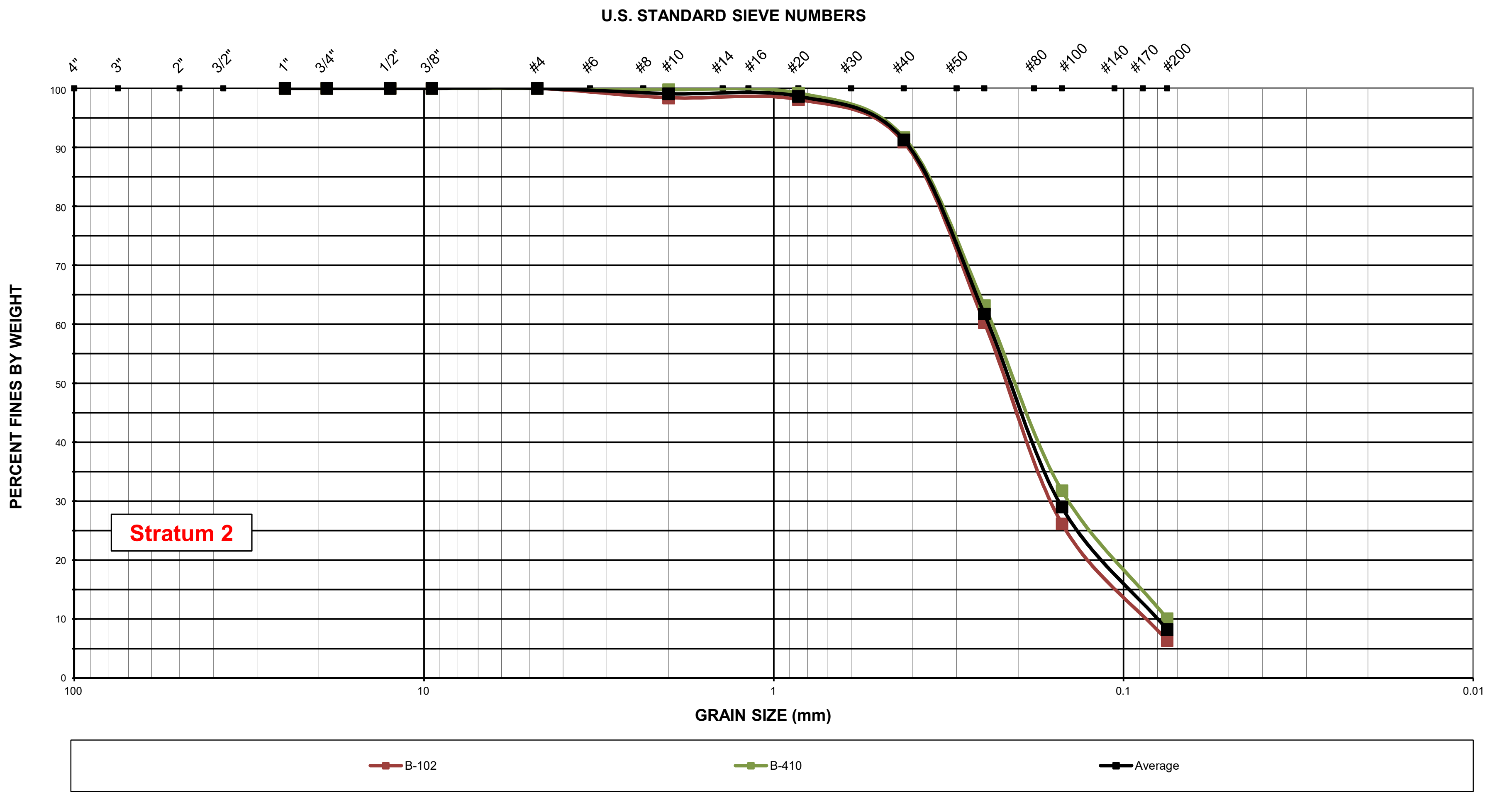


Boring Location	Depth (feet)	USCS Classification	Percent Passing Sieve										
			1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
B-101	18 - 20	SP	100.0	100.0	100.0	100.0	100.0	100.0	99.7	96.0	78.7	24.5	0.8
B-103	3 - 5	SP	100.0	100.0	100.0	100.0	100.0	100.0	99.7	92.3	63.2	29.8	2.7
B-104	13 - 15	SP	100.0	100.0	100.0	100.0	100.0	100.0	100.0	96.9	75.1	21.9	1.4
B-203	5 - 7	SP	100.0	100.0	100.0	100.0	100.0	100.0	99.8	93.0	64.6	31.1	3.2
B-206	18 - 20	SP	100.0	100.0	100.0	100.0	100.0	100.0	99.9	94.6	83.7	39.5	1.9
B-405	3 - 5	SP	100.0	100.0	100.0	100.0	100.0	100.0	99.7	93.9	65.7	33.3	3.0
B-411	3 - 5	SP	100.0	100.0	100.0	100.0	100.0	100.0	99.8	93.4	60.5	25.7	2.2
			-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average			100.0	100.0	100.0	100.0	100.0	100.0	99.8	94.3	70.2	29.4	2.2

Exhibit B-1

DUNKELBERGER
engineering & testing, inc.
A Terracon COMPANY

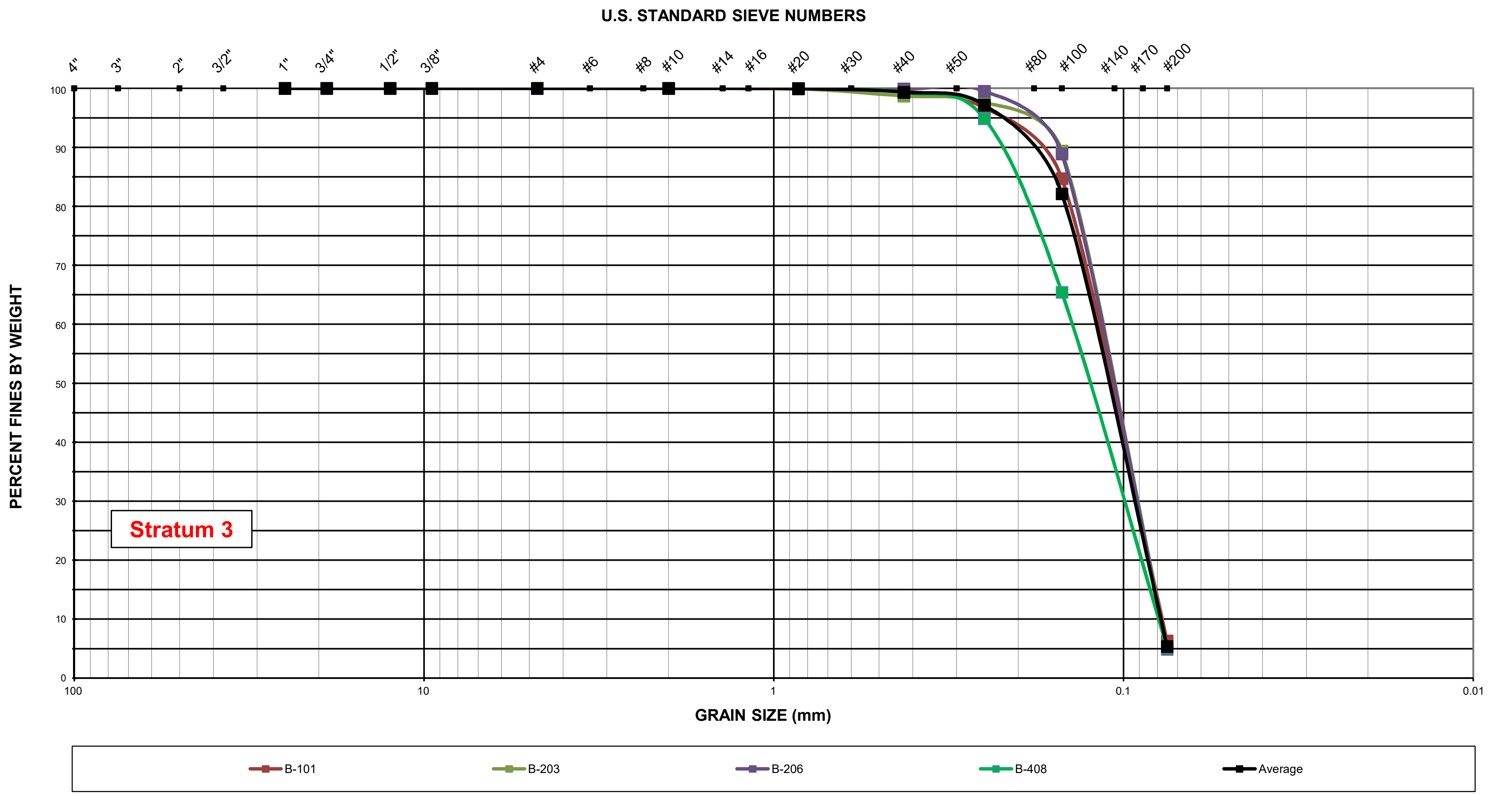
Particle Size Analysis of Soil



Boring Location	Depth (feet)	USCS Classification	Percent Passing Sieve										
			1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
B-102	3 - 5	SP-SM	100.0	100.0	100.0	100.0	100.0	98.4	98.1	90.9	60.3	26.2	6.4
B-410	7 - 9	SP-SM	100.0	100.0	100.0	100.0	100.0	99.8	99.2	91.7	63.2	31.8	10.1
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	-	SP-SM	100.0	100.0	100.0	100.0	100.0	99.1	98.7	91.3	61.8	29.0	8.3

Exhibit B-2

Particle Size Analysis of Soil

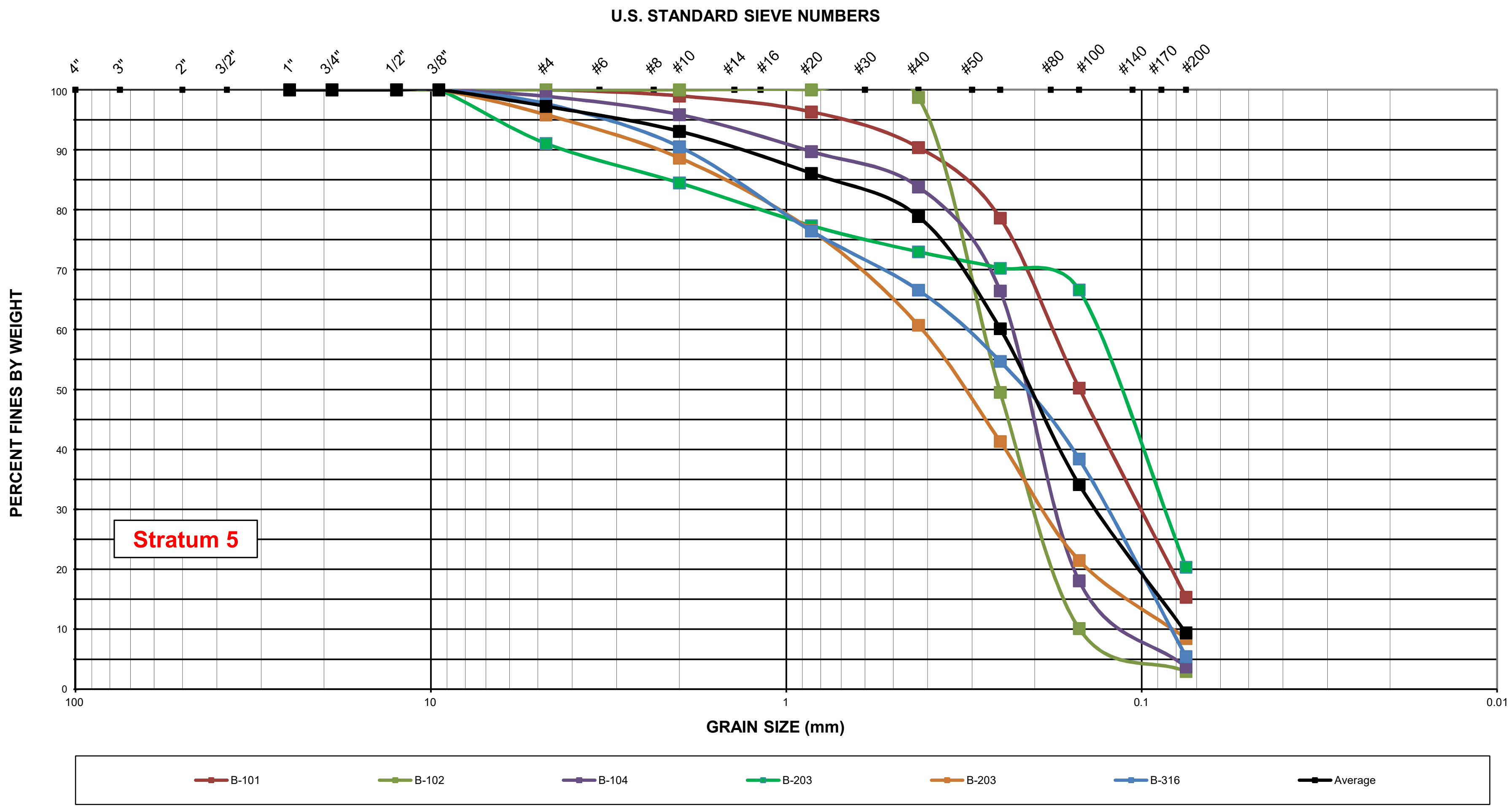


Boring Location	Depth (feet)	USCS Classification	Percent Passing Sieve										
			1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
B-101	9 - 11	SP-SM	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.5	96.7	84.7	6.3
B-203	38 - 40	SP-SM	100.0	100.0	100.0	100.0	100.0	100.0	99.9	98.7	97.6	89.4	5.2
B-206	13 - 15	SP	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.5	88.9	4.9
B-408	13 - 15	SP-SM	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.3	94.9	65.4	5.1
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
Average			100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.4	97.2	82.1	5.4

Exhibit B-3

DUNKELBERGER
engineering & testing, inc.
A Terracon COMPANY

Particle Size Analysis of Soil

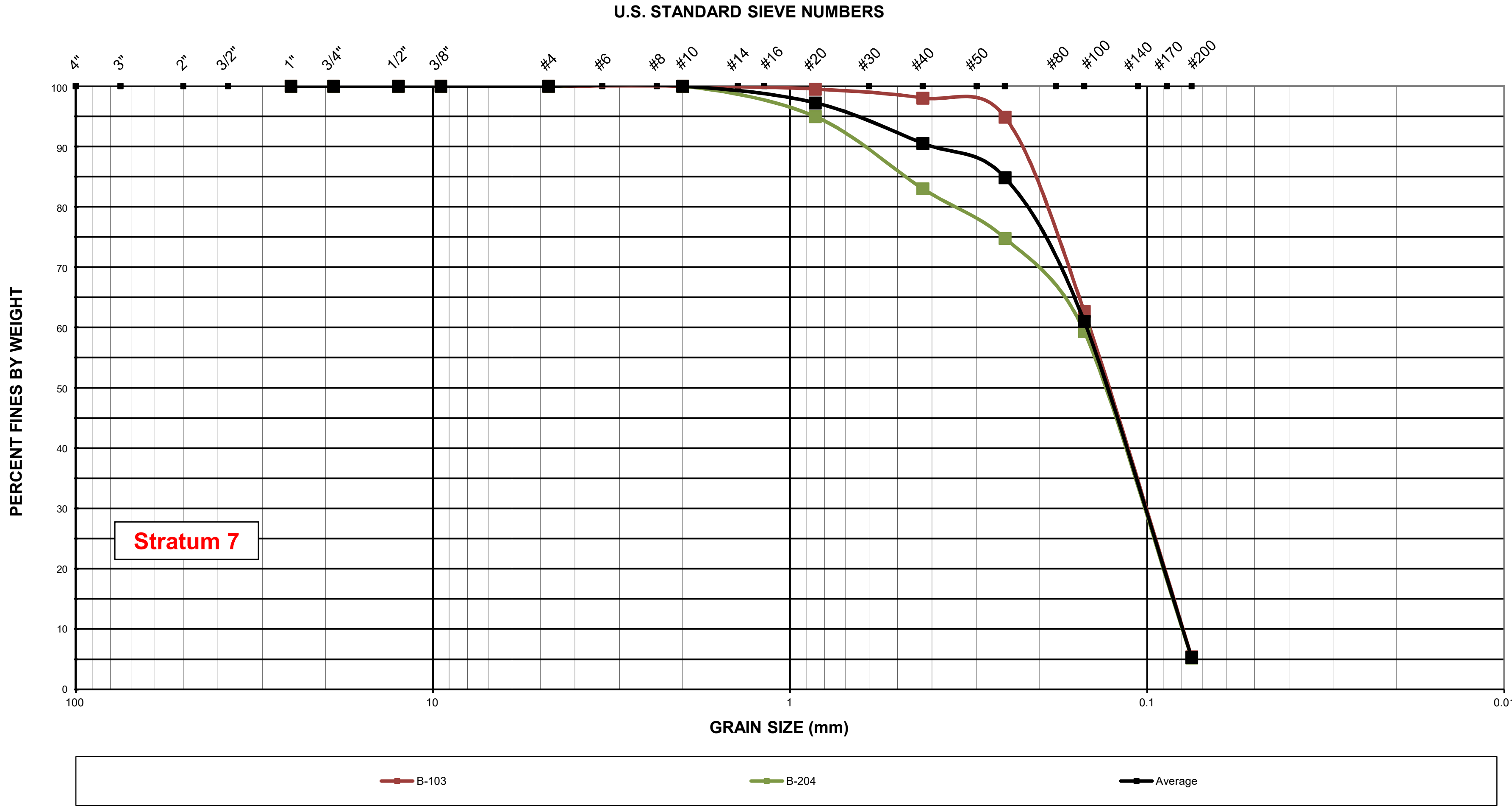


Boring Location	Depth (feet)	USCS Classification	Percent Passing Sieve										
			1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
B-101	53 - 55	SM	100.0	100.0	100.0	100.0	100.0	99.0	96.3	90.4	78.6	50.3	15.4
B-102	58 - 60	SP	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.7	49.5	10.1	3.0
B-104	43 - 45	SP	100.0	100.0	100.0	100.0	98.9	95.9	89.7	83.8	66.4	18.1	3.7
B-203	58 - 60	SM	100.0	100.0	100.0	100.0	91.1	84.5	77.3	73.0	70.2	66.6	20.4
B-203	78 - 80	SP-SM	100.0	100.0	100.0	100.0	95.8	88.6	76.6	60.7	41.3	21.5	8.5
B-316	38 - 40	SP-SM	100.0	100.0	100.0	100.0	97.7	90.5	76.4	66.6	54.7	38.4	5.5
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
Average			100.0	100.0	100.0	100.0	97.2	93.1	86.1	78.9	60.1	34.2	9.4

Exhibit B-4

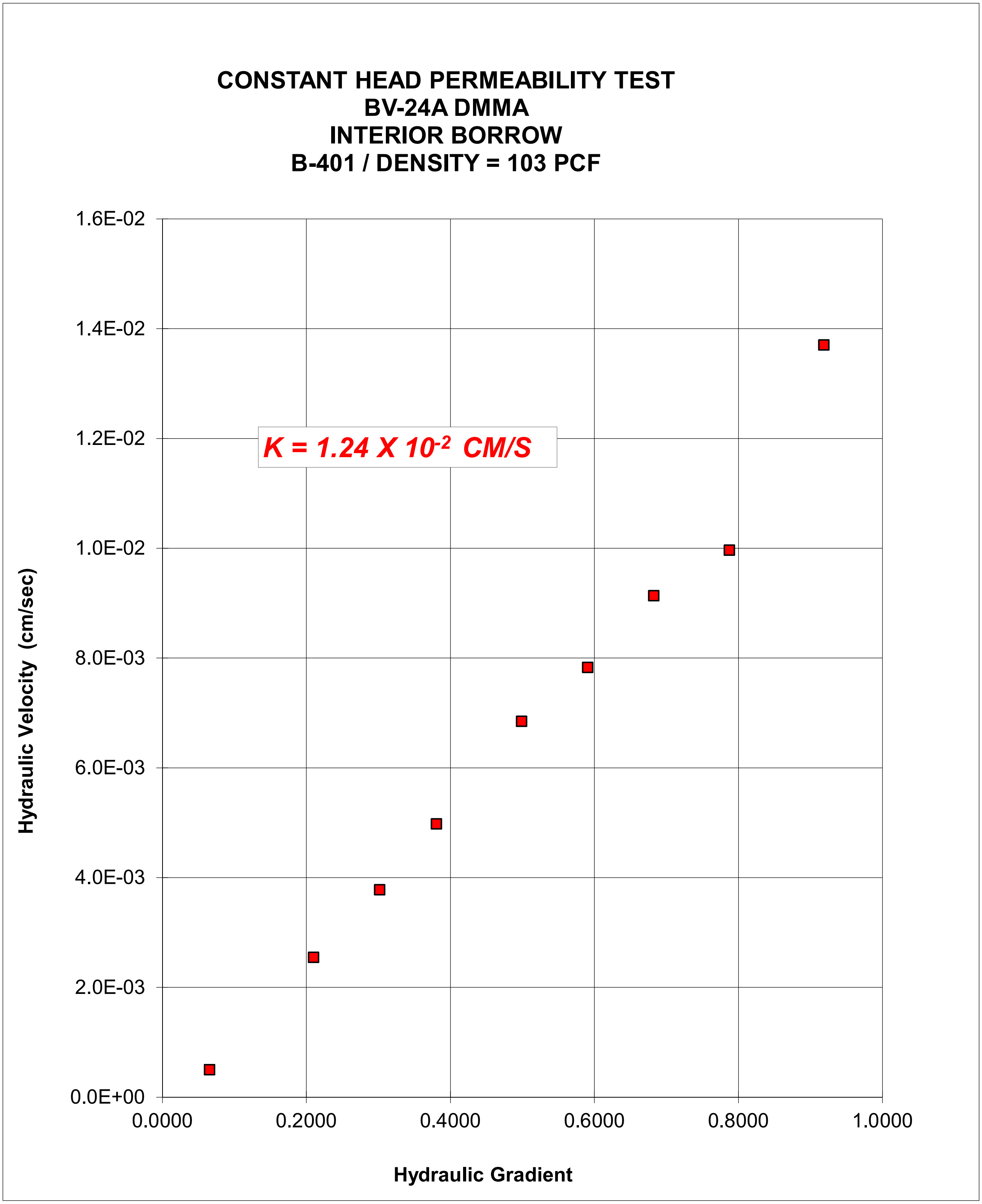
DUNKELBERGER engineering & testing, inc. A Terracon COMPANY

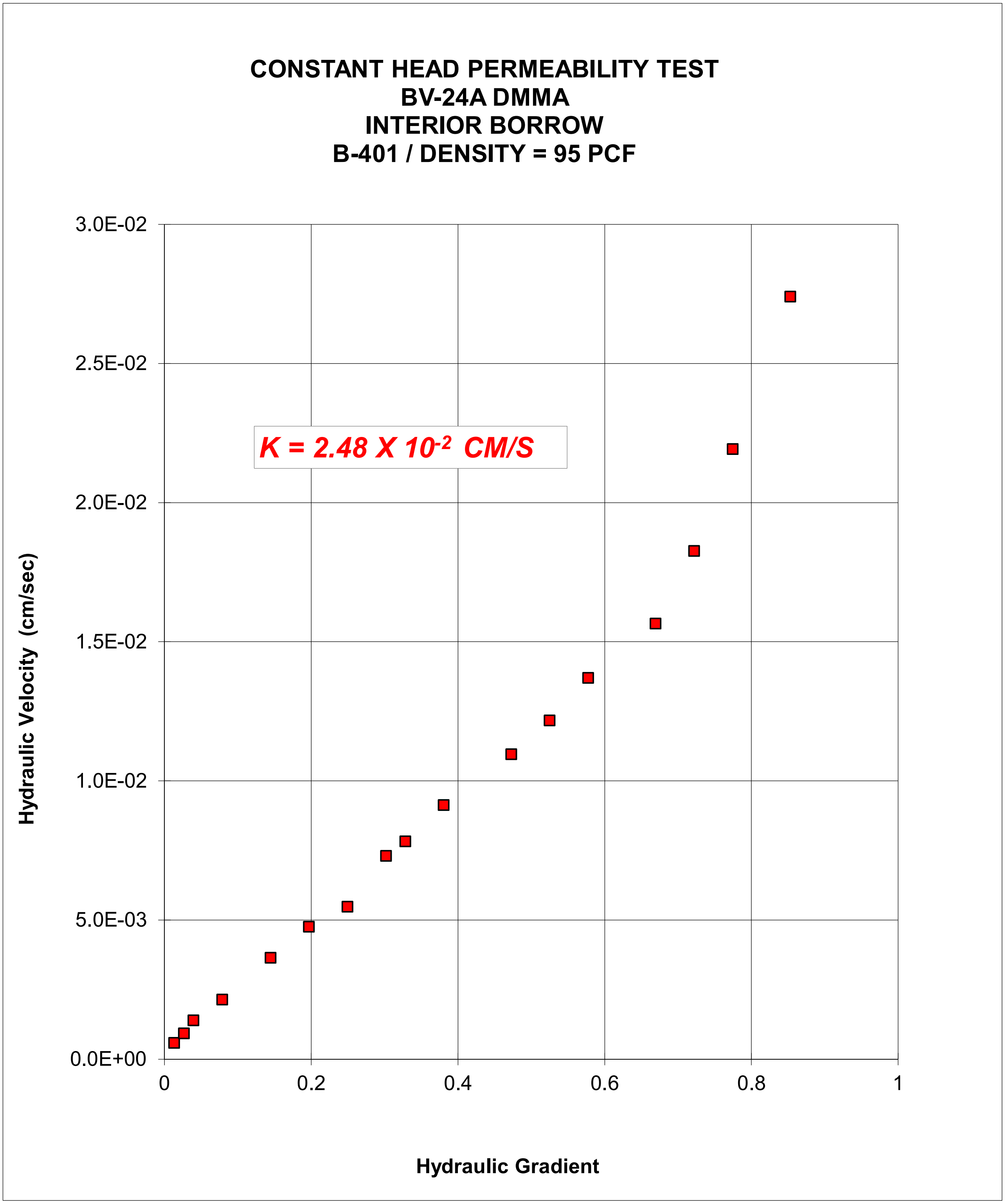
Particle Size Analysis of Soil

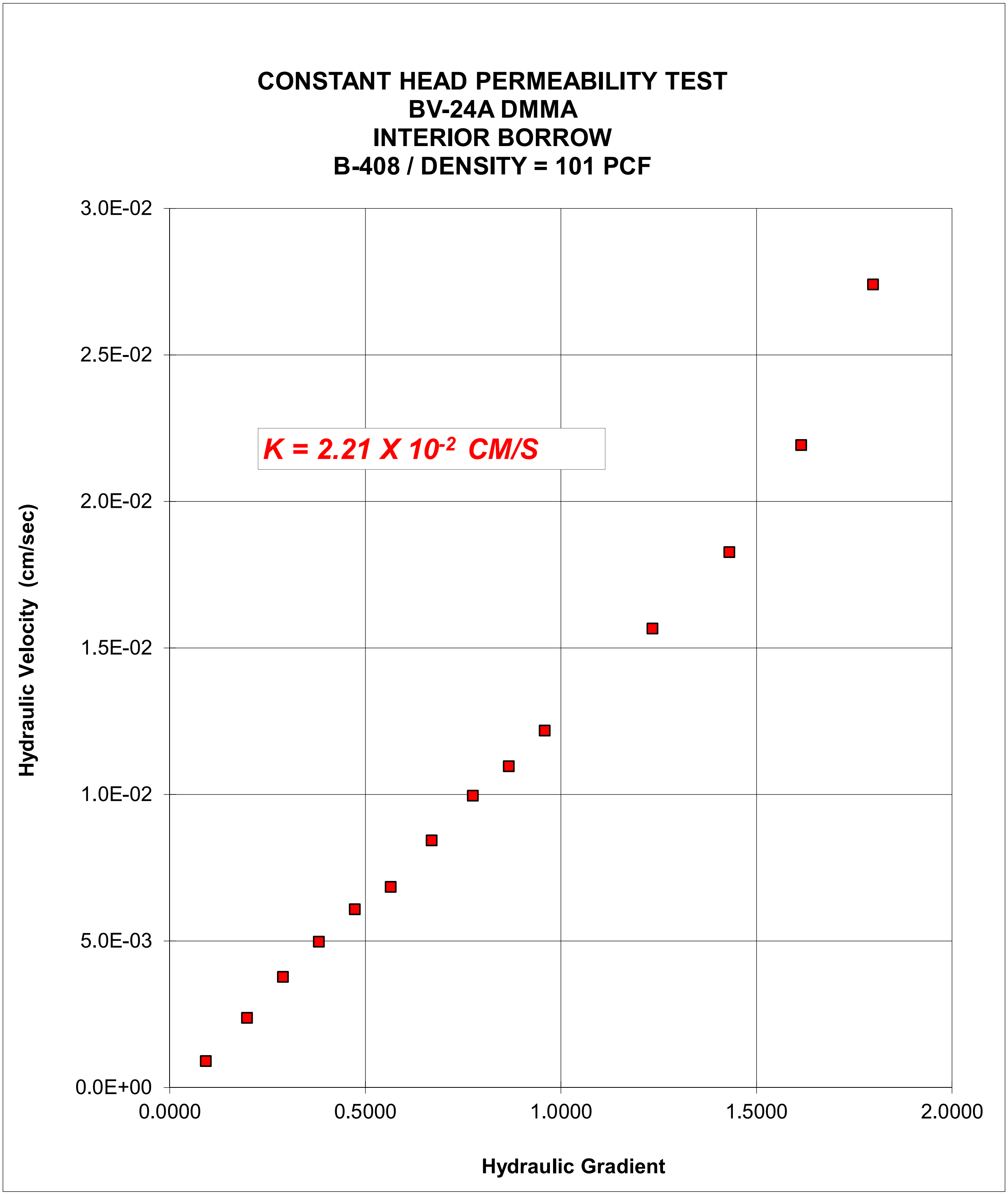


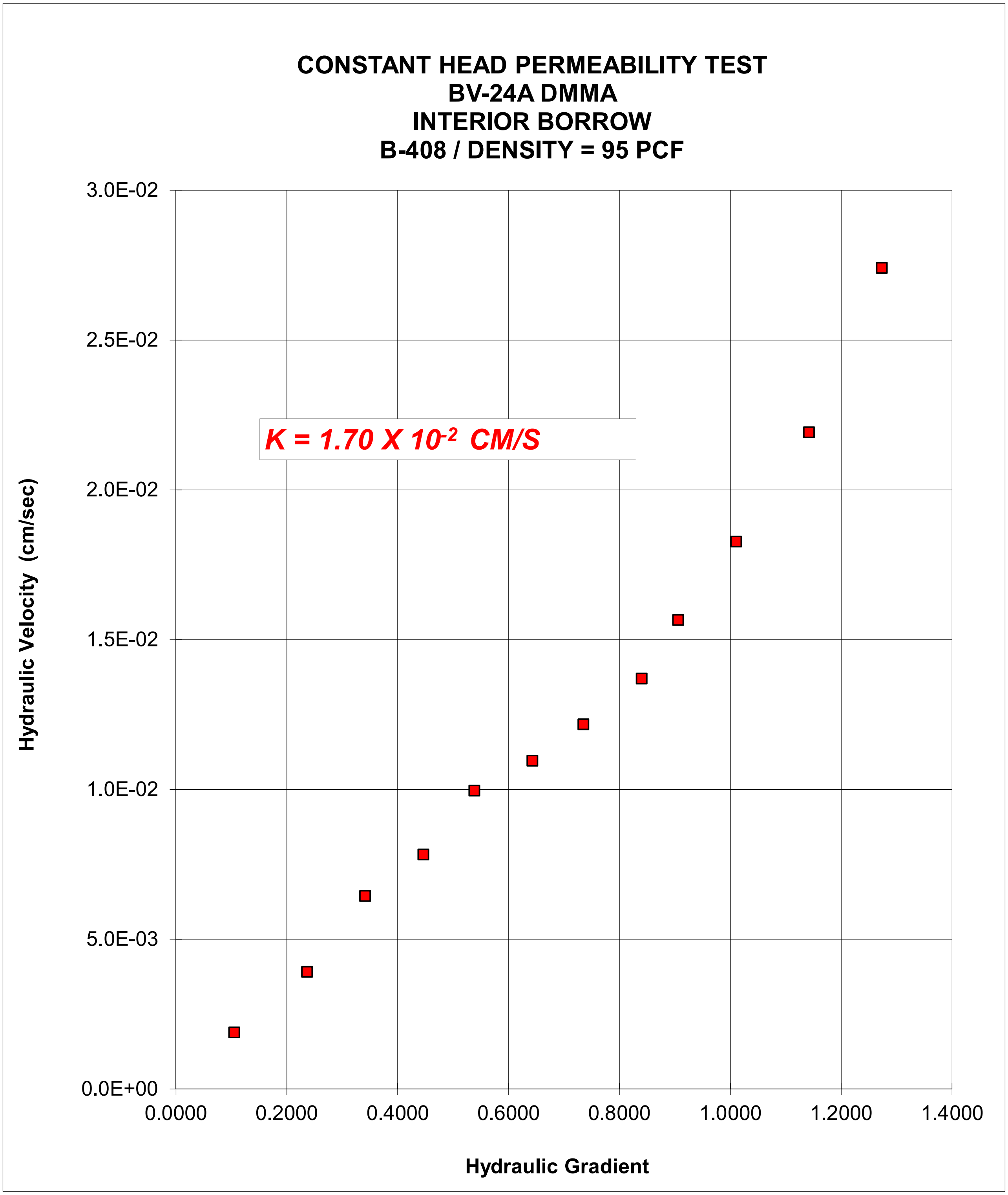
Boring Location	Depth (feet)	USCS Classification	Percent Passing Sieve										
			1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
B-103	38 - 40	SP-SM	100.0	100.0	100.0	100.0	100.0	100.0	99.5	98.0	94.9	62.7	5.4
B-204	38 - 40	SP-SM	100.0	100.0	100.0	100.0	100.0	100.0	94.9	83.0	74.8	59.3	5.2
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-	-
Average			100.0	100.0	100.0	100.0	100.0	100.0	97.2	90.5	84.8	61.0	5.3

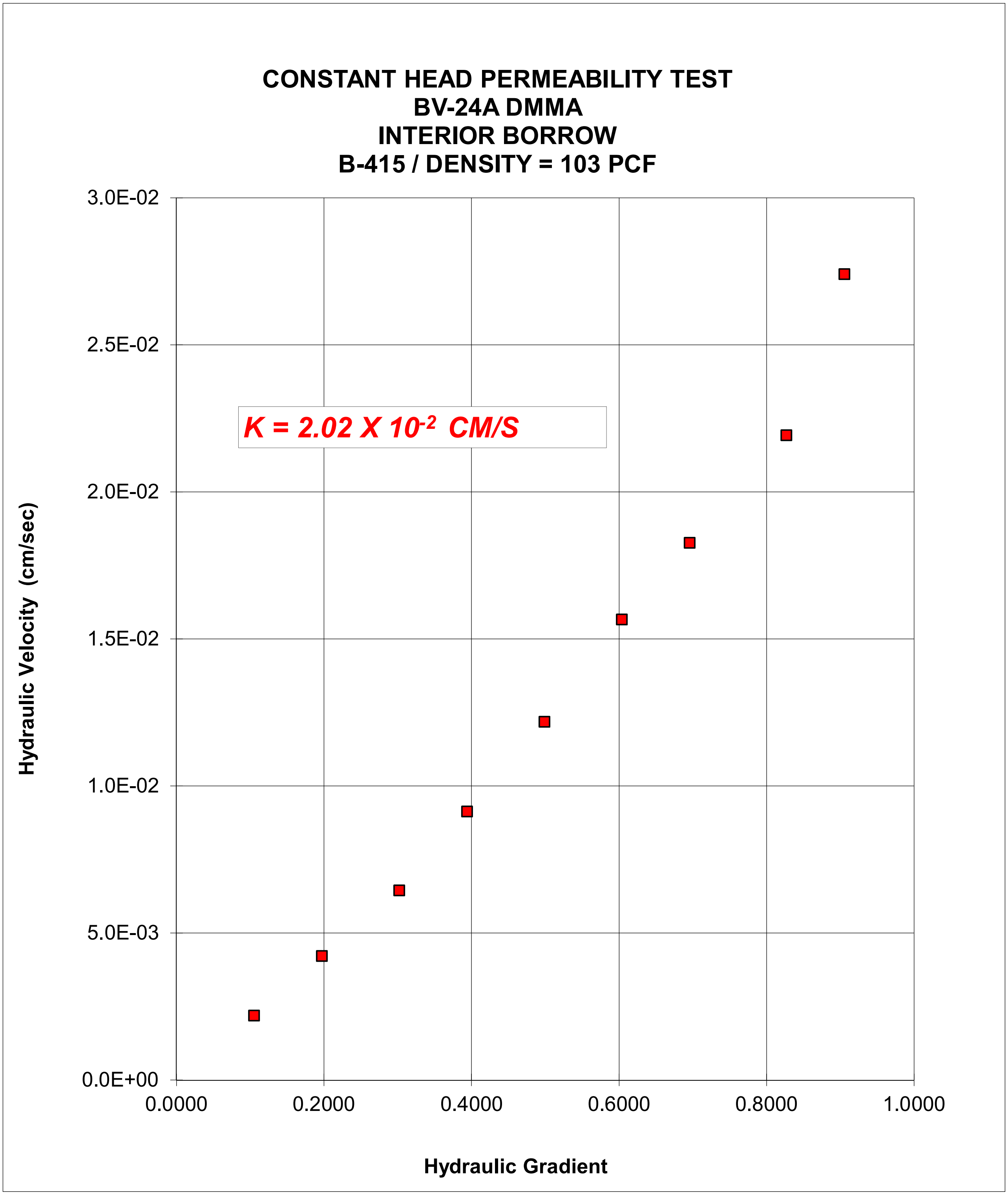
Exhibit B-5


CONSTANT HEAD PERMEABILITY TEST
BV-24A DMMA
INTERIOR BORROW
B-401 / DENSITY = 103 PCF
K = 1.24 X 10-2 CM/S
Hydraulic Velocity (cm/sec)
Hydraulic Gradient
1.6E-02
1.4E-02
1.2E-02
1.0E-02
8.0E-03
6.0E-03
4.0E-03
2.0E-03
0.0E+00
0.0000
0.2000
0.4000
0.6000
0.8000
1.0000

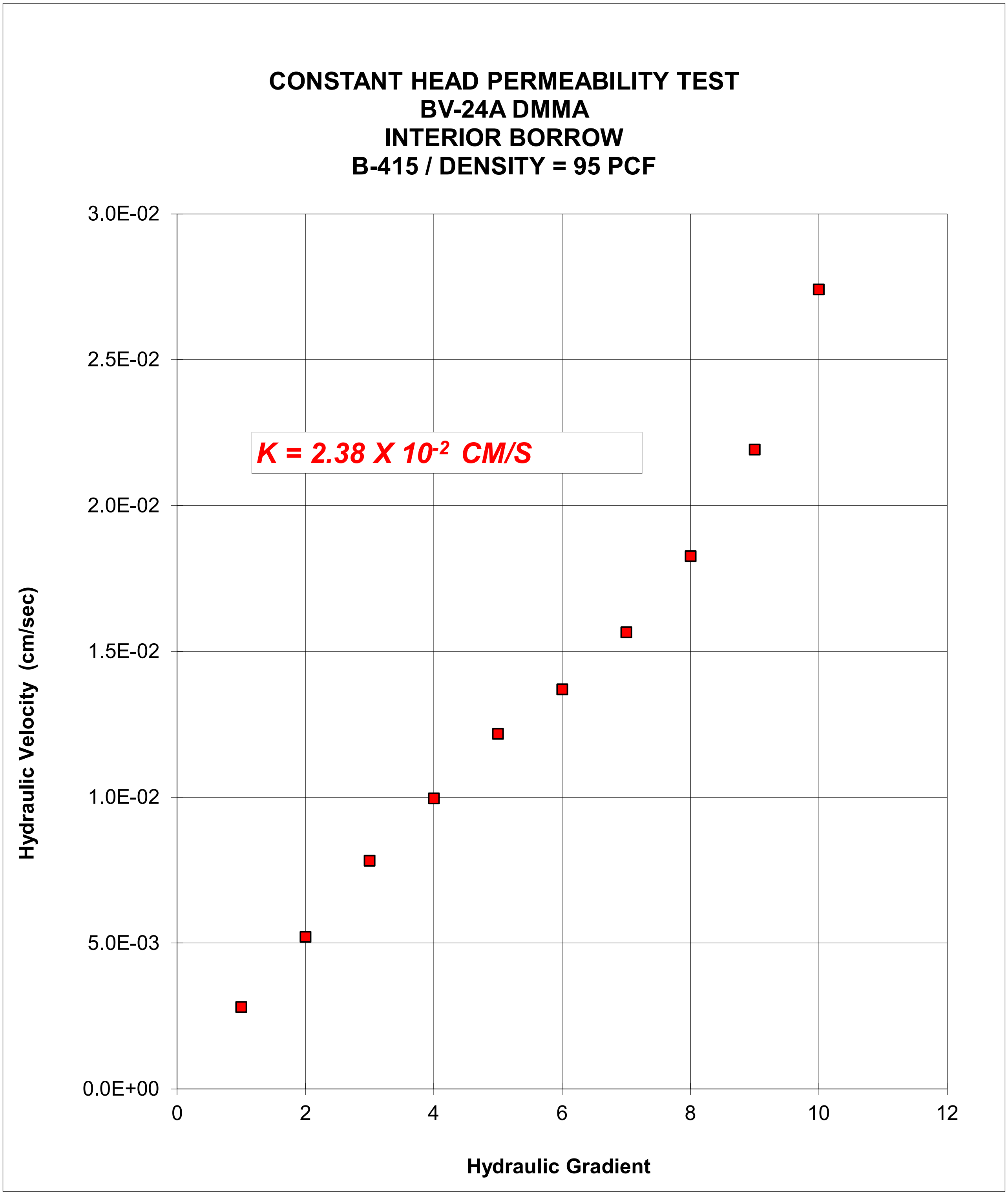

CONSTANT HEAD PERMEABILITY TEST
BV-24A DMMA
INTERIOR BORROW
B-401 / DENSITY = 95 PCF
K = 2.48 X 10-2 CM/S
Hydraulic Velocity (cm/sec)
3.0E-02
2.5E-02
2.0E-02
1.5E-02
1.0E-02
5.0E-03
0.0E+00
0
0.2
0.4
0.6
0.8
1
Hydraulic Gradient


CONSTANT HEAD PERMEABILITY TEST
BV-24A DMMA
INTERIOR BORROW
B-408 / DENSITY = 101 PCF
K = 2.21 X 10-2 CM/S
Hydraulic Velocity (cm/sec)
Hydraulic Gradient
3.0E-02
2.5E-02
2.0E-02
1.5E-02
1.0E-02
5.0E-03
0.0E+00
0.0000
0.5000
1.0000
1.5000
2.0000


CONSTANT HEAD PERMEABILITY TEST
BV-24A DMMA
INTERIOR BORROW
B-408 / DENSITY = 95 PCF
K = 1.70 X 10-2 CM/S
Hydraulic Velocity (cm/sec)
3.0E-02
2.5E-02
2.0E-02
1.5E-02
1.0E-02
5.0E-03
0.0E+00
0.0000
0.2000
0.4000
0.6000
0.8000
1.0000
1.2000
1.4000
Hydraulic Gradient



CONSTANT HEAD PERMEABILITY TEST
BV-24A DMMA
INTERIOR BORROW
B-415 / DENSITY = 103 PCF
K = 2.02 X 10-2 CM/S
3.0E-02
2.5E-02
2.0E-02
1.5E-02
1.0E-02
5.0E-03
0.0E+00
0.0000
0.2000
0.4000
0.6000
0.8000
1.0000
Hydraulic Velocity (cm/sec)
Hydraulic Gradient


CONSTANT HEAD PERMEABILITY TEST
BV-24A DMMA
INTERIOR BORROW
B-415 / DENSITY = 95 PCF
K = 2.38 X 10-2 CM/S
Hydraulic Velocity (cm/sec)
3.0E-02
2.5E-02
2.0E-02
1.5E-02
1.0E-02
5.0E-03
0.0E+00
0
2
4
6
8
10
12
Hydraulic Gradient

HYDRAULIC CONDUCTIVITY TEST RESULTS
(ASTM D 5084 - Method C)

PROJECT NAME: BV-24A
SAMPLE ID: B-102 (31 - 33 ft)

Hydraulic Conductivity = 4.87E-08 cm/sec

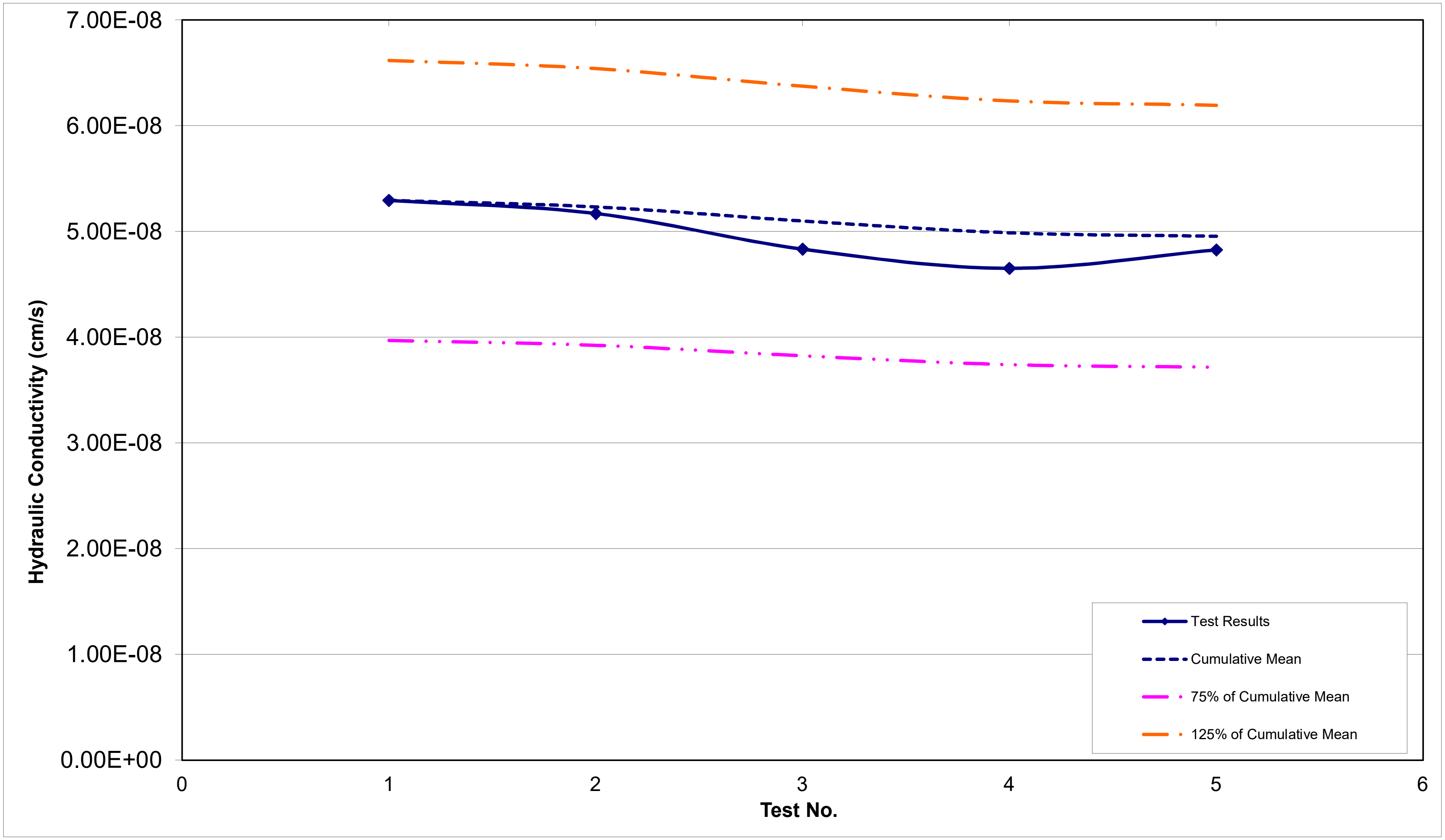


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Exhibit B-12

HYDRAULIC CONDUCTIVITY TEST RESULTS
(ASTM D 5084 - Method C)

PROJECT NAME: BV-24A
SAMPLE ID: B-203 (66 - 68 ft)

Hydraulic Conductivity = 5.57E-08 cm/sec

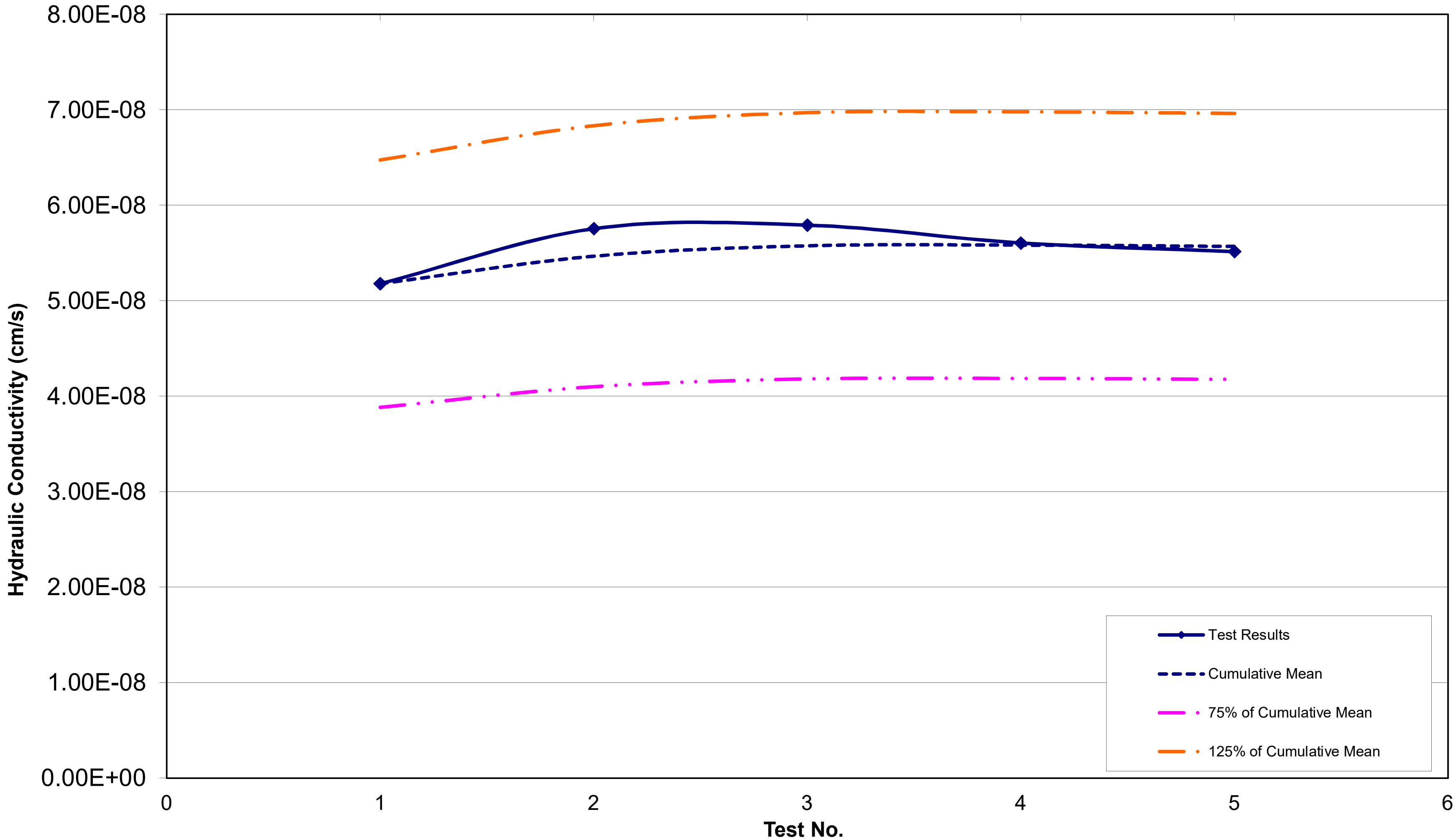

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Exhibit B-13

TRIAXIAL SHEAR TEST REPORT

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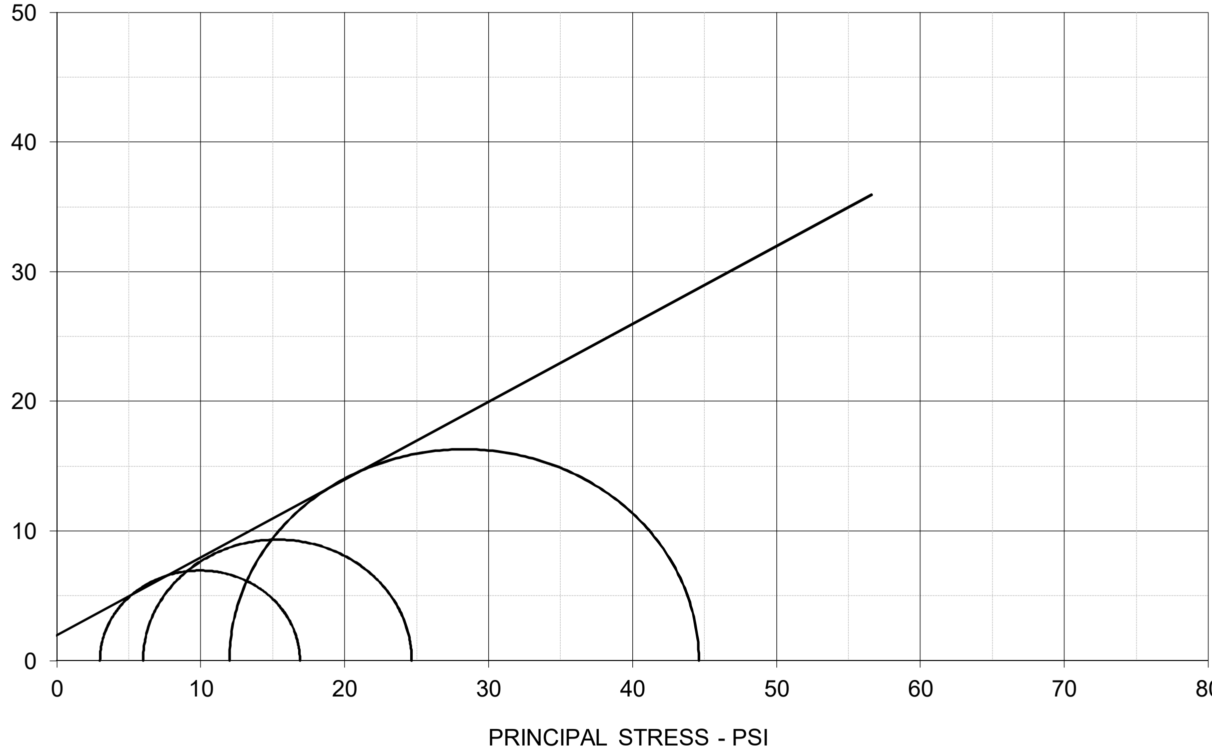
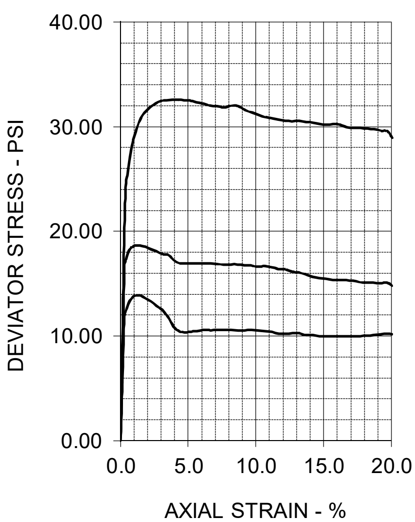


EFFECTIVE STRESS PARAMETERS	ϕ ' = 31.0 deg	c' = 1.9 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	15.0	15.0	15.0	
Dry Density - pcf	96.9	96.9	96.9	
Diameter - inches	2.80	2.80	2.80	
Height - inches	5.60	5.60	5.60	
AT TEST				
Final Moisture - %	27.0	27.1	26.7	
Dry Density - pcf	96.9	97.0	97.3	
Calculated Diameter (in.)	2.79	2.80	2.76	
Height - inches	5.58	5.59	5.49	
Effect. Cell Pressure - psi	3.0	6.0	12.0	
Failure Stress - psi	13.89	18.66	32.61	
Total Pore Pressure - psi	50.0	50.0	50.0	
Strain Rate - inches/min.	0.05600	0.05600	0.05600	
Failure Strain - %	1.4	1.4	4.3	
σ_1' Failure - psi	16.89	24.66	44.61	
σ_3' Failure - psi	3.00	6.00	12.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CD Triaxial
SAMPLE TYPE: Remolded
DESCRIPTION: Gray Fine-Medium Sand
SAMPLE LOCATION: 401-402
ASSUMED SPECIFIC GRAVITY: 2.70
LL: NP PL: NP PI: NP Percent -200: 2.8
REMARKS: Specimens remolded to 95% at opt.

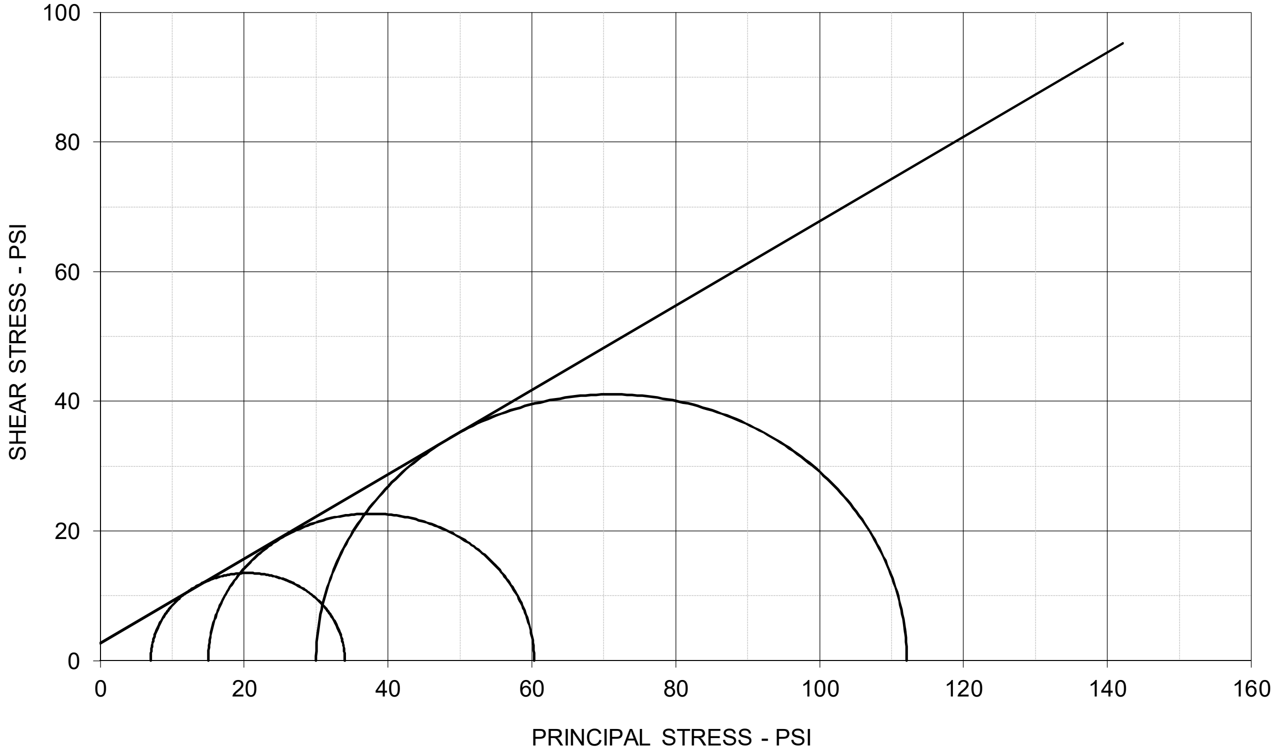
PROJECT INFORMATION

PROJECT: BV-24A DMMA
LOCATION: Grant-Valkaria, FL
PROJECT NO: HB155022
CLIENT: Taylor Engineering, Inc
DATE: 5/24/16

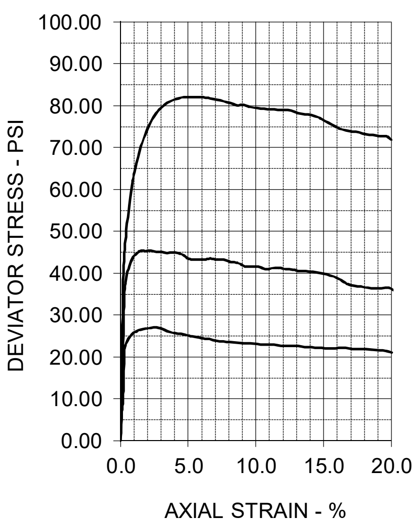
TERRACON Exhibit B-14

TRIAXIAL SHEAR TEST REPORT

DUNKELBERGER engineering & testing, inc. A Terracon COMPANY



EFFECTIVE STRESS PARAMETERS	ϕ ' = 33.1 deg	c' = 2.7 psi

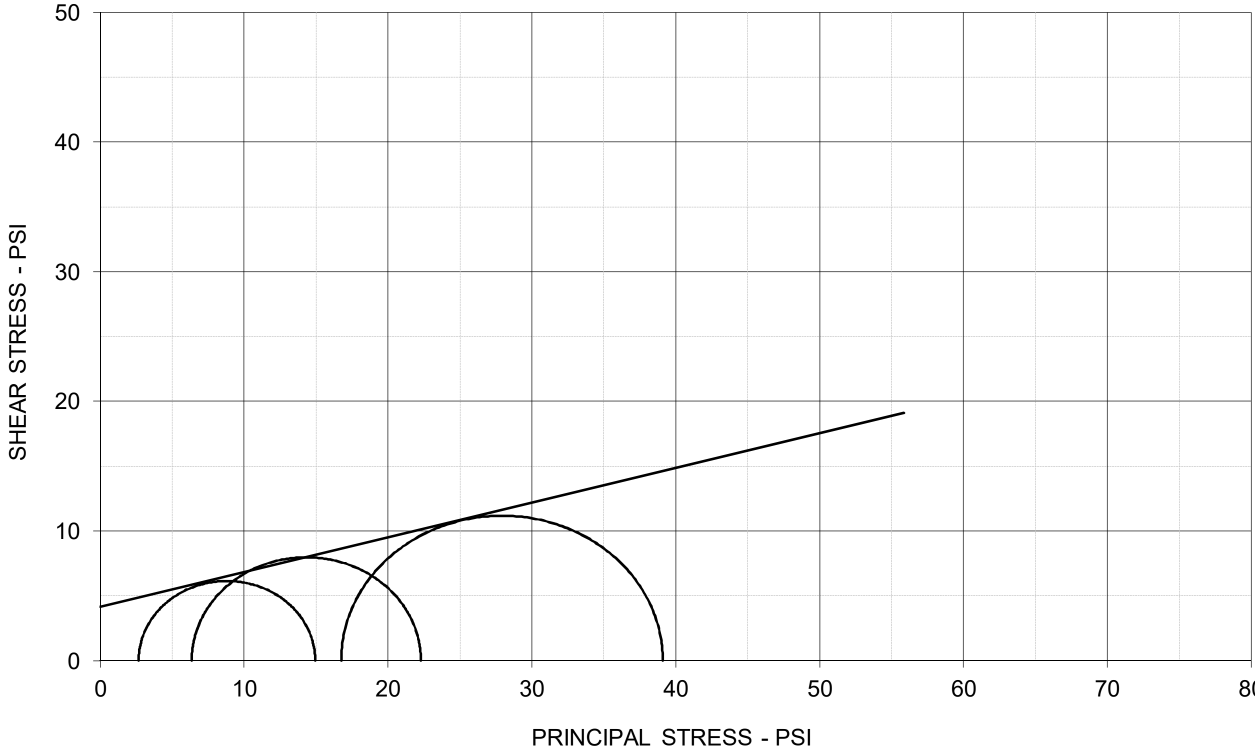


SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	10.0	10.0	10.0	
Dry Density - pcf	97.9	97.9	97.9	
Diameter - inches	2.80	2.80	2.80	
Height - inches	5.60	5.60	5.60	
AT TEST				
Final Moisture - %	26.2	26.0	26.0	
Dry Density - pcf	98.0	98.2	98.4	
Calculated Diameter (in.)	2.76	2.75	2.77	
Height - inches	5.47	5.46	5.51	
Effect. Cell Pressure - psi	7.0	15.0	30.0	
Failure Stress - psi	27.01	45.32	82.12	
Total Pore Pressure - psi	50.0	50.0	50.0	
Strain Rate - inches/min.	0.05600	0.05600	0.05600	
Failure Strain - %	2.7	2.3	5.1	
σ_1' Failure - psi	34.01	60.32	112.12	
σ_3' Failure - psi	7.00	15.00	30.00	

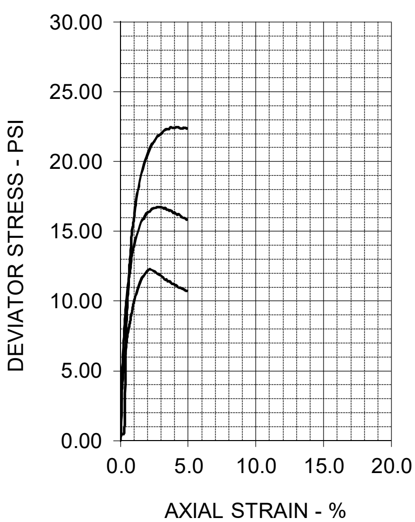
TEST DESCRIPTION	PROJECT INFORMATION
TYPE OF TEST & NO: CD Triaxial	PROJECT: BV-24A DMMA
SAMPLE TYPE: Remolded	LOCATION: Grant-Valkaria, FL
DESCRIPTION: Gray Fine-Medium Sand	PROJECT NO: HB155022
SAMPLE LOCATION: 413-414	CLIENT: Taylor Engineering, Inc
ASSUMED SPECIFIC GRAVITY: 2.70	DATE: 5/24/16
LL: NP PL: NP PI: NP Percent -200: 2.5	TERRACON
REMARKS: Specimens remolded to 95% at opt.	Exhibit B-15

TRIAXIAL SHEAR TEST REPORT

DUNKELBERGER engineering & testing, inc. A Terracon COMPANY



EFFECTIVE STRESS PARAMETERS	ϕ ' = 15.0 deg	c' = 4.2 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	54.0	54.0	54.0	
Dry Density - pcf	68.6	68.6	68.6	
Diameter - inches	2.86	2.86	2.86	
Height - inches	5.69	5.69	5.69	
AT TEST				
Final Moisture - %			42.9	
Dry Density - pcf	69.6	72.3	77.6	
Calculated Diameter (in.)	2.83	2.85	2.83	
Height - inches	5.60	5.66	5.61	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.27	15.93	22.35	
Total Pore Pressure - psi	57.3	63.6	73.3	
Strain Rate - inches/min.	0.00060	0.00060	0.00060	
Failure Strain - %	2.1	4.8	4.9	
σ_1' Failure - psi	14.94	22.29	39.10	
σ_3' Failure - psi	2.67	6.36	16.75	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with Pore Pressure
SAMPLE TYPE: Tube
DESCRIPTION: Grayish Brown Clay
SAMPLE LOCATION: B102 31.0-33.5 ft
ASSUMED SPECIFIC GRAVITY: 2.70
LL: X PL: X PI: X Percent -200: X
REMARKS: Multistage Triaxial

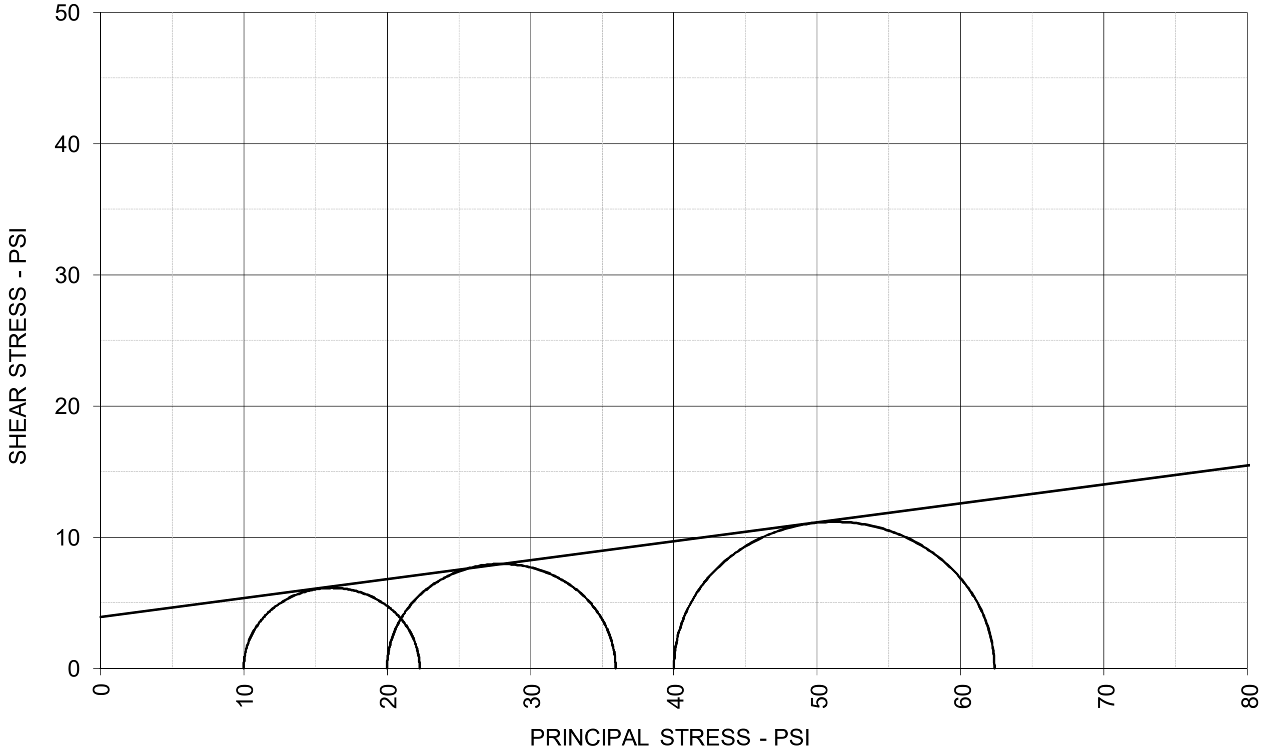
PROJECT INFORMATION

PROJECT: BV-24A DMMA
LOCATION: Grant-Valkaria, FL
PROJECT NO: HB155022
CLIENT: Taylor Engineering, Inc
DATE: 5/26/16

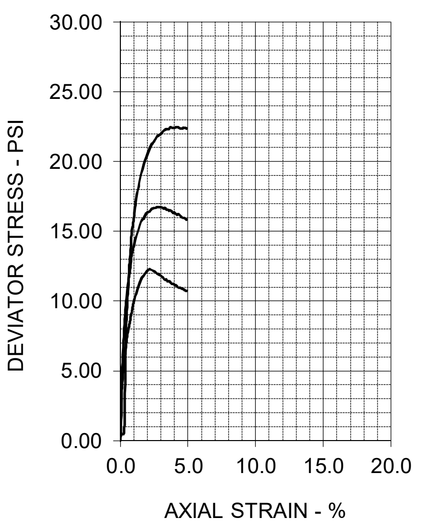
TERRACON | Exhibit B-16

TRIAXIAL SHEAR TEST REPORT

DUNKELBERGER engineering & testing, inc. A Terracon COMPANY



TOTAL STRESS PARAMETERS	ϕ = 8.2 deg	c = 3.9 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	54.0	54.0	54.0	
Dry Density - pcf	68.6	68.6	68.6	
Diameter - inches	2.86	2.86	2.86	
Height - inches	5.69	5.69	5.69	
AT TEST				
Final Moisture - %			42.9	
Dry Density - pcf	69.6	72.3	77.6	
Calculated Diameter (in.)	2.83	2.85	2.83	
Height - inches	5.60	5.66	5.61	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	12.27	15.93	22.35	
Total Pore Pressure - psi	57.3	63.6	73.3	
Strain Rate - inches/min.	0.00060	0.00060	0.00060	
Failure Strain - %	2.1	4.8	4.9	
σ_1 Failure - psi	22.27	35.93	62.35	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

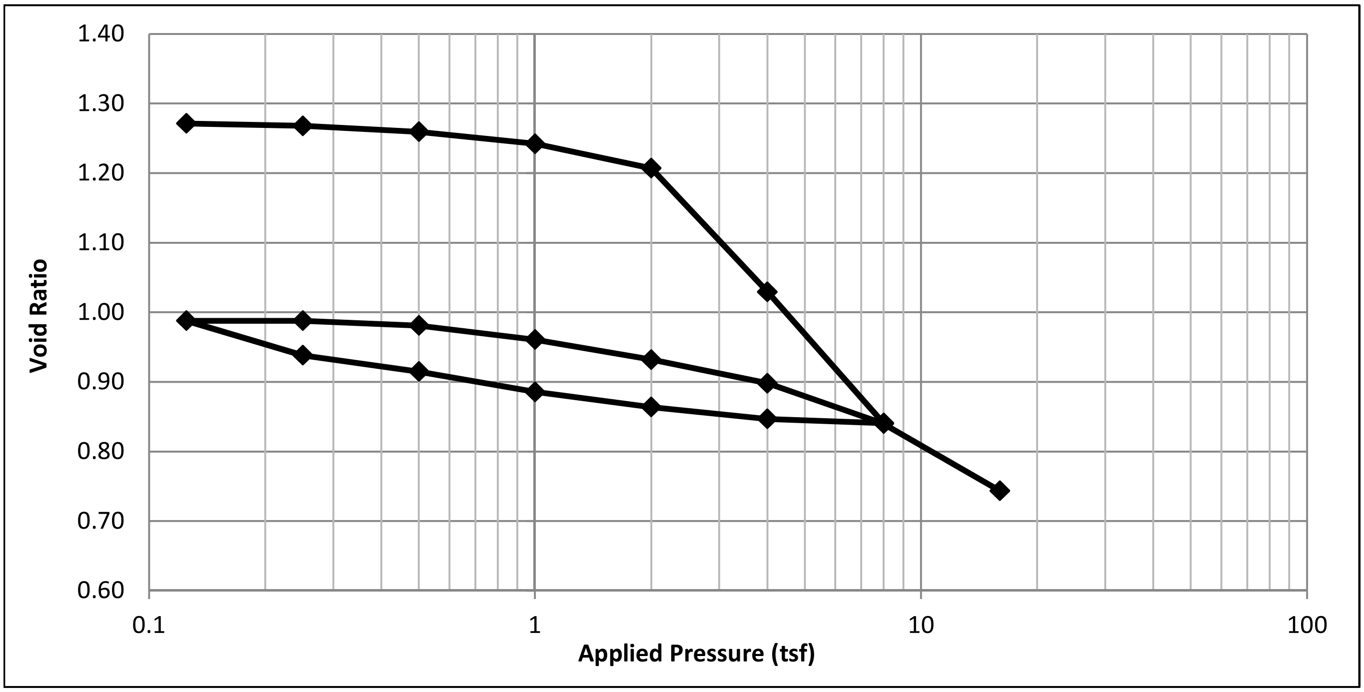
TYPE OF TEST & NO: CU with Pore Pressure
SAMPLE TYPE: Tube
DESCRIPTION: Grayish Brown Clay
SAMPLE LOCATION: B102 31.0-33.5 ft
ASSUMED SPECIFIC GRAVITY: 2.70
LL: X PL: X PI: X Percent -200: X
REMARKS: Multistage Triaxial

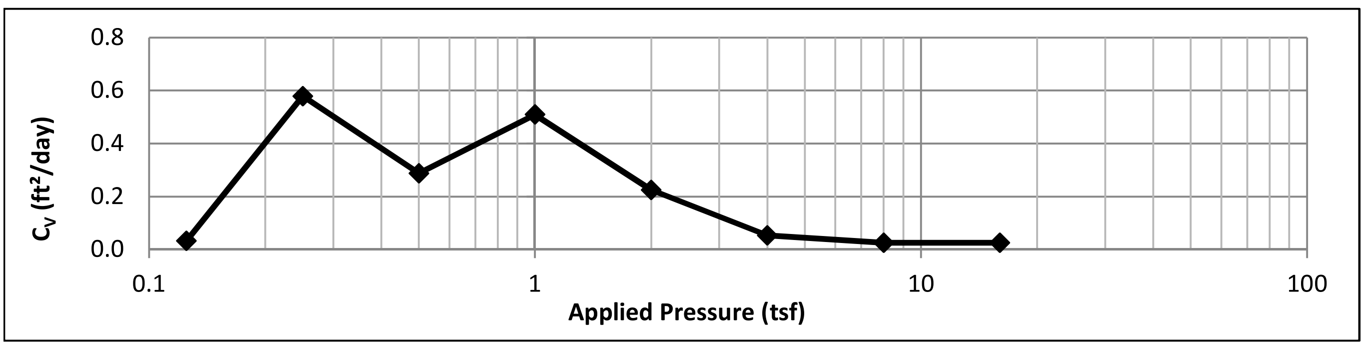
PROJECT INFORMATION

PROJECT: BV-24A DMMA
LOCATION: Grant-Valkaria, FL
PROJECT NO: HB155022
CLIENT: Taylor Engineering, Inc
DATE: 5/26/16

TERRACON | Exhibit B-17

CONSOLIDATION TEST REPORT





Boring	Sample Depth (feet)	Material Description	USCS
B-102	31 to 33.5	Dark gray clay	CL

LL	PI	SG (Assume)	Dry Density (pcf)		Moisture Content (%)		Void Ratio		P_C (ksf)	C_C	C_R	-200 (%)
			Initial	Final	Initial	Final	Initial	Final				
34.0	16.7	2.7	74.2	96.6	48.0	27.6	1.27	0.74	4.0	0.47	0.08	85.0

Project	Project Number	Client
BV-24A DMMA Brevard County, Florida	HB155022	Taylor Engineering

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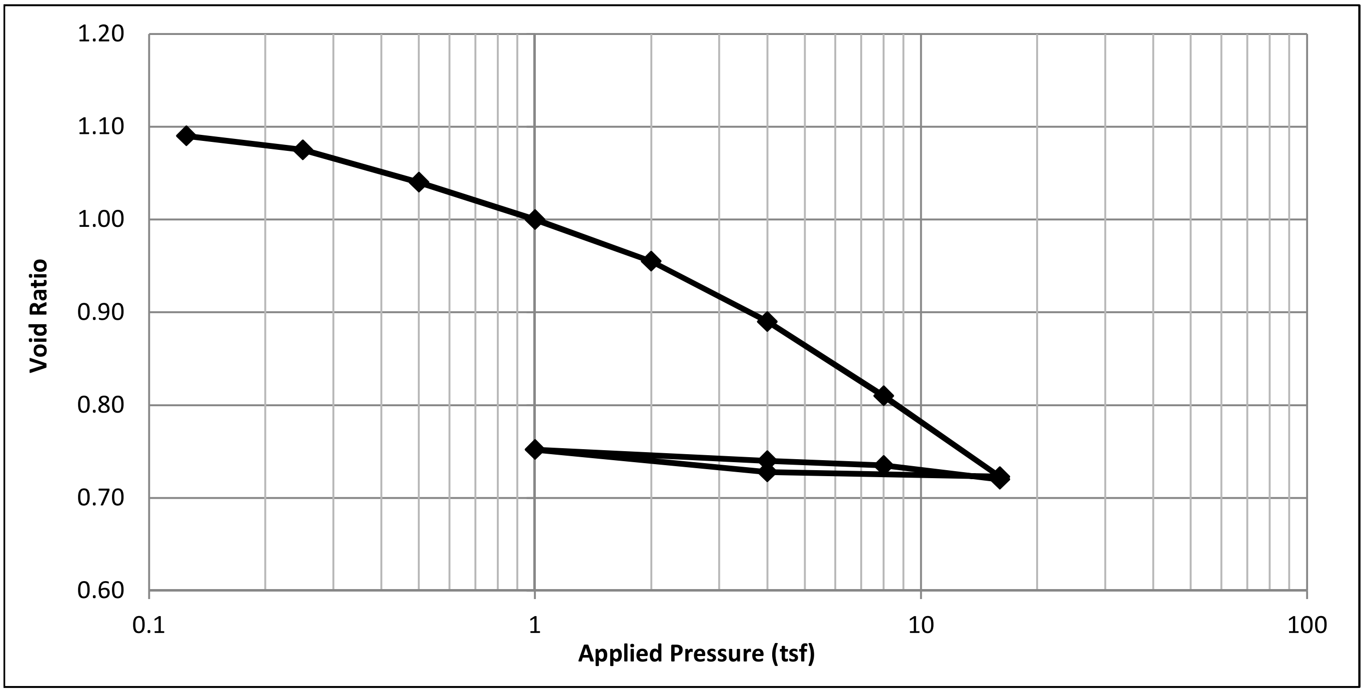
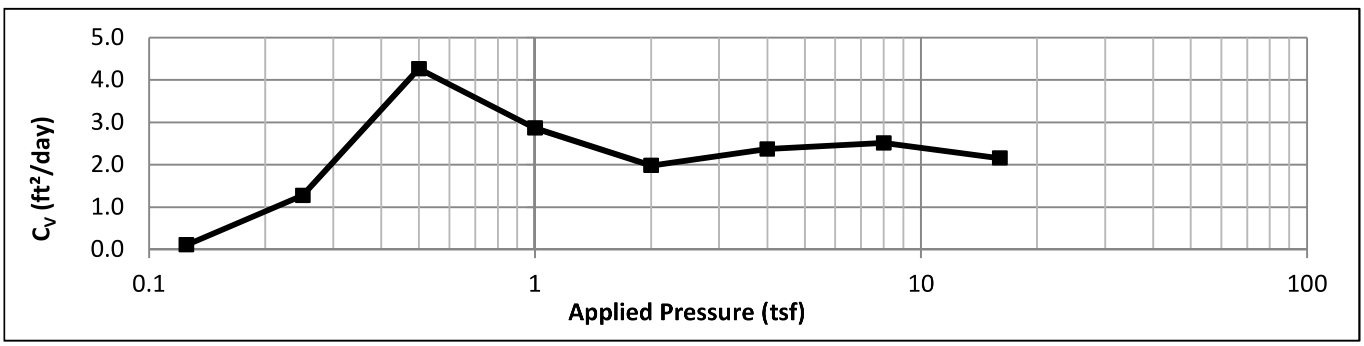
Exhibit B-18

CONSOLIDATION TEST REPORT





Boring	Sample Depth (feet)	Material Description	USCS
B-104	71 to 73.5	Light gray silt with traces of shell	ML

LL	PI	SG (Assume)	Dry Density (pcf)		Moisture Content (%)		Void Ratio		P_C (ksf)	C_C	C_R	-200 (%)
			Initial	Final	Initial	Final	Initial	Final				
38.0	11.0	2.7	80.9	98.0	39.5	29.9	1.10	0.72	3.0	0.29	0.03	87.2

Project	Project Number	Client
BV-24A DMMA Brevard County, Florida	HB155022	Taylor Engineering

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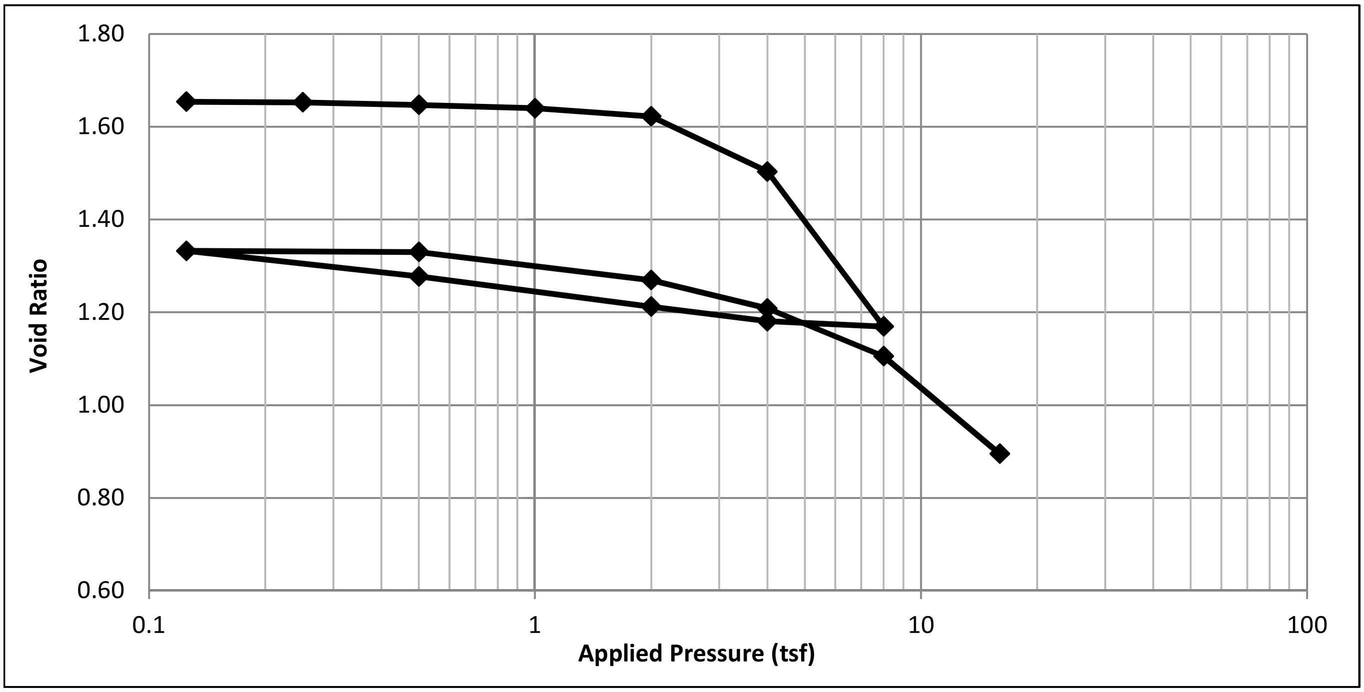
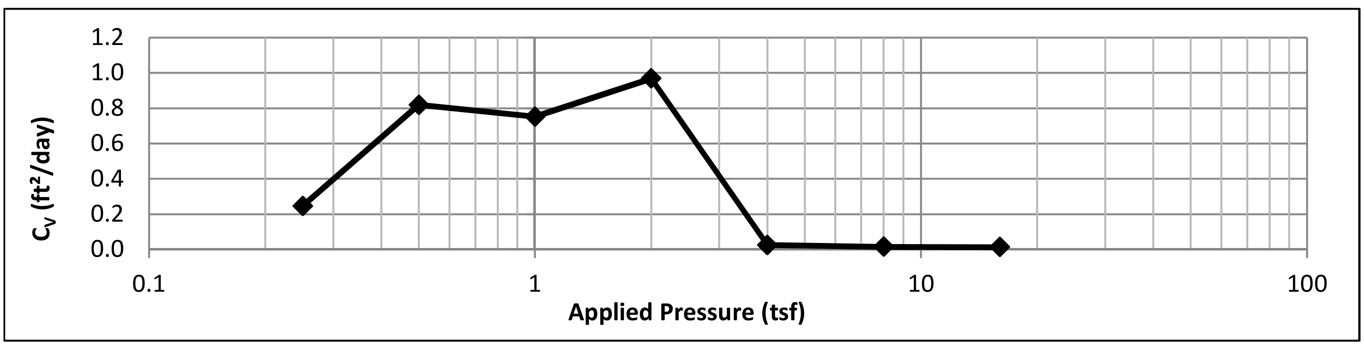
Exhibit B-19

CONSOLIDATION TEST REPORT





Boring	Sample Depth (feet)	Material Description	USCS
B-203	66 to 68.5	Dark gray clay	CH

LL	PI	SG (Assume)	Dry Density (pcf)		Moisture Content (%)		Void Ratio		P_C (ksf)	C_C	C_R	-200 (%)
			Initial	Final	Initial	Final	Initial	Final				
6.0	43.0	2.7	63.5	88.9	61.6	35.3	1.65	0.90	6.2	0.70	0.09	98.7

Project	Project Number	Client
BV-24A DMMA Brevard County, Florida	HB155022	Taylor Engineering

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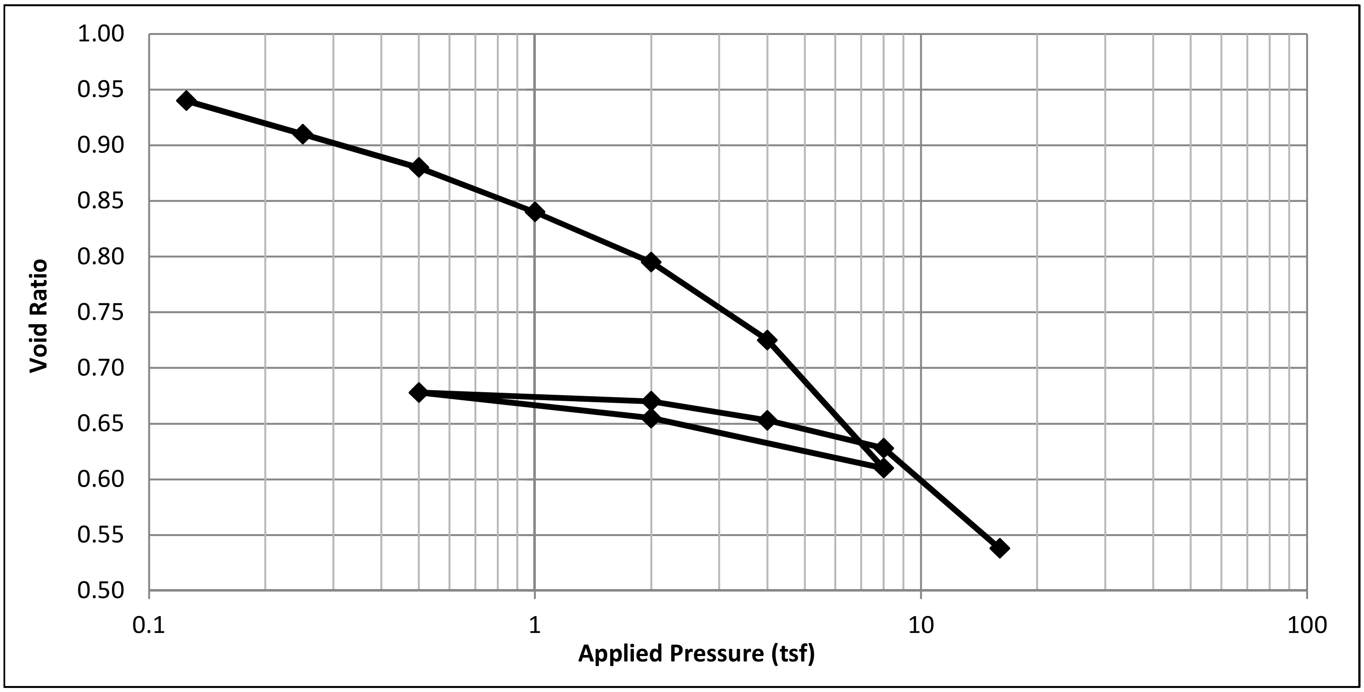
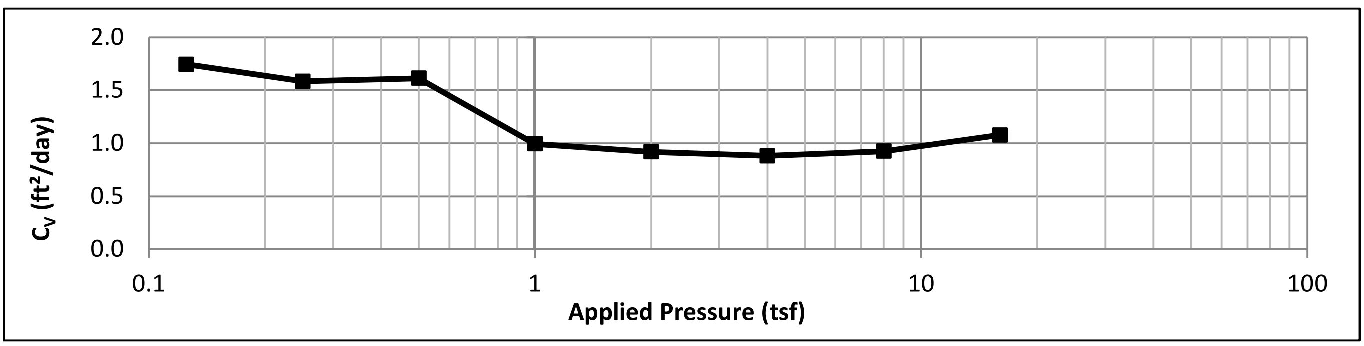
Exhibit B-20

CONSOLIDATION TEST REPORT





Boring	Sample Depth (feet)	Material Description	USCS
B-206	56 - 58.5	Dark gray CLAY	CL

LL	PI	SG (Assume)	Dry Density (pcf)		Moisture Content (%)		Void Ratio		P_C (ksf)	C_C	C_R	-200 (%)
			Initial	Final	Initial	Final	Initial	Final				
43.0	23.0	2.7	86.5	109.4	27.7	26.1	0.96	0.54	4.2	0.31	0.04	82.4

Project	Project Number	Client
BV-24A DMMA Brevard County, Florida	HB155022	Taylor Engineering

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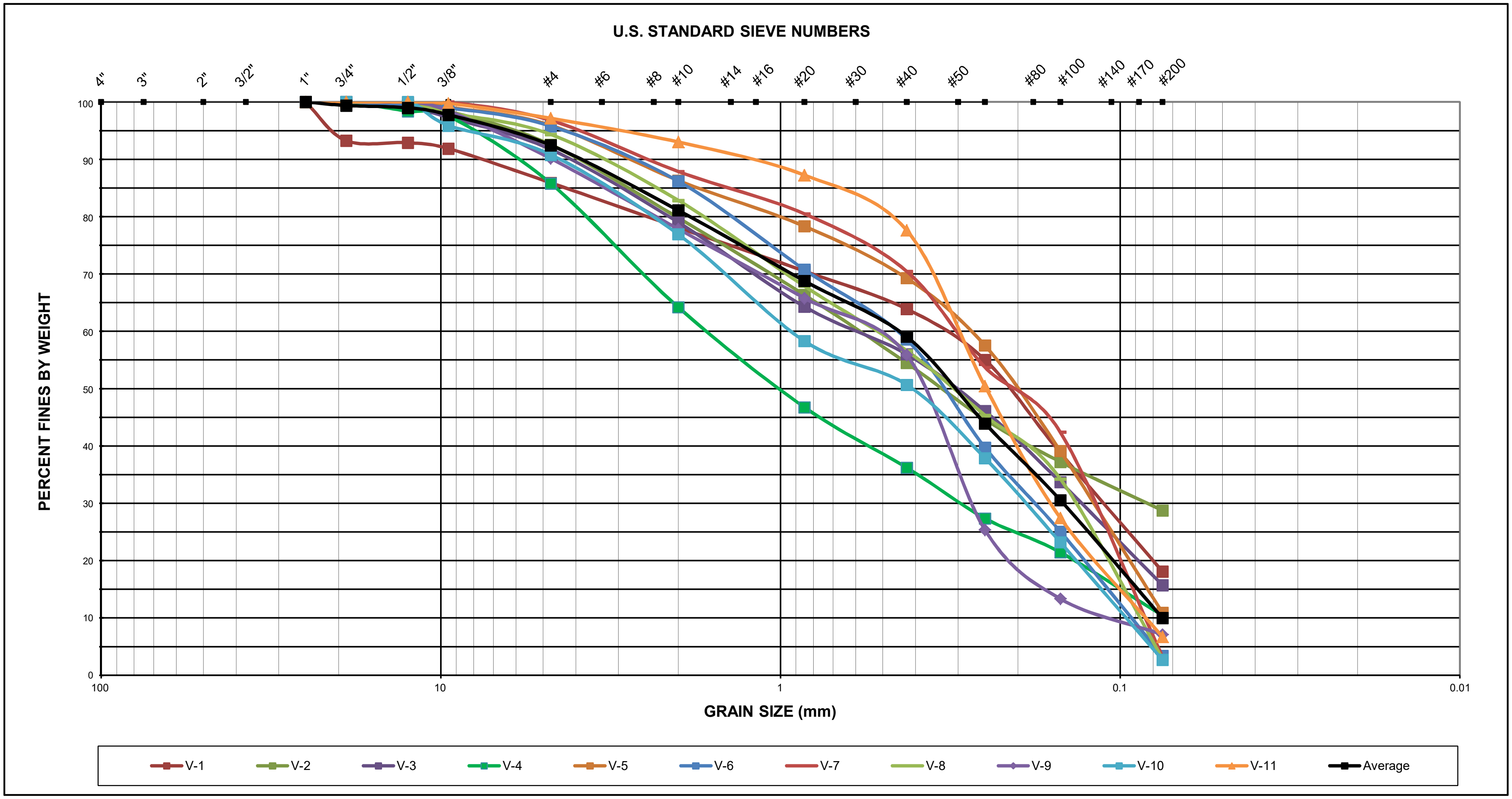
Exhibit B-21

APPENDIX C
DREDGED MATERIAL LABORATORY RESULTS

Particle Size Analysis of Soil



Boring Location	Depth (feet)	USCS Classification	Percent Passing Sieve										
			1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200
V-1		SC	100.0	93.2	92.9	91.9	85.9	78.1	70.5	63.9	55.0	38.8	18.1
V-2		SC	100.0	100.0	99.0	98.4	92.6	79.8	66.4	54.5	44.6	37.2	28.8
V-3		SC	100.0	100.0	99.0	97.3	91.7	79.0	64.3	56.0	46.1	33.7	15.7
V-4		SP-SC	100.0	100.0	98.4	97.6	85.8	64.2	46.8	36.2	27.4	21.5	10.4
V-5		SP-SC	100.0	100.0	99.9	99.1	95.9	86.3	78.3	69.3	57.5	39.1	10.9
V-6		SP	100.0	100.0	99.5	99.0	95.8	86.2	70.7	58.6	39.7	25.1	3.4
V-7		SP	100.0	100.0	100.0	100.0	96.8	87.9	80.5	70.5	53.7	42.4	3.2
V-8		SP	100.0	100.0	100.0	98.1	94.3	82.8	67.9	56.6	45.3	34.3	2.9
V-9		SP-SC	100.0	100.0	100.0	98.5	90.1	77.8	65.8	55.9	25.4	13.3	7.1
V-10		SP	100.0	100.0	100.0	95.9	90.8	76.9	58.3	50.7	37.9	23.2	2.7
V-11		SP-SC	100.0	100.0	100.0	99.8	97.2	93.0	87.2	77.6	50.4	27.5	6.7
-			-	-	-	-	-	-	-	-	-	-	-
Average		SP-SC	100.0	99.4	99.0	97.8	92.5	81.1	68.8	59.1	43.9	30.6	10.0

Influent Parameters:	Chloride Content:	94
	pH:	9.2

Sample ID V1

Elapsed (min)	Disp (in)	Vol (in³)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
43055	4.8	33.9	1	13200	8.3
			2		
			3		
			4		
			5		
			6		
			Sum/Avg		
			Comp		

Pace Results:

SPLP Total Chl = 295 mg/L

Sample ID V2

Elapsed (min)	Disp (in)	Vol (in³)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
8792	7.7	54.3	1	13200	6.3
43089	11.6	82.3	2	4320	9.0
			3		
			4		
			5		
			6		
			Sum/Avg		
			Comp		

Pace Results:

SPLP Total Chl = 183 mg/L

Sample ID V3

Elapsed (min)	Disp (in)	Vol (in³)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
188	9.0	63.6	1	12000	7.7
2390	17.6	124.7	2	1440	9.4
13865	27.0	190.9	3	1440	9.7
36744	37.2	263.0	4	1200	10.0
			5	1440	10.4
			6		
			Sum/Avg	3504	9.4
			Comp		

Pace Results:

SPLP Total Chl = 311 mg/L

Sample ID V4

Elapsed (min)	Disp (in)	Vol (in³)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
85	9.0	63.6	1	9600	8.7
269	18.0	127.2	2	1680	9.3
847	27.2	192.6	3	1200	9.7
1438	31.8	224.8	4	960	9.7
4634	45.0	318.1	5	1200	8.7
6061	48.6	343.5	6	960	9.5
			Sum/Avg	2600	9.3
			Comp	2400	9.4

Pace Results:

SPLP Total Chl = 162 mg/L

Sample ID V5

Elapsed (min)	Disp (in)	Vol (in³)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
870	8.9	62.8	1	14400	8.9
11724	18.0	127.2	2	1440	7.8
35702	25.2	178.1	3	1440	9.8
			4	1680	9.3
			5	1920	8.8
			6	2160	9.4
			Sum/Avg	3840	9.0
			Comp	4320	9.4

Pace Results:

SPLP Total Chl = 175 mg/L

Sample ID V6

Elapsed (min)	Disp (in)	Vol (in³)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
25	15.0	106.0	1	9600	8.9
29	18.6	131.5	2	1920	9.2
44	26.5	187.5	3	1680	9.1
66	35.6	251.9	4	2160	9.3
95	45.4	320.6	5	1680	9.2
130	51.8	366.4	6	1920	9.1
			Sum/Avg	3160	9.1
			Comp	3120	9.0

Pace Results:

SPLP Total Chl = 136 mg/L

"Comp" indicated a composite sample of all liquid exract passed through soil column.

Exhibit C-2

Influent Parameters:	Chloride Content:	94
	pH:	9.2

Sample ID **V7**

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
30	9.0	63.6	1	10800	8.1
59	17.9	126.4	2	2160	9.3
100	27.3	192.6	3	1920	9.1
144	36.0	254.5	4	1920	9.0
201	45.2	319.8	5	1920	9.0
269	53.6	379.2	6	1920	8.9
			Sum/Avg	3440	8.9
			Comp	3120	9.0

Pace Results:

SPLP Total Chl = 252 mg/L

Sample ID **V8**

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
16	9.0	63.6	1	14400	8.1
39	17.9	126.4	2	1920	8.7
70	26.8	189.2	3	1200	8.7
111	35.9	253.6	4	1200	8.7
157	45.3	319.8	5	1200	8.5
205	53.6	379.2	6	1200	8.8
			Sum/Avg	3520	8.6
			Comp	2880	8.7

Pace Results:

SPLP Total Chl = 253 mg/L

Sample ID **V9**

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
35	9.0	63.6	1	18000	8.2
100	17.9	126.4	2	3600	8.8
347	25.1	177.3	3	1200	9.2
1660	34.3	242.6	4	1200	9.4
10366	44.8	316.4	5	1200	9.3
21744	52.1	368.1	6	960	9.8
			Sum/Avg	4360	9.1
			Comp	2640	9.4

Pace Results:

SPLP Total Chl = 252 mg/L

Sample ID **V10**

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
21	9.0	63.6	1	8880	7.9
37	17.5	123.8	2	1440	8.4
66	27.0	190.9	3	960	9.2
97	36.0	254.5	4	960	9.3
135	45.4	320.6	5	960	8.8
182	52.1	368.1	6	1200	9.0
			Sum/Avg	2400	8.8
			Comp	3120	7.3

Pace Results:

SPLP Total Chl = 250 mg/L

Sample ID **V11**

Elapsed (min)	Disp (in)	Vol (in^3)	Sample #	Chloride (ppm)	pH
0	0.0	0.0			
48	9.0	63.6	1	18750	7.1
211	18.0	127.2	2	4080	7.5
471	24.2	171.3	3	960	8.5
680	27.6	195.1	4	720	8.7
7239	41.4	292.6	5	864	9.2
10071	44.6	315.5	6	1200	8.8
22764	51.2	362.2	7	1200	8.8
			Sum/Avg	3968	8.4
			Comp	2400	9.3

Pace Results:

SPLP Total Chl = 305 mg/L

"Comp" indicated a composite sample of all liquid exract passed through soil column.

Exhibit C-3

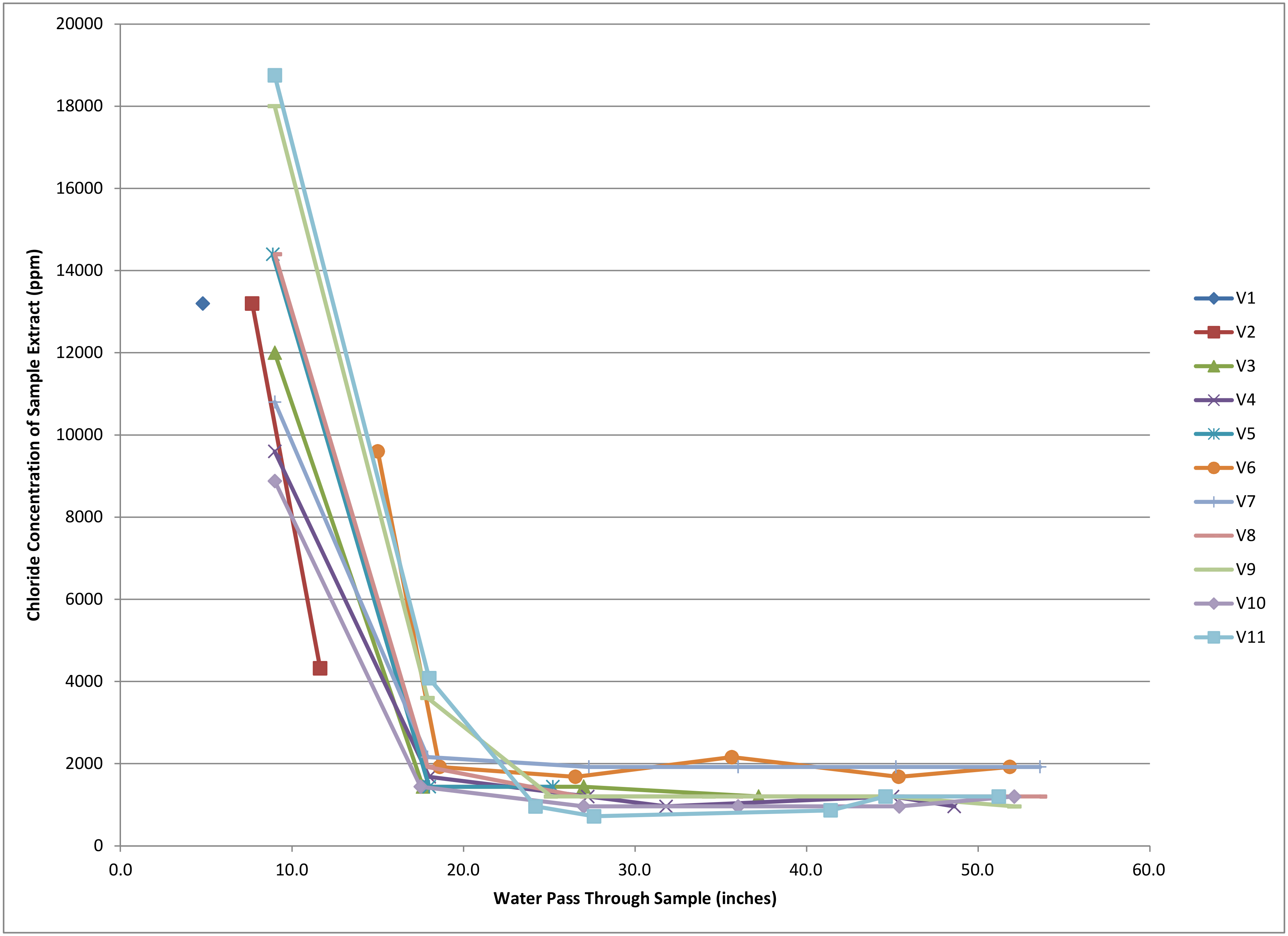


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Exhibit C-4

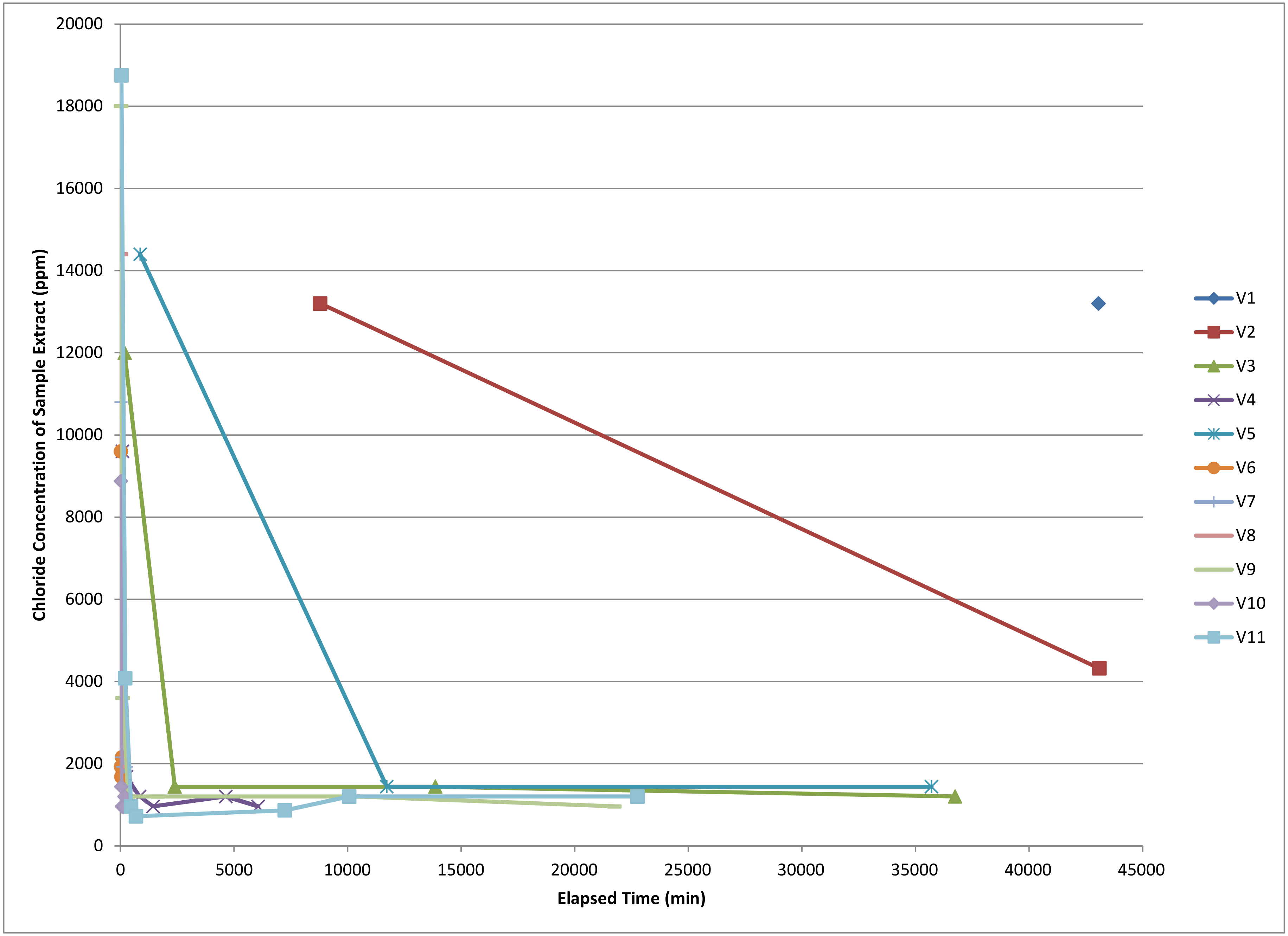

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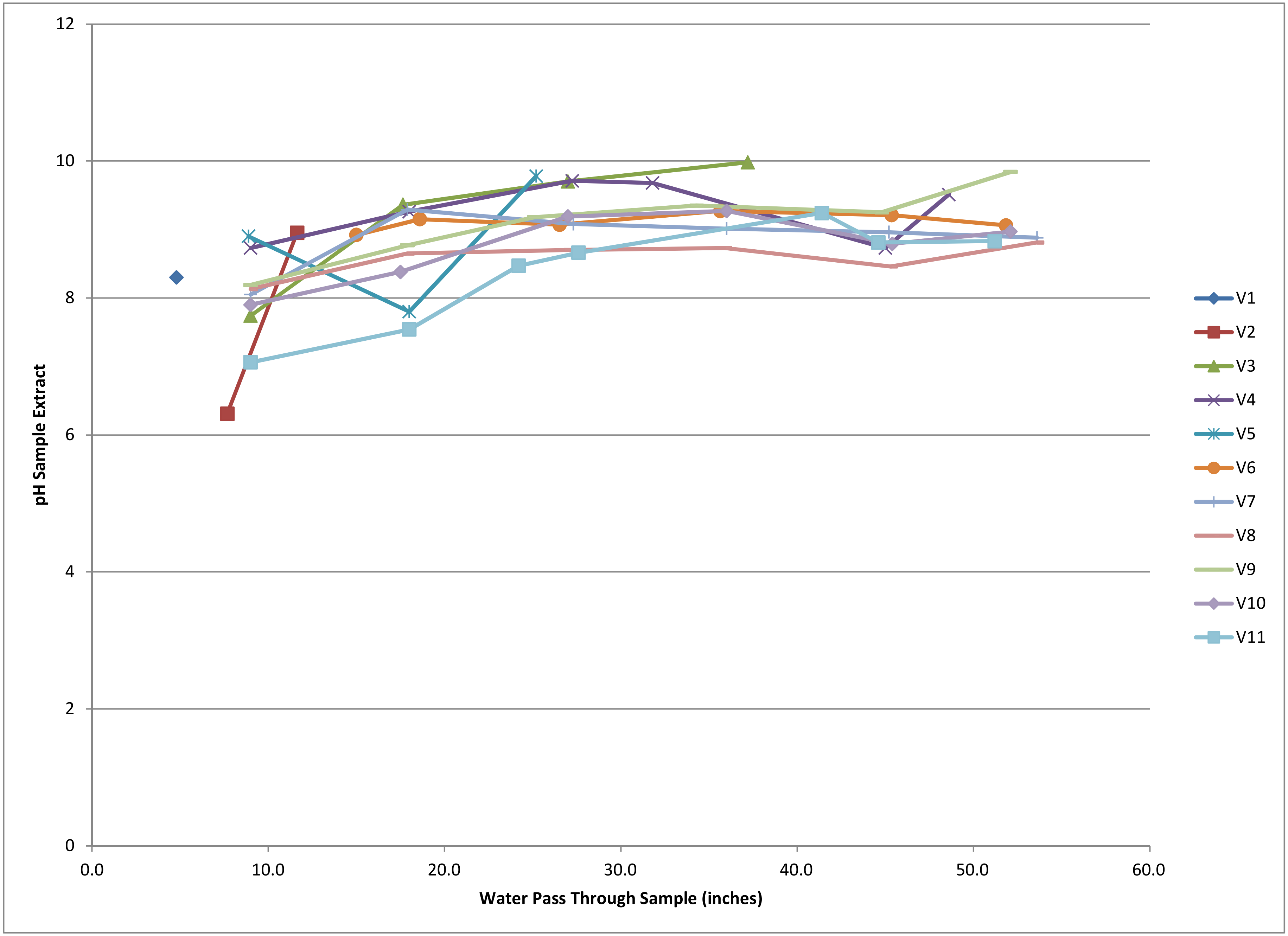
Exhibit C-5



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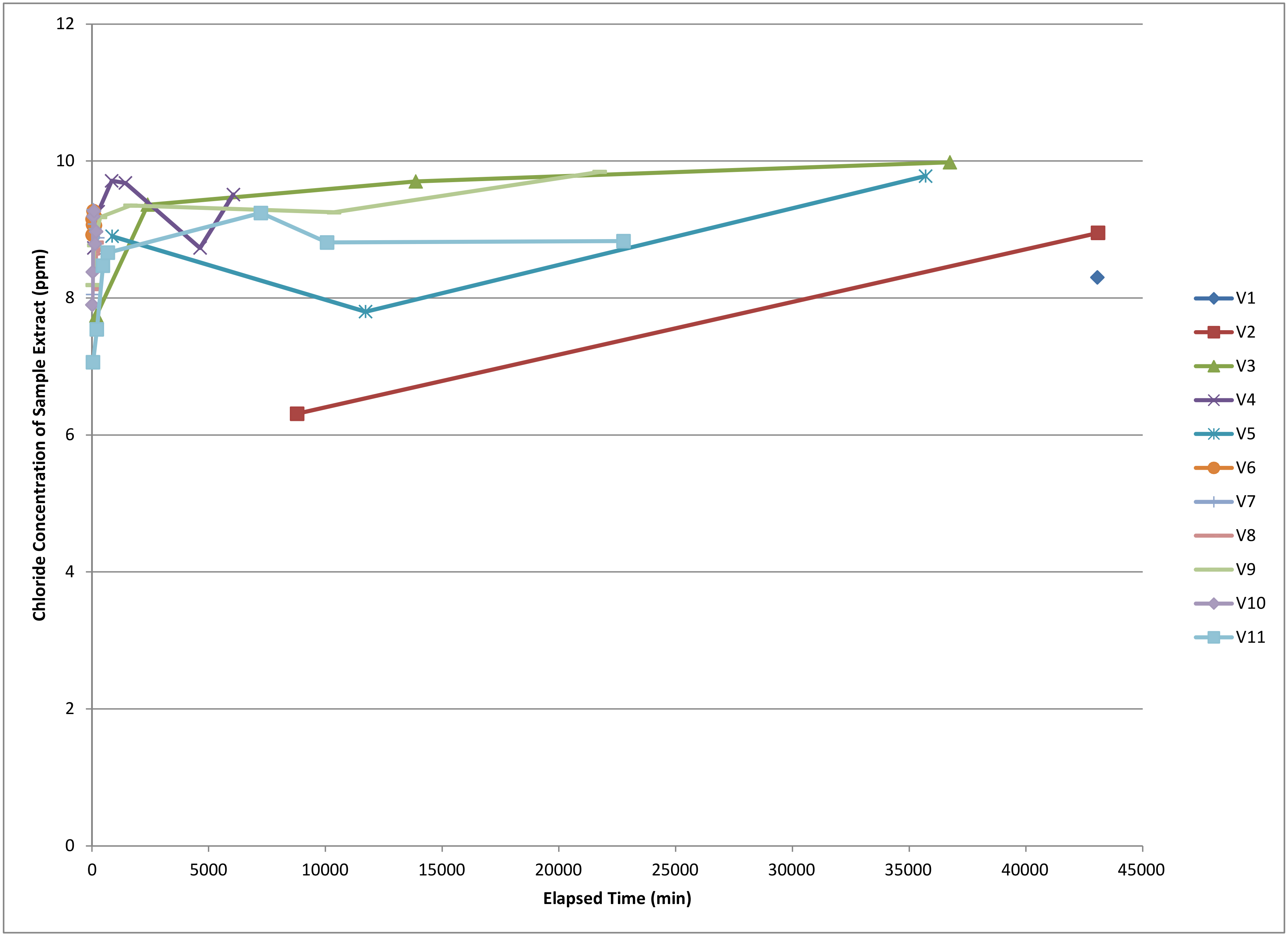

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Exhibit C-7