Paul C. Rizzo Associates, Inc.
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SURFICIAL MUCK DEPOSITS

FIELD AND LABORATORY INVESTIGATION DATA REPORT

TURKEY POINT NUCLEAR POWER PLANT UNITS 6 & 7

REVISION 1

Engineering & Construction Management
Hydro-Nuclear-Fossil
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PROJECT NO. 13-5054
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SURFICIAL MUCK DEPOSITS
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1.0 INTRODUCTION

Paul C. Rizzo Associates, Inc. (RIZZO) was contracted by Florida Power and Light (FPL) to collect and describe "muck" deposits (soft, surficial soil, and sediment layers) at the Turkey Point Nuclear Power Plant Units 6 & 7 site (PTN site).

A summary of the in-field core collection, evaluation, and sampling activities completed at the PTN site is provided in this Data Report, along with a description of the laboratory testing program used to define the physical and chemical characteristics of the recovered samples. Field and laboratory data from these surficial deposit samples provide information related to the recent geologic history at the site, and supplement previous geotechnical and geophysical investigations at the site.

2.0 METHODS

Core collection, core handling and storage, core description/evaluation, sampling, and laboratory testing methods are detailed below in ***Sections 2.1 through 2.7***. Core collection and testing followed the directions provided in the overall Field Investigation Work Plan (RIZZO, 2013a) and the Work Plan for the Collection, In-Field Evaluation, and Sampling of Surficial Muck Deposits (RIZZO, 2013b). Field and laboratory activities were completed in accordance with the Project-specific Health, Safety, and Environmental Plan (RIZZO, 2013c), the Quality Assurance Project Plan (RIZZO, 2013d), ASME NQA-1-1994, and USNRC 10 CFR 50 Appendix B.

2.1 CORE COLLECTION

In late September 2013, cores were collected from the surficial sediments in five discrete locations at the PTN site, ***Figure 2-1 and Table 2-1***. Multiple cores were recovered from three of these sampling locations, in order to capture the lateral variability of the deposits found within each location, and were designated as “a,” “b,” and “c” cores.

Surficial sediment samples were collected from the PTN site sampling locations in continuous 20-inch runs using a new (uncontaminated) 2.1-inch outside diameter sampling apparatus, commonly known as a “Russian peat borer” or “Macaulay sampler.” This sampler was originally developed by researchers at the Macaulay Institute for Soil Research in Craigiebuckler, Aberdeen, Scotland (Jowsey, 1966) and was based on a Russian design, first described by Belekopytov and Beresnevich (1955).

At the PTN site, RIZZO specifically deployed a sampler built by Aquatic Research Instruments (EPA, 1999a; 1999b). The sampler is a semi-cylindrical core barrel with a fin/faceplate assembly that is driven vertically into a soil, sediment, or peat mass in a closed position, using extension rods. In the closed position, the blunt edge of the core barrel is locked against the aforementioned faceplate assembly (***Figure 2-2***). At a required sampling depth, the rods are rotated clockwise 180 degrees (using a T-handle attached to the uppermost extension rod), to longitudinally cut (***Figure 2-3***) and enclose a sample completely within a sample chamber (***Figure 2-4***). On withdrawing the core barrel from the soil, sediment, or peat mass, the sample is exposed (supported by the faceplate) by a 180 degree reverse (counter-clockwise) turn.

At the PTN site, the sampler was deployed from a small, wood-topped floating platform that was "anchored" temporarily at each coring location by wooden stakes (***Figure 2-5***). Contiguous samples were collected at successively greater depths using 4-foot aluminum extension rods. Sampling depths were confirmed by counting and measuring extension rod lengths above the water surface.

Coring runs extended from the ground surface (or the soil/water interface) to the underlying Miami Limestone (bedrock) contact at all locations. Total core depths varied, but sampling was always stopped when refusal was found at this bedrock contact. Core collection included the use of a slide-hammer assembly (to effectively tap the core barrel through stiff soils), but was otherwise "powered" manually (i.e., by hand). Constant clockwise pressure was maintained on the sampler during withdrawal to ensure that the core barrel remained in the closed position.

As noted above, duplicate samples were obtained from several locations in an additional effort to collect samples of the material underlying the refusal point (i.e., the Miami Limestone). These samples were positioned side-by-side and slightly offset in depth to ensure continuity across core run terminations, and are clearly identified in the boring logs provided in ***Appendix 1***.

Following coring operations, each core location was marked with a stake for as-built surveying and mapping. All sampling boreholes were then allowed to close "naturally" (i.e., by collapse) and did not require backfilling and/or grouting.

As-built surveys were completed by Ford, Armenteros & Fernandez, Inc. (hereinafter, Ford) in October 2013 (Ford, 2013).

2.2 RECOVERED CORE HANDLING AND STORAGE

Collected cores were exposed on a dry and stable working surface on the anchored wooden coring platform (***Figure 2-6***). Exposed core lengths were then photographed with appropriate identifier data (project number, core depth interval, top direction, dates, etc.) and scale information. Individual cores were then covered with a layer of stretch plastic wrap and a secondary layer of aluminum foil. A polyvinyl chloride (PVC), half-cylinder of appropriate size to accommodate the approximately 2-inch diameter core, was in turn placed over the plastic wrap and foil. The core barrel and faceplate (and covering PVC half-cylinder) was then inverted so that the recovered sample was wholly contained within the PVC half-cylinder, and photographed again. Remaining exposed core surfaces were then covered with plastic wrap and aluminum foil.

Wrapped and protected cores placed in PVC half-cylinders were labeled in accordance with ASTM International Standard D4220-95 (2007) titled “Standard Practices for Preserving and Transporting Soil Samples” (ASTM, 2007a) and applicable RIZZO procedures. Labeled cores were then placed in similarly labeled core trays, covered with a lid, and transported for temporary storage (and follow-up descriptions and/or sub-sampling) in RIZZO’s climate-controlled work trailer.

2.3 CORE DESCRIPTIONS

Recovered sediment cores were logged in accordance with applicable RIZZO procedures. Description of the logged cores was also completed in line with ASTM D5434-12, “Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock” (ASTM, 2012), and ASTM D2488-09a, “Standard Practice for Description and Identification of Soils” (ASTM, 2009a). Additional core descriptions were completed in general accordance with ASTM D5715-95, titled “Standard Test Method for Estimating the Degree of Humification of Peat and Other Organic Soils (Visual/Manual Method)” (ASTM, 1995).

Surficial sediment core logs were completed using a handheld personal digital assistant (PDA) device (a Meazura™ MEZ1000™ model PDA manufactured by Aceeca Ltd.) pre-loaded with a geotechnical core-logging template developed by Dataforensics, LLC. Log data from the device were downloaded to a gINT® (Bentley Systems, Inc.) software platform for management and reporting purposes.

2.4 CORE SAMPLING

Following core logging, samples for additional laboratory testing were collected from discrete horizons (i.e., zones with distinct differences in sediment characteristics) within each recovered core. In total, 14 samples were collected for soil index property and organic matter tests, as detailed in ***Table 2-2***.

Samples for soil index property and loss-on-ignition testing were transported to Geotechnics, Inc. (hereinafter, Geotechnics) laboratory facilities in Pittsburgh, Pennsylvania. Sample transport was completed in accordance with ASTM D4220-95 (2007) (ASTM, 2007a) and applicable RIZZO procedures.

2.5 LABORATORY TESTING

Soil index properties (particle size, density/unit weight, specific gravity, and Atterberg limits) and organic matter, ash, and moisture content in select core samples were determined by laboratory testing at Geotechnics' facilities in Pittsburgh, Pennsylvania, as noted above. Analyses were completed in accordance with the ASTM standards identified in ***Table 2-2***. Results from the laboratory testing were used to further refine core descriptions, per ASTM D4427-13, "Standard Classification of Peat Samples by Laboratory Testing" (ASTM, 2013).

3.0 RESULTS AND DISCUSSION

Results from the surficial deposits field investigation and laboratory testing program at the PTN site are described below, in ***Sections 3.1 through 3.4***. Detailed surficial deposit descriptions (i.e., core logs) and individual core section photographs for each core location at the PTN site are provided in ***Appendix 1 and Appendix 2***, respectively.

3.1 CORE DESCRIPTIONS AND INTERPRETATION

Based on the core data provided in ***Table 3-1***, the thickness of the surficial soil and sediment layers overlying the Miami Limestone at the PTN site is typically between 2.70 and 3.65 ft, except within the small, vegetated surface depressions present at various locations at the site (e.g., at the M-7-2a, M-7-2b, and M-7-3b core locations, as shown on ***Figure 2-1***). Surficial sediment thicknesses within the vegetated depressions, in contrast, range between 4.95 and 6.68 ft.

Surficial deposits in the relatively flat areas outside the vegetated depressions at the PTN site were variably characterized as either elastic silt, organic-rich elastic silt, or peat sediments (***Appendix 1***, core logs M-6-1a, M-6-1b, M-6-2a, M-7-1a, M-7-2c, and M-7-3a). The surficial layers within the vegetated surface depressions at the PTN site were characterized as peat (***Appendix 1***, core logs M-7-2a, M-7-2b, and M-7-3b).

Sediment coring at all locations terminated on a relatively hard, coarse-grained, calcareous rock mass interpreted to be the Pleistocene-aged Miami Limestone, although rock material was not necessarily recovered at each core site. Miami Limestone was typically reached at elevations between -4.15 and -4.80 ft North American Vertical Datum 1988 (NAVD 88), except within the small, vegetated surface depressions (e.g., at the M-7-2a, M-7-2b, and M-7-3b core locations) (***Table 3-1***). Top of rock elevations within the vegetated depressions, in contrast, ranged between -6.17 and -7.75 ft NAVD 88. As recovered, the rock mass was generally described as an oolitic, moderately soft, intensely to moderately weathered grainstone, and typically ranging in color from greenish gray (5GY 6/1) to olive gray (5Y 4/1) (***Appendix 1*** core logs).

Composite descriptions for the surface deposits at the PTN site, based on logged cores and available laboratory analysis, are generally as follows:

- **ELASTIC SILT**: soft; 95 percent fines; low to medium plasticity; low toughness; low dry strength; typically greenish gray (5G 6/1) color; strong reaction to hydrochloric acid (HCl); wet; partially mottled; less than 5 percent of organic matter as determined by loss on ignition test as per ASTM D2974-07a (ASTM, 2007b). Where present, the elastic silts represent the uppermost surficial sediments.
- **ORGANIC-RICH ELASTIC SILT**: soft; 90 to 95 percent fines; low plasticity; low toughness; low dry strength; pale brown (5YR 5/2) to light olive gray (5Y 6/1) to brownish gray (5YR 4/1) to brownish black (5YR 2/1) to greenish gray (5G 6/1) to light brownish gray (5YR 6/1) to grayish brown (5YR 3/2) in color; strong reaction to HCl; wet; partially mottled or mottled, partially laminated or laminated; often contains isolated fragments of discoidal gastropods up 0.5 inches in diameter (*Planorbella* spp.); contains isolated root fragments up to 0.5 inches in diameter; between 5 and 30 percent of organic matter as determined by loss on ignition test as per ASTM D2974-07a (ASTM, 2007b). Found widespread on site, but not within vegetated depressions.
- **PEAT**: soft; sapric to hemic; moderately absorbent; moderately to strongly decomposed; non plastic; brownish black (5YR 2/1) to greenish gray (5GY 6/1) to dark greenish gray (5G 4/1) to brownish gray (5YR 4/1) to grayish black (N2) in color; occasionally laminated; generally no reaction to HCl, although laminae may react strongly to HCl; wet; frequently contains roots up to 0.5 inches in diameter; often contains small fragments of discoidal gastropods (*Planorbella* spp.); more than 30 percent of organic matter as determined by loss on ignition test as per ASTM D2974-07a (ASTM, 2007b). Found primarily within the vegetated depressions at the PTN site, in main water drainages, and as basal deposits (directly above the Miami Limestone).

In addition to the composite classifications provided above for the surficial deposits at the site, a single clayey silt layer was also identified, in boring M-7-3a. This clayey silt was described as soft, with medium plasticity, low dry strength, low toughness, and containing 85 percent fines. Color varied from yellowish gray (5Y 8/1) to light olive gray (5Y 6/1).

It is assumed that the laminations in the organic-rich elastic silt and peat deposits at the site (described above) likely resulted from cyclical changes in oxidation-reduction conditions and/or chemical equilibria, wherein dark colored, organic-rich sediments were likely deposited under flooded, low-oxygen (reducing) conditions, and light colored, carbonate-rich (HCl reactive) laminae were likely deposited under open marsh, shallow water (and thereby less anaerobic) conditions (for example, Flügel, 2009). In coastal Florida wetlands, marl deposition is typically associated with freshwater conditions. Within the PTN cores, evidence for historic freshwater conditions is provided by the presence of intact specimens of *Planorbella* spp., a freshwater gastropod (Easton et al., 2012).

It is important to note that the surficial deposits described at the PTN site generally correspond to the surficial sediment sequences described within other coastal wetland systems adjacent to Biscayne Bay (Willard and Bernhardt 2011; Robles et al. 2005; Schroeder et al., 1958). Moreover, the thickness of the surficial sediments at the PTN site is similar to those reported for other coastal wetland locations in southern Florida and the greater circum-Caribbean, including the Bahamas and Bermuda. For example, Schroeder et al. (1958) reported "recent" organic soil and marl accumulations up to 5 ft thick from a test well at a location approximately 5 miles northwest of the PTN site. Bernhardt et al., (2013) similarly reported surficial sediment thickness up to 3.65 ft in multiple sediment cores from various areas in the southwestern portion of Everglades National Park. In Florida Bay, at Crane Key and Pigeon Key, and in the Bahamas, at Lee Stocking Island, Strasser and Samankassou (2003) described surficial sediments similar to those found at PTN with thicknesses near 3.1 and 4.2 ft, respectively. Tackaberry et al., (2004) reported up to 6 ft of sediment accumulation above basal peat deposits in cores from Spittal Pond, in Bermuda.

It should also be noted that the basal peat deposits from the aforementioned locations generally date to between 4,400 and 1,100 years before present, based on radiocarbon age determinations. At Crane Key, reported radiocarbon dates ranged between 1,070 and 1,040 years before present (Strasser and Samankassou, 2003). Basal peat deposits at Pigeon Key were determined to be slightly older (2,320 years before present) (Strasser and Samankassou, 2003). Also in Florida, within the Everglades National Park, Bernhardt et al., (2013) reported basal sediment ages equal to 3,510 years before present. At the locations in the Bahamas and Bermuda described above, basal peat ages were reported as 3,440 years before present (Strasser and Samankassou, 2003) and as ranging from 4,390 to 3,040 years before present (Tackaberry et al., 2004).

Assuming that peat accumulation in the PTN core locations is generally consistent with other locations in Florida and the circum-Caribbean (as described above) and with Holocene sea level rise (Toscano and Macintyre, 2003), it is likely that the surficial sediments at the site were deposited during a period extending back no more than about 4,400 years.

3.2 SURFICIAL SEDIMENT PROPERTIES

Results from laboratory testing (Geotechnics, 2013) indicate that the surficial sediment layers within the vegetated depressions at the PTN site are characterized by high organic matter content (at least 37 percent by weight and typically closer to 55 percent) (***Table 3-2*** and ***Appendix 3***). Contrastingly, soft sediment samples recovered from cores located outside of the surface depressions generally contain less than 12 percent organic matter by weight. Predictably, these loss-on-ignition results are consistent with classification of the deposits within the depressions as peat, and the surrounding deposits as organic-rich elastic silts.

Unit wet weight laboratory determinations from borings recovered in the vegetated depressions (namely, boring M-7-2b) indicate that the peat deposits at the site, generally exhibit a relatively low density (approximately 65.24 pounds per cubic foot [pcf]), whereas organic-rich elastic silt deposits in other areas appear to maintain higher unit wet weights (81.20 pcf, in boring M-7-2c). It should be noted that these peat and organic-rich elastic silts values are much lower than the values previously reported by MACTEC (2008) for samples from test pits in similar deposits at the PTN site (124.7 and 116.0 pcf for test pits TP-601 and TP-701, as shown on ***Figure 2-1***).

Specific gravity values determined from surficial deposit boring samples from the site ranged between 1.73 and 2.58, although values in samples from borings located in the vegetated depressions (i.e., peat borings) were generally lower (***Table 3-2***). Atterberg limit values from elastic silt samples averaged 87 and 62 percent for liquid and plastic limits, respectively. Plasticity index values in the elastic silt samples ranged between 18 and 28, suggesting that the samples were medium plastic. Atterberg limits were not determined in non-plastic peat samples.

Grain size distribution data from the boring samples recovered at the PTN site are discussed in detail below.

3.3 EVIDENCE FOR HIGH-ENERGY DEPOSITIONAL UNITS

Sedimentological evidence, in terms of sediment deposition and erosion, for hurricane landfalls, catastrophic storm surges, and/or tsunamis (i.e., high-energy depositional events) is not uncommon in circum-Caribbean coastal regions. Several examples of such evidence are described below.

Hart (2003) studied Florida coastal ponds and evaluated their sedimentary records as paleocyclone indicators, in an environment that "is near the shoreline, that experiences little disturbance from waves and tides, and that has the potential for rapid sedimentation rates." Such a physical setting is similar to the conditions at the PTN site. Hart (2003) analyzed cores for evidence of major hurricanes, as well as minor hurricanes that have affected St. Vincent Island (off the panhandle). Specifically, Hart (2003) identified three significant events based on abrupt changes in the composition of the sediments and overwash deposits from storm surge flooding in the area, and suggested that these were indicative of erosional and depositional events associated with the effects of a tropical cyclone. Erickson (2007), in a study of salt marsh deposits on the same island, used peaks in percent sand, in addition to peaks in gamma bulk density and sediment core x-radiographs, to identify similar tropical cyclone derived deposits in organic-rich sandy muds.

Donnelly (2005) cited 0.4-inch to 8-inch thick sand layers in sediment cores from a salt pond on Isla de Culebrita, Puerto Rico as evidence for substantial marine flooding events, and suggested that the layers were likely over-wash sands associated with intense hurricanes (although tsunami-induced deposition was not ruled out). Donnelly (2005) noted that the sand layers were characterized by extremely abrupt upper and lower contacts, and that the layers contained clay intraclasts (i.e., rip-up clasts).

Lane et al., (2013) similarly cited two relatively thick sand lenses in sediment cores from a large saltwater lagoon in northeastern Puerto Rico (Laguna Grande) as evidence for repeated tropical storm or tsunami landfalls.

Other studies in the circum-Caribbean have interpreted unusual sand layers in coastal wetlands and ponds as tsunami-induced. For example, Reinhardt et al., (2011) favored a tsunamigenic origin for a thick (up to 20 inches) shell and sand sheet in marine ponds on Anegada, in the British Virgin Islands, citing coeval inland cobble and boulder fields and dune breaches (identified during corresponding geomorphological field investigations) as further evidence for tsunami-induced deposition (Atwater et al., 2012). In describing the shell/sand sheet, Reinhardt et al., (2011) also noted carbonate intraclasts, and an overlying "mud cap," the latter likely tied to a seaward backwash commonly associated with tsunamis (Morton et al., 2007).

In a sediment core study within a coastal embayment on Bonaire, in the Netherlands Antilles, Engel et al., (2013) identified a sharp, lower erosional contact (based on radiocarbon dating) and normally graded bedding within an 8-inch thick sand unit as evidence for a high-energy wave event, most likely a tsunami. Similar to the aforementioned studies on Anegada, Engel et al. (2013) completed geomorphological field investigations on Bonaire that also identified extensive boulder fields and sub-aerially exposed sand sheets that strongly suggested tsunami processes, rather than storm/hurricane activity.

A hurricane landfall record, developed by McCloskey and Liu (2012) from coastal marsh sediment cores located along Nicaragua's southern Caribbean coast, provides additional data on marine flooding events in the circum-Caribbean, with a "calibration" based on sedimentary signatures from a recent hurricane landfall (1988's Hurricane Joan). Within the cores, Hurricane Joan is recorded as a relatively coarse-grained, light-colored layer with two upward fining (i.e., normally graded) sequences that were interpreted as the storm's traction and suspension loads (storm surge wash over and flooding, respectively). Based on this calibration data, McCloskey and Liu (2012) argued that the cores preserve multiple clastic layers with upward fining sequences (up to 4-inches thick) generated by storms, and not by tsunamis. Evidence derived from the 2011 Tohoku-oki tsunami from Sendai Plain, Japan (Goto et al., 2011), indicated that sand deposits associated with the event extended only 62 percent of the inundation distance, with a mud layer continuing to the inundation limit of the tsunami, up to 4.5km inland.

Analysis of the samples collected (***Appendix 1***) did not show evidence of discrete sedimentary structures (anomalous sand sheets or layers) at the PTN site that could be interpreted as evidence for a high-energy depositional event (***Figure 3-1***). Hydrometer analyses on samples from borings M-6-1a, M-6-2a, M-7-1a, M-7-2c, and M-7-3b suggest that, on average, silt and clay sized particles (fines) constitute approximately 85 percent (by weight) of the soft, surficial sediment deposits at the site (***Table 3-2***). Significant sand content was identified by laboratory testing in only one sample, from location M-7-1a, extracted from near-basal sediments equated with the Miami Limestone.

Surface sediment particle size determinations by hydrometer analysis are also largely consistent with sieve analysis results. Generally, the surficial deposits (i.e., elastic silts) at the site were classified as fine-grained soils (MH group soils, using the Unified Soil Classification System) (***Table 3-2***). Only samples from peat borings (M-7-2a, M-7-2b, and M-7-3b) and boring depths equated with the Miami Limestone (the sample from location M-7-1a) received coarse-grained (SM group) soil classifications, per ASTM guidance.

4.0 SUMMARY AND CONCLUSIONS

Sediment coring at the PTN site indicates that the Miami Limestone is, on average, encountered at the PTN site at -5.32 ft NAVD 88. Site borings also indicate that top of rock elevation in the sampled locations does not exceed -7.75 ft NAVD 88.

The sediment layers within the vegetated surface depressions at the PTN site should be characterized as peat, and that the surficial deposits at the site generally correspond to the sediment sequences observed in other coastal Florida wetlands, and coastal wetlands in the wider circum-Caribbean region.

The sediment record described in samples from the site provided no direct evidence for material and sedimentary structures that could be interpreted as evidence for high-energy depositional events (e.g., hurricane or tsunami landfalls). That is, no storm bed, tsunamigenic deposits (upward fining clastic sequences), peaks in sand content (sand sheets), nor erosive surfaces, were identified in any borings at the site.

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TABLES

TABLE 2-1
SURFICIAL SEDIMENTS SAMPLING LOCATIONS AND ELEVATIONS

BORING [1]	SAMPLING DATE [2]	NORTHING [3] (ft)	EASTING [4] (ft)	WATER DEPTH [5] (ft)	WATER HEIGHT ABOVE REFERENCE [6] (ft)	WATER SURFACE ELEVATION [7] (ft NAVD 88)	GROUND SURFACE ELEVATION [8] (ft NAVD 88)
M-6-1a	9/19/2013	397160.96	877019.73	0.70	0.50	-0.62	-1.32
M-6-1b	9/19/2013	397117.71	877034.98	0.65	0.50	-0.62	-1.27
M-6-2a	9/20/2013	396691.76	876549.80	0.50	0.32	-0.80	-1.30
M-7-1a	9/20/2013	397495.08	875787.83	0.35	0.32	-0.80	-1.15
M-7-2a	9/19/2013	396951.72	875656.19	0.45	0.50	-0.62	-1.07
M-7-2b	9/18/2013	396928.33	875636.38	0.50	0.20	-0.92	-1.42
M-7-2c	9/20/2013	396897.85	875630.22	0.35	0.32	-0.80	-1.15
M-7-3a	9/20/2013	396852.38	875967.82	0.95	0.32	-0.80	-1.75
M-7-3b	9/19/2013	396903.26	876137.69	0.60	0.50	-0.62	-1.22

Notes:

ft = feet

ft NAVD 88 = feet North American Vertical Datum 1988

(1) See ***Figure 2-1*** for additional location information.

(2) Boring collection date. Note that the table is ordered by boring identification number, not sequentially by boring collection date.

(3) Site northing.

(4) Site easting.

(5) Water depth measured at the boring location on the boring collection (sampling) date.

(6) Water height above reference marker ML-1 on the sampling date. Note that the ML-1 reference was fixed temporarily at a central location. Prior to removal, the reference point was surveyed and determined to be positioned at -1.12 ft North American Vertical Datum 1988 (NAVD 88).

(7) Water surface elevation (ft NAVD 88) at the boring location on the boring collection date, calculated as the sum of the water height above the ML-1 reference marker and the ML-1 surveyed elevation (-1.12 ft NAVD 88) (Ford, 2013).

(8) Ground surface elevation (ft NAVD 88) at the boring location calculated as the water surface elevation at the boring location less the measured water depth.

TABLE 2-2
LABORATORY TESTS AND MEASUREMENT COUNTS

BORING [1]	TOP DEPTH [2] (ft)	BOTTOM DEPTH [3] (ft)	SIEVE ANALYSIS [4] ASTM D422-63 (2007)	HYDROMETER ANALYSIS [5] ASTM D422-63 (2007)	ATTERBERG LIMITS [6] ASTM D 4318-10	WET UNIT WEIGHT [7] ASTM D 7263-09	SPECIFIC GRAVITY [8] ASTM D 854-10	LOSS-ON-IGNITION [9] ASTM D2974-07A
M-6-1a	2.600	3.350	1	1	1		1	1
M-6-1b	2.250	2.900	1	1	1		1	1
M-6-2a	0.700	1.200	1	1	1		1	1
M-6-2a	2.150	2.800	1	1	1		1	1
M-7-1a	1.000	1.550	1	1	1		1	1
M-7-1a	4.100	4.625	1	1	1		1	1
M-7-2b	0.000	1.775	1	1	1	1	1	1
M-7-2c	0.000	1.775	1	1	1	1	1	1
M-7-2a	6.000	6.600	1	1	1		1	1
M-7-2b	1.625	2.300	1	1	1		1	1
M-7-2b	3.350	4.100	1	1	1		1	1
M-7-2c	2.100	2.800	1	1	1		1	1
M-7-3a	1.000	1.550	1	1	1		1	1
M-7-3b	4.000	4.800	1	1	1		1	1

Notes:

ft = feet

(1) See ***Figure 2-1 and Table 2-1*** for additional boring location information.

(2) Sample interval top depth (ft) relative to the water surface at the boring location, from the boring logs provided in ***Appendix 1***.

(3) Sample interval bottom depth (again, in ft) relative to the water surface at the boring location, from the boring logs provided in ***Appendix 1***.

(4) Here, ASTM D422-63 (2007) (ASTM, 2007c) covers the quantitative determination of the distribution of particle sizes by sieving.

(5) In this case, ASTM D422-63 (2007) (ASTM, 2007c) addresses the quantitative determination of particle sizes by a sedimentation process, using a hydrometer.

(6) ASTM D4318-10 (ASTM, 2010a) covers the determination of the liquid limit, plastic limit, and the plasticity index of soils.

(7) ASTM D7263-09 (ASTM, 2009b) addresses the determination of soil wet density.

(8) ASTM D854-10 (ASTM, 2010b) covers the determination of the specific gravity of soil solids.

(9) ASTM D2974-07a (ASTM, 2007b) covers the measurement of moisture content, ash content, and organic matter in peats and other organic soils, such as organic clays, silts, and mucks.

TABLE 3-1
MEASURED THICKNESS AND ELEVATION OF CORED SAMPLES

BORING [1]	GROUND SURFACE ELEVATION [2] (ft NAVD 88)	THICKNESS OF SURFICIAL SEDIMENTS [3] (ft bgs)	ELEVATION AT TOP OF ROCK [4] (ft NAVD 88)	TOTAL CORING DEPTH [5] (ft bgs)	CORE BOTTOM ELEVATION [6] (ft NAVD 88)
M-6-1a	-1.32	2.85	-4.17	2.85	-4.17
M-6-1b	-1.27	3.00	-4.27	3.20	-4.47
M-6-2a	-1.30	2.85	-4.15	2.85	-4.15
M-7-1a	-1.15	3.50	-4.65	4.30	-5.45
M-7-2a	-1.07	6.68	-7.75	6.85	-7.92
M-7-2b	-1.42	6.10	-7.52	6.10	-7.52
M-7-2c	-1.15	3.65	-4.80	3.70	-4.85
M-7-3a	-1.75	2.70	-4.45	2.90	-4.65
M-7-3b	-1.22	4.95	-6.17	4.95	-6.17

Notes:

ft = feet

ft NAVD 88 = ft North American Vertical Datum 1988

ft bgs = feet below ground surface

(1) See ***Figure 2-1*** for additional location information.

(2) Ground surface elevation at the boring location from ***Table 2-1***.

(3) Depth to rock is the depth to the top of the Miami Limestone at the boring location, in feet below ground surface (ft bgs). Note that depth to rock was calculated as the depth to the top of the Miami Limestone (from the corresponding boring log in ***Appendix 1***) minus the water depth at the boring location (***Table 2-1***).

(4) Elevation of the top of the Miami Limestone at the boring location, in ft NAVD 88, calculated as the ground surface elevation minus depth to top of rock.

(5) Calculated as the depth of the bottom of the boring (from the corresponding boring log in ***Appendix 1***) minus the water depth at the specific location (***Table 2-1***).

(6) Calculated as the ground surface elevation minus the core bottom depth.

TABLE 3-2
SUMMARY OF LABORATORY TEST RESULTS

BORING (1)	TOP ELEVATION (2) (ft NAVD 88)	BOTTOM ELEVATION (3) (ft NAVD 88)	SIEVE ANALYSIS (4)	HYDROMETER ANALYSIS (5)			ATTERBERG LIMITS (6)			SHELBY TUBE UNIT WEIGHT (7)		SPECIFIC GRAVITY (8)	LOSS-ON-IGNITION (9)		
				SAND (%)	SILT (%)	CLAY (%)	LL (%)	PL (%)	PI (%)	UNIT WET WEIGHT (pcf)	Moisture (%)		MOISTURE (%)	ASH (%)	OM (%)
M-6-1a	-3.220	-3.970	Elastic Silt (MH)	10.84	65.57	23.59	93	65	28	-	-	2.31	173.8	87.3	12.7
M-6-1b	-2.870	-3.520	Silty Sand (SM)	-	-	-	NP	NP	NP	-	-	1.86	361.2	69.7	30.3
M-6-2a	-1.500	-2.000	IM	5.41	65.29	29.30	IM	IM	IM	-	-	2.38	89.4	95.8	4.2
M-6-2a	-2.950	-3.600	Elastic Silt (MH)	4.00	78.52	17.48	78	55	23	-	-	2.40	128.6	91.5	8.5
M-7-1a	-1.800	-2.350	IM	3.72	75.41	20.87	IM	IM	IM	-	-	2.38	114.0	92.3	7.7
M-7-1a	-4.900	-5.425	Silty Sand (SM)	59.90	21.00	19.11	NP	NP	NP	-	-	2.58	69.7	97.1	2.9
M-7-2a	-6.620	-7.220	Silty Sand (SM)	-	-	-	NP	NP	NP	-	-	2.09	335.9	62.8	37.2
M-7-2b	-0.920	-2.695	Silty Sand (SM)	-	-	-	NP	NP	NP	65.24	591.72	1.90	13.5 (10)	44.3	55.7
M-7-2b	-2.545	-3.220	Silty Sand (SM)	-	-	-	NP	NP	NP	-	-	1.83	561.7	45.1	54.9
M-7-2b	-4.270	-5.020	Silty Sand (SM)	-	-	-	NP	NP	NP	-	-	1.81	539.2	45.8	54.2
M-7-2c	-0.800	-2.575	Elastic Silt (MH)	5.3	73.54	21.15	85	67	18	81.20	170.83	2.47	17.9 (10)	91.1	8.9
M-7-2c	-2.900	-3.600	Elastic Silt (MH)	6.53	75.28	18.18	90	62	28	-	-	2.39	145.9	89.9	10.1
M-7-3a	-1.800	-2.350	IM	14.78	51.25	33.97	IM	IM	IM	-	-	2.33	148.4	89.7	10.3
M-7-3b	-4.620	-5.420	Silty Sand (SM)	-	-	-	NP	NP	NP	-	-	1.73	692.0	41.6	58.4

Notes:

ft NAVD 88 = feet North American Vertical Datum

pcf = pounds per cubic foot

(1) See ***Figure 2-1 and Table 2-1*** for additional boring location information.

(2) Sample interval top elevation in feet North American Vertical Datum 1988 (ft NAVD 88). Note that the elevation was calculated as the ground surface elevation at the boring location minus the difference between the top of the sample interval (in ft, ***Table 2-2***) and the water depth (in ft) at the boring location (***Table 2-1***).

(3) Sample interval bottom elevation in ft NAVD 88. Note that the sample interval bottom elevation was calculated as the ground surface elevation at the boring location minus the difference between the bottom of the sample interval (in ft, ***Table 2-2***) and the water depth (in ft) at the boring location (***Table 2-1***).

(4) Unified Soil Classification System (USCS) designation, based on laboratory results from Geotechnics (2013). Note that "IM" designations indicate that insufficient material was available for the analyses.

(5) Particle size distribution data (percentages by weight) from Geotechnics (2013).

(6) Liquid limit (LL), plastic limit (PL), and plasticity index (PI) values (i.e., Atterberg limit data) from Geotechnics (2013). Note that "IM" designations indicate that insufficient material was available for the analyses, whereas "NP" denotes an unanalyzed, non-plastic sample.

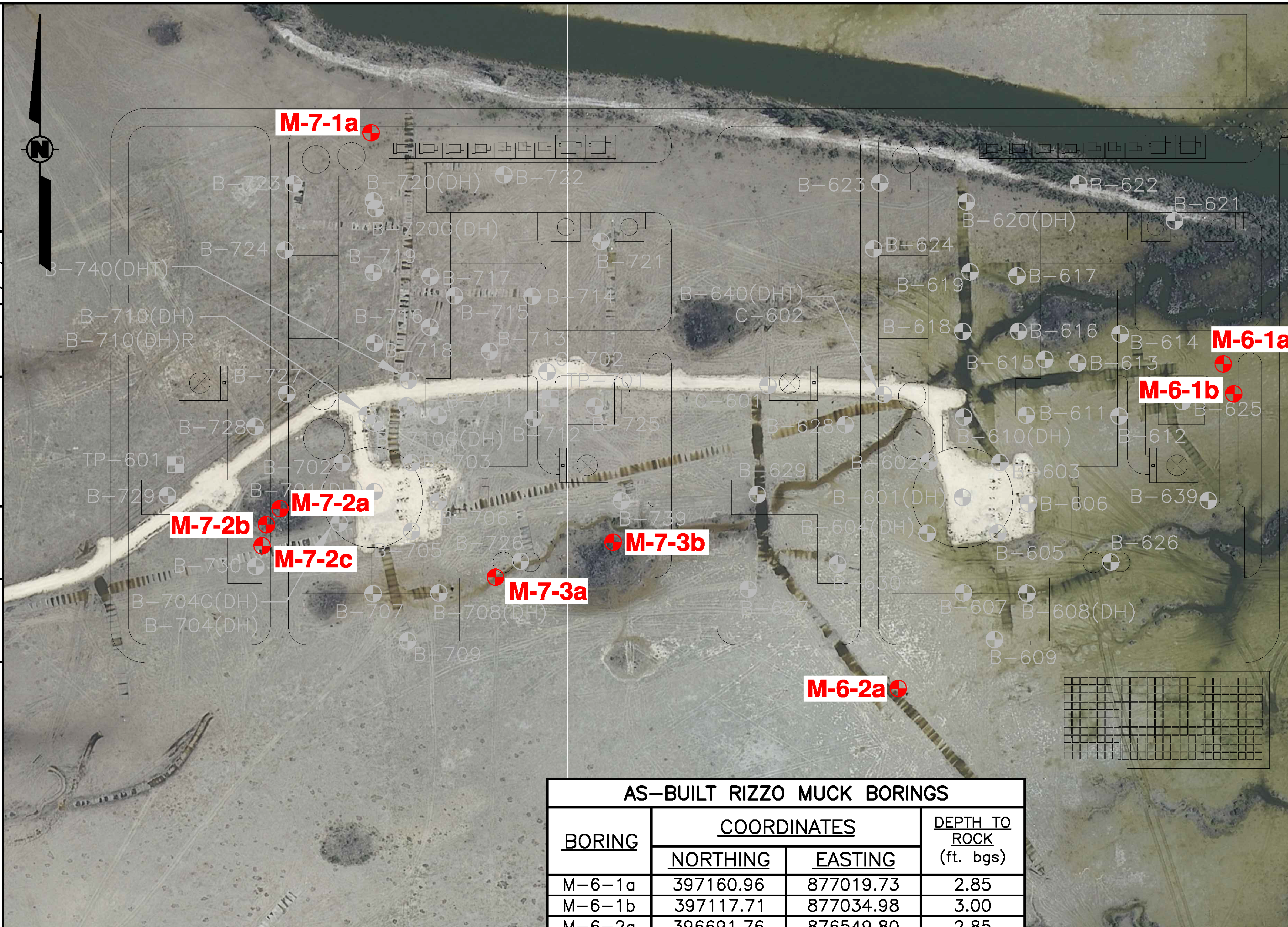
(7) Unit wet weight (wet density) values from Geotechnics (2013). Note that 62.43 pounds per cubic foot (pcf) is equal to 1 gram per cubic centimeter (g/cm^3).

(8) From Geotechnics (2013). Reported as specific gravity at 20 degrees Celsius.

(9) Moisture content, ash content, and organic matter (OM) content (percents by weight) from Geotechnics (2013).

(10) Moisture content percentage is not reliable; use moisture content percentage derived from the Shelby tube unit weight test.

FIGURES



LEGEND:

- RIZZO MUCK BORING
- AS–BUILT BORING & CPT PROBE FROM PREVIOUS INVESTIGATION
- AS–BUILT TEST PIT FROM PREVIOUS INVESTIGATION

NOTES:

1. SITE COORDINATE SYSTEM IS NAD83, FLORIDA STATE PLANE, U.S. FOOT, EAST ZONE.
2. DEPTH TO ROCK IS THE DEPTH TO THE INFERRED TOP OF THE MIAMI LIMESTONE IN FEET BELOW GROUND SURFACE (ft. bgs).

AS–BUILT RIZZO MUCK BORINGS

BORING	COORDINATES		DEPTH TO ROCK (ft. bgs)
	NORTHING	EASTING	
M–6–1a	397160.96	877019.73	2.85
M–6–1b	397117.71	877034.98	3.00
M–6–2a	396691.76	876549.80	2.85
M–7–1a	397495.08	875787.83	3.50
M–7–2a	396951.72	875656.19	6.68
M–7–2b	396928.33	875636.38	6.10
M–7–2c	396897.85	875630.22	3.65
M–7–3a	396852.38	875967.82	2.70
M–7–3b	396903.26	876137.69	4.95

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1. Turkey Point Units 6 & 7, COL Application, Part 2–FSAR, Table 2.5.4–212 As–Built Boring and CPT Probe Information.
2. Google Earth, 2013.
3. Ford, Armenteros & Fernandez, Inc. drawing titled, "Sketch of Survey and Surveyor's Notes," Sheet 1 of 1, Rev. No. 2, Project No. 13–073–5602.

SCALE
150 0 150 FEET

FIGURE 2–1

AS–BUILT MUCK LAYER BORING LOCATIONS

TURKEY POINT UNITS 6 & 7 SITE

PREPARED FOR

FLORIDA POWER & LIGHT
MIAMI–DADE COUNTY, FLORIDA

PCR Paul C. Rizzo Associates, Inc.
ENGINEERS / CONSULTANTS / CM

CAD FILE NUMBER	13–5054–B6
DRAWN BY	J.S.S. 122313
CHECKED BY	JML 2/20/14
APPROVED BY	EOT 2/20/14

Figure 2-2

Core Barrel in Locked Starting Position

Prepared for
Florida Power & Light

Miami-Dade County, Florida

DRAWN BY	CHECKED BY	APPROVED BY	GIS FILE NUMBER
KMR	JML	EOT	13-5054-GIS-A005
19 FEB 14	12 MAR 14	12 MAR 14	

PCR Paul C. Rizzo Associates, Inc.
ENGINEERS / CONSULTANTS / CM

Figure 2-3

Core Barrel During Cutting Process

Prepared for Florida Power & Light

Miami-Dade County, Florida

Paul C. Rizzo Associates, Inc.
ENGINEERS/CONSULTANTS/CM

DRAWN BY	KMR	19 FEB 14
CHECKED BY	JML	12 MAR 14
APPROVED BY	EOT	12 MAR 14
GIS FILE NUMBER	13-5054-GIS-A006	