CITY OF LAKELAND

LAKE BONNET POLLUTANT SOURCE REDUCTION FEASIBILITY STUDY
CITY OF LAKELAND—POLK COUNTY, FL

Wood Project #600537.5
Date: December 2018

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FEASIBILITY STUDY
CITY OF LAKELAND – POLK COUNTY, FL

Prepared for

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Wood Project No. 600537.5

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<u>**EXECUTIVE SUMMARY**</u>

Introduction

Lake Bonnet encompasses a surface area of approximately 79 acres and is located northwest of downtown Lakeland, in central Polk County, Florida. Previous studies suggest that water quality at Lake Bonnet is impacted by internal loading, stormwater runoff, and groundwater seepage inputs. Currently, the lake is not meeting the Florida Department of Environmental Protection's (FDEP) numeric nutrient criteria (NNC) for biology (i.e., aquatic vegetation) and nutrients, including total phosphorous, total nitrogen, and chlorophyll-a.

This report was commenced to evaluate the potential sources of nutrient load to Lake Bonnet and evaluate the feasibility of surface water quality improvement through source reduction.

Assessment

Wood conducted a multifaceted data analysis assessing factors and relationships that may affect the Lake Bonnet water quality and ecological conditions. The assessment included:

- Preliminary evaluation of the ecological conditions within and surrounding the Lake Bonnet shoreline
- Geotechnical investigation and bathymetric survey of Lake Bonnet to determine the extent and thickness of the fine-grained organic sediments
- Characterization of the physical and chemical properties of the muck and underlying native sediment layer in the Lake
- Sediment internal loading evaluation
- Stormwater pollutant loading modeling of the drainage basins within the Lake Bonnet watershed
- Estimated the groundwater quantity to the lake
- Estimated the groundwater quality to the lake

A summary of the results found during the assessment is listed below.

<u>Ecological Evaluation</u> - A forested wetland system dominates the eastern edge of Lake Bonnet. There is indication that much of the forested wetland is "floating" above a muck layer. A stream, enters the forested wetland from the northeast and is fed by a large drainage flume which conveys stormwater runoff from upgradient areas. At the time of the field investigation the stream had a low flow fed only by the seep and there was a large amount of trash throughout. Very little wildlife was observed during the site visits apart from a few songbirds and wading birds, although it is in the consultation area for several listed species.

<u>Geotechnical Investigation and Bathymetric Survey</u> - The geotechnical investigation indicated three primary sediment layers within Lake Bonnet including muck, sand and silty sand, and sandy clays. Unconsolidated muck was present as the top sediment layer throughout most of the lake and ranged in thickness between 0.3 ft and 15.3 ft. A sandy silt layer was present below

the muck layer in thicknesses between 0.1 and 5.3 ft. Sandy clays were generally present below the sandy silt layers at thicknesses between 0.3 and 5.3 ft.

Sediment Chemical Analysis - The sediment characterization indicated three of the eleven sample locations contained arsenic (As) concentrations above the 2.1 mg/kg Soil Clean-up Target Level (SCTL) for residential direct exposure limits. Chromium (Cr) exceeded the Groundwater Clean-up Target Level (GCTL) for leachability by up to 40% at four locations. No other samples were found to exceed any SCTLs or GCTLs for any other parameter.

Sediment Internal Loading Evaluation - A total of 18 intact sediment cores were collected from within the lake to document nutrient flux and internal loading from the sediments and to assess different sediment treatment alternatives. Four treatment amendments were added to the intact sediment cores to assess treatment alternative efficiencies. Overall, the "Floc&Lock" treatment appeared to provide the most consistent overall reductions for TP in all scenarios and during the early and late phases of the incubation. Phoslock® alone appeared to provide the second-best reduction of TP, with alum and sand as third and fourth in terms of reductions at different time steps. Further study of these products should be conducted under a pilot scale field study to assess potential issues with ammonia prior to large scale application.

Stormwater Loading Analysis - Wood developed stormwater pollutant loading estimates from the drainage basins within the Lake Bonnet watershed. Based on our interpretation of the drainage pipe network, the stormwater runoff that is conveyed through pipes and into the northeastern corner of the proposed Bonnet Springs Park provide a sizable portion of the storm water pollutant load coming into Lake Bonnet as follows:

- 43.5% of the total TN;
- 47.2% of the total TP;
- 38.9% of the total BOD;
- 39.8% of the total TSS; as well as
- 32.9% of the total rainfall runoff volume to the lake

Groundwater Quantity - To quantify annual groundwater contributions to the lake from groundwater inflow, Wood estimated the annual average discharge volume from Lake Bonnet. Based on the normal operating water levels specified by the City of Lakeland (142.69 ft – 144.19 ft) the estimated daily discharge (groundwater and stormwater runoff) ranges from 722,616 ft3/ day (when lake levels are 141.89 ft) to 1,030,705 ft3/ day (when lake levels are 143.39 ft). Therefore, baseflow was approximated by subtracting the stormwater associated runoff from the WMP report (Keith and Schnars 2004) from the total estimated runoff which equates to between 605,494 ft3/ day – 913,583 ft3/ day.

Groundwater Quality – Water quality samples were collected at the Bonnet Springs seep, which is assumed to be representative of the groundwater in the area. The average TN and TP concentrations (based on the sampled data) of the Bonnet Springs seep are 2.82 mg/L and 0.15 mg/L respectively, which is high compared to groundwater from undeveloped areas in Florida. The average TN and TP concentrations from the collected samples were applied to the estimated daily groundwater flow to determine TN and TP mass loading to Lake Bonnet. Based on the limited available data as discussed above, the *preliminary* estimated annual average TN load ranges from 38,907 – 58,704 lbs TN/year and from 2,060 – 3,109 lbs TP/year.

Recommendations

Wood evaluated a variety of alternatives to address both the external and internal loading sources. Projects aimed at external load reduction primarily involve structural and non-structural stormwater BMPs. Internal loading reduction can be achieved by dredging and/or capping of organic sediments within the lake. Results from the internal loading analyses, which assessed several different nutrient inactivation alternatives were used to develop options that can be blended with dredging and other BMPs. Natural systems restoration, which could include aquatic vegetation enhancement and/or rehydration of the wetland fringe are also important options that should be considered.

Based on the various sources contributing nutrient loads to the lake, it was estimated that the total annual load to the lake was 140,546 lbs TN and 27,498 lbs TP. Assuming that the proposed dredging project (30 acres complete dredging down to hard bottom), along with sediment chemical inactivation (with partial dredge of 49 acres down to 135′ elevation), stormwater and groundwater BMPs are implemented, the total loads would be reduced by 29%, and 76% for TN and TP. Reducing the sediment internal nutrient loading source via dredging and chemical inactivation would provide the greatest load reduction since sediment is contributing approximately 62% and 93% of the total TN and TP loads.

1.0 INTRODUCTION

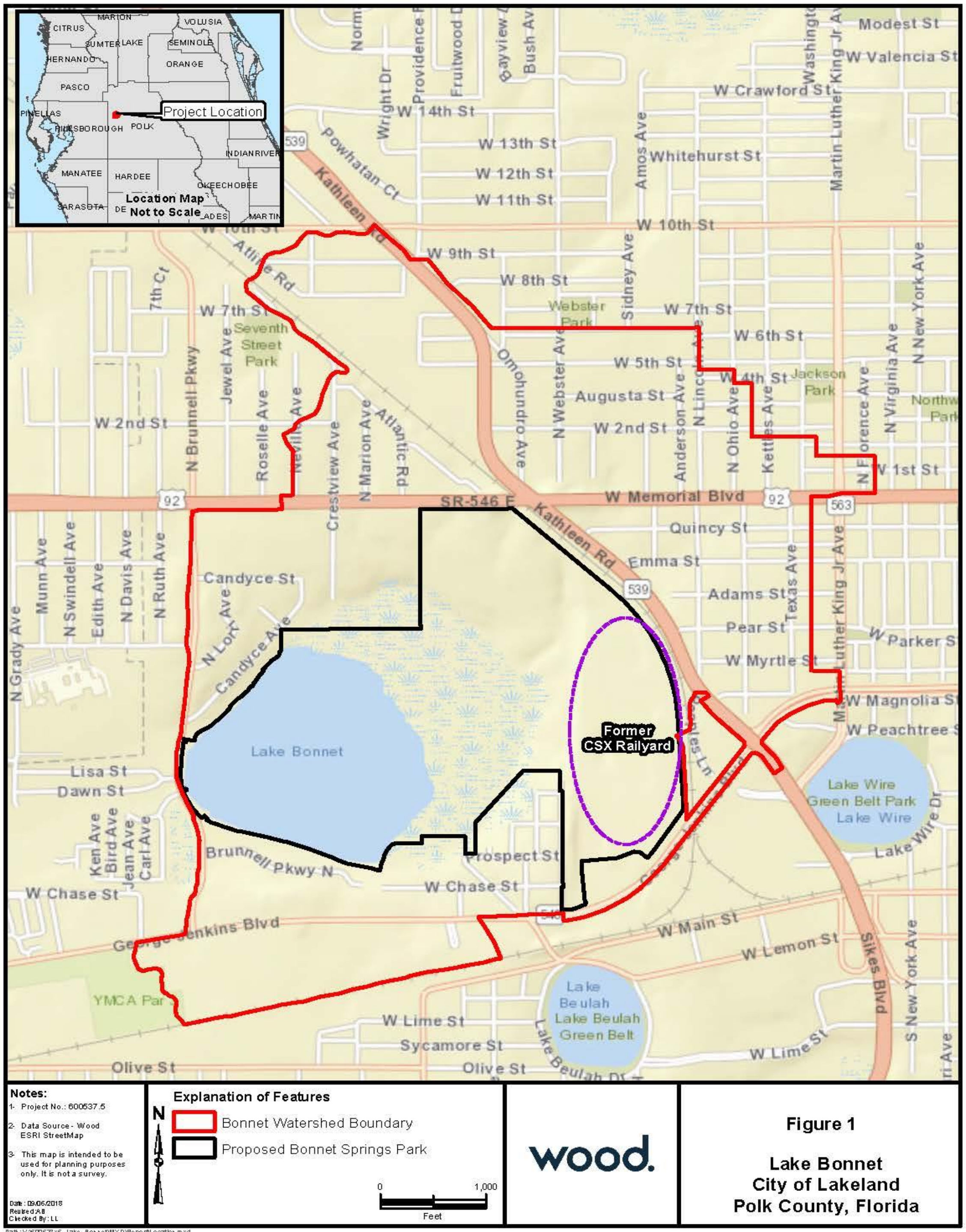
This study was undertaken to investigate the potential sources of nutrient load to Lake Bonnet (WBID 1537A) and evaluate the feasibility of surface water quality improvement through source reduction. Lake Bonnet is a hydrologically altered waterbody that has undergone advanced eutrophication because of long-term and primarily untreated development in the watershed. Lake Bonnet's water quality has degraded over the past several decades likely because of sediment and nutrient inputs from groundwater inputs and stormwater runoff. The accumulated sediments have reduced Lake Bonnet's volume and are likely a source of internal nutrient loading (also known as legacy loading). External nutrient loading from stormwater runoff continues to contribute to water quality impairments causing persistent algal blooms and inhibiting the growth of submerged aquatic vegetation. The study area for this project includes Lake Bonnet and the Lake Bonnet watershed located just northwest of downtown Lakeland, in the west-central portion of Polk County, as shown on the site location map, **Figure 1-1**.

Based on previous studies, water quality in Lake Bonnet is primarily impacted by internal loading, stormwater runoff, and groundwater seepage inputs. Currently, this Class III lake is not meeting the Florida Department of Environmental Protection's (FDEP) numeric nutrient criteria (NNC) for biology (i.e. aquatic vegetation) and nutrients, including total phosphorous (TP), total nitrogen (TN), and chlorophyll-a. Several options are available, which may improve water quality conditions and promote restoration within Lake Bonnet including reduction of stormwater inputs, removal of nutrient laden sediments, and improving the lake's hydrology.

Stormwater best management practices (BMPs) can be implemented to minimize or eliminate continuous sources of external pollution. Capping and/or targeted removal of muck sediments through excavation or dredging operations is another option that may promote lake restoration by reducing internal pollutant loading from legacy sources. Water quality benefits may also be realized by improving Lake Bonnet's hydrology through management of the normal pool water elevation, which could limit nutrient inputs from seepage sources.

Natural resource restoration options should also be considered to provide a comprehensive lake restoration plan. Natural system restoration would include reintegration of hydraulic connectivity with the wetlands on the eastern shore of the lake to the greatest extent possible. This should be incorporated into the ongoing park planning and design. Treated stormwater and/or water that would typically discharge out of the lake from the Lake Bonnet Drain could be routed back into the wetland fringe to rehydrate the wetlands and provide additional treatment prior to discharging back into the lake. The restoration plan should also include aquatic plant restoration once other more engineered concepts have taken place (i.e. dredging, capping of sediments, stormwater BMPs, wetland re-hydration, etc.). Since water quality and sediment restoration alone may not induce sufficient conditions for the desired biological communities to respond in a reasonable time frame, enhancement of aquatic vegetation communities would improve the potential for the lake to eventually meet the NNC biological criteria (Lake Vegetation Index - LVI).

Figure 1-1 – Site Location Map



Reduction of internal and external nutrient loads using the various approaches discussed above should reduce algal growth and chlorophyll-a concentrations in the lake. Reducing suspended algae generally improves light transparency through the water column, which may promote growth of beneficial aquatic vegetation and should lead to an overall improvement in Lake Bonnet's ecological health. The overall goals of future restoration efforts are to manage the lake so that it meets Class III swimmable and fishable water quality standards established by the FDEP and achieve compliance with the NNC. The City has directed Wood to evaluate stormwater, groundwater, and in-lake remediation methods including sediment removal.

Wood was tasked to provide the following work efforts related to Lake Bonnet authorized under Purchase Order #274059:

- Assessment of physical and chemical sediment characteristics
- Bathymetric survey
- Preliminary ecological assessment
- Sediment phosphorus speciation and diffusive nutrient flux analysis
- Stormwater loading analysis
- Groundwater loading analysis
- Lake restoration project alternatives
- Conceptual project designs
- Regulatory pre-application meetings

2.0 BACKGROUND

Lake Bonnet's water quality is impaired by excessive levels of nutrients according to a 2002 Lake Bonnet Diagnostic Study (Environmental Consulting & Technology et al.), the 2009 Lakes Report (City of Lakeland 2010), and the 2017 Lake System Hydraulic Management Plan (Amec Foster Wheeler). The previous studies indicated that at least three sources of pollutants impacted lake Bonnet. These potential sources included internal loading from thick deposits of existing nutrient-rich organic sediments; groundwater discharge (seepage) contributions; and untreated stormwater runoff. Historic lake water quality data indicates that Lake Bonnet has exhibited hypereutrophic conditions for fifteen of the last twenty years with elevated concentrations of TP, TN, and chlorophyll-a.

The 2002 Lake Bonnet diagnostic study estimated that roughly 970,000 cubic yards (cy) of organic sediments have accumulated in Lake Bonnet. The study noted that the lake sediments exhibit relatively high concentrations of TP when compared to other Florida lakes.

The 2009 Lakes Report documented that TP concentration within Lake Bonnet's thick layer of organic sediments indicates the potential for significant internal phosphorus loading. Specific mechanisms for the internal loading included diffusion, resuspension, and bioturbation by fish. The 2002 Lake Bonnet diagnostic study indicated that bioturbation might be the dominant source of internal loading and a source of turbidity in Lake Bonnet. The 2002 study also indicated that TP loading from diffusion and resuspension may exceed 2,100 pounds per year whereas loading from bioturbation may exceed 14,000 pounds per year.

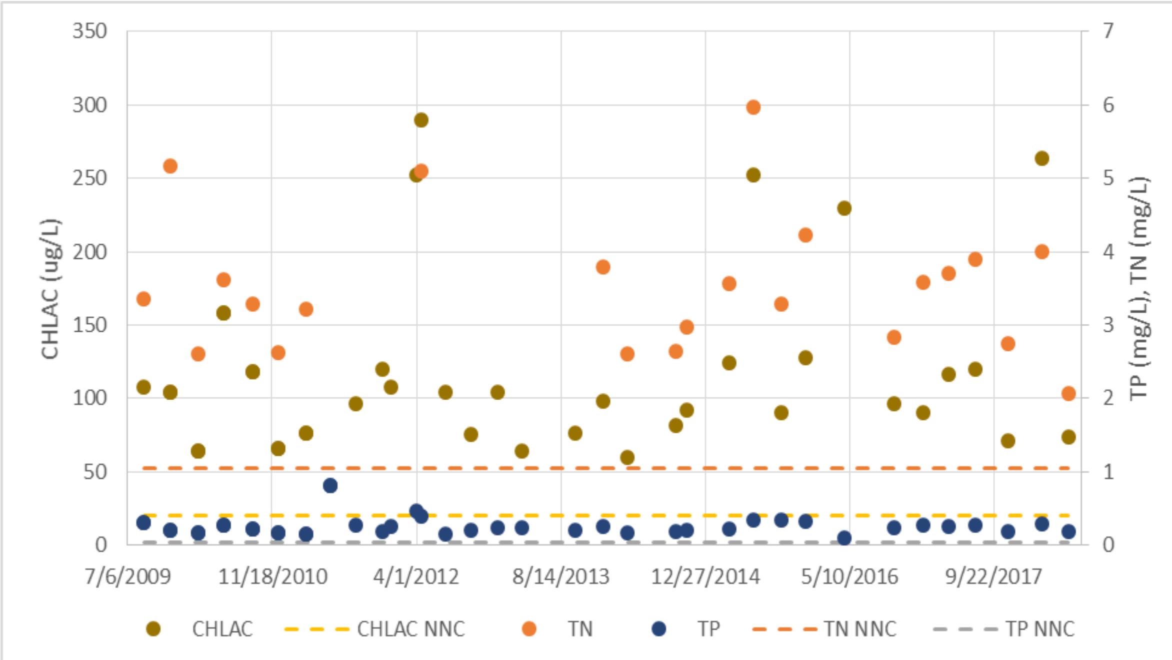
The 2009 Lakes Report indicated the sources of Lake Bonnet's nutrients were likely due to the urbanization of the watershed, much of it prior to the implementation of stormwater management and treatment regulations. Untreated stormwater runoff from agricultural, industrial, and residential inputs such as excess fertilizer use, sediment, wastewater, and detergents, which all typically contain high concentrations of phosphorus and/or nitrogen, has contributed to the degradation of water quality in the lake. Once these nutrients reach Lake Bonnet, they can stimulate algal productivity. The 2009 Lakes Report documented a maximum chlorophyll-a concentration of 133.1 μg/L, a maximum TN concentration of 9.7 mg/L, and a maximum TP concentration of 0.73 mg/L in Lake Bonnet for the period of record (POR) evaluated for that study

Wood evaluated a more recent POR (2009-2018) that was retrieved from the Polk County Water Atlas to determine the level of water quality impairment and found that nutrients and chlorophyll-a are still clearly exceeding the NNC requirements (**Figure 2-1**). For Lake Bonnet to meet the prescribed NNC, the following values need to consistently be met on an annual basis (calculated as an annual geometric mean, AGM):

- TN NNC: 1.05 mg/L
- TP NNC: 0.03 mg/L
- Chlorophyll-a NNC: 20 ug/L

Lake Bonnet's median TN, TP, and chlorophyll-a values were calculated to be 3.46 mg/L, 0.23 mg/L, and 104 ug/L, respectively using the 2009-2018 POR. Therefore, the lake will likely be verified as an impaired waterbody during the next formal impairment assessment by the FDEP. Lake Bonnet's long-term mean of the AGM using the same POR for TN, TP, and chlorophyll-a were 3.51 mg/L, 0.24 mg/L, and 115 ug/L respectively. If implemented within the next several years, the watershed and in-lake restoration activities recommended in this report may reduce the potential for impairment verification and provide alternative corrective action options other than development of a Total Maximum Daily Load (TMDL).

Figure 2-1 – TN, TP, and Chlorophyll-a (CHLAC) Water Quality Time Series in Lake Bonnet (POR 2009-2018)



The restoration concepts proposed in this study consider hydrologic factors that help improve the lake's water quality and natural systems (i.e. in-lake and surrounding wetland ecological integrity). The 2017 Lake System Hydraulic Management Plan report found that chlorophyll-a and lake levels were highly inversely correlated. This suggests that if lake levels are increased to a sufficient elevation, then water quality may be improved. This could be a function of several factors such as dilution, and/or the potential to reduce groundwater inflows via seepage from the contaminated surficial groundwater aquifer.

3.0 LAKE BONNET WATERSHED

The Lake Bonnet watershed is approximately 770 acres and has previously been characterized for the City as part of the Lake Bonnet Drain Study by Keith and Schnars (2004). Former industrial areas north and east of Lake Bonnet include a railway switchyard, refueling depot, and maintenance yard as well as a coal gasification plant. Both facilities have been decommissioned, and the FDEP has designated the properties as Brownfield sites. The general geological conditions within the Lake Bonnet watershed are detailed in **Appendix A.** Wood also performed a preliminary evaluation of the ecological conditions within and surrounding the Lake Bonnet shoreline. A summary of the ecological assessment is provided in **Appendix C**.

Lake Bonnet encompasses a surface area of approximately 79 acres and is located northwest of downtown Lakeland, in central Polk County, Florida. The southern and western banks of Lake Bonnet are lined with residential structures and roadways, while the northern and eastern banks are densely vegetated. Lake Bonnet's western boundary is formed by the North Brunnell Parkway embankment.

The water elevation in Lake Bonnet is controlled by an outfall structure, consisting of two 7.0 ft wide operable weir gates located along the western side of the lake. The outfall discharges via a double 7.3 ft by 3.0 ft box culvert beneath Brunnell Parkway to a canal that flows westward to Lake Blanton, and subsequently into Itchepackesassa Creek. According to the 2017 Lake Bonnet Drain May Manor Flood Relief Feasibility Study, discharges from Lake Bonnet out of the structure are restricted to low flows (approximately 11 cfs) to minimize the potential for flooding downstream of the outfall on the canal. During storm events, the lake may stage up and flows may increase out of the structure. Adopted water levels for Lake Bonnet by the South West Florida Water Management District (SWFWMD) are 145.59 ft for the ten-year flood elevation and a normal low elevation of 144.19 ft [all elevations referenced to the North American Vertical Datum of 1988 (NAVD 88), converted from 1929 NGVD using VERTCON when necessary].

Based on the 2009 Lakes Report (City of Lakeland 2010), water levels in Lake Bonnet have ranged from a minimum low elevation of 141.29 ft to a maximum high elevation of 145.81 ft. The operating range for Lake Bonnet water elevation is between 142.69 and 144.19 ft. Lake Bonnet's mean elevation during 2009 was 145.3 ft. As mentioned above, water quality was found to be related to lake levels by the 2017 Lake System Hydraulic Management Plan, which recommended that to improve water quality, the lake's operating range should be within the range of 143.99 to 144.19 ft. This range is slightly higher than the District's operation levels. However, higher water levels may allow further improvement in water quality.

4.0 PHYSICAL AND CHEMICAL SEDIMENT CHARACTERIZATION

Wood performed a geotechnical investigation of Lake Bonnet to determine the extent and thickness of the fine-grained organic sediments and to characterize the physical and chemical properties of the muck and underlying native sediment layers. The purpose of this geotechnical investigation was to develop data to support the delineation of the project dredging limits. Wood's geotechnical field and laboratory investigation program included:

- Completion of a sediment sampling plan based on FDEP muck removal guidance documents for fine-grained nutrient-rich organic sediments removal
- Collection of twelve (12) continuous samples using an electric vibracore system in accordance with ASTM D 4823
- Collection of piston tube samples within the muck layer at sixteen (16) locations
- Logging and classification of recovered sediment samples in general accordance with visual-manual classification method (ASTM D 2488) and the Unified Soil Classification System (USCS) (ASTM D 2487)

The findings of the physical portion of the geotechnical analysis are included in **Appendix A** and chemical results are provided in **Appendix B, Section B3**. The geotechnical investigation indicated three primary sediment layers within Lake Bonnet including muck, sand and silty sand, and sandy clays. Unconsolidated muck was present as the top sediment layer throughout most of the lake and ranged in thickness between 0.3 ft and 15.3 ft. A sandy silt layer was present below the muck layer in thicknesses between 0.1 and 5.3 ft. Sandy clays were generally present below the sandy silt layers at thicknesses between 0.3 and 5.3 ft.

Sediment samples for chemical analyses were collected using a steel piston tube sediment samples from eleven locations within Lake Bonnet and analyzed for metals, polychlorinated biphenyls (PCB), polycyclic aromatic hydrocarbons (PAHs), pesticides, and phthalates between April 6 and 9, 2018 in accordance with FDEP SOPs FS 3000 and FS 4000. Locations were selected on a transect basis to provide an appropriate level of spatial distribution coverage. The vertical distribution of the cores included samples from the top of the sediment down to hard bottom or natural substrate, which varied with each coring location. The results of the sediment analyses as compared to the FDEP Cleanup Target Levels (CTLs) per Florida Administrative Code (FAC) 62-777 and 62-780 are provided in **Appendix B, Section B2.**

Results from the chemical characterization of the sediment showed that when compared to the CTLs, only two metals (arsenic and chromium) showed potential for exceeding soil or groundwater contamination target levels (Soil: SCTL, Groundwater: GCTL). Both SCTL and GCTL need to be compared against the sediment results unless a final disposal method and location is defined prior to sampling. The SCTL provides protection for human contact and the GCTL protects against groundwater contamination.

The sediment characterization indicated three of the eleven sample locations contained arsenic (As) concentrations above the 2.1 mg/kg Soil Clean-up Target Level (SCTL) for residential direct exposure limits. Chromium (Cr) exceeded the Groundwater Clean-up Target Level (GCTL) for leachability by up to 40% at four locations as shown in **Figure 4-1** and **4-2**. No other samples were found to exceed any SCTLs or GCTLs for any other parameter. Median As and Cr concentrations for all sample locations were below the corresponding SCTL and GCTL. Median values are likely more representative of the anticipated homogeneous dredged material conditions than an individual location.

Figure 4-1 – Arsenic Concentrations within Sediment Samples Collected from Lake Bonnet

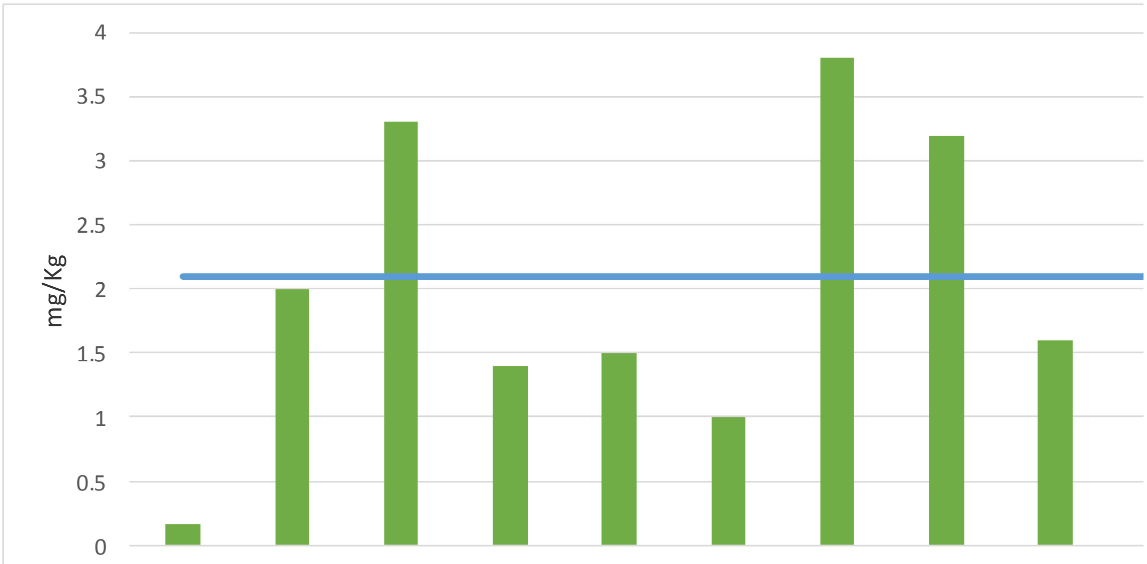
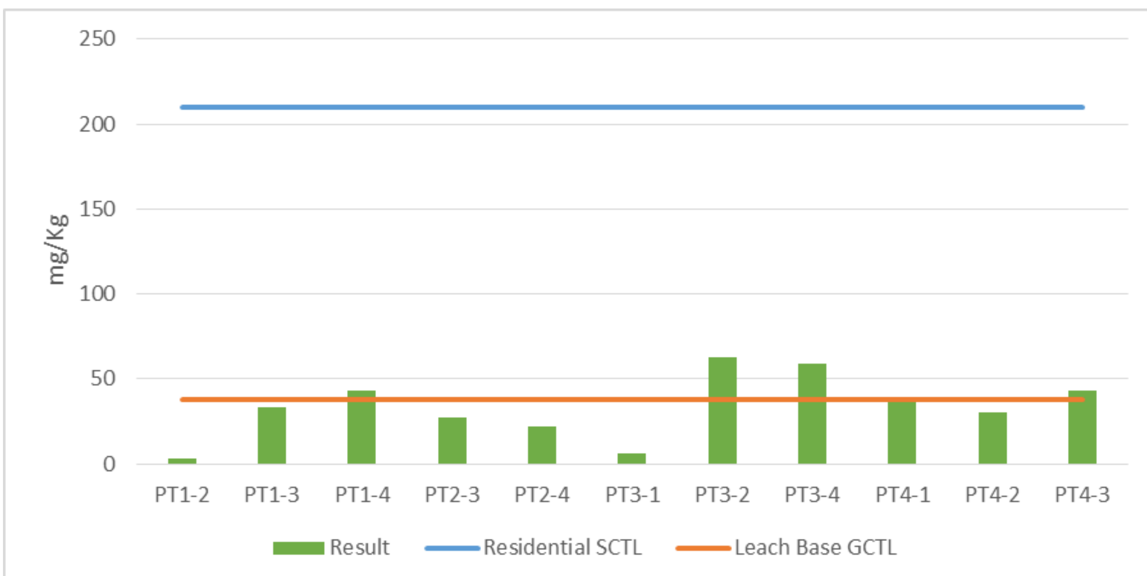


Figure 4-2 – Chromium Concentrations within Sediment Samples Collected from Lake Bonnet



Chemical analyses indicated that the minimum detection limit (MDL) for some analytes were above some of the CCTLs. Although, there is no reason to suspect elevated concentrations of these pollutants. Several of the CTLs are very low, and many labs are not able to provide analytical results below the low-level CTLs such as some PAHs and PCBs, and the minimum detection values are reported above the CTLs. Typically, the regulatory agencies accept the MDLs as non-detects and as non-exceedances for certain contaminants of concern. Several of the analytes tested were found below the MDL, which was also above the CTLs as shown in the figures in **Appendix B, Section B1**. For 37 of the 44 parameters analyzed, a qualifier code of “U” was noted by the processing laboratory for the sampling locations (**Appendix B, Section B3)**. This qualifier signifies that a compound was analyzed, but the value was below the instrument’s detection level for the specific dilution matrix needed for that particular sample. When this qualifier is used the laboratory assigns the MDL to the sample record, which varies by parameter. It should be noted that the lowest possible MDLs that would fall below the lowest CTLs were requested from the contract analytical laboratory for each contaminant of concern and are provided in **Appendix B, Section B2**. The contract laboratory attempted to attain the low-level contaminants of concern CTLs. However, due to sample consistency and texture, the laboratory was unable to attain most of the CTLs in question due to quality control standards. It is recommended that the analytes with MDLs that were above CTLs are analyzed again prior to beginning dredging. Samples should be collected from only within the profile of sediments that are assigned to be dredged. Wood also recommends performing a synthetic pollutant leachability procedure (SPLP) test to estimate leachability values for arsenic and other potentially leachable pollutants.

5.0 BATHYMETRIC SURVEY

Wood performed a bathymetric survey of Lake Bonnet between March 6 and March 17, 2018 (**Figure 5-1**). Survey points were collected using hand probe soundings approximately every 100 feet along north-south transects spaced 200 feet apart. The bathymetric soundings were located and measured utilizing Global Positioning System (GPS) technology operating in Real Time Kinematic (RTK) mode from a fixed base station. The horizontal project datum was the North American Datum of 1983/2011 Adjustment (NAD 83/11), and the vertical project datum was NAVD 88 with horizontal positions expressed in the Florida State Plane Coordinate System, Florida West Zone (902) in US Survey Feet and elevations in Feet.

Figure 5-1 - Lake Bonnet Bathymetric Map

The soundings were completed using a calibrated steel rod with a 2-inch diameter foot at each grid point to identify the approximate top of sediment, noted as the level of first resistance, and then pushed by hand to refusal. Refusal from the bathymetric soundings was not considered the absolute hard bottom (natural sandy substrate) as the hand probes can reflect refusal in denser sandy layers within the soft sediment column, particularly where soft muck sediments extend deeper than 10 ft. from the top of the sediment surface. During the bathymetric survey, the mean Lake Bonnet water elevation was 144.0 ft Lake depths are shown in **Appendix E**.

6.0 SEDIMENT INTERNAL LOADING EVALUATION

6.1 Sediment Phosphorus Fractionation

The mass of potentially bioavailable P in the upper 10 cm of sediments was quantified using the sequential phosphorus extraction procedures used by Meis et al. (2012), which are based on methods developed earlier by Hupfer et al. (1995) and Psenner et al. (1988). An overview of the operational sediment P fractions quantified using this procedure, the driving factors that cause them to release BAP to the water column, and the likelihood of BAP releases is provided in **Table 6-1**. The P fractionation sequence includes the following steps:

1. extraction with 1 M NH_4Cl to determine loosely adsorbed and porewater P ('labile P');

2. extraction with 0.11 M NaHCO3/0.11 M Na2S2O4 to determine P mainly bound to Fe-hydroxides or manganese (Mn) compounds ('reductant-soluble P');

3a. extraction in 1 M NaOH to mobilize P which is mainly exchangeable against hydroxide ions determined as SRP ('metal-oxide adsorbed P') and

3b. organic bound P in the same fraction quantified by subtracting NaOH-SRP from NaOH-TSP ('organic P');

Sediments were collected on April 9, 2018 from 3 locations within the lake shown and sequential phosphorus extractions were performed to generally characterize fractions of biologically available and recalcitrant phosphorus in the sediments. To provide a representative analysis of the bottom conditions, three intact sediment cores were collected from soft sediments within the lake. The three locations were chosen based upon the physical characterization of the sediments collected between March 6 and 17, 2018 during the piston tube survey of the lake. The locations were selected to cover the spatial distribution and to capture the gradient of sediment thickness and quality (i.e. low to high organic matter). The top 10 cm of each core was extruded in the field and returned to the laboratory (DB Environmental) where it was homogenized and analyzed for percent dry weight, as well as TP and sequential phosphorus extraction methodology was utilized to estimate the various phosphorus species within the sediments. Phosphorus availability is operationally defined (from most available to most strongly bound) by: labile, reductant-soluble, metal-oxide, organic, and apatite and residual.

Table 6-1 shows the breakdown of different fractions of P, drivers for each fraction and results from the P fractionation analysis. Analytical reports from the laboratory and results of the analyses are provided in **Appendix B, Section B4**. As expected, sediment dry weight was higher in the mineral sediments versus the organic sediments (8.46 and 2.67%, respectively). TP ranged from 3,740 to 6,540 mg/kg within the three cores collected. The fractionation analysis suggests that the readily-available portion of phosphorus was relatively low (36%) and the majority of the P was recalcitrant or readily unavailable (residual P). This suggests that under aerobic conditions, sediments may not be major source of phosphorus to the water column. The oxidation-reduction potential of the sediments is also likely to be relatively low due to their depth so release of the iron-bound phosphorus is possible. The fractionation data agrees with the sediment nutrient flux findings discussed in a later section.

Table 6-1 - Measured Concentrations and Estimated Masses (MG) of P Fractions in the Upper 10 cm of Lake Bonnet Sediments (Source: Meis et al. 2012)

P FRACTION	P FORMS IN FRACTION	DRIVER OF BAP RELEASE FROM SEDIMENTS	LIKELIHOOD OF BAP RELEASE TO WATER COLUMN	MEAN P FRACTION CONCENTRATION (MG/KG)	ESTIMATED MASS IN UPPER 10 CM OF SEDIMENTS
Labile P	Directly bioavalable P; loosely bound or adsorbed P	Desorption; diffusion; steep concentration gradients	High	41.23	69
Reductant solubale P	P bound to Fe-hydroxides and Mn-compounds	Anoxia	High	93.20	156
Organic P	Allochthomous organic material; detritus	Bacterial mineralization (temperature dependent)	Medium to High	656.33	1096
Metal-oxide adsorbed P	P adsorbed to metal oxides (mainly FE, Al); P exchangable against OH-	High pH (e.g., from high levels of photosynthetic activity in water column)	Medium to High	913.67	1526
Apatite bound P	P bound to carbonates and apatite P	Low pH	Medium	559.67	935
Residual P	Refractory compounds		Low	2453.33	4097
Total BAP	Labile P + Reductant soluble P + Metal oxide adsorbed P + Organic P	See individual driver's above	Medium to High	1704.43	2846

Note: The assumed specific gravity of solids= 1.8 (sediments not tested for this parameter); mg/kg = miligram of parameter per kilogram of sediment

6.2 Sediment Flux Methodology

A total of 18 intact sediment cores were collected from within the lake to document nutrient flux and internal loading from the sediments and to assess different sediment treatment alternatives. The intact sediment cores were incubated and data were analyzed to estimate nutrient flux rates in the Wood Flux Laboratory in accordance with SOP Wood-SFLUX-002 Rev. 9 (**Appendix B, Section B5**). Each core was collected from the top 20 cm of the substrate within the lake. Incubations were completed over a period of eight days. During the incubation the overlying water column was sampled for TP and ammonia and analyzed at a NELAC Analytical Laboratory. Incubations occurred under dark light conditions, and temperatures were controlled in a range of 23-25 degrees C.

During sediment core incubations, water quality parameters were evaluated and recorded periodically (daily) within the water column of each core to ensure that the test requirements were being met (i.e. anoxic: <2 mgO_2/L or aerobic: >2 mgO_2/L conditions in the water column). The water quality parameters that were evaluated in the columns were pH, dissolved oxygen (DO), percent saturation of DO, temperature, and turbidity. Turbidity concentrations were monitored mainly to identify when the sedimentation flux phase was complete, and equilibrium was achieved (i.e. no more evidence of sediment resuspension following incubation setup).

The time following turbidity stabilization is assumed to be the "diffusive" flux phase, which occurs at about 12 hours after incubations began. Typically, the duration of time needed for the sedimentation phase to complete was based on how fine the sediment material was in the core. Hence, the more fine the sediments, the more time needed to reach equilibration. Flux rates for this study are considered "gross flux rate", which includes both phases of diffusive and sedimentation flux. These flux rates may be a slight overestimate when used to calculate long term or annual loads. However, for the purposes of assessing treatment alternative efficiencies, it is appropriate to use a gross flux rates to gain an understanding of relative nutrient flux rate and load reductions across various treatment alternatives.

The four treatment amendments that were added to the intact sediment cores included the following:

1) 20 cm Lake Bonnet substrate + Phoslock® Full Strength Dose (3.02 g)
2) 20 cm Lake Bonnet substrate + Alum Full Strength Dose (5.15 ml)
3) 20 cm Lake Bonnet substrate + "Floc&Lock" (Phoslock® (3.02 g) and alum (0.34 ml))
4) 20 cm Lake Bonnet substrate + 5 cm of clean sand

The doses for Phoslock® and alum (liquid aluminum sulfate) were calculated based on the P fractionation data discussed previously. The "Floc&Lock" treatment consisted of a combination of both alum and Phoslock® where alum was added at a dose to treat the water column TP and the Phoslock® dose was calculated as described above. There is no method to calculate the depth/mass of sand, therefore, an assumed depth of 5 cm was selected based on previous studies. The sediment cores were tested using filtered and unfiltered ambient water to assess the performance efficiency under different conditions. The overlying water column was sampled at the following time intervals: 0, 24, 48, 96, and 192 hours during the 8-day incubation period to assess relative changes in flux or retention of nutrients across the different treatment alternatives.

Nutrient flux rates were estimated using the nutrient release rate equation, which was calculated based on the change of nutrient concentration over time (see equation below, in accordance with SOP AFW-SFLUX-002 Rev. 9). Annual internal load of nutrients were estimated following the methods described by Ogdahl et al. (2014). For the purposes of this study, the 0 to 48-hour range of the incubation period under anoxic conditions was used to calculate maximum flux rates so that the treatment alternatives could be assessed for performance efficiency given the maximum potential load that could be expected to be reduced by each alternative. The "sediment control" represents the cores that had bare, untreated Lake Bonnet sediment, which were used to compare against the cores with Lake Bonnet sediment plus a treatment alternative added to the top of the core.

6.3 Sediment Flux, Loading and Treatment Alternatives Analysis Results

In-situ water quality data vertical profiles were collected from the lake during intact sediment cores collection. **Table 6-2** provides the range of data collected across a depth profile, representing top, middle and bottom of the water column. Turbidity measurements were made at a depth of 0.3 meters from all locations and ranged from 19.8 to 20.8 NTU. The DO and pH values were elevated, likely due to an active algae bloom.

Table 6-2 - In-situ Sample Site Water Quality Data

Date Collected	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	pH
8/27/2018	29.51-31.19	9.18-13.6	120.6-177.9	9.26-9.56

Figures 6-1 through **6-4** show TP and ammonia concentration flux curves under anoxic conditions during the eight-day incubation period. The concentrations of TP for all test cores using filtered ambient water reached a peak between 24 and 48 hours, then remained relatively constant for the remainder of the incubation. The concentrations of TP for the test cores using unfiltered ambient water peaked at varying times throughout the incubations. The most notable peak was within the alum test core which peaked at hour 192 (at the end of the incubation), which was an unexpected observation. Under all conditions, the cores displayed low to medium flux rates and slight increases in concentration of TP. The low fraction of labile P was evident in the incubations as shown by the early peak of the TP concentrations. However, since the majority of the P was found to be more tightly bound, it is possible that with a longer incubation, a subsequent release of P from metal-oxides and organic fraction could occur and add further P load into the system. Due to the apparent phased releases of P due to the P

fractionation, reduction efficiencies were compared as an early and late response to the treatment type in an attempt to mimic field conditions for short term and long-term results that may be observed after application.

It is apparent from the flux curves that reduction efficiencies for the treatment alternatives varied for the early and later response likely due to the early release of labile P and the relatively low percentage of BAP within the total phosphorus, as noted by P fractionation analysis. The shift in response was most evident with the change observed in TP concentrations within the alum test core with unfiltered ambient water under anoxic conditions. The early response for alum treatment under these previously noted conditions showed a larger decrease of TP, whereas the later response showed an additional release in TP concentrations. The largest decrease in concentration of TP within the early response was found in the "Floc&Lock" treatment and the lowest was in sand. The change in concentrations in the late response of TP showed the highest reduction with the "Floc&Lock" treatment and the lowest in the alum treatment. The early and late responses in ammonia concentrations showed that the largest change was seen in the alum treatment and the smallest was in the "Floc&Lock" treatment.

The ammonia concentrations for all test cores using filtered ambient water also reached a peak between 24 and 48 hours, then remained relatively constant for the remainder of the incubation. The ammonia concentrations for the test cores using unfiltered ambient water peaked at varying times. Most of the cores using unfiltered ambient water peaked within 48 hours and remained relatively constant.

During addition of the different treatment types to the test cores it was observed that the addition of the 5 cm of sand resuspended the flocculent material. This is apparent from the rapid increase in sedimentation flux at the beginning of the incubation, which would likely occur during field scale applications. When flocculent material is disturbed, nutrients are released into the water column. Therefore, the sand treatment and the sediment control (i.e untreated sediment from the lake) were compared between the 96 and 192-hour. By the 96th hour of the incubation, the turbidity within these test cores stabilized. These results are important operational considerations for field scale applications. Some treatment alternatives such as a sediment cap may not be the best option for highly flocculent material. Rather, the flocculent material should be removed by hydraulic dredging to a certain depth where a more consolidated organic material is reached, which can then be capped with sand or other capping alternatives without disturbing the sediments to a high degree causing further nutrient or other contaminant release into the water column.

The reduction in parameter concentrations in treatment cores as compared to the sediment controls was inconsistent. However, overall, the "Floc&Lock" treatment appeared to provide the most consistent overall reductions for TP in all scenarios and during the early and late phases of the incubation. Phoslock® alone appeared to provide the second-best reduction of TP, with alum and sand as third and fourth in terms of reductions at different time steps. Under unfiltered anoxic conditions, alum was found to be the most efficient at reducing ammonia. Under filtered anoxic conditions for ammonia, all four treatment alternatives seemed to cause greater releases of ammonia than the sediment control, thereby no apparent reduction of ammonia. This result was not unexpected. Prior studies have shown that amendments such as Alum and Phoslock can cause an initial ammonia release. It is unknown if the amendment itself is causing the release or the application of the amendment causes the sediment to undergo a release of ammonia.

Figure 6-1 – Total Phosphorus Concentrations Measured under Filtered Anoxic Conditions for each Treatment Scenario during Laboratory Incubations of Sediment Cores

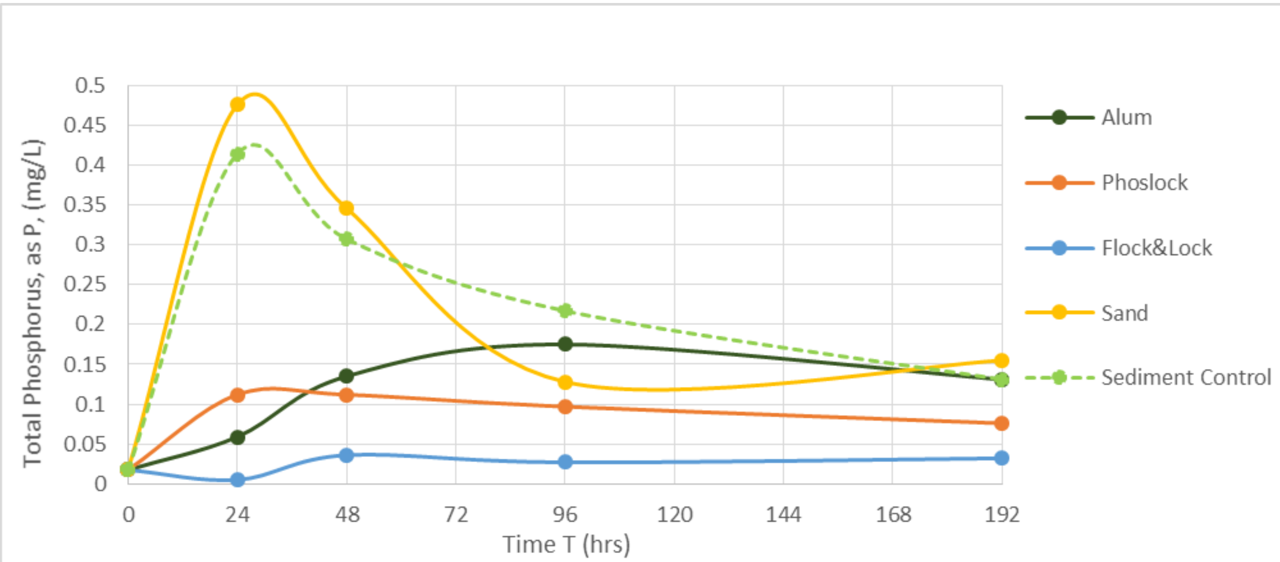


Figure 6-2 –Ammonia Concentrations Measured under Filtered Anoxic Conditions for each Treatment Scenario during Laboratory Incubations of Sediment Cores

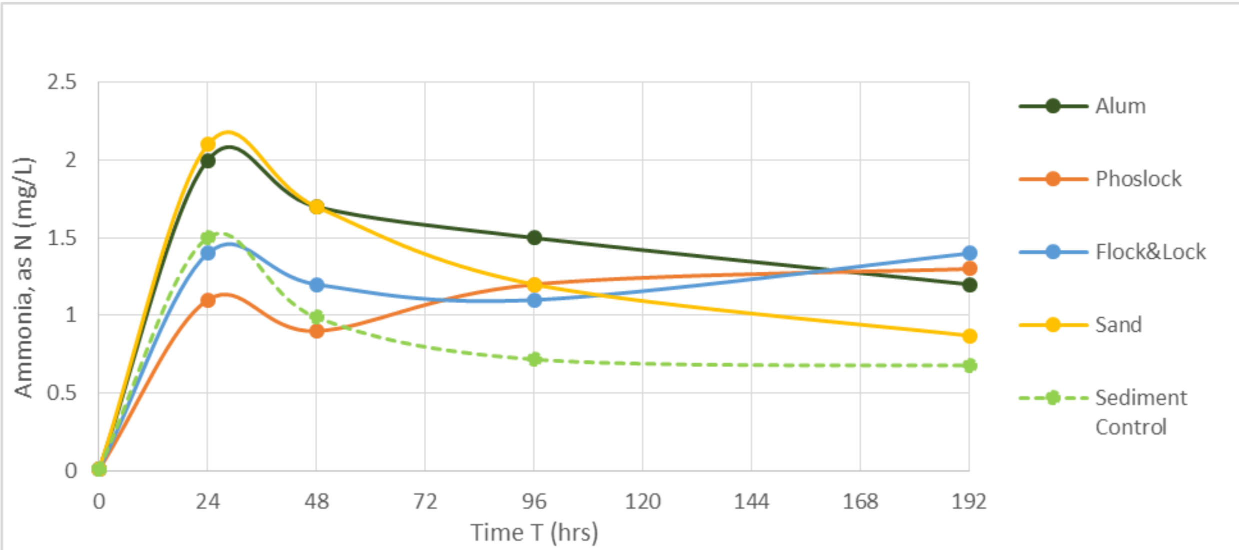


Figure 6-3 – Total Phosphorus Concentrations Measured under Unfiltered Anoxic Conditions for each Treatment Scenario during Laboratory Incubations of Sediment Cores

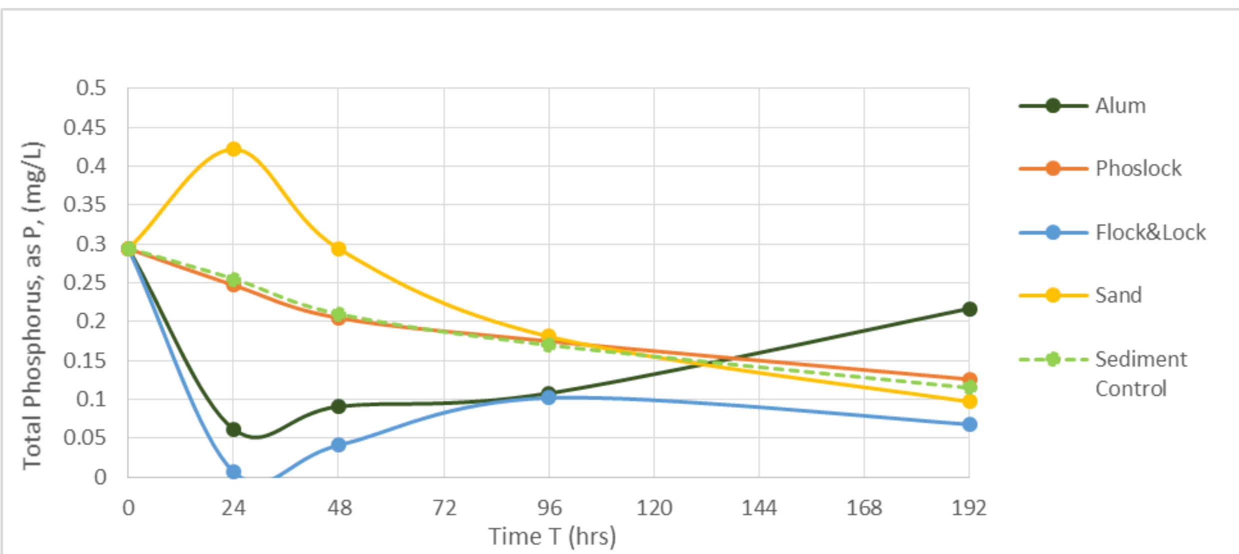


Figure 6-4 –Ammonia Concentrations Measured under Unfiltered Anoxic Conditions for each Treatment Scenario during Laboratory Incubations of Sediment Cores

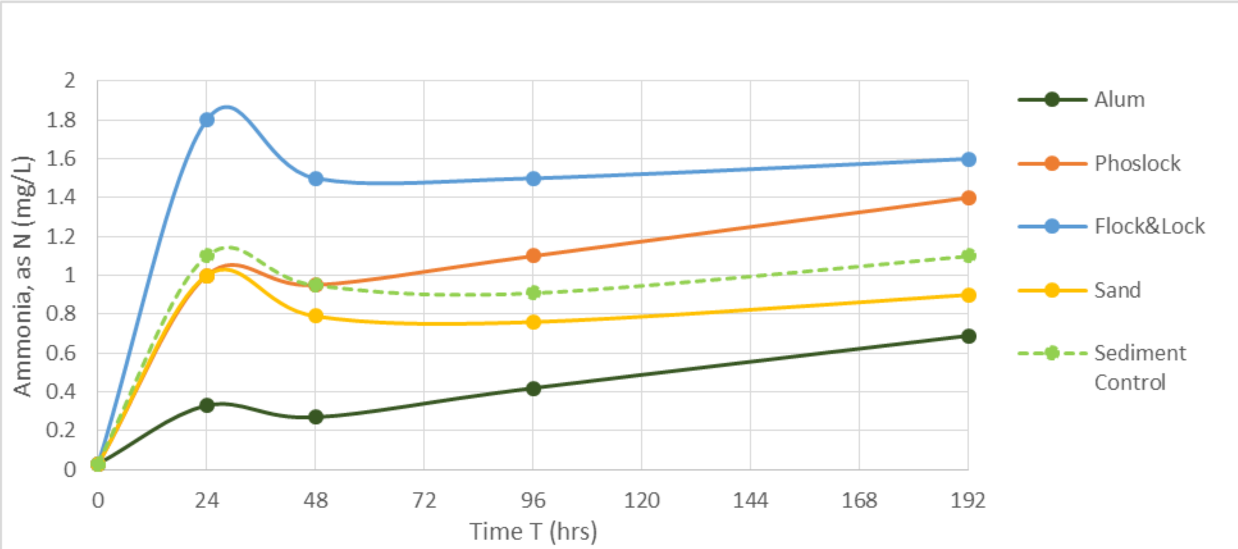


Table 6-3 provides a summary of anoxic flux rates and loads for the different amendments and from the sediment control. The flux rates from incubation under anoxic conditions would represent a maximum flux rate. The TP flux rates that were estimated from Lake Bonnet sediments were within range, but on the low side of rates estimated from other Florida lakes (Trefry et al. 1992, Wood 2017). The annual gross loads from untreated Lake Bonnet sediments were estimated to be 25,665.7 lb P/yr, and 86,882.2 lb N/yr. Therefore, if 100% of the lake bottom area is hydraulically dredged down to sand bottom, it is expected that those gross loads will be removed from the total loads delivered to the lake.

The highest mean TP flux rate and load occurred within the core containing the sand as an amendment, which was likely due to resuspension. The highest mean ammonia flux rates and loads occurred in the cores with the alum and sand amendments. Based on the mean flux rates and the loads calculated, the percent reductions of total phosphorus ranged between -13% and 93.6% (a negative reduction means there was an additional release, not reduction) for the different treatment types. Phoslock® was the only amendment to have a reduction of ammonia over the 0 to 48-period of incubation, and the other amendments experienced an additional release of ammonia instead of a reduction. The "Floc&Lock" amendment was found to be most efficient at removing P (with 93.6% removal efficiency), and the sand amendment was the least effective (**Table 6-3**).

Table 6-3 – Summary of Anoxic Flux Rates Under Filtered Conditions, Loads, and Load Reductions of Total Phosphorus and Ammonia by Treatment type for 0 to 48 hours

Treatment Type	Flux Parameter	Flux Rate ($mg/m^2/d$)	Reduction Efficiency (%)	Load (lb/yr)	Load Reduction (lb/yr)
Alum	TP	40.6	59.4%	10,417.0	15,248.7
Phoslock	TP	32.6	67.4%	8,377.9	17,287.8
Floc&Lock	TP	6.3	93.6%	1,640.1	24,025.6
Sand	TP	113.5	-13.5%	29,123.3	-3,457.6
Sediment Control	TP	100.1	NA	25,665.7	NA
Alum	NH3	584.1	-72.4%	149,827.4	-62,945.2
Phoslock	NH3	307.6	9.2%	78,903.2	7,979.0
Floc&Lock	NH3	411.2	-21.4%	105,499.8	-18,617.6
Sand	NH3	584.1	-72.4%	149,827.4	-62,945.2
Sediment Control	NH3	338.7	NA	86,882.2	NA

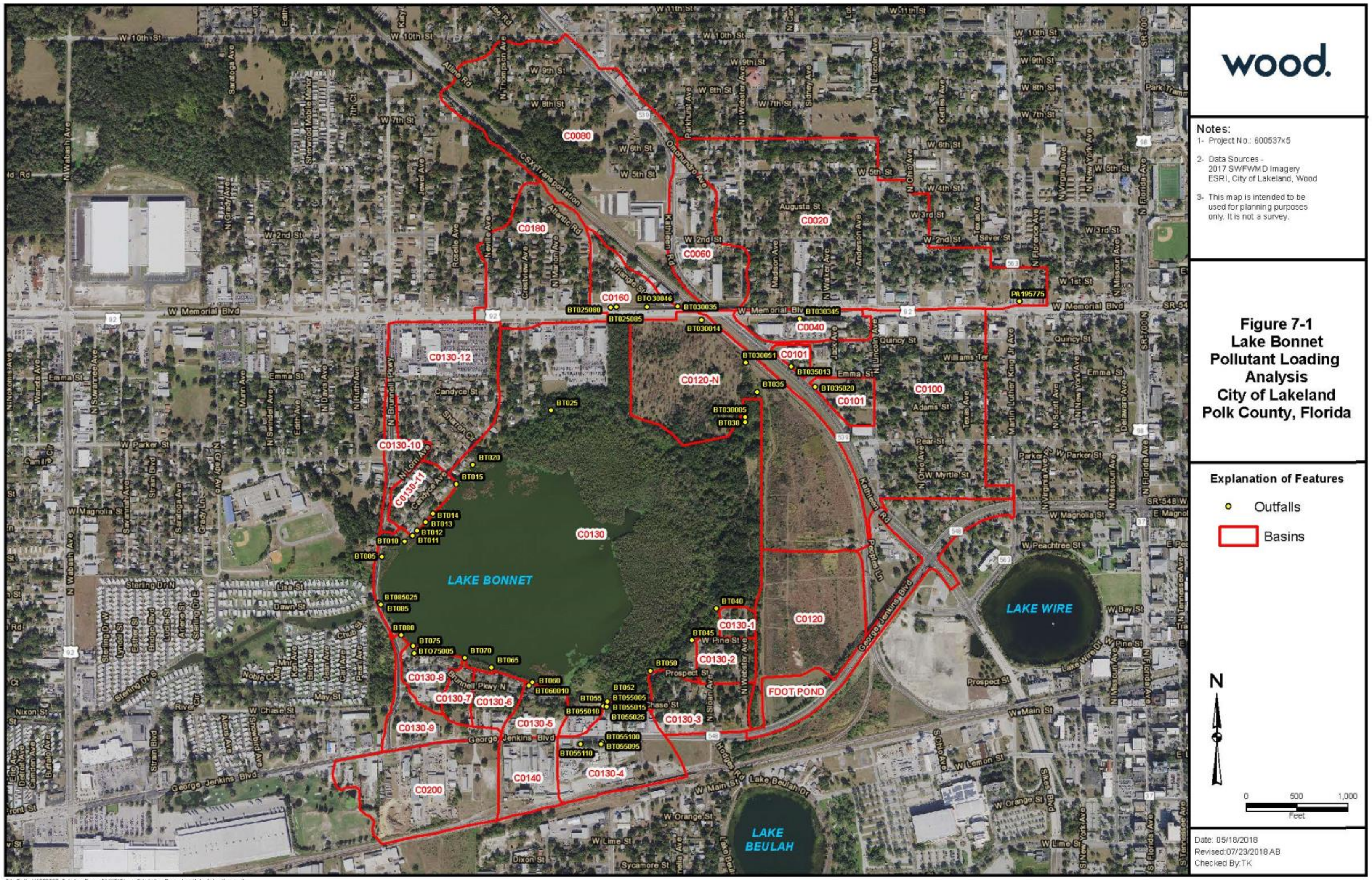
Note: A negative load reduction value indicates an increase in load excess of the sediment control load value.

It should be noted that the long-term effects of the increases in ammonia observed within the 192-hour bench test are currently unknown. Therefore, there is a potential with "Floc& Lock" and Phoslock®, or any of the other treatment alternatives evaluated that increases of nutrients can occur and may be dependent on environmental conditions during application. Further study of these products should be conducted under a pilot scale field study to assess potential issues with ammonia prior to large scale application.

7.0 STORMWATER LOADING ANALYSIS

External loading from stormwater is an important factor that can have major impacts on water quality. Wood developed stormwater pollutant loading estimates from the drainage basins within the Lake Bonnet watershed (**Figure 7-1**). Pollutant load quantification of stormwater to Lake Bonnet was facilitated by the report "Lake Bonnet Drain Study" (Keith and Schnars, 2004) as contributing drainage areas to the lake were identified in that study. The primary change to the drainage basins since 2004 has resulted from the construction of the In-Town bypass/George Jenkins Boulevard and those changes have been added to the drainage basin map. There is a lake outfall on the west side of Lake Bonnet that discharges into a canal known as the Lake Bonnet Drain. **Figure 7-1** identifies the drainage basins to Lake Bonnet and sub-basin naming convention is based on the flood routing nodal nomenclature.

Figure 7-1 – Lake Bonnet Pollutant Load Model Delineations



The storm water nutrient pollutant load into Lake Bonnet is one order of magnitude less for TP and two orders of magnitude less for TN than that compared to the nutrient flux from the sediments, but its impacts accumulate and are the source of internal legacy loads. Unless treated, stormwater pollutant loading will continue and will accumulate as an additional sediment nutrient load that will persist after in-lake restoration activities are completed. Bonnet Springs Park is currently being considered for development and the developer has committed to providing stormwater treatment features for treatment of existing untreated discharges to Lake Bonnet within the site development plan.

7.1 Stormwater Quality Model

The pollutant load modeling was accomplished using a Microsoft Excel spreadsheet developed in-house by Wood that is based on design criteria that was developed by FDEP and the Water Management Districts during production of the draft guidance documents conceived during past statewide stormwater regulation efforts. The model utilizes the modified U.S. Environmental Protection Agency's (EPA) Simple Method (Schueler, 1987) inclusive of event mean concentrations (EMCs) of pollutant parameters. The model also uses an effective rainfall-runoff coefficient "c" which is derived from each drainage basin's non-directly connected impervious area curve number (NDCIA CN) and directly connected impervious area (DCIA) combination. The March 2010 Draft Stormwater Quality Applicant's Handbook (FDEP & Water Management Districts) has the runoff coefficients published for each NDCIA CN-DCIA combination and for each meteorological zone in Florida. Among the five meteorological zones defined in Florida, Polk County is within Zone 2 and the applicable table for Zone 2 is included as **Table D-1** in **Appendix D**. The NDCIA CN for the various land uses and soil types comprising the drainage basins were determined by using the lookup table provided in this report as **Table D-2** (refer to **Appendix D**).

The DCIA/impervious conditions within each basin were estimated by using the landuse designations (refer to **Table D-3, Appendix D**). **Table D-4** (refer to **Appendix D**) lists the event mean concentrations (EMC) used to estimate pollutant loads for the MS4 basins. EMCs were developed using land use specific pollutant concentrations obtained from past monitoring activities conducted throughout the State of Florida. EMCs were developed for total nitrogen (TN), total phosphorous (TP), biological oxygen demand (BOD), total suspended solids (TSS), lead (Pb), copper (Cu) and zinc (Zn). The City of Lakeland's past stormwater monitoring information for Lakes Bonny and Hunter were reviewed and the average EMC values for mixed landuse and residential areas for those landuses were used for similar basins within the Lake Bonnet watershed. Those EMCs are shown in **Table D-5** of **Appendix D**.

The estimated annual pollutant loads are shown in **Table 7-1** for the various sub-basin areas.

Table 7-1 - Estimated Storm Water Pollutant Loads in the Lake Bonnet Drainage Basin

Basin ID	Estimated Existing Annual TN Load (lb)	Estimated Existing Annual TP Load (lb)	Estimated Existing Annual BOD Load (lb)	Estimated Existing Annual TSS Load (lb)	Annual Basin Runoff (Ac-ft)	Basin Composite TN EMC	Basin Composite TP EMC
C0100	739.9	138.7	2002	15107	113.4	2.40	0.45
C0020	687.9	129.0	2206	14045	105.4	2.40	0.45
C0130	864.3	90.4	2741	13836	323.0	0.98	0.10
C0180	315.6	59.2	940	6444	48.4	2.40	0.45
C0080	361.6	54.9	1648	10254	92.3	1.44	0.22
C0200	230.9	45.6	1505	11851	73.9	1.15	0.23
C0060	181.4	34.0	517	3704	27.8	2.40	0.45
C0130-12	197.2	33.1	1276	8619	61.5	1.18	0.20
C0130-4	157.0	30.7	1010	7924	49.8	1.16	0.23
C0160	133.4	25.0	391	2724	20.4	2.40	0.45
C0130-3	108.8	20.4	348	2222	16.7	2.40	0.45
C0130-5	88.5	16.6	310	1807	13.6	2.40	0.45
C0140	83.3	16.5	544	4281	26.6	1.15	0.23
C0130-9	70.3	13.7	391	2829	18.0	1.43	0.28
C0130-6	69.4	13.0	279	1417	10.6	2.40	0.45
C0101	58.8	11.0	175	1200	9.0	2.40	0.45
C0040	81.8	10.4	431	2430	28.2	1.07	0.14
C0130-8	51.4	9.6	224	1050	7.9	2.40	0.45
C0130-10	50.3	9.4	141	1026	7.7	2.40	0.45
C0130-11	46.1	8.6	152	941	7.1	2.40	0.45
FDOT POND	122.9	8.5	249	852	46.8	0.97	0.07
C0130-7	39.5	7.4	165	806	6.0	2.40	0.45
C0130-2	33.8	6.3	107	690	5.2	2.40	0.45
C0120-N	58.9	5.0	147	1007	17.4	1.25	0.11
C0130-1	11.4	2.1	36	233	1.7	2.40	0.45
C0120	13.0	0.6	16	95	4.1	1.15	0.06
Totals	**4,858**	**800**	**17,953**	**117,395**	**1,143**		

Note: Basins are listed in order of decreasing TP pollutant load.

7.2 Stormwater Pollutant Load Reduction Estimates

7.2.1 Definition of BMP Area

Existing BMP areas were identified based on visible dry or wet stormwater treatment facilities from review of recent aerial photographs. The significant BMPs observed within the watershed and included in the calculations were those serving the former Lakeland Toyota site, the FDOT pond serving George Jenkins Boulevard, and a BMP serving St. Luke's Senior Affordable Housing. There are other smaller BMPs that exist within the catchment area, but any such adjustments are not anticipated to significantly change the estimated stormwater pollutant loads to the lake. During final design of any retrofits proposed because of this study, the City of Lakeland and SWFWMD Environmental Resource Permitting (ERP) inventory can be accounted for to identify all existing BMPs within the subject drainage basin.

7.2.2 Existing BMP Load Reduction

To accurately quantify MS4 basin pollutant loading, a load reduction factor was applied to the raw storm water loads where BMPs were present. The "adjusted" pollutant loading provides storm water basin pollutant loads minus the treatment provided by the onsite BMPs. These areas were assigned a pollutant reduction factor. Wet pond pollution removal efficiencies were based on an assumed 14-day hydraulic residence time. Dry pond pollution removal efficiencies were based on 0.50" of retention. Load reductions are based on the methodology presented in the March 2010 FDEP/WMD document previously referenced.

7.2.3 Stormwater Loading Results and Discussion

The adjusted storm water pollutant loads are shown in **Table 7-1**. Based on our interpretation of the drainage pipe network, some of which could not be verified in the field, the stormwater runoff that is conveyed through pipes and into the northeastern corner of the proposed Bonnet Springs Park includes rainfall runoff from basins C0020, C0040, C0060, C0080, C0100, and C0101. These drainage basins provide a sizable portion of the storm water pollutant load coming into Lake Bonnet as follows:

- 43.5% of the total TN;
- 47.2% of the total TP;
- 38.9% of the total BOD;
- 39.8% of the total TSS; as well as
- 32.9% of the total rainfall runoff volume to the lake

The next largest contributors of storm water nutrient pollutant loads, excluding the large basin C0130 which includes direct rainfall on the lake and associated wetlands and is not conducive for treatment, are basins C0180 (7.4% of the TP load), C0200 (5.7% of the TP load), and C0130-12 (4.1% of the TP load).

8.0 GROUNDWATER ASSOCIATED POLLUTANT LOADING

Groundwater seepage is also expected to contribute phosphorus load to Lake Bonnet, as it has similarly been shown to contribute to Lake Hollingsworth and Lake Parker (among others). Sources of nutrients to groundwater, such as septic tanks, farm or urban turf grass fertilizer and other sources, were evaluated to determine which sources are the most significant contributors of nutrient loading to groundwater that may be affecting Lake Bonnet.

8.1 Estimation of Groundwater Quantity

To quantify annual groundwater contributions to the lake from groundwater inflow, Wood estimated the annual average discharge volume from Lake Bonnet. Lake Bonnet discharges through 2 sluice gates where the north gate is 80 inches wide and the south gate is 74 inches wide. Based on discussion with City of Lakeland staff, the typical operating regime for the discharge structure is to completely close the north gate and provide a 2-inch opening on the south gate. The 2004 report titled "Lake Bonnet Drain Watershed Management Program Watershed Management Plan (L144) (Keith and Schnars 2004) establishes the aforementioned configuration as the recommended configuration. These outfall operating conditions are applied in the absence of substantial rainfall. In periods of substantial rainfall changes are made to increase or decrease the water discharging from Lake Bonnet.

Based on the typical operating conditions, constant outflow from Lake Bonnet via the existing sluice gate may provide a reasonable representation of baseflow entering Lake Bonnet from groundwater. Estimation of baseflow through the existing sluice gate is based on the Bernoulli Equation. Based on the normal operating water levels specified by the City of Lakeland (142.69 ft – 144.19 ft) the estimated daily discharge (groundwater and stormwater runoff) ranges from 722,616 ft^3/ day (when lake levels are 141.89 ft) to 1,030,705 ft^3/ day (when lake levels are 143.39 ft). The report titled "Lake Bonnet Drain Watershed Management Program Watershed Management Plan (L144) (Keith and Schnars 2004) specifies the maximum normal flow through the sluice gate structure to be 11 cfs which corresponds to 950,400 ft^3/day, this falls between the estimated average daily discharge based on the minimum and maximum operating levels given the established typical operating configuration. It is noted in the stormwater section of this report that the average estimated annual stormwater runoff volume is approximately 981 acre-feet. This translates to a daily discharge value of about 117,122 ft^3/day or only 11 to 16% of the estimated daily discharge values noted above. Therefore, baseflow may be approximated by subtracting the stormwater associated runoff from the total estimated runoff which equates to between 605,494 ft^3/ day – 913,583 ft^3/ day.

8.2 Estimation of Groundwater Quality

Water quality data collected at the Bonnet Springs seep is summarized in **Table 8-1**. Water at the collection site emanates from a seepage face that is assumed to be representative of the groundwater in this area. The average TN and TP concentrations (based on the sampled data) of the Bonnet Springs seep are 2.82 mg/L and 0.15 mg/L respectively, which is high compared to groundwater from undeveloped areas in Florida. Although, the nitrate values are in-line with urban areas that receives infiltration from septic tanks, other wastewater sources and fertilizer. TN and TP concentrations at the Bonnet Springs seep location are less than the 5-year lake average TN (3.83 mg/L) and TP (0.280 mg/L) concentrations obtained from the Polk Water Atlas for TP (2007-2018) and TN (2009-2018).

Table 8-1 - Water Quality Data for the Bonnet Springs Site

Sample Date	Nitrate + Nitrite (mg/L)	TKN (mg/L)	TP (mg/L)	Orthophosphorus (mg/L)	Ammonia-N (mg/L)	TN (mg/L)
3/8/2018	3.7	0.075	0.114	0.098	0.025	3.775
4/5/2018	1.2	0.11	0.138	0.086	0.025	1.31
5/3/2018	3.3	0.075	0.196	0.084	0.025	3.375
Average	**2.73**	**0.09**	**0.15**	**0.09**	**0.03**	**2.82**

8.3 Groundwater Load Estimation

The average TN and TP concentrations from the collected samples were applied to the estimated daily groundwater flow to determine TN and TP mass loading to Lake Bonnet. Based on the limited available data as discussed above, the *preliminary* estimated annual average TN load ranges from 38,907 – 58,704 lbs TN/year and from 2,060 – 3,109 lbs TP/year. These values are intermediate in comparison to internal sediment and external stormwater loading. Accuracy of the load estimates expressed in this narrative can be improved with site specific groundwater seepage meter data collection with respect to water quality and quantity. A relatively small sample size (n=3) was used to define the characteristic groundwater quality. All the samples were collected during the dry season and do not represent the annual average. The accuracy of the estimate may be improved by collecting additional water quality data from the seepage face and/or by installing groundwater monitoring wells if seepage meters are not an appropriate option due to sediment quality. Additionally, the volume of discharge could be improved through continuous water level recording in the lake combined with detailed information on operation of the control structure openings to improve the estimate of volume discharged from the lake. Adjustments in the stormwater volume calculation based on observed rainfall and further resolution of the DCIA estimates of the drainage basins throughout the watershed would be subtracted from this discharged volume to provide a more reasonable estimate of the groundwater volume flowing into the lake.

9.0 <u>LAKE RESTORATION PROJECT ALTERNATIVES</u>

Wood evaluated a variety of alternatives to address both the external and internal loading sources discussed above. Projects aimed at external load reduction primarily involve structural and non-structural stormwater BMPs. Internal loading reduction will be achieved by dredging and/or capping of organic sediments within the lake. Results from the internal loading analyses, which assessed several different nutrient inactivation alternatives were used to develop options that can be blended with dredging and other BMPs. Natural systems restoration, which could include aquatic vegetation enhancement and/or rehydration of the wetland fringe are also important options that should be considered. These options are discussed below.

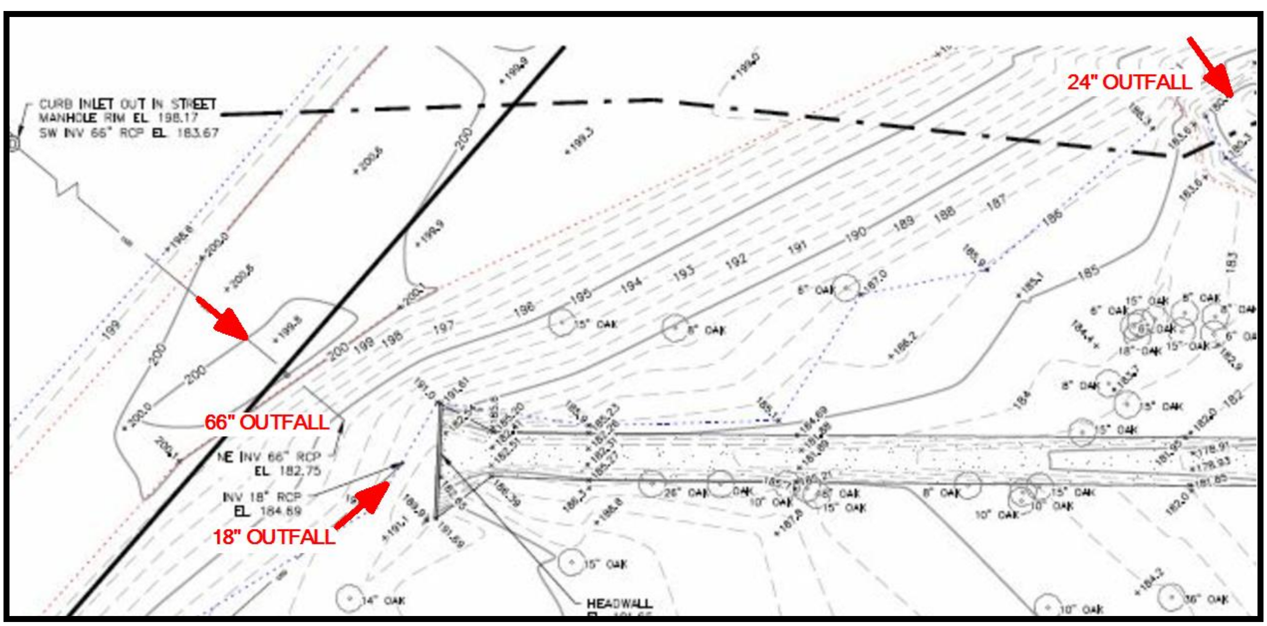
9.1 Conceptual Stormwater Project Alternatives for External Load Reduction

Wood reviewed the basins generating the highest storm water pollutant load and developed some coarse BMP concepts that may be considered by the City of Lakeland, or others, in the future for reducing storm water pollutant loads to Lake Bonnet. Those concepts are noted as follows by basin.

9.2 Bonnet Springs Park

The drainage basins identified in **Figure 7-1** as C0020, C0040, C0060, C0080, C0100, and C0101 constitute a cumulative drainage area of approximately 255 acres and more importantly a significant nutrient and TSS pollutant load as discussed above. The Park developers have already identified the "Springs", which constitutes the convergence of the pipes serving the above drainage basins into one location, as a focal point to the proposed park (see **Figure 9-1**). There is a significant amount of fall from the drainage structures serving the adjacent highways to the "springhead" location, therefore it is probable that engineered modifications to the outfall pipes can be made without impacting the storm sewer hydraulic capacity.

Figure 9-1 - Proposed Springhead Area



It is assumed the Park designer will construct a pre-treatment BMP to remove gross pollutants such as sediments, litter, floatables, as well as oil sheen. The concepts presented in the park's brochures suggest that a pool of water at this headwater location will be created. If human contact with the pooled water will occur at this location, the Park designer will have to examine bacteria levels in the storm water and address those as needed to eliminate any risks to human health.

The water table is estimated to be deep at the springhead location therefore stormwater runoff treatment via infiltration into the ground is assumed to be an option at this location. However, to maintain the "springs" concept, a means of reducing the leakance of the water into the ground to an acceptable level would be desired. Additionally, stormwater infiltrated into the ground can be a pollutant source (as groundwater) to the lake, particularly nitrates due to nitrate from the incomplete denitrification process that occurs in stormwater treatment process for many infiltration BMPs constructed on sandy soils. A soil amendment known as biosorption activated media (BAM) is one possible solution to this issue. BAM has a slower infiltration rate as it must stay saturated and in an anaerobic condition to facilitate denitrification. This would help to keep the water levels up in the springhead and springs footprint. Additionally, BAM has the ability to reduce the concentration of dissolved nutrients such as nitrate and dissolved phosphorus into the groundwater through enhanced denitrification and adsorption, respectively.

Stormwater replenishment of the Park's headwaters will come in pulses due to the erratic nature of rainfall events. Lake Bonnet may provide a dependable and consistent source of water to maintain optimal performance of the BAM and may have other advantages as well. Treatment of Lake Bonnet water through infiltration using a soil amendment would have several benefits including:

- Supplying water to the springhead and the associated infiltration treatment pathways;
- Ensuring the springs never go dry as a result of stormwater supply;
- Potentially help to increase groundwater supply to hydrate the fringe wetlands of the lake.

A relatively large footprint for infiltration will be required to ensure that a sufficient volume of stormwater or lake water can be treated by the concept BAM-augmented infiltration BMP. For instance, a ½ inch rainfall event is estimated to produce 2.8± acre-feet of storm water from the 6 drainage basins draining the springhead. Based on infiltration treatment tables for Zone 2 in the 2010 FDEP/WMD document, sizing the system for ½ inch of stormwater runoff would provide a ±65 to 70 % level of treatment for that storm sized event.

The current invert of the influent pipes to the springhead will necessitate a moderate amount of earthwork to make this concept possible and lateral storage pipe lengths will likely be necessary to provide the additional treatment volume capacity required for this concept. The following summarizes the required elements of the conceptual treatment train described above.

Concept BAM-Augmented Infiltration BMP Treatment Train Elements:

- Pre-Treatment Chamber for Sediment, Litter, Floatables
- Pre-Treatment for Bacteria and Pathogens (as deemed applicable)
- Springhead Pool Maintained at Controlled Level (BAM substrate)
- Infiltration Pipes/Chambers Connected to Pool for Volume (BAM substrate)
- Pumping System to Springhead Pool from Lake w/ Sensors Tied to Rainfall or Influent Storm Pipe Water Levels
- Meandered Stream Path with Level Pools (BAM substrate)

Wood has not been advised as to the exact locations of potentially hazardous soils within the park site, therefore concepts presented in this report do not have the benefit of that knowledge.

However, we have attempted to provide a preliminary engineering conceptual cost estimate for this type of BMP. A "planning level" conceptual cost analysis was prepared for the Bonnet Springs Park dry retention system supplemented with BAM. The purpose of this cost estimate is to provide the City of Lakeland with an approximated benefit to cost comparison for the treatment of currently untreated stormwater runoff from both the Florida Department of Transportation (FDOT) and the City's municipal separate storm sewer system (MS4). The 255-acre basin generates an estimated 3.5 acre-feet of stormwater for a ½" rainfall event, based on estimated directly connected impervious area (DCIA) values and non-DCIA curve numbers for each of the sub-basins in the 255-acre drainage basin.

The conceptual treatment of this ½"-size rainfall event is assumed because it exceeds the technology-based criteria for dry retention systems for new development (must treat runoff from the first one-inch of rainfall) since the estimated effective rainfall runoff coefficient for the 255-acre basin is 0.33±. Based on a theoretical estimated DCIA and non-DCIA curve number value of 35% and 75, respectively, and using methodology from the "Environmental Resource Permit Stormwater Quality Applicant's Handbook (March 2010 draft by FDEP and WMDs), dry retention treatment would remove 68.8% of the rainfall runoff volume via infiltration into the soil. However, Wood cautiously notes that the treatment level could be less. This is based on the fact that Wood has reviewed historical rainfall and storm events and estimates that the percentage of the estimated annual rainfall runoff attributed to ½" and smaller storm events is only about 13%. This value increases to about 30% when considering storm events of 1" or smaller. Therefore, Wood recommends that a lower range for a retention system design for capture of ½" of rainfall runoff may actually treat (remove from the surface water discharge to Lake Bonnet) about 40% on the lower end of the effectiveness spectrum.

The cost estimate shown in **Table 9-1** assumes some generalized major cost elements that are assumed required for the concept BMP. A sketch of the concept is not included due to the conceptual nature of this BMP and because the landowner of Bonnet Springs Park has the ultimate control of the Park design features. A typical section through the retention pond bottom is shown as **Figure 9-2**. The estimated effectiveness of the system at removing nutrients from the surface water discharge is assumed to range from 40 to 68.8% based on previous discussion. The estimated annual nutrient load from the 255-acre basin is 2,111 lbs TN and 378 lbs TP. For a 20-year present worth mass removal cost estimate, the capital improvement cost estimate is $1,662,500 and the present worth cost of 20 years of maintenance is assumed to be $13,600. In 20 years, 42,220 Lbs. and 7,560 lbs. of TN and TP, respectively, would be removed and the estimated unit removal cost is $39.70 per lb and $221.70 per lb of TN and TP, respectively. This is a very good effective removal cost for a dry retention system based on current industry cost/benefit averages.

Figure 9-2- Conceptual Typical Dry Retention System Pond Bottom Section

8" Backfilled Soil
12" Biosorption Activated Media
In-Situ Sandy Soil (Depth Varies)
In-Situ Clayey Soil (Depth Varies)

A defined hydraulically-restrictive clay layer is evident on the shear slope of the existing eroded gorge that exists just east of the concrete flume that serves the 8'x5' concrete box culvert outfall from Kathleen Road. However, it appears the dry retention system pond bottom could be located above this clay layer to where infiltration will still be effective.

Table 9-1- Opinion of Construction Cost for Conceptual-Level Dry Retention BMP with BAM

Element	Assumed Quantity	Units	Estimated Cost
Mobilization	1	Lump Sum	$ 125,000
Earthwork	11,300	CY	$ 100,000
Biosorption Activated Media	1,400	CY	$ 280,000
Sod	4000	SY	$ 10,000
Fencing	1000	LF	$ 25,000
Duplex Pump Station w/ Electrical Supply, Intake and Discharge Lines	1	Lump Sum	$ 390,000
Drainage Structures	1	Lump Sum	$ 100,000
Baffle Box/Pretreatment Structures	1	Lump Sum	$ 300,000
Contingency (25%)	1	Contingency	$ 332,500
Preliminary Conceptual Cost			**$ 1,662,500**

9.2.1 <u>Basin C00180 Retrofit</u>

The C00180 drainage basin is a high-ranking basin relative to pollutant load. Additionally, this basin's 30-inch outfall originating from Memorial Boulevard crosses through the former Lakeland Toyota property including a dry retention with effluent filtration (underdrain) pond serving that property (see **Figure 9-3**). Based on the City's pipe network information, it is possible the pipe does not have much cover where it crosses the pond. The concept BMP at this location would include, if the existing BMP has capacity, capturing the first flush of discharge from the 30" outfall and at the same time improving the treatment of the car dealership's stormwater flowing through the existing pond's underdrain system. Underdrain systems are notorious for allowing the dissolved fraction of nutrients to pass through the sand media and be discharged offsite. To address this problem, storm water managers throughout the State are retrofitting similar systems where benefit/cost analysis dictates using upflow filters with BAM to improve the pollutant removal of these systems.

This concept BMP would rely on the implementation of a public/private partnership to successfully be executed. Such partnerships are becoming more and more frequent, particularly in redevelopment or infill development areas of municipalities. The above concept is just one potential alternative and there may be other alternatives that would provide greater benefits to both the City and the property owner.

Figure 9-3 - Location of Concept BMP for Basin C00180

9.2.2 <u>Basin C00200 Retrofit</u>

According to SWFWMD GIS-based permitting information, this area has soil contamination throughout, therefore no concept BMPs were considered within this basin.

9.2.3 <u>FDOT Pond Outfall Pipe</u>

The 30-inch outfall pipe from the FDOT pond has eroded the receiving grade and will continue to do so until stabilized. The erosion process will contribute sediment and associated nutrients to Lake Bonnet. Due to the poor aesthetics and the impact it has on the Park, it is anticipated that the Park developer will incorporate natural and engineered channel stabilization practices to eliminate this erosion problem on the Park property.

9.2.4 Groundwater Treatment

Groundwater volumes and pollutant load estimates were provided in Section 7 and are very concept in nature due to the many assumptions that had to be made. Wood has not been provided any water table or soils data for the Bonnet Springs site. This section describes a conceptual BMP in which the groundwater flowing from the Bonnet Springs site to Lake Bonnet is intercepted by a vertical soil amendment "barrier". This soil amendment barrier would slow the flow of the surficial groundwater and provide a means for the treatment of the nitrogen species (nitrite and nitrate) identified in the water quality samples. Denitrification through this anaerobic barrier will be able to occur, reducing the amount of nitrogen in the groundwater. Phosphorus will also be attenuated to some extent.

A "planning level" conceptual cost analysis for a groundwater treatment alternative is schematically shown in **Figure 9-4**. A soil amendment with nutrient attenuation capabilities would be constructed in a vertical barrier wall and will have to key in to the existing clay layer. An engineered opinion of construction cost of this concept is shown in **Table 9-4** inclusive of the assumptions made on this concept BMP.

Figure 9-4- Conceptual Vertical BAM Wall for Groundwater Treatment

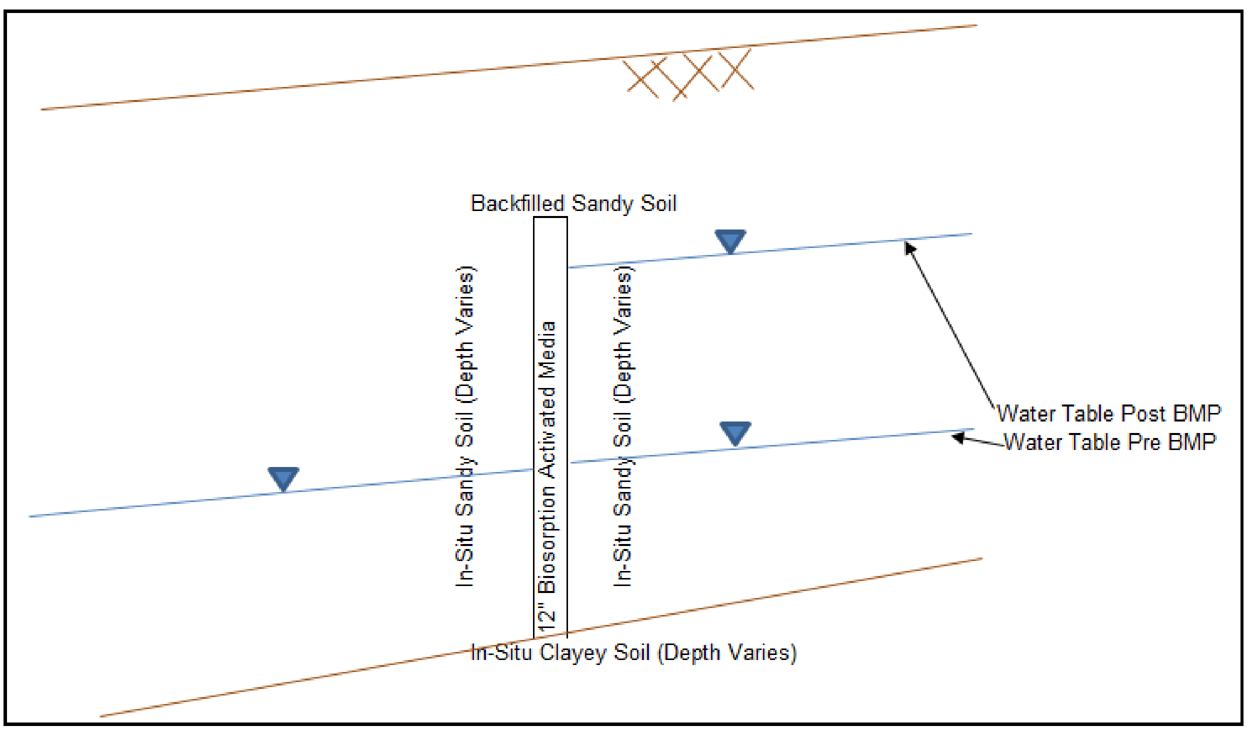


Table 9-4- Opinion of Construction Cost for Conceptual-Level Groundwater Treatment BMP with BAM

Element	Assumed Quantity	Units	Estimated Cost	Assumptions
Mobilization	1	Lump Sum	$ 50,000	
Trench Excavation	1	Lump Sum	$ 112,000	
Biosorption Activated Media	740	CY	$ 210,000	2800' long, 10' deep
Sod	1	Lump Sum	$ 35,000	
Contingency (35%)	1	Contingency	$ 142,000	
Preliminary Conceptual Cost			**$ 549,000**	

The coarse groundwater pollutant loading estimates to Lake Bonnet ranged from 38,907 to 58,704 lbs TN/year and 2,060 to 3,109 lbs TP/year. Assuming the groundwater contribution from the Bonnet Springs property is a fraction of this (2,800'/10,000' based on lake border distance), then 28% of the estimated load could be treated with the concept BMP. For a 20-year present worth mass removal cost estimate, the capital improvement cost estimate is $549,000 and there is no assumed annual operation and maintenance cost. The BAM treatment wall BMP could potentially work for an extended period of time in treating nitrogen due to that treatment being a biological process. The effective service life on phosphorus would be less as the phosphorus removal is related to cation exchange and the media would eventually lose exchange sites for phosphorus capture. A treatment efficiency of the BAM is assumed to be 50% based on past studies in Marion County for systems constructed under pond bottoms using a similar BAM depth. In 20 years, 5,447-8,219 lbs and 289-435 lbs of TN and TP, respectively, would be removed. The estimated unit removal cost range is $101-$67 per Lb. and $1,900-$1,260 per lb. of TN and TP, respectively. Compared to current industry cost/benefit averages for many types of BMPs, these costs are favorable.

9.2.5 Street Sweeping

The City of Lakeland has advanced its study of the City's street sweeping operations and effectiveness. This includes confirming the high (relative to FSA study results Statewide) nutrient concentrations of the street sweeping particulate matter. It is anticipated that the City will implement a modified frequency of sweeping within the Lake Bonnet drainage basin to further optimize removal of this pollutant source from the storm water collection system.

10.0 CONCEPTUAL CAPPING AND DREDGING ALTERNATIVES FOR INTERNAL LOAD REDUCTION

Results from the sediment flux alternatives analyses indicate that organic sediments in Lake Bonnet contribute significantly to the internal nutrient load. The internal nutrient loading to Lake Bonnet was estimated to be 25,666 lbs TP/yr and 86,882 lbs TN/year. This load is higher than both groundwater and stormwater loads combined. Therefore, managing and restoring sediment quality within Lake Bonnet is critical for the restoration of Lake Bonnet's water quality and natural systems.

Sediment quality can be restored by a combination of targeted sediment removal and capping with chemical inactivation amendments or by creating a physical barrier with sand, or other clean fill material. Removal of these sediments using hydraulic dredging could be an effective tool for lake restoration. Hydraulic dredging provides the ability to remove nutrient-rich sediments down to a specific elevation without the need to disturb areas outside of the dredge footprint. For Lake Bonnet, dredging to the natural sand bottom or a target bottom elevation of 135 ft is recommended followed by capping with a thick layer of sand to cover sediments that remain below the target elevation and effectively prevent their interaction with the water column (**Appendix E**). Based on the nutrient flux results, it was found that this concept could work if the remaining sediments after targeted dredging would be at least partially consolidated. Adding sand to unconsolidated flocculent material will not be effective at creating a physical barrier to reduce nutrient flux since the sand will likely fall through the flocculent material instead of on top of it to cover.

10.1 Capping Alternatives

There are two scenarios that can be considered to cap the sediments in areas that are not fully dredged down to natural substrate. It is estimated that approximately 49 acres of the lake will only be partially dredged down to an elevation of 135 ft. Depending on the remaining organic material, whether it be consolidated or unconsolidated muck, will drive the decision on which capping material would be most effective. These areas could be capped with sand if the material is consolidated. Capping the partially dredged areas with consolidated organic material remaining below 135 ft will require a 1.0 to 1.5 ft thick layer of clean sand or fill. Sand from the dredged sediments, estimated at approximately 10 to 15% of the materials to be dredged, can be separated and returned to the lake to provide roughly 53,000 cy of the 120,000 cy necessary for the sand cap. The additional 67,000 cy of sand cap can be brought in from off-site or could be dredged from the lake.

As an alternative, Phoslock® could be applied on top of the sand cap since the remaining off-site sand would potentially cost more than the needed dosage of Phoslock® or the "Floc&Lock" combined capping alternative. Phoslock® and "Floc&Lock" were found to be much more effective in terms of nutrient reduction and cost-effectiveness in this study and other similar studies. At an approximately $15,000 per-acre cost to apply Phoslock® to the 49 partially dredged acres that would need to be capped, the additional cost for capping with Phoslock would be $735,000 for material, application, and follow up monitoring for effectiveness. These costs are preliminary and based on limited data and should only be used for planning purposes. The final cost would need to be revised based on the mass of BAP within the sediment at the 135 ft elevation, which may reduce the overall cost if BAP is less at that part of the sediment strata.

Treatment efficiencies were estimated to be 67% to 94% for TP for Phoslock® or the "Floc&Lock" amendments, respectively. Therefore, between 15,000 to 24,000 lbs of TP could be removed per year if Phoslock® or "Floc&Lock" are implemented as a sediment restoration strategy, respectively. This yields an estimated unit removal cost of $49 and $31 lb of TP removed for Phoslock® and "Floc&Lock", respectively. The "Floc&Lock" combined alternative would only be recommended if after partial dredging, the water column still had large volumes of phytoplankton algae in it. The purpose of the "Floc" (alum) is to strip the water column of algae before applying the "Lock" (Phoslock®) so that it is more effective at binding BAP within the sediments. It must be noted that the potential for additional ammonia release could be an issue with any of the capping alternatives that were evaluated. However, the long-term effects are unknown at this time and should be further investigated.

10.2 Dredge Design

Dredging represents the most critical element of Lake Bonnet restoration and it directly addresses the most significant source of nutrient loading discussed above. The total required dredge volume is currently estimated at approximately 425,000 cubic yards (cy). Additional pre- and post-dredge surveys will be required prior to project commencement and following project completion. As with most dredge projects, dewatering and final placement of the dredged material are generally the most challenging and costly elements. The City has identified a potential location for material management and final placement within the adjacent Bonnet Springs Park area (see **Appendix E**). The conceptual project details discussed below assume that the Bonnet Springs Park area is available and suitable for the project needs.

This conceptual dredging project is based on the best available information for current conditions. Determining the final project area, dike heights, and site layouts will require agreements with Bonnet Springs Park, additional geotechnical testing, and analysis on the proposed site Bonnet Springs Park area footprint. Following this site-specific data collection, Wood will perform the necessary engineering design, acquiring permits, and develop final bid and construction documents (plans and specifications).

Preliminary calculations based only on the amount and types of sediments to be dredged, indicate that a diked dredge material management area (DMMA) would cover approximately 25 to 30 acres and consist of several diked cells and work areas. The maximum diked cell walls will likely be no higher than 20 to 25 feet above the site grade.

Based on our preliminary review of the upland areas available, the previous site of the large CSX railway switchyard will likely serve as the best location for the construction of a large diked DMMA within the Bonnet Springs Park area. Importantly, the CSX location allows for direct road access, movement of construction equipment, and direct hydraulic pipeline access for the transportation of the dredge slurry and the return of decanted water, to and from Lake Bonnet.

10.3 DMMA Construction and Operation

The construction phase of the DMMA is probably the most complex processes in the construction sequence and is outlined in this section. The first phase of construction will constitute the selected contractor mobilizing to the DMMA site. The next step in the process will consist of the construction of the diked DMMA within the Bonnet Springs Park area.

The DMMA project footprint will likely consist of a main central dike area, designed to contain the fine-grained nutrient-rich organic (muck) sediments and two additional diked areas, which will ideally share cell walls with the large central diked area.

The DMMA will require direct hydraulic pipeline access to and from Lake Bonnet. The DMMA will require direct road access for the movement of construction equipment. The DMMA will ideally have a total temporary storage capacity of at least 400,000 cy, which will allow continuous dredging 7 days a week during daylight hours. The DMMA site will be partially lighted to allow the selected contractor to continuously dewater and decant the dredged material 7 days a week, 24 hours a day.

One of the smaller diked areas will serve as pretreatment of the incoming dredge slurry. Here the slurry stream will be directed through the selected contractor's designed series of non-traditional mechanical dewatering techniques (e.g., hydrocyclones, filter presses). The course dredged material (sandy sediments and debris) will be captured by the mechanical dewatering techniques and will be sorted, stacked, and temporarily stored. Later this course dredged material will be slurried, returned to Lake Bonnet, and then placed as a thick sand cap over the muck sediments that remain below the dredging elevation of 135 ft.

The slurry stream will then be directed to the main central dike area designed to contain the fine-grained nutrient-rich organic (muck) sediments. As the slurry stream leaves the first area and travels to the main central dike area, the selected contractor will have the opportunity to introduce chemical additives (flocculants or coagulants) to the slurry stream. Any flocculants or coagulants will require preapproval through the permitting process. Introducing chemical additives is not anticipated to be necessary during the early dredging period when the site holding capacity and treatment times are at their largest and longest, respectively. However, it may become necessary as the site fills, which in turn decreases the site treatment time.

A weir system or sluice gate will separate and control water levels and flow rates between the main central dike area and the final dike cell, the polishing pond. The polishing pond will serve as the final opportunity to introduce chemical additives to the slurry stream before the decanted water can flow back to Lake Bonnet.

Once all in-lake dredging has been completed, the polishing pond can be repurposed to serve as the location where course dredged material will be re-slurried, returned to Lake Bonnet, and then placed as a thick sand cap over the muck sediments that remain.

By themselves, the muck sediments are not suitable for direct capping of areas in Bonnet Springs Park area. Therefore, for cost estimation purposes, Wood has assumed that the selected contractor will dewater, decant, and condense the sediments left in the main central dike area of the DMMA before capping this cell with at least two feet of clean sand. However, as noted earlier, these sediments (Stratum 2) could efficiently serve as a soil amendment to be mixed in with the existing on-site soils. Care would need to be taken to be sure that this material was stabilized, so that resulting sediment mix did not get fluidized and returned to Lake Bonnet as stormwater runoff, but otherwise, the geotechnical and nutrient levels make this material well suited for a soil amendment.

10.4 Dredging and DMMA Natural Resources Impact Avoidance

Wood performed an assessment of potential natural resources impacts that could result from dredging and dredge material management and placement within the proposed work area and DMMA. As a part of this analysis, suitable means for impact avoidance was also developed. The findings of this assessment are provided below.

Lake Bonnet contains approximately 62 acres of forested wetlands which could be undermined unless properly designed. Forested wetlands are typically buoyant and loss of material beneath them may result in the physical collapse of the ground surface and tree canopy. This necessitates careful planning and monitoring of any excavation of sediments near these wetlands. This concern is true for the both the City's dredging efforts as well as the Bonnet Springs Park developer's proposed stormwater restoration efforts. As noted, at the time of the field investigation stream flow appeared to be sustained primarily by seepage, although alluvial sand deposits and gross solids were presumably washed in from the upstream drainage structures along the channel and indicate much higher flows during storm events.

To prevent the collapse of the forested wetlands during dredging, Wood recommends the temporary or permanent installation of a sheet pile wall along the forested wetland edge with Lake Bonnet and creating a gradual slope from the forested wetland edge to the final dredging depth. This gradual slope would be reinforced with coarser sediments or other stabilization methods, including plantings, in addition to the proposed sand layer for the capped sediments. Once the dredging and capping have been completed the temporary sheet pile wall could be carefully removed. Alternatively, the sheet pile wall could be installed as a permanent stabilization measure. The additional cost would provide greater assurance that the forested wetland would remain in place and along for greater depths along the forested wetland edge. These greater depths would, in turn, provide better boating access to the forested wetland edge.

By aligning the hydraulic pipelines within the proposed Bonnet Springs Park developer's storm water restoration corridor, until the pipeline reaches uplands, all wetland impacts can be avoided. In any case, the hydraulic pipeline should *not* pass through or over the forested wetlands, as vibrations from the pipes could cause the soils underneath to become unstable and collapse.

10.5 Pre-application Meetings

Wood coordinated and attended, along with City staff, pre-application meetings, with representatives from the USACE on July 10, 2018 and with South Florida Water Management District (SWFWMD) on July 12, 2018. The purpose of these meetings was to review the preliminary dredging design and determine potential regulatory concerns related to the proposed dredging project within Lake Bonnet. Wood develop detailed notes from these meetings, which Wood shared with both agencies and modified as necessary based on agency review and comments.

10.6 Preliminary Order of Magnitude Engineering and Construction Cost Estimate

Wood has prepared the following preliminary Order of Magnitude Engineering and Construction Cost Estimate herein referred to as "estimate." This effort covers hydraulically dredging fine-grained nutrient-rich organic sediments down to an elevation of 135 ft and placing a thick sand cap over most of the sediments that remain below this elevation.

For specialized construction items such as dredging and dredged material management, the Wood's cost estimating team utilizes means and methods along with production rates observed on similar projects to assist in deriving unit costs and production rates. To further assist with this estimation, our cost estimating team contacted two reputable dredging and sediment removal firms who operate throughout the Southeastern U.S. to aid in verifying general rates and support costs to mobilize/demobilize personnel and equipment to the project site.

The provided preliminary estimate includes all the currently foreseeable project costs: including mobilization/demobilization; pre and post-construction surveying; maintenance of traffic; DMMA dike construction; dredging; dewatering, decanting, and condensing the sediments left in the main central dike area of the DMMA before capping the cell; capping; erosion controls and soil tracking prevention and associated attendant items.

The estimate presented herein includes a 20 percent contingency (typically a 20 to 30 percent contingency is applied to infrastructure projects at the conceptual stage with the contingency being reduced as the initial design is advanced and unknown/uncertainties reduced) and 3 percent contingency for construction supervision and project closeout costs.

For this preliminary estimate, Wood has made the following assumptions based on data collected, meetings with regulatory agencies and City of Lakeland staff, and other readily available external literature and discussions. The estimate for the preliminary dredging and DMMA plans presented within was prepared based on the following assumptions and stipulations.

- The preliminary estimate is consistent with the recommendations made to the City of Lakeland as outlined in this report.
- Before permitting and bid document creation and submission, Wood will conduct additional data collection, engineering analysis, and update the draft plan listed here based on the data collection findings. This may significantly alter the proposed design, ultimate site capacity, and cost.
- The City of Lakeland and Wood will be able to acquire permits that allow the project to proceed as outlined above, which includes:
    - Permitting the final disposal of sediments within the DMMA, with no material taken offsite;
    - Acquiring the necessary agreements to use the Bonnet Springs Park area.
- The City of Lakeland and Wood will garner assurances that the proposed design is acceptable to Polk County stormwater and floodplain management coordinators.
- The City of Lakeland will maintain lake levels within the historic conditions (i.e., an extreme low elevation of 141.27 ft to a high elevation of 145.81 ft with a normal operating range from 142.69 – 144.19 ft).
- The City of Lakeland will restrict any boat traffic on the lake to small trailerable watercraft with minimal draft and engine size. Alternatively, if larger watercraft are desired Lake Bonnet will need to be dredged to a lower elevation before capping.
- An independent surveyor will establish (pre- and post-construction) horizontal and vertical limits and establish/verify existing elevations for payment applications.
- The selected contractor's means and methods must indicate how the selected contractor will stabilize the DMMA during operation. The presumed plan for this preliminary estimate assumes that the selected contractor can successfully stabilize the DMMA without the use geotextile materials, sheet pile walls, etc.
- The selected contractor will excavate roughly 425,000 cubic yards of dredged material from the proposed dredging template. Given a conservative sand ratio of 10 to 15% approximately 53,000 cy of sandy material is assumed to be available as a possible capping material.
- As needed, the selected contractor will truck additional clean sandy sediments to the lake and used to cap the remaining fine-grained nutrient-rich organic sediments. It is currently estimated that an additional 67,000 cy of sand will be required.
- Alternatively, the additional 67,000 cy of sand could be dredged from the lake (below the natural bottom and used as a possible capping material.
- The preliminary estimate presented herein includes a 20 percent construction contingency and 3 percent contingency for construction supervision and permit closeout costs.

Based on the verification of all the listed assumptions and the project proceeding as outlined above, the analyses suggest a preliminary estimate of between approximately $17,800,000 and $21,200,000 for the proposed dredging project as outlined in this document. The proposed construction activities will remove approximately 425,000 cy of sediment from Lake Bonnet, which is a cost of around $33.50 to $41.50 per cubic yard removed.

10.7 Limitations and Risks

Final permits and the final design will require agreements with Bonnet Springs Park, additional geotechnical testing, and analysis on the proposed site Bonnet Springs Park area footprint. Following this site-specific data collection, Wood will perform the necessary engineering design, acquiring permits, and develop final bid and construction documents (plans and specifications).

Also, insufficient geotechnical data is available to assess the proposed new dike height, crest-width, and side slopes. For example, the presence of non-building grade sediments below the proposed location for the DMMA may limit the dike height to less than +15 ft above grade, which would limit the site's final storage capacity. Conversely, better soils than anticipated within the area will allow for steeper side slopes than anticipated, which would increase the dike's capacity. With the addition of sufficient data, a more accurate cost element can be developed. Since adequate site data and an understanding of final permit requirements is currently unavailable, this prevents accurately determining the exact project requirements as well as the final design. However, Wood's familiarity with the project put this risk at likely less than a 25% to 50% inaccuracy.

Prior to proceeding with any capping efforts, Wood recommends addressing both stormwater and groundwater inputs to the lake. Unless these nutrient-rich organic sediments and soluble nutrient loads are controlled, Lake Bonnet will continue to collect particulates which will release nutrients. As an alternative, the City may also construct a deep and broad sump near the major stormwater outfalls and commit to regularly dredging these collection points and permit this as a stormwater quality improvement project.

11.0 <u>NATURAL SYSTEMS IN-LAKE RESTORATION OPTIONS</u>

11.1 Wetland Fringe Hydration Option

Natural resource restoration options are also considered as an integral component of a comprehensive lake restoration plan. Natural system restoration would include reintegration of hydraulic connectivity with the wetlands on the eastern shore of the lake to the greatest extent possible. This could be incorporated into the ongoing park planning and design. Treated stormwater and/or water that would typically discharge out of the lake from the Lake Bonnet Drain could be routed back into the wetland fringe to rehydrate the wetlands and provide additional treatment prior to discharging back into the lake. The wetland footprint may need to be reconfigured to a certain extent if this concept is determined to be feasible. In addition, the Lake Bonnet outfall structure will be evaluated for possible modifications so that water levels can stage up higher in the lake. The intent of this dual lake level raising, and wetland treatment concept is to provide multiple water quality benefits to the lake, which includes: 1) dilution from the added flow volume, 2) enhancement of the lake-wetland fringe connectivity, and 3) hydration and restoration of the hydroperiod of the existing wetlands. The lake will also benefit from greater flushing with higher quality water. And, finally there is an added potential benefit of reducing flooding downstream of the lake. To determine if this concept is feasible, additional hydraulic and hydrologic modeling is required to evaluate flooding impacts from raising lake levels. Hydrologic and hydraulic modeling was not included as a scope item for this project. If this concept is deemed to be permittable and desired by the City, then a separate scope to conduct additional modeling as part of a more in-depth feasibility study could be submitted to the City.

11.2 Aquatic Vegetation Enhancement Option

The comprehensive restoration plan should also include aquatic plant enhancement once other more engineered concepts have taken place (i.e. dredging, capping of sediments, stormwater BMPs, wetland re-hydration, etc.). Enhancement of aquatic vegetation communities and habitat would improve the potential for the lake to eventually meet the biological NNC (Lake Vegetation Index, LVI). This is an important concept since water quality and sediment restoration alone may not induce sufficient conditions for the desired biological communities to respond in a reasonable time frame which may also provide opportunity for undesirable nuisance and exotic species.

The shorelines along the western half of the lake have been altered and now only support patchy desirable shoreline and littoral vegetation, and no submerged aquatic vegetation (SAV). Restoration of a more natural shoreline will provide water quality and water clarity improvement. Full shoreline restoration would require removal of undesirable vegetation, seawalls, and re-grading of steep banks, followed by supplemental planting and continued exotic and nuisance plant control. The northwestern and southwestern shorelines are currently under private ownership, which could potentially pose issues if the owners of the properties are not willing to engage in a public-private partnership to allow restoration to occur on their property. Existing seawalls on the north side and steep banks along south shore will pose additional challenges. If the City decides to pursue this restoration option, an access agreement or easement will be needed to allow construction to occur on a small linear stretch of the shoreline. This type of public-private partnership has begun to occur in other places in Florida, where municipalities and the water management districts have approached landowners for shoreline access to conduct living shoreline restoration. The west side of Lake Bonnet is under public ownership with a gradual sloping shoreline; therefore, construction can occur within the public parcel boundary unhindered.

Due to the complexities involved in the use of the adjacent properties, the recommended restoration of these shorelines along the private parcels involves the creation of a fringing wetland waterward of the property lines avoiding the seawalls and steep bank areas. This will involve the placement of sandy material dredged from the lake bottom along these areas to create a wetland bench sloping into the lake from there. The resulting shoreline would then be planted with desirable species as in the full restoration scenario. While this approach will avoid direct use of the private parcels, outreach to these stakeholders will be necessary. It is further recommended that corridors or viewing windows in the vegetated shorelines be incorporated into the design to maintain riparian property access. Increased interest of riparian property owners in water access post lake restoration should be considered in the final planting plans to allow for future dock installation.

A conceptual shoreline planting plan was developed and is depicted on **Sheet E6** of **Appendix E**. This assumes full cooperation with riparian property owners. The planting profile in **Sheet E8** includes a shrub and forested riparian shoreline located at and above the water line that transitions waterward to open water sequentially through a forested bald cypress zone, emergent littoral zone and a floating-leaved and submersed aquatic vegetation (SAV) zone.

The shrub and forested riparian zone will help produce a deep root zone greater than that provided by the existing mowed grass that will reduce the inputs of nutrients through shallow water seepage from upslope yards. The leafy shrub and tree cover will have the added value of providing greater wildlife habitat value compared to the existing mowed grass or exotic vegetation.

Restoration costs of the replanting efforts, based on similar projects, should average $77 per linear foot of shoreline for a full tree to SAV planting zone. Extending this cost along the entire 4,300 feet of western shoreline results in a planting cost of roughly $330,000. Volunteer efforts to provide plant installation labor may reduce this by 50% or more. Removal of seawalls and re-grading of steep banks will substantially increase overall restoration costs and are not recommended or deemed necessary to achieve the desired results. Exotic and nuisance plant removal and replanting of desirable species is recommended along the shoreline of the private parcels if stakeholders agree.

12.0 SUMMARY OF RESTORATION OPTIONS

A summary of restoration costs and load reductions is provided in **Tables 12-1 and 12-2**. It should be noted that estimated costs and load reductions were based on limited data and additional data will be needed to confirm these values during design. Based on the various sources contributing nutrient loads to the lake, it was estimated that the total annual load to the lake was 140,546 lbs TN and 27,498 lbs TP. Loads to the lake by source and reductions by source are provided in **Table 12-1**. Assuming that the proposed dredging project (30 acres complete dredging down to hard bottom), along with sediment chemical inactivation (with partial dredge of 49 acres down to 135′ elevation), stormwater and groundwater BMPs are implemented, the total loads would be reduced by 29%, and 76% for TN and TP. As shown in the table, reducing the sediment internal nutrient loading source via dredging and chemical inactivation would provide the greatest load reduction since sediment is contributing approximately 62% and 93% of the total TN and TP loads.

Table 12-1 – Estimated Load to Lake and Associated Load Reductions

Loads to Lake	TN (lb/yr)	TP (lb/yr)	% of Total TN Load	% of Total TP Load
Total Sediment Load to Lake	86,882	25,666	62%	93%
Total Stormwater Load to Lake	4,858	800	3%	3%
*Total Groundwater Load to Lake	48,806	1,032	35%	4%
****Total Loading to Lake**	**140,546**	**27,498**	**100%**	**100%**
Loads Removed by Source	**TN (lb/yr)**	**TP (lb/yr)**	**% of Total TN Load Removed**	**% of Total TP Load Removed**
Sediment Load Removed by 100% Dredging for 30 acres	32,993	9,747	23%	35%
Sediment Load Removed by Phoslock Application for 49 acres	4,949	10,723	4%	39%
***Stormwater Load Removed by BMPs	2,111	378	2%	1%
Groundwater Load Removed by BMPs	342	18	0.2%	0.1%
Total Load Removed	**40,395**	**20,866**	**29%**	**76%**

Note: *Total groundwater load to lake is the calculated mean of the estimated ranges provided in Section 1.10.4.
**From sediment, stormwater, and groundwater only, not including load from direct atmospheric deposition.
***Assuming treatment of drainage basins: C0020, C0040, C0060, C0080, C0100, and C0101.

A variety of restoration opportunities are available to the City for Lake Bonnet. Stormwater best management practices (BMPs) can be implemented to minimize or eliminate continuous sources of external pollution. Capping and/or targeted removal of muck sediments through excavation or dredging operations is another option and addresses the largest source of nutrients within the lake which may promote lake restoration by reducing internal pollutant loading from legacy sources. Water quality benefits may also be realized by improving Lake Bonnet's hydrology through management of the normal pool water elevation, which could limit nutrient inputs from seepage sources. Natural resource restoration options should also be considered to provide a comprehensive lake restoration plan. Natural system restoration would include reintegration of hydraulic connectivity with the wetlands on the eastern shore of the lake to the greatest extent possible. Treated stormwater and/or water that would typically discharge out of the lake from the Lake Bonnet Drain could be routed back into the wetland fringe to rehydrate the wetlands and provide additional treatment prior to discharging back into the lake. The restoration plan should also include aquatic plant restoration once other more engineered concepts have taken place (i.e. dredging, capping of sediments, stormwater BMPs, wetland re-hydration, etc.). Enhancement of aquatic vegetation communities would improve the potential for the lake to eventually meet the biological criteria (Lake Vegetation Index, LVI). Since water quality and sediment restoration alone may not induce sufficient conditions for the desired biological communities to respond in a reasonable time frame.

In addition, restoration concepts of the lake should also include a thorough evaluation of hydrologic factors to help improve the lake's water quality and natural systems (i.e. in-lake and surrounding wetland ecological integrity). The 2017 Lake System Hydraulic Management Plan report found that chlorophyll-a and lake levels were highly inversely correlated. This suggests that if lake levels are increased to a sufficient elevation, then water quality may be improved. This could be a function of several factors such as dilution, and/or the potential to reduce groundwater inflows via seepage from the contaminated surficial groundwater aquifer. A summary of estimated restoration concept costs is provided below in **Table 12-2**, a more detailed Opinion of Probable Costs is provided in **Appendix F**.

Table 12-2 – Estimated Opinion of Probable Cost Summary

Description	Estimated Costs
Engineering Costs	$864,000
General Items	$573,500
Sediment Dredging and Capping	$13,685,125
Natural Resource Enhancements	$715,475
Stormwater BMPs	$1,662,500
Groundwater BMPs	$549,000
Total	**$21,510,000**

Note: Restoration Costs include 20% contingency

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APPENDIX A

Geotechnical Data Report

CITY OF LAKELAND
LAKE BONNET GEOTECHNCIAL DATA REPORT
APPENDIX A

Prepared for

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Prepared by

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Wood Project No. 600537.5

September 2018

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1.0 INTRODUCTION

1.1 Project Summary

The City of Lakeland has been working to improve the quality of water in Lake Bonnet. Lake Bonnet has undergone long-term sedimentation, which has drastically reduced the lake volume from its original capacity. The quality of the lake water has also been greatly reduced due to three potential sources of pollutants. Currently, the lake is not meeting the Florida Department of Environmental Protection's (FDEP) numeric nutrient criteria (NNC) for biology (i.e. aquatic vegetation). To meet the NNC, it will be necessary to reduce the storm water inputs that are acting as a possible pollutant sources, remove sediments through dredging operations, and raise lake levels. The project area is located just northwest of downtown Lakeland, in west-central Polk County, as shown in **Appendix E, Figure A-1.**

The City of Lakeland requested Wood Environment and Infrastructure Solutions, Inc., (Wood) to perform a scope of services to assist in the assessment of the extent of sedimentation within Lake Bonnet. This scope of services includes a geotechnical evaluation of the proposed dredge area (Task 5A). This evaluation occurred from April 2 and April 9, 2018, in general accordance with the FDEP's "Indian River Lagoon Basin Management Action plans (BMAP), Muck Removal Project Credit Guidance" (September 2012). Consistent with the guidance, Wood collected data across 4 transects spanning the width of Lake Bonnet, as shown in **Appendix E, Figure A-2**. The geotechnical investigation was performed to determine the extents and thickness of the fine-grained organic sediment (muck) layer(s); and to characterize the physical properties of the muck and underlying sandy layers. The purpose of this geotechnical investigation was to develop data to support the delineation of the project dredging limits.

1.2 Investigation Program

Wood's field and laboratory investigation program included the following:

- Developed a sediment sampling plan based on Florida Department of Environmental Protection (FDEP) guidance documents for muck removal.
- Performed twelve continuous core samples using an electric vibracore system in accordance with ASTM D 4823.
- Collected piston tube samples within the muck layer at sixteen locations.
- Logged and classified recovered sediment samples in general accordance with visual manual classification method (ASTM D 2488) and the Unified Soil Classification System (USCS) (ASTM D 2487).

2.0 PROJECT SITE CHARACTERISTICS

2.1 Project Limits and Site Description

Lake Bonnet encompasses a surface area of approximately 79 acres, and is located northwest of downtown Lakeland, in central Polk County, Florida. The southern and western banks of the lake are lined with residential structures and roads, while the northern and eastern banks are bounded by vegetation. The water elevation is controlled by a discharge structure located along the western side of Lake Bonnet. The western lake boundary is formed by the North Brunnell Parkway embankment. Land use in the surrounding areas of the lake has evolved over time. Areas North of the of the lake were owned by CSX, and operated as a railway switchyard, refueling depot, and maintenance yard. In the same general area, People's Gas operated a coal gasification plant. Since both facilities have been decommissioned, the FDEP has designated the property as a Brownfield site.

2.2 Polk County Soil survey

The Natural Resources Conservation Services (NRCS) Soil Survey Map was reviewed to better understand the near-surface soils near Lake Bonnet. The United States Department of Agriculture (USDA) NRCS Web Soil Survey (2018) for Polk County was reviewed for the project site, as shown in **Attachment A**. The mapped soil units at the site were identified as Samsula muck (Map Unit Symbol 13), Sparr sand (Map Unit Symbol 14), Smyrna and Myakka fine sands (Map Unit Symbol 17), Immokalee sand (Map Unit Symbol 21), Adamsville fine sand (Map unit Symbol 31), Hontoon muck (Map unit Symbol 35), Sparr-Urban land complex (Map Unit Symbol 55), Arents-urban land complex (Map Unit Symbol 59), and Arents, organic substratum urban land complex (Map Unit Symbol 61).

The north and east banks of Lake Bonnet predominantly consist of Hontoon muck and Samsula muck, with Adamsville fine sand further to the north and east, approaching the perimeter of the lake boundary. The south and west banks of Lake Bonnet predominantly consist of Sparr sand, with variances in urban land complexes.

2.3 Geology

The Lake Bonnet site is located in the Polk Upland, a geologic feature that occurs within the majority of Polk County, and is bounded by the Gulf Coastal Lowlands to the West, the Western Valley to the North, the DeSoto Plain to the South, and the Lake Wales Ridge to the East (Campbell, 1986). The Polk Upland is characterized by surface and near-surface sediments consisting of quartz sand, clay, phosphorite, limestone, and dolomite, ranging in age from late Eocene to Holocene. The first recognizeable lithostratigraphic unit occurring below these near-surface sediments is the Hawthorn Group, Arcadia Formation, Tampa Member, of the Miocene/Oligocene age. The Tampa Member can reach thicknesses of up to 50 feet, and is composed of limestone with subordinate dolostone, sand, and clay. Underlying the Hawthorn Group, Arcadia Formation, Tampa Member is the Suwannee Limestone of the Oligocene age. The Suwannee Limestone can reach thicknesses up to 150 feet, and is characterized by being white, cream, or tan, variably textures, fossiliferous, poorly to well indurated and variably recrystalized, with localized dolimitized or silicified zones. The Suwannee Limestone rests on top of the Ocala Group, which consists of three limestone formations, which in acending order are the Inglis, Williston, and Crystal River formations. The limestone formations of the Ocala Group reach thicknesses of 90-150 feet, and primarily consist of white, to cream, to dark brown, granular to chalky, fossiliferous, poorly to well indurated limestone and dolomite, and is known for its very high permiability (USGS, 2018). The regional geology of Polk County in the general vicinity of Lke Bonnet is presented below in **Table A-1.**

Table A-1 – Generalized Stratigraphic Units

Geologic Age	Stratigraphic Unit	Approximate Thickness (ft)	General Lithologic Character
Holocene (Recent)	Holocene Sediments	0-5	Quartz sands, carbonate sands and muds, and organics.
Pleistocene/ Holocene	Undifferentiated Sediments	0-100	Fine to coarse sands with silts, clay, and marl.
Pleistocene/ Pliocene	Reworked Cypresshead Sediments	0-20	Fine to coarse grained quartz sands with gravel and clay.
	Dunes	0-20	Fine to medium grained quartz sand.
Pliocene	Cypresshead Formation	100-200	Very fine to very coarse grained clean to clayey sands.
Miocene/ Oligocene	Hawthorn Group, Arcadia Formation, Tampa Member	0-50	Limestone with subordinate dolostone, sand, and clay.
Oligocene	Suwannee Limestone	0-150	Fossiliferous, vuggy to moldic limestone with finely to coarsely crystalline dolostone.
Eocene	Ocala Limestone	100	Porous, marine limestone, soft, granular to chalky, highly fossiliferous.

3.0 <u>SURVEYING AND SAMPLING PROGRAM</u>

3.1 Bathymetric Survey

A bathymetric was conducted over the project area between March 6 and 17, 2018. The survey points were collected using hand probe soundings every 100 feet along 200-foot spaced north-south transects. The bathymetric survey points are shown on **Appendix E, Figure 2**. The bathymetric soundings were located and measured utilizing Global Positioning System (GPS) technology operating in Real Time Kinematic (RTK) mode from a fixed base station. Project datums were the North American Datum of 1983/2011 Adjustment (NAD 83/11) and the North American

Vertical Datum of 1988 (NAVD 88) with horizontal positions expressed in the Florida State Plane Coordinate System, Florida West Zone (902), in US Survey Feet and elevations in Feet.

The soundings were completed using a calibrated steel rod with a 2-inch diameter foot at each grid point to identify the approximate top of sediment, noted as the level of first resistance, and then pushed by hand to refusal. Refusal from the bathymetric soundings is not considered the definitive hard bottom (natural sandy substrate) as the hand probes can reflect refusal in denser sandy layers within the soft sediment column, particularly where soft muck sediments extend deeper than 10 feet from the top of the sediment surface. During the bathymetric survey, Lake Bonnet's level was recorded at elevations between +143.97 and +144.10 feet, an average lake level of +144.0 feet was utilized for determination of the sediment levels and volumes.

3.2 Vibracore Borings

Vibracore borings were completed within Lake Bonnet at twelve (12) locations as shown on **Appendix E, Figure A-2**. The collection of vibracores was performed by Amdrill, Inc. (Amdrill) of Orlando, Florida between April 3 and 4, 2018. Amdrill utilized a 34-foot long and 10-foot wide aluminum work boat with the electric vibracore head mounted to an A-frame platform. The vibracore borings were performed in general accordance with ASTM D 4823 (Section 6) - "Standard guide for core sampling submerged, unconsolidated sediments". The sampling was performed under the supervision of a Wood field geologist. Three vibracores were completed along each of the four sampling transects as shown on **Appendix E, Figure A-3**.

Before coring, all vibracore locations were hand probed with a ½-inch steel rod to determine the approximate top of sediment. The vibracores were advanced until the rig operator detected a change in vibration frequency and push rate, which was inferred as hard bottom (natural sandy strata). The core borings were advanced by vibrating a new 4-inch diameter aluminum core liner. After the liner was removed from the boring, it was sealed and labeled with boring identification number and depth. On completion, the boring locations were surveyed to determine the horizontal coordinates (NAD 83). The vibracore location and sediment level data is summarized on **Table A-2**.

Table A-2 - Vibracore Locations and Sediment Levels

Vibracore Number	Northing (ft)	Easting (ft)	Average Lake Water Elevation (NAVD, ft)	Top of Sediment Recovery Elevation (ft)	Top of Hard Layer Elevation (ft)
VC 1-1	1349830.4	662941.3	+144.0	+138.0	- (1)
VC 1-2	1349608.3	663443.0	+144.0	+138.0	+137.3
VC 1-3	1349386.2	663935.9	+144.0	+139.0	+136.3
VC 2-1	1350194.0	663165.2	+144.0	+138.0	+136.4
VC 2-2	1349982.0	663658.0	+144.0	+138.0	+137.0
VC 2-3	1349739.7	664150.8	+144.0	+138.5	+123.3
VC 3-1	1350497.0	663469.8	+144.0	+138.0	+134.8
VC 3-2	1350274.9	663962.6	+144.0	+138.5	+132.3

Vibracore Number	Northing (ft)	Easting (ft)	Average Lake Water Elevation (NAVD, ft)	Top of Sediment Recovery Elevation (ft)	Top of Hard Layer Elevation (ft)
VC 3-3	1350073.1	664527.1	+144.0	+139.0	+129.5
VC 4-1	1350931.3	663622.0	+144.0	+139.0	+136.0
VC 4-2	1350769.8	664016.2	+144.0	+139.0	+130.9
VC 4-3	1350557.8	664428.4	+144.0	+139.0	+123.7

(1) VC 1-1 did not encounter soft muck deposits (Stratum 1), refer to section 5.

The core samples were transferred to Wood's Tampa, Florida materials testing laboratory for logging and laboratory testing. Wood engineers and geologists familiar with soil classification logged the cores in the laboratory in general accordance with ASTM D 2488 (Visual-Manual Description of Soils). The vibracore boring logs are presented in **Attachment B**. The vibracore photographs are shown in **Attachment C**.

3.3 Piston Tube Sampling

Piston tube sampling was completed in Lake Bonnet at sixteen (16) locations shown on **Appendix E, Figure 2**. The piston tube sampling was performed between April 6 and April 9, 2018 by a Wood field crew. Piston tube samples were collected from a 17-foot Carolina Skiff.

The piston tube sampler is comprised of a stainless steel thin-walled, 2-inch diameter by 18-inch long sampling tube with 5-foot long threaded rod extensions. The sampler is advanced by hand and typically cannot penetrate a relatively dense muck or sand layer given the diameter and length of the sampling tube. Prior to sampling, all piston tube locations were hand probed with a ½-inch diameter steel rod to determine the approximate top of sediment and thickness of the soft muck layer. The piston sampling was performed over discreet depth intervals, typically 2- to 4-foot thick zones within the sediment layer, to collect composite samples for subsequent logging and testing. All samples were placed into sealed jars and buckets and labeled with sample identification numbers and depths.

The elevation of the sediment surface at each sampling location was recorded by measuring the depth of the sampler from the water surface to the top of sample extraction zone. Wood surveyed the location of each piston tube sample using a handheld Garmin GPS 72 model with a horizontal accuracy of +/- 2 feet (NAVD 88). The location data was collected in Graphic Coordinate System (GCS) WGS 1984 (NAD 83). The top of sediments and sampling zone elevations for each piston tube are summarized in **Table A-3.**

Table A-3 - Piston Tube Locations and Sediment Levels

Piston Tube	Northing (ft)	Easting (ft)	Average Lake Water Elevation (NAVD, ft)	Top of Sediment Elevation (ft)	Bottom Sampling Elevation (ft)
PT 1-1	1349960.4	662699.9	+144.0	+138.0	+137.0
PT 1-2	1349702.8	663138.0	+144.0	+138.0	+137.5
PT 1-3	1349513.8	663615.4	+144.0	+138.0	+135.0
PT 1-4	1349288.5	664112.2	+144.0	+138.5	+131.5
PT 2-1	1350149.9	662796.1	+144.0	+138.0	+137.5
PT 2-2	1350077.6	663418.5	+144.0	+138.0	+134.0
PT 2-3	1349848.3	663902.5	+144.0	+138.0	+132.0
PT 2-4	1349568.5	664463.7	+144.0	+139.0	+115.0
PT 3-1	1350575.3	663237.9	+144.0	+138.0	+134.5
PT 3-2	1350382.7	663689.5	+144.0	+138.0	+130.0
PT 3-3	1350198.6	680429.1	+144.0	+138.0	+127.0
PT 3-4	1350026.6	664641.1	+144.0	+139.0	+124.0
PT 4-1	1350957.1	663512.0	+144.0	+139.0	+133.0
PT 4-2	1350867.7	696137.0	+144.0	+139.0	+131.0
PT 4-3	1350653.4	683600.0	+144.0	+138.5	+123.0
PT 4-4	1350456.1	664627.5	+144.0	+138.0	+121.0

Four piston tube samples (PT 1-1, PT 2-2, PT 3-3 and PT 4-4) were transferred to Wood's Tampa, Florida materials testing laboratory for logging and laboratory testing, samples from twelve (12) vibracore locations were transferred to Advanced Environmental Laboratories (AEL) for geo-chemical testing. Wood engineers and geologists familiar with soil classification logged the cores in the laboratory in general accordance with ASTM D 2488 (Visual-Manual Description of Soils). The piston tube sampling logs are shown in **Attachment D.**

4.0 <u>SEDIMENT LABORATORY TESTING AND LOGGING</u>

4.1 Laboratory Testing

Selected sediment samples collected from the vibracore borings and piston tube samplings were tested for index parameters to determine sediment composition and assist with soil classification. The tests included the following:

- Natural moisture content (ASTM D 2216)
- Mechanical gradation (ASTM D 422)
- Percentage of sediment passing the No. 200 sieve by wet wash method (ASTM D 1140)
- Atterberg Limit Tests (ASTM D 4318)

- Organic Content (ASTM D 2974)
- Specific Gravity (ASTM D 874)
- Hydrometer (ASTM D 7928)

The laboratory test data and results are shown in **Attachment E** and results are summarized on the vibracore and piston tube logs in **Attachment B** and **D,** respectively. **Tables A-4** and **A-5** present a summary of the lab test data for each soil stratum for the vibracores and piston tube samples.

Table A-4 - Laboratory Test Data Summary by Strata from Vibracore Samples

Stratum No.	Description	Moisture Content (%)	% Finer #200 Sieve	Organic Content (%)	Plasticity Index (%)
1	Muck Deposits (Organic Silts, Organic Silts with Sands and Sandy Organic Silts)	68% - 765%	30% - 92%	8% - 45%	N/A
2	Sands and Silty Sands	11% - 37%	2% - 42%	1% - 2%	NP
3	Sandy Clays and Clayey Sands	21%	45% - 65%	N/A	27 - 40

Table A-5 - Laboratory Test Data Summary by Strata from Piston Tube Samples

Stratum No.	Description	Moisture Content (%)	% Finer #200 Sieve	Organic Content (%)	Plasticity Index (%)
1	Muck Deposits (Organic Silts, Organic Silt with Sands and Sandy Organic Silts)	520% - 1196%	53% - 68%	20% - 45%	N/A

4.2 Sediment Logging

Upon completion of laboratory testing, the visual sediment descriptions were reviewed and classified in general accordance with the Unified Soils Classification System (ASTM D 2487). The USCS system is based on percentage of dry mass of the range of particle sizes (sand, gravel, silt, and clay) in a soil sample and the plasticity (Atterberg Limits – ASTM D 4318) of the fines. Based on visual classification, the organic muck sediments were assessed as being non-plastic.

The 4-inch diameter core samples recovered from the vibracore borings were split in the laboratory and logged. The split core samples were labeled and photographed with demarcation of visual changes in stratigraphy. Details of the sediment core profile at the specific vibracore locations are shown on the boring logs and photographs in **Attachment B** and **C,** respectively.

The description of the bulk samples recovered from the piston tube sampling were reviewed based on the laboratory test and the logs are present in **Attachment D**.

The soil descriptions represent Wood's interpretation of the subsurface conditions based on the vibracore and piston tube sampling logs and a visual re-examination of the samples by a geotechnical engineer in our laboratory. It should be noted that the actual transition between strata may be gradual. The computer generated boring logs should imply no increased accuracy.

5.0 SEDIMENT STRATIGRAPHY AND PROFILES

5.1 Sediment Stratigraphy

Based on the findings of the investigation and laboratory testing, three generalized strata were identified within the Lake Bonnet project area. The generalized strata are grouped by similar description and physical characteristics as described below:

- *Stratum 1 – Muck (Organic Silts, Organic Silts with Sands and Sandy Organic Silts)*

The Muck layer was identified as very soft, spongy brown to black organic silts (OL) and very soft to soft, grayish brown to black organic silt with sands (OL) and sandy organic silts (OL). This stratum is characterized by a spongy and loose texture with a noticeable organic odor. Thin (less than 1 inches) lenses of sand were observed throughout the Muck strata. This stratum was observed between 4 feet and 19 feet below the lake water surface. The Muck stratum was typically encountered as the top surface sediment layer varying in thickness from 0.3 ft to 15.3 ft. The fines content was measured between 30% and 92%, with corresponding organic content between 8% and 45%. The moisture content ranged between 68% and 765%. The consistency of the Muck stratum was assessed based on criteria presented in ASTM D 2488 (**Table A-4**) which relates depth of (finger) penetration to strength descriptors such as very soft, soft, and firm. The consistency of this stratum varied between very soft and soft.

- *Stratum 2 – Sands, Sands with Silts and Silty Sands*

Beneath Stratum 1, a stratum composed of silty sands, sands with silts, and sands was identified. This stratum was typically observed from 5 feet to 23 feet below lake water surface and varied in thickness typically from 0.1 foot to 5.3 feet in the borings. It is interpreted to be the natural substrate prior to deposition of the muck sediments. The USCS classification within the strata included fine sands (SP), sands with silts (SP-SM) and silty sands (SM). The sands varied in color from very dark grayish brown, to very pale brown to very dark grayish to white. The fines content ranged between 2% and 42%, organic content between 1% and 2% and moisture contents between 11% and 37%.

➢ *Stratum 3 – Sandy Clays and Clayey Sands*

Beneath Stratum 2, a stratum composed of sandy clayey and clayey sand was identified The USCS classification within the strata included low plasticity to high plasticity (CL to CH) sandy clays and clayey sands (SC). The stratum was observed from 8 feet to 16 feet below the lake water surface and varied in thickness from 0.3 feet to 5.3 feet (limited by vibracore drilling depth). The fines content ranged between 45% and 65% with moisture content values of 21%.

➢ *General Strata Observations*

Some significant observations on the sediment stratigraphy include:

- The Muck deposit (Stratum 1) thickness increases in depth approaching the east boundary of the lake, extending between 5 feet and 22 feet below lake water surface.
- Vibracore 4-3 had an intermediate layer of sand (Stratum 2) at 19.3 feet deep. The very soft organic silt (OL) reappeared at 20.2 feet deep. The sandy layer may represent the original lake bottom with underlying natural organic sediments (as opposed to run-off sediments)
- The sandy soil (Stratum 2) thickness is greatest in the middle of the lake, varying between 2.3 feet and 5.3 feet. The Stratum 2 thicknesses decreased approaching the north-east boundary of the lake.
- Piston Tubes PT 3-3, PT 3-4, PT 4-3 and PT 4-4 did not encountered sands (Stratum 2) immediately below Stratum 1, they encountered clayey soils (Stratum 3).

5.2 Sediment Profiles

Due to the differences in probing and sampling methods (bathymetric soundings, vibracores and piston tubes) as described above, a difference in the top of sediment surface of approximately 6 inches to 2 feet was observed throughout the project area. The differences are attributed to the size of the probing equipment varying from ½-inch diameter probe rods, 2-inch diameter piston tube sleeves and 4-inch-diameter vibracore barrels, along with the operator interpretation of the top of the fluid to very soft sediment surface. The top of sediment surface was adjusted to account for the surveying and sampling variations and normalized to an average lake water elevation of +144.0 feet.

Appendix E, Figure 4 presents the muck deposit thicknesses (Stratum 1) encountered by the vibracores and the piston tubes along with a definitive hard sandy bottom where encountered. In general, the muck deposits are thicker along the north-east and south-east boundaries of the lake, predominantly ranging from approximately 8 feet to 15 feet, and up to 24 feet at PT 2-4. The muck deposit thickness decreases towards the south-west boundary of the lake, typically ranging in thickness from approximately 0.5 feet to 4 feet. **Appendix E, Figures 5** to **8** present the stratigraphy of the lake sediments along the sampling transects (**Appendix E, Figure 3**).

6.0 CLOSING AND LIMITATIONS

The vibracore and piston tube sampler logs represent the subsurface conditions at the specific location at the time of the exploration along the previously discussed sampling transect (**Appendix E, Figure 3**). The subsurface conditions at other locations may differ, and no warranty as to the subsurface conditions elsewhere is neither expressed nor implied by the data presented herein. Furthermore, the depths of the vibracores and piston tube samplers, designating the interface between the various soils, are only approximate boundaries where the transition is gradual or could not be detected by the boring operations. In addition, the water and sediment elevation are only indicative of the conditions at the time of the investigation as water and sediment levels may fluctuate significantly because of numerous factors.

7.0 REFERENCES

Campbell, Kenneth M., (1986), Geology of Polk County, Florida, Florida Geological Survey, Tallahassee, Florida.

United States Department of Agriculture (USDA), Custom Soil Resource Report for Polk County, Florida, (Lake Bonnet Area), April 17, 2018.

United States Geological Survey (USGS), Geologic Units in Polk County, Florida, April 24, 2018.

ATTACHMENT A

Site Geology

United States
Department of
Agriculture

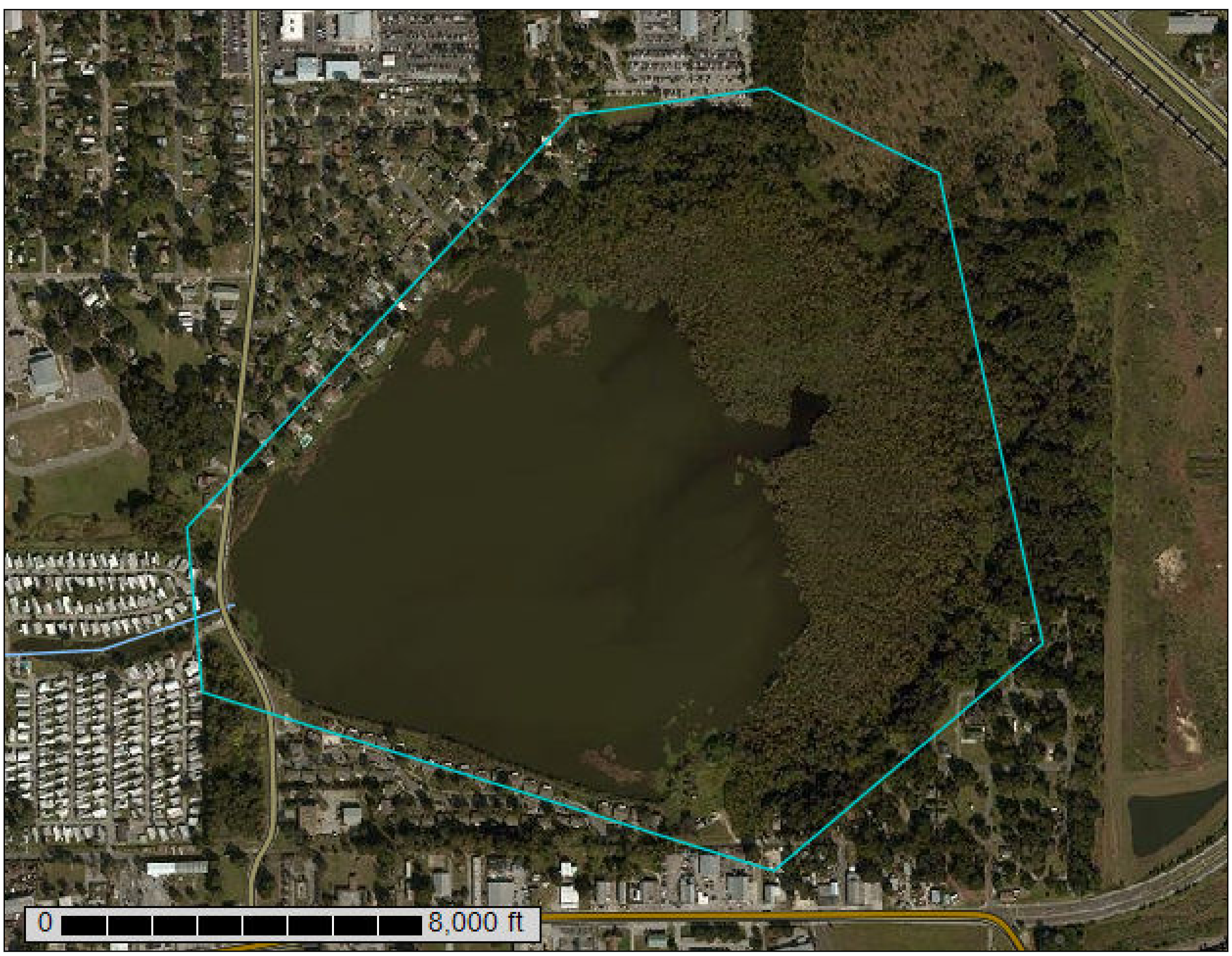
NRCS

Natural
Resources
Conservation
Service

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

Custom Soil Resource Report for

Polk County, Florida



April 17, 2018

Soil Map


81° 59' 6" W
81° 57' 57" W
28° 3' 14" N
28° 2' 34" N
403200
403400
403600
403800
404000
404200
404400
404600
404800
405000
3103500
3103300
3103100
3102900
3102700
3102500
Candyce St
N Swindell Ave
N Ruth Ave
35a
Dawn St
Lake Bonnet Dr
W Chase St
Devane St
92
14
17
13
31
59
55
35
99
13
61
13
14
21
Soil Map may not be valid at this scale.
N
Map Scale: 1:8,610 if printed on A landscape (11" x 8.5") sheet.
Meters
0 100 200 400 600
Feet
0 400 800 1600 2400
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Polk County, Florida
Survey Area Data: Version 15, Oct 6, 2017

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

Date(s) aerial images were photographed: Nov 28, 2014—Dec 9, 2014

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
13	Samsula muck, frequently ponded, 0 to 1 percent slopes	10.6	5.6%
14	Sparr sand, 0 to 5 percent slopes	31.4	16.6%
17	Smyrna and Myakka fine sands	1.6	0.8%
21	Immokalee sand	3.0	1.6%
31	Adamsville fine sand, 0 to 2 percent slopes	21.6	11.4%
35	Hontoon muck, frequently ponded, 0 to 1 percent slopes	26.1	13.8%
55	Sparr-Urban land complex, 0 to 5 percent slopes	2.3	1.2%
59	Arents-Urban land complex, 0 to 5 percent slopes	4.6	2.4%
61	Arents, organic substratum-Urban land complex	3.8	2.0%
99	Water	84.1	44.5%
Totals for Area of Interest		**189.1**	**100.0%**

ATTACHMENT B

Vibracore Survey Data and Logs

Lake Bonnet Pollutant Source Reduction Feasibility Study - Vibracore Data Summary

Vibracore No.	Location		Lake Water Level Average Elevation (ft) (2) (3)	Lake Water Level Depth to top of sediment (ft)	Top of Sediment Recovery Elevation (ft) (4)	Top of Hard layer Elevation (ft)	Vibracore Recovery Bottom Elevation (ft)
	Northing (ft) (1)	Easting (ft) (1)					
VC 1-1	1349830.4	662941.3	144.0	6.0	138.0	-	133.6
VC 1-2	1349608.3	663443.0	144.0	6.0	138.0	137.3	133.3
VC 1-3	1349386.2	663935.9	144.0	5.0	139.0	136.3	133.0
VC 2-1	1350194.0	663165.2	144.0	6.0	138.0	136.4	130.9
VC 2-2	1349982.0	663658.0	144.0	6.0	138.0	137.0	134.0
VC 2-3	1349739.7	664150.8	144.0	5.5	138.5	123.3	120.4
VC 3-1	1350497.0	663469.8	144.0	6.0	138.0	134.8	130.5
VC 3-2	1350274.9	663962.6	144.0	5.5	138.5	132.3	127.7
VC 3-3	1350073.1	664527.1	144.0	5.0	139.0	129.5	126.7
VC 4-1	1350931.3	663622.0	144.0	5.0	139.0	136.0	131.7
VC 4-2	1350769.8	664016.2	144.0	5.0	139.0	130.9	126.7
VC 4-3	1350557.8	664428.4	144.0	5.0	139.0	123.7	121.9

Notes:
(1) Florida State Plane East (NAD 83)
(2) 1988 North American Vertical Datum (NAVD 88), State Plane System Zone: FLORIDA EAST.
(3) Based on the bathymetric survey performed between 03/06/2018 and 03/17/2018
(4) VC 1-1 did not recover muck.

BORING NUMBER VC 1-1

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/4/18 **COMPLETED** 4/4/18
WATER ELEVATION 144 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AMDRILL, Inc
DRILLING LOCATION N1349830.4 , E662941.3
DRILLING METHOD Vibracore
∇ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	Depth	MATERIAL DESCRIPTION	Elev.
0					∇	Average lake water level (Elev. 144.0 ft)	
5					6.0'	Top of sediment recovery at elevation 138.0 ft.	138.0
	VC	MC = 37% #200 = 4% OC=1%	SP		6.8'	Very soft, Very dark brown, fine grained SAND (SP). (Munsell 10YR2/1)	137.2
	VC	MC = 17% #200 = 15%	SM		9.0'	White, fine grained SILTY SAND (SM). (Munsell 10YR8/1).	135.0
	VC	MC = 18% #200 = 6%	SP-SM		9.8'	Very dark greyish brown SAND with SILT (SP-SM). (Munsell 10YR3/2)	134.2
10	VC	LL = NP PL = NP #200 = 26%	SM		10.4'	Light greenish gray SILTY SAND (SM), with angular fragments (<3/8"). (Munsell 10YR8/1)	133.6

Bottom of borehole at 10.4 feet.

BORING NUMBER VC 1-2

wood.

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/4/18 **COMPLETED** 4/4/18
WATER ELEVATION 144 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AMDRILL, Inc
DRILLING LOCATION N1349608.3 , E663443
DRILLING METHOD Vibracore
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	Depth	MATERIAL DESCRIPTION	Elev.
0					▽	Average lake water level (Elev. 144.0 ft)	
5					6.0'	Top of sediment recovery at elevation 138.0 ft.	138.0
	VC	MC = 402% #200 = 72% OC=15%	OL		6.7'	Black, very soft, spongy, ORGANIC SILT (OL). (Munsell10YR2/1) Top of Hard Bottom at elevation 137.3 ft.	137.3
	VC		SP		8.0'	Very pale brown, SAND (SP). (Munsell 10YR8/2)	136.0
	VC	MC = 20% #200 = 6%	SP-SM		8.5'	Very dark greyish brown, SAND with SILT (SP-SM). (Munsell 10YR3/2)	135.5
	VC	MC = 18% #200 = 3%	SP		9.0'	Mottling very dark greyish brown to white, SAND (SP). (Munsell 10YR3/2)	135.0
10	VC	LL = 61 PL = 21 #200 = 63%	CH		10.7'	Very pale brown, desiccated SANDY CLAY (CH). (Munsell 10YR8/2).	133.3

Bottom of borehole at 10.7 feet.

BORING NUMBER VC 1-3

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/4/18 **COMPLETED** 4/4/18
WATER ELEVATION 144 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AMDRILL, Inc
DRILLING LOCATION N1349386.2 , E663935.9
DRILLING METHOD Vibracore
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	Elev.
0					▽	Average lake water level (Elev. 144.0 ft)	
5					5.0'	Top of sediment recovery at elevation 139.0 ft.	139.0
	VC	MC = 541% #200 = 62% OC=25%	OL			Soft, very dark brown ORGANIC SILT (OL) with trace wood fragments. (Munsell 10YR2/2).	
					7.7'	Top of Hard Bottom at elevation 136.3 ft.	136.3
	VC		SP		8.4'	Grayish yellow brown mottled to brownish black SAND (SP). (Munsell 10YR5/2 to Munsell 10YR3/2)	135.6
	VC	MC = 21% #200 = 4%	SP		9.3'	Very dark grayish brown SAND (SP). (Munsell 10YR3/2)	134.7
10	VC	MC = 19% #200 = 11%	SP-SM		9.9'	Grayish brown SAND with SILT (SP-SM). (Munsell 10YR5/2)	134.1
	VC	MC = 19% #200 = 3%	SP		11.0'	Very pale brown SAND (SP). (10YR8/2)	133.0

Bottom of borehole at 11.0 feet.

BORING NUMBER VC 2-1

wood.

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/4/18 **COMPLETED** 4/4/18
WATER ELEVATION 144 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AMDRILL, Inc
DRILLING LOCATION N1350194 , E663165.2
DRILLING METHOD Vibracore
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	Elev.
0					▽	Average lake water level (Elev. 144.0 ft)	
5					6.0'	Top of sediment recovery at elevation 138.0 ft	138.0
	VC	MC = 352% #200 = 61% OC=11%	OL		7.6'	Very soft, spongy, black ORGANIC SILT (OL). (Munsell 10YR2/1) Top of Hard Bottom at elevation 136.4 ft	136.4
	VC	MC = 17% #200 = 4%	SP		9.8'	Mottling very pale brown to very dark greyish brown fine grained SAND (SP). (Munsell 10YR8/2 to Munsell 10YR 3/2)	134.2
10	VC	MC = 14% #200 = 10%	SP-SM		11.3'	Very dark brown fine SAND with SILT (SP-SM). (Munsell 10YR2/2)	132.7
	VC	LL = 38 PL = 11 #200 = 51%	CL		13.1'	Light greenish gray SANDY CLAY (CL). (Munsell 8/1)	130.9

Bottom of borehole at 13.1 feet.

BORING NUMBER VC 2-2

wood.

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/4/18 **COMPLETED** 4/4/18
WATER ELEVATION 144 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AMDRILL, Inc
DRILLING LOCATION N1349982 , E663658
DRILLING METHOD Vibracore
GROUND WATER LEVEL AT TIME OF DRILLING 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	Depth	MATERIAL DESCRIPTION	Elev.
0						Average lake water level (Elev. 144.0 ft)	
5					6.0'	Top of sediment recovery at elevation 138.0 ft.	138.0
	VC	MC = 459%	OL		6.3'	Very soft, very dark brown SANDY ORGANIC SILT (OL). (Munsell10YR2/2)	137.7
	VC	#200 = 30% OC=30%	SP		7.0'	Very soft, Very pale brown fine grained SAND (SP). (Munsell 10YR8/3) / Top of Hard Bottom at elevation 137.0 ft.	137.0
	VC	MC = 20% #200 = 9%	SP-SM		7.7'	Gray fine grained SILTY SAND (SM). (Munsell 10YR4/1)	136.3
	VC		SP		9.0'	White fine grained SAND (SP). (Munsell 10YR8/1)	135.0
	VC		SM		9.7'	Gray fine grained SILTY SAND (SM) (Munsell 10YR4/1)	134.3
10	VC	MC = 21% LL = 52 PL = 20 #200 = 65%	CH		10.0'	Greenish gray SANDY CLAY (CH). (Munsell GLEY6/1)	134.0

Bottom of borehole at 10.0 feet.

BORING NUMBER VC 2-3

wood.

CLIENT City of Lakeland		**PROJECT NAME** Lake Bonnet Pollutant Source Reduction Feasibility Study	
PROJECT NUMBER 600537		**PROJECT LOCATION** Lakeland, Polk County, Florida	
DATE STARTED 4/3/18	**COMPLETED** 4/3/18	**WATER ELEVATION** 144 ft	**HOLE SIZE** 4 inches
DRILLING CONTRACTOR AMDRILL, Inc		**DRILLING LOCATION** N1349739.7 , E664150.8	
DRILLING METHOD Vibracore		▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft	
LOGGED BY CS	**CHECKED BY** LG	**HOLE COMPLETION**	
NOTES			

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	Elev.
0					▽	Average lake water level (Elev. 144.0 ft)	
5					5.5'	Top of sediment recovery at elevation 138.5 ft.	138.5
10	VC	MC = 521% #200 = 72% OC=28%	OL			Very soft, spongy, black ORGANIC SILT (OL). (Munsell 10YR2/1).	
					14.2'	At 14.2 ft, lens of Very dark grayish brown fine SILTY SAND (SM). (Munsell 10YR3/2). (Thickness < 1 inch)	129.8
15	VC	MC = 324% #200 = 50%	OL			Very soft, spongy black ORGANIC SILT (OL). (Munsell 10YR2/1)	
					18.1'		125.9
	VC	MC = 575% #200 = 50%	OL			Dark grayish brown ORGANIC SILT (OL). (Munsell 10YR4/2)	
					19.4'		124.6
20	VC	MC = 87%	OL		19.7'	Very soft spongy ORGANIC SILT (OL). (Munsell 10YR7/4 to Munsell 10YR2/1)	124.3

(Continued Next Page)

BORING NUMBER VC 2-3

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
20	VC	#200 = 92%	OL		Very soft spongy ORGANIC SILT (OL). (Munsell 10YR2/1) *(continued)*	
20.7'					Top of Hard Bottom at elevation 123.3 ft.	123.3
	VC	MC = 11% #200 = 20%	SM		Very dark brown fine SILTY SAND (SM). (Munsell 10YR3/2)	
23.6'						120.4

Bottom of borehole at 23.6 feet.

BORING NUMBER VC 3-1

wood.

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/4/18 **COMPLETED** 4/4/18
WATER ELEVATION 144 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AMDRILL, Inc
DRILLING LOCATION N1350497 , E663469.8
DRILLING METHOD Vibracore
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	Elev.
0					▽	Average lake water level (Elev. 144.0 ft)	
5					6.0'	Top of sediment recovery at elevation 138.0 ft.	138.0
	VC	MC = 323% #200 = 75% OC=17%	OL			Very soft spongy ORGANIC SILT (OL). (Munsell 10YR2/1)	
					9.2'	Top of Hard Bottom at elevation 134.8 ft.	134.8
10	VC		SP		10.2'	Yellowish brown fine SAND (SP). (Munsell 10YR5/6)	133.8
	VC		SP-SM		10.6'	Gray fine SAND with SILT (SP-SM). (Munsell 10YR5/1)	133.4
	VC	MC = 28% #200 = 20%	SM		11.8'	Very dark grayish brown fine SILTY SAND (SM). (Munsell 10YR3/2)	132.2
	VC	MC = 21% #200 = 2%	SP		13.5'	White fine grained SAND (SP). (Munsell 10YR2/1)	130.5

Bottom of borehole at 13.5 feet.

BORING NUMBER VC 3-2

wood.

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/4/18 **COMPLETED** 4/4/18
WATER ELEVATION 144 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AMDRILL, Inc
DRILLING LOCATION N1350274.9 , E663962.6
DRILLING METHOD Vibracore
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	Depth	MATERIAL DESCRIPTION	Elev.
0					▽	Average lake water level (Elev. 144.0 ft)	
5					5.5'	Top of sediment recovery at elevation 138.5 ft.	138.5
	VC	MC = 424% #200 = 72% OC=37%	OL		9.0'	Very soft black ORGANIC SILT (OL). (Munsell 10YR2/1)	135.0
10	VC	MC = 300% #200 = 54%	OL		11.7'	Very soft spongy grayish brown to black ORGANIC SILT (OL). (Munsell 10YR5/2 to 10YR2/1)	132.3
	VC		SM		12.4'	Top of Hard Bottom at elevation 132.3 ft. At 11.7, lens of Tan brown mottling to grayish brown fine grained SILTY SAND (SM). (Munsell 10YR8/3 to Munsell 10YR 5/2) (Thickness < 1 inch) Very dark gray fine grained SILTY SAND (SM). (Munsell 10YR3/1)	131.6
	VC	MC = 20% #200 = 23%	SM		13.3'	Brown fine grained SILTY SAND (SM). (Munsell 10YR5/3)	130.7
	VC		SM		14.3'	Gray fine grained SILTY SAND (SM). (Munsell 10YR5/1)	129.7
15	VC	MC = 22% #200 = 42%	SM		16.3'	Very dark brown fine grained SILTY SAND (SM). (Munsell 10YR2/2)	127.7

Bottom of borehole at 16.3 feet.

BORING NUMBER VC 3-3

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/4/18 **COMPLETED** 4/4/18
WATER ELEVATION 144 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AMDRILL, Inc
DRILLING LOCATION N1350073.1 , E664527.1
DRILLING METHOD Vibracore
GROUND WATER LEVEL AT TIME OF DRILLING 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					Average lake water level (Elev. 144.0 ft)	
5.0'					Top of sediment recovery at elevation 139.0 ft.	139.0
5.0'–10.0'	VC	MC = 531% #200 = 61% OC=23%	OL		Very soft black ORGANIC SILT (OL) with trace wood fragments. (Munsell 10YR2/1).	134.0
10.0'–14.5'	VC	MC = 494% #200 = 43% OC=28%	OL		Very soft, black ORGANIC SILT WITH SAND (OL). (Munsell 10YR2/1)	129.5
14.5'					Top of Hard Bottom at elevation 129.5 ft.. At 14.5 ft, lens of Very dark brown fine grained SILTY SAND (SM). (Munsell 10YR2/2). (Thickness < 1 inch)	
14.5'–17.3'	VC	MC = 21% #200 = 45%	SC		Dark gray, fine grained CLAYEY SAND (SC). (Munsell 10YR4/1)	126.7

Bottom of borehole at 17.3 feet.

BORING NUMBER VC 4-1

wood.

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/4/18 **COMPLETED** 4/4/18
WATER ELEVATION 144 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AMDRILL, Inc
DRILLING LOCATION N1350931.3 , E663622
DRILLING METHOD Vibracore
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	Elev.
0					▽	Average lake water level (Elev. 144.0 ft)	
5					5.0'	Top of sediment recovery at elevation 139.0 ft.	139.0
	VC	MC = 534% #200 = 49% OC=25%	OL			Soft, black ORGANIC SILT WITH SAND (OL) (Munsell10YR2/1)	
					8.0'	Top of Hard Bottom at elevation 136.0 ft.	136.0
	VC		SP-SM		8.7'	Brownish yellow fine grained SAND with SILT (SP-SM). (Munsell 10YR6/6)	135.3
10	VC	MC = 25% #200 = 6% OC=2%	SP-SM		10.3'	Very dark brown fine grained SAND with SILT (SP-SM). (Munsell 10YR2/2)	133.7
	VC	MC = 20% #200 = 5%	SP-SM		10.8'	Very pale brown, fine grained SAND with SILT (SP-SM). (Munsell 10YR7/3)	133.2
	VC	MC = 20% #200 = 5%	SP-SM		12.3'	White fine grained SAND with SILT (SP-SM). (Munsell 10YR8/1)	131.7

Bottom of borehole at 12.3 feet.

BORING NUMBER VC 4-2

wood.

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/4/18 **COMPLETED** 4/4/18
WATER ELEVATION 144 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AMDRILL, Inc
DRILLING LOCATION N1350769.8 , E664016.2
DRILLING METHOD Vibracore
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	Layer boundary depth	MATERIAL DESCRIPTION	Elev.
0					▽	Average lake water level (Elev. 144.0 ft)	
5					5.0'	Top of sediment recovery at elevation 139.0 ft.	139.0
	VC	MC = 482% #200 = 53% OC=8%	OL			Soft, spongy black ORGANIC SILT (OL). (Munsell 10YR2/1)	
10					12.0'	Layer at 11.9 ft described as Grayish, brown fine grained SAND (SP). (Munsell 10YR5/2) (Thickness < 1 inch)	132.0
	VC	MC = 394% #200 = 49% OC=26%	OL		13.1'	Soft, black ORGANIC SILT WITH SAND (OL). (Munsell 10YR2/1) Top of Hard Bottom at elevation 130.9 ft.	130.9
	VC		SM		13.3'	Light gray fine grained SILTY SAND (SM). (Munsell 10YR7/2)	130.7
15	VC	MC = 19% #200 = 38%	SM		15.3'	Very dark grayish brown mottling to light gray fine grained SILTY SAND (SM). (Munsell 10YR3/2 to Munsell 10YR7/2)	128.7
	VC		SM		15.4'	Very dark grayish brown fine grained SILTY SAND (SM). (Munsell 10YR3/2)	128.6
	VC	MC = 18% #200 = 2%	SP		17.3'	White fine grained SAND (SP). (Munsell 10YR3/1)	126.7

Bottom of borehole at 17.3 feet.

BORING NUMBER VC 4-3

wood.

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/3/18 **COMPLETED** 4/3/18
WATER ELEVATION 144 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR AMDRILL, Inc
DRILLING LOCATION N1350557.8 , E664428.4
DRILLING METHOD Vibracore
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION	Elev.
0					▽	Average lake water level (Elev. 144.0 ft)	
5					5.0'	Top of sediment recovery at elevation 139.0 ft.	139.0
	VC	MC = 601% #200 = 73% OC=45%	OL			Very soft, spongy black ORGANIC SILT (OL) with few roots (<10%). (Munsell 10YR2/1)	
					6.2'	At 6.2 ft, Lens of very pale brown fine grained SAND (SP). (Munsell 10YR8/2) (thickness < 1 inch)	137.8
10	VC	MC = 765% #200 = 70% OC=40%	OL			Very soft, spongy black ORGANIC SILT (OL) with few roots (<10%). (Munsell 10YR2/1)	
					13.4'	At 13.4 ft, Lens of very pale brown fine grained SAND (SP). (Munsell 10YR8/2) (thickness < 1 inch)	130.6
	VC		OL			Very soft, spongy, black ORGANIC SILT (OL). (Munsell 10YR2/1)	
15					14.3'		129.7
20	VC	MC = 558% #200 = 65% OC=38%	OL			Very soft, spongy, black ORGANIC SILT (OL). (Munsell 10YR2/1)	

(Continued Next Page)

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
20					20.3' Top of Hard Bottom at elevation 123.7 ft.	123.7
	VC		SP		Very dark grayish brown fine grained SAND (SP). (Munsell 10YR3/2) 21.2'	122.8
	VC	MC = 68% #200 = 89%	OL		Very soft, spongy black ORGANIC SILT (OL). (Munsell 10YR2/1) At 21.5 ft, lens of very dark grayish brown fine grained SAND (SP). (Munsell 10YR3/2) (thickness < 1 inch) 22.1'	121.9

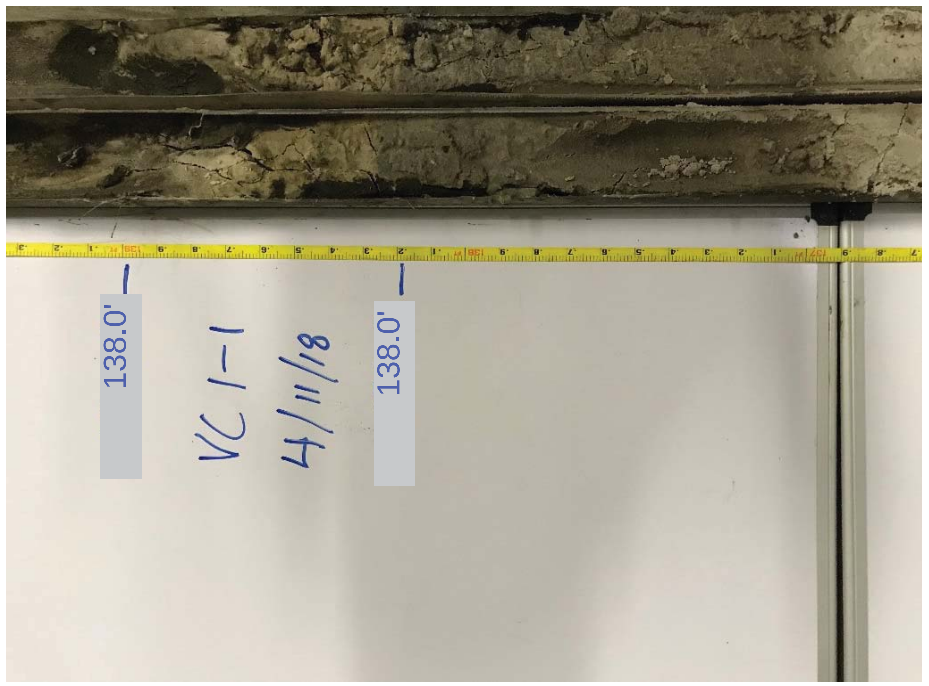
Bottom of borehole at 22.1 feet.

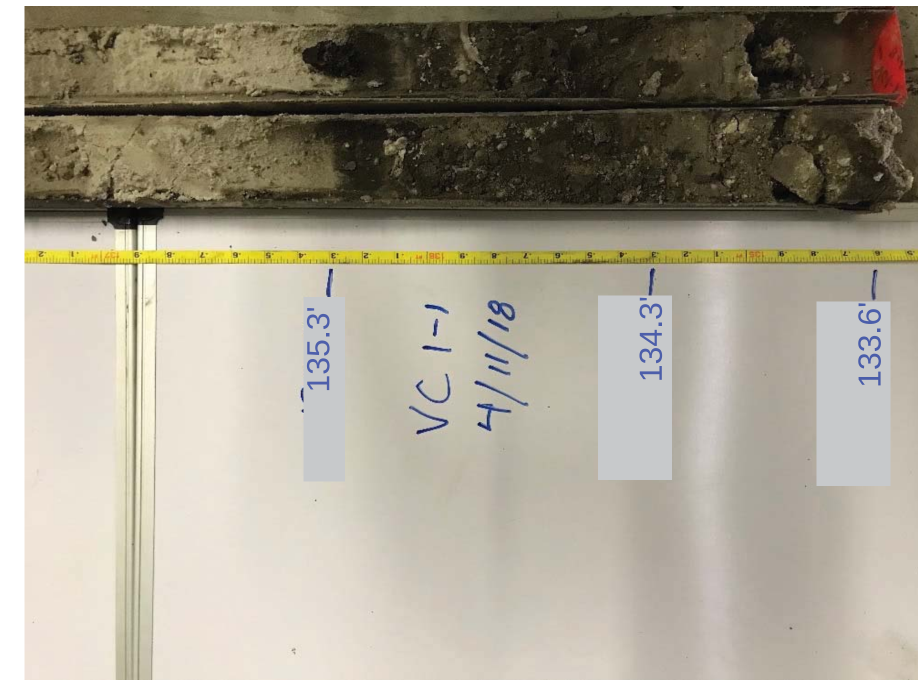
ATTACHMENT C

Vibracore Photographs

Vibracore: 1-1

Average Lake Water Elevation: 144.0 ft / Top of Sediment Recovery Elevation: 138.0 ft / Top of Hard Stratum Elevation: 137.2 ft / Vibracore Recovery Bottom Elevation: 133.6 ft

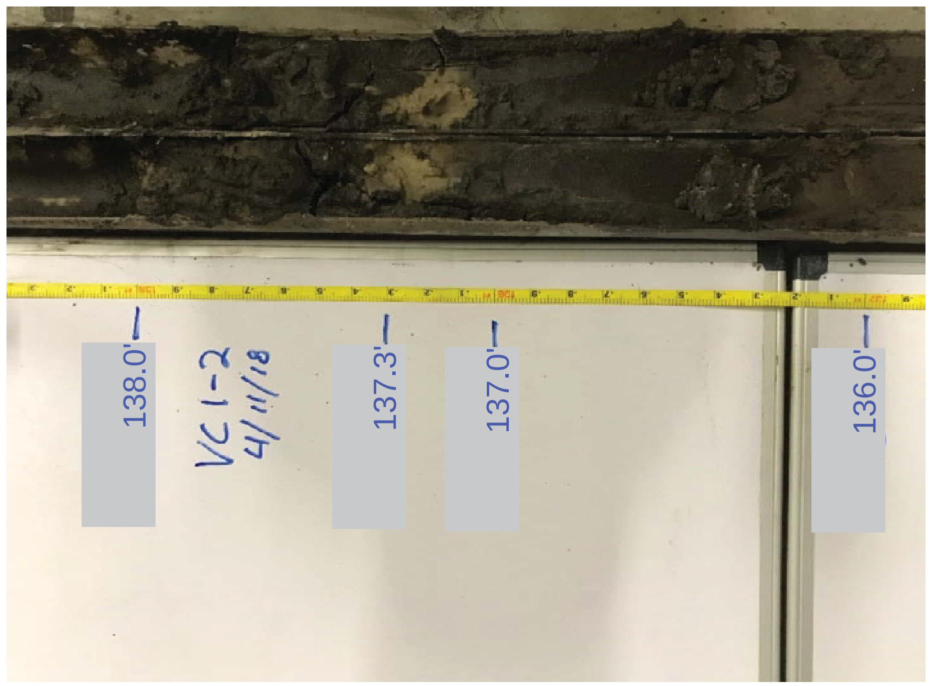


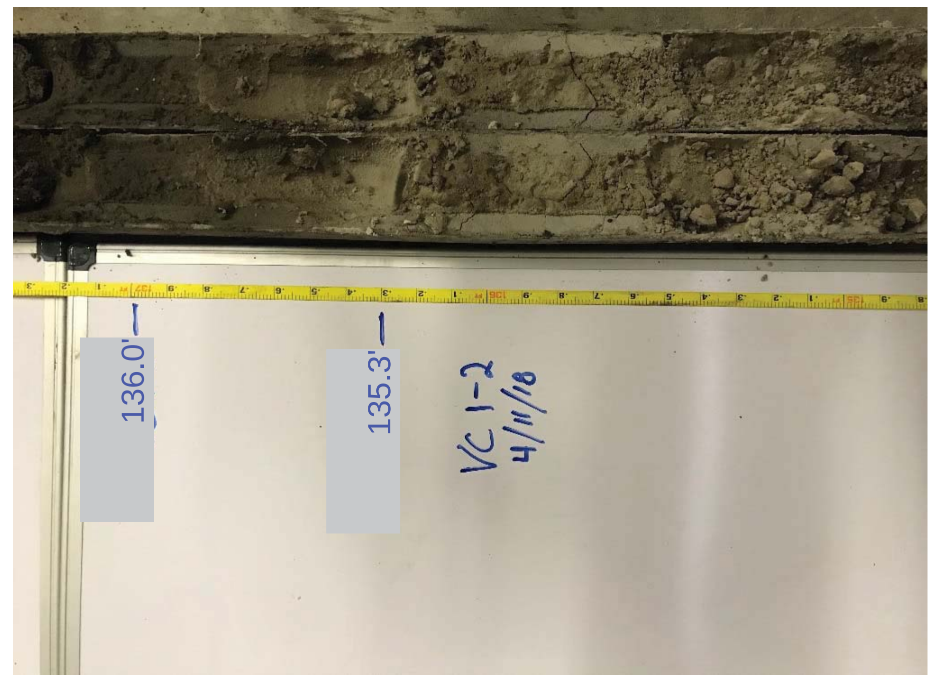


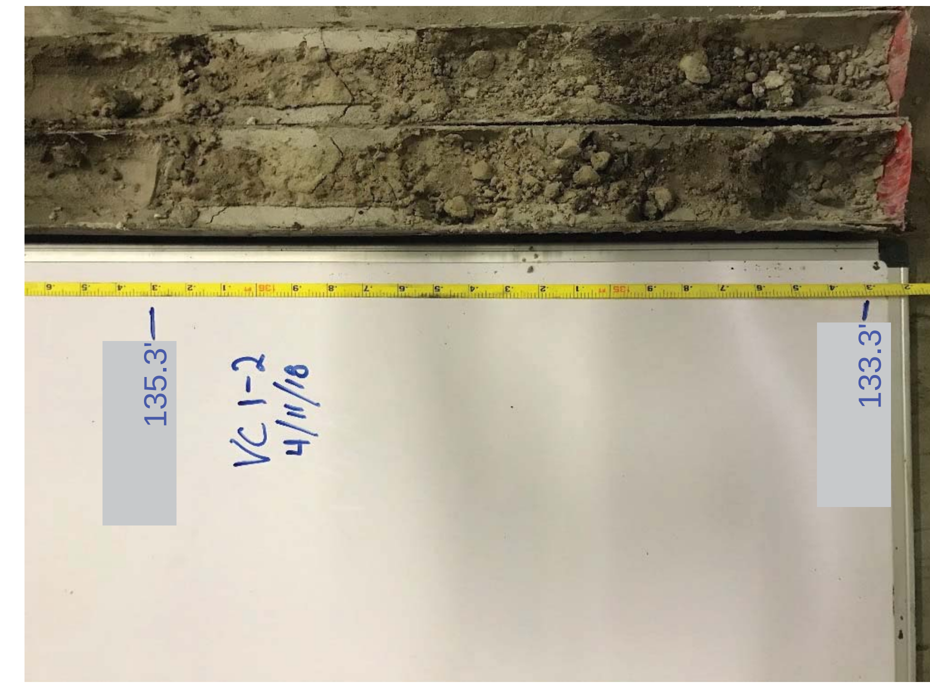
wood.

Vibracore: 1-2

Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 138.0 ft / Top of Hard Stratum Elevation: 137.3 ft / Vibracore Recovery Bottom Elevation: 133.3 ft



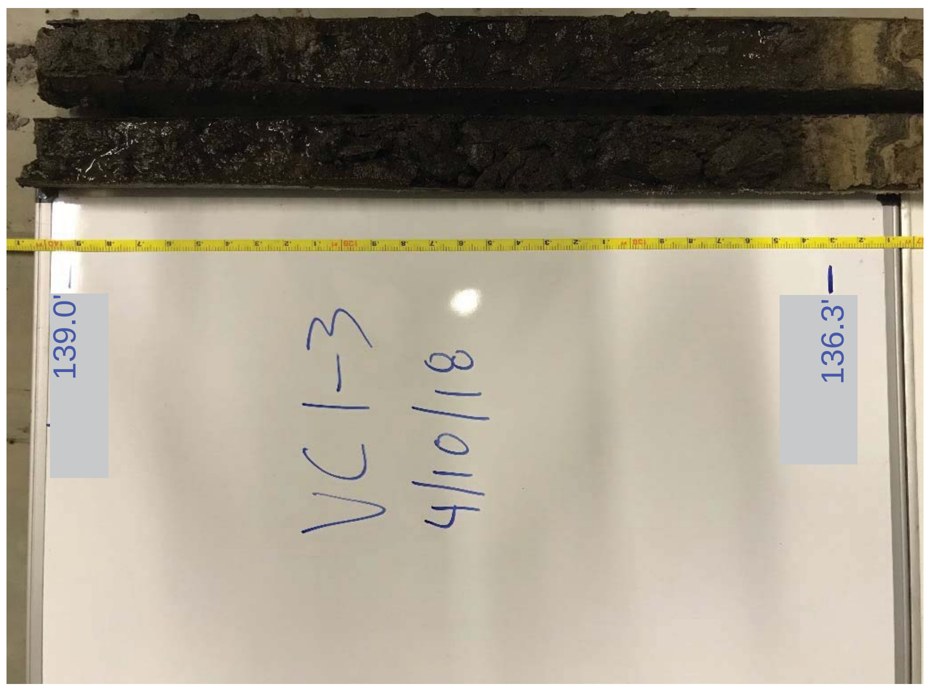


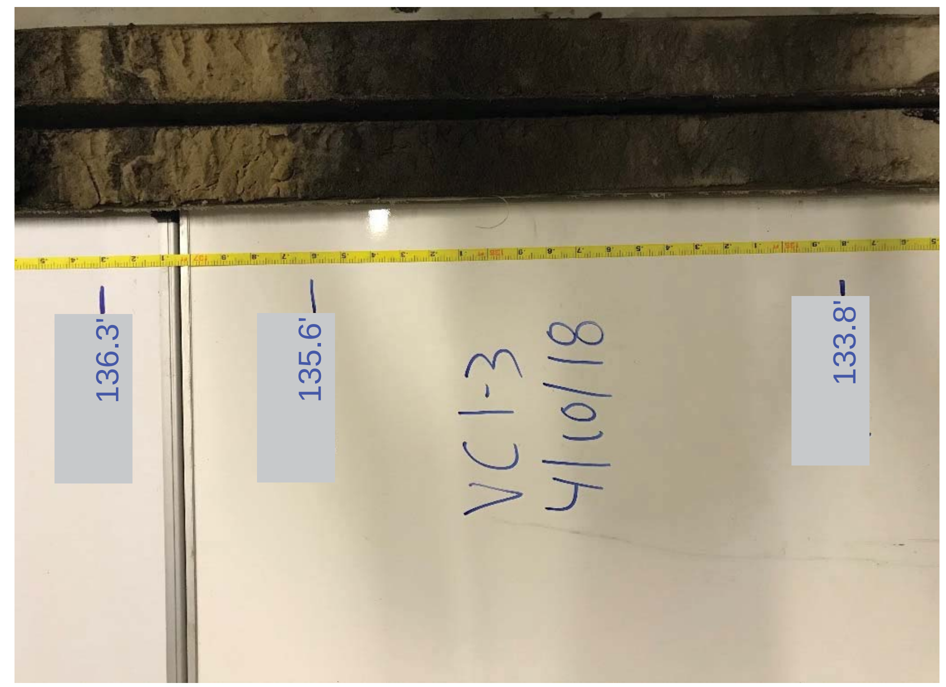


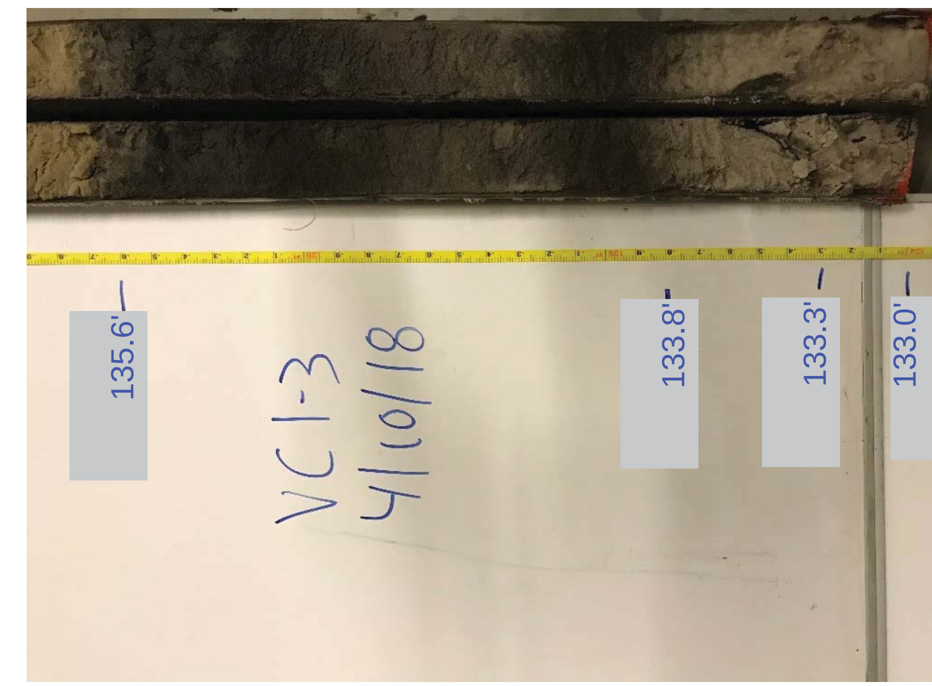
wood.

Vibracore: 1-3

Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 139.0 ft / Top of Hard Stratum Elevation: 136.3 ft / Vibracore Recovery Bottom Elevation: 133.0 ft

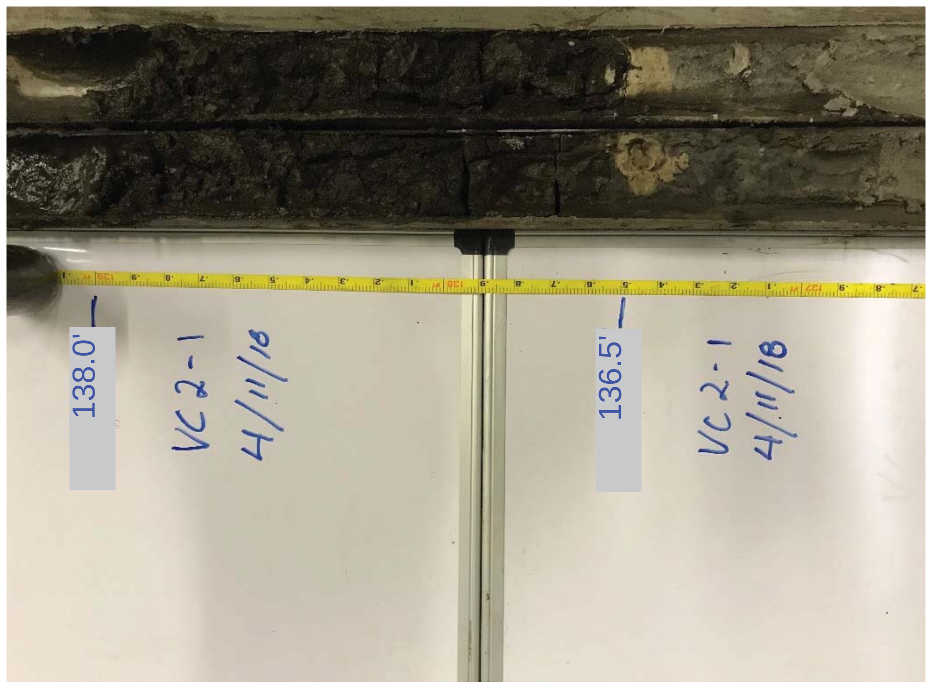


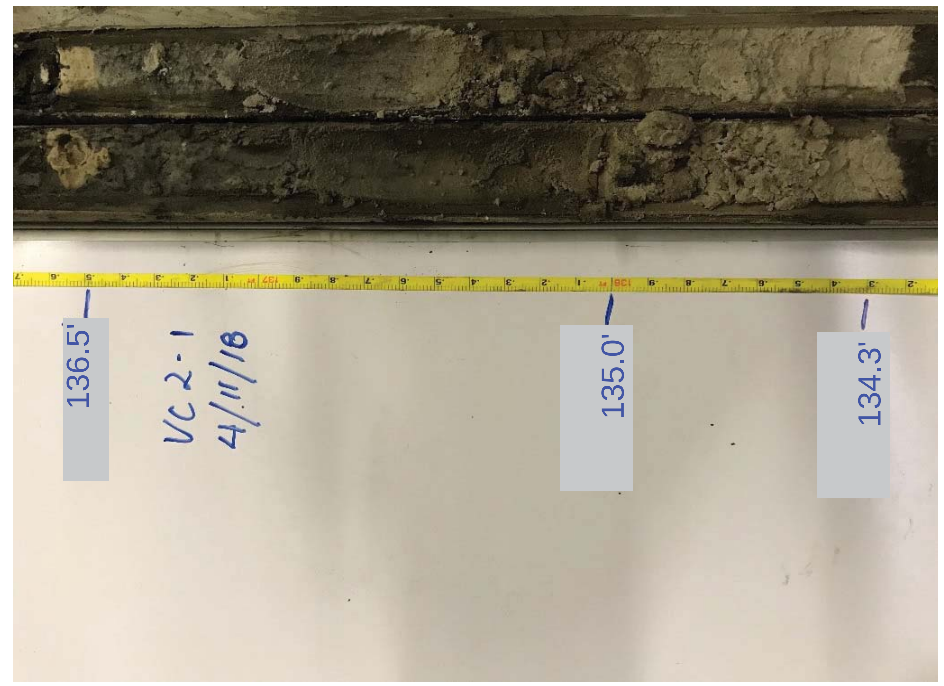


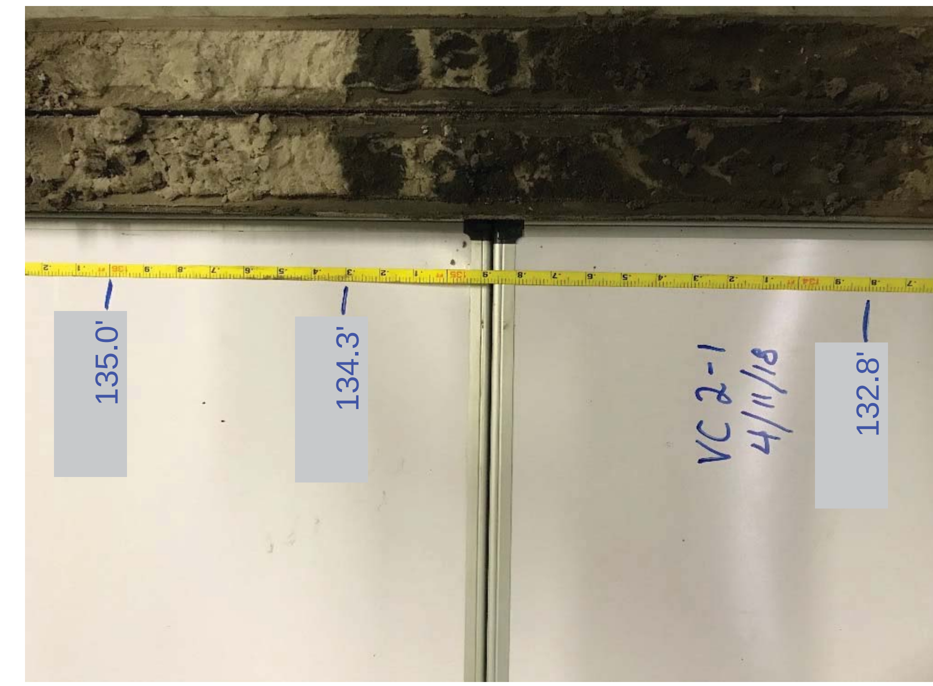


Vibracore: 2-1

Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 138.0 ft / Top of Hard Stratum Elevation: 136.4 ft / Vibracore Recovery Bottom Elevation: 130.9 ft

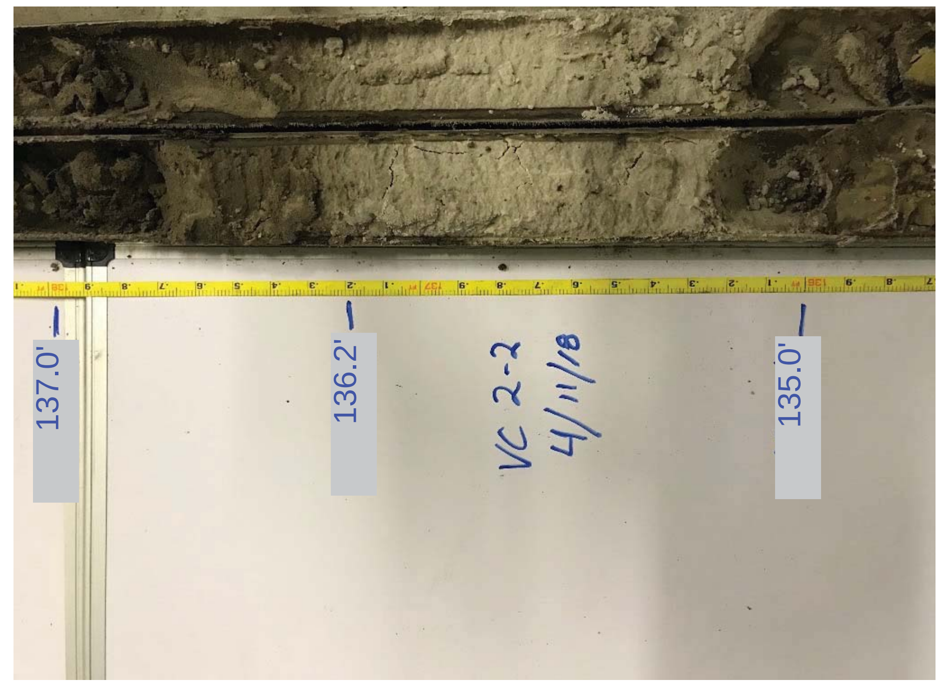


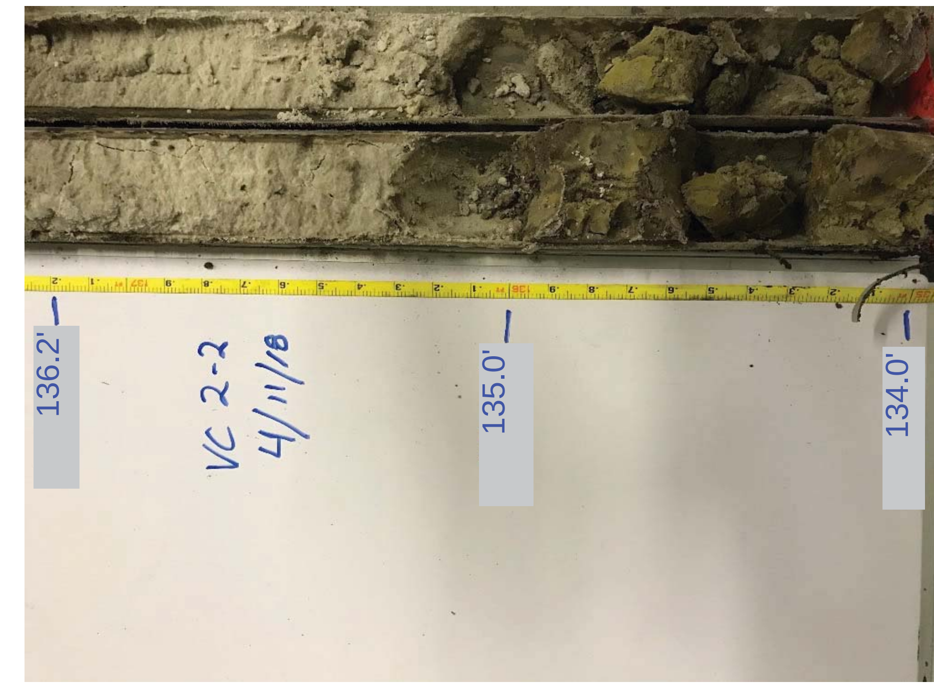




Vibracore: 2-2

Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 138.0 ft / Top of Hard Stratum Elevation: 137.0 ft / Vibracore Recovery Bottom Elevation: 134.0 ft

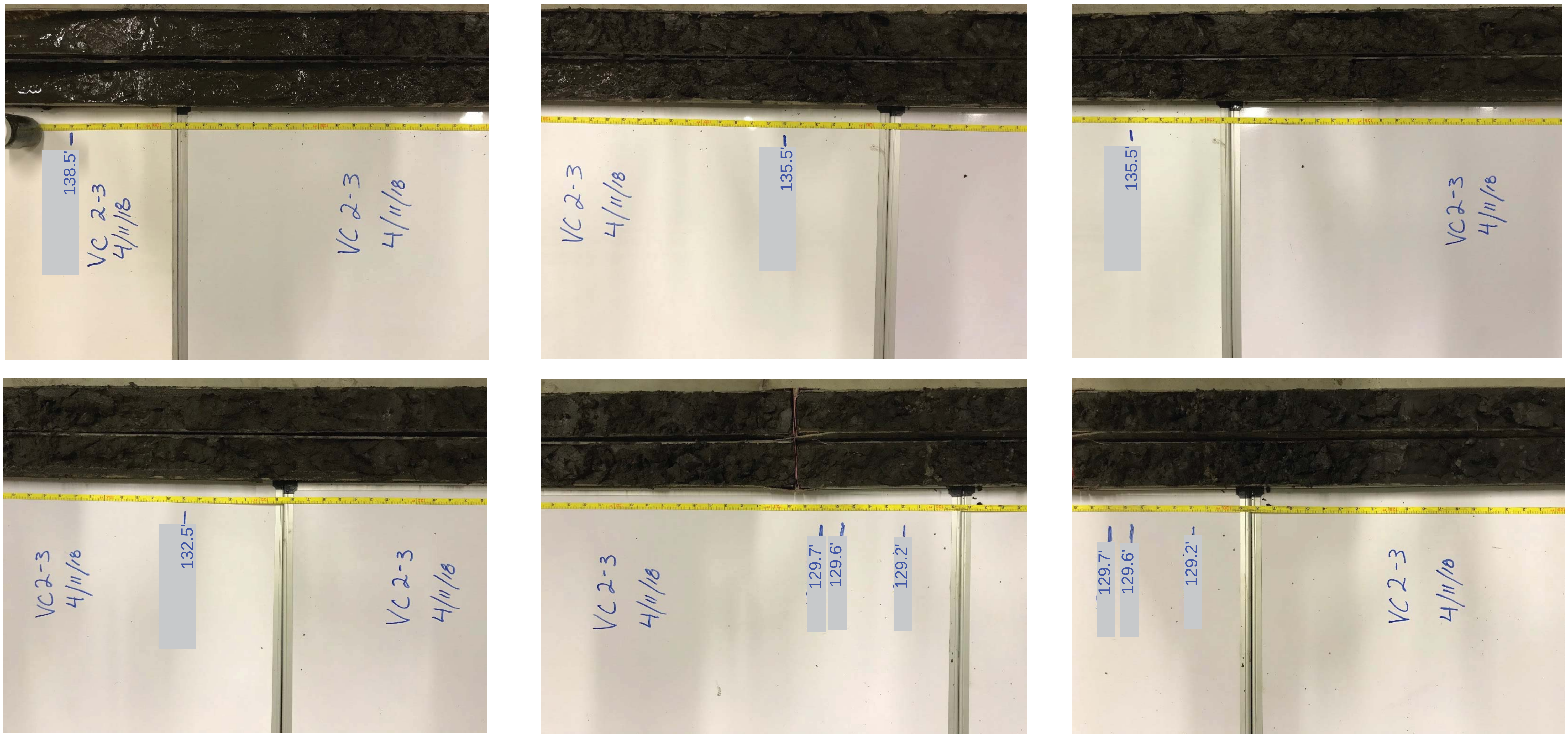




wood.

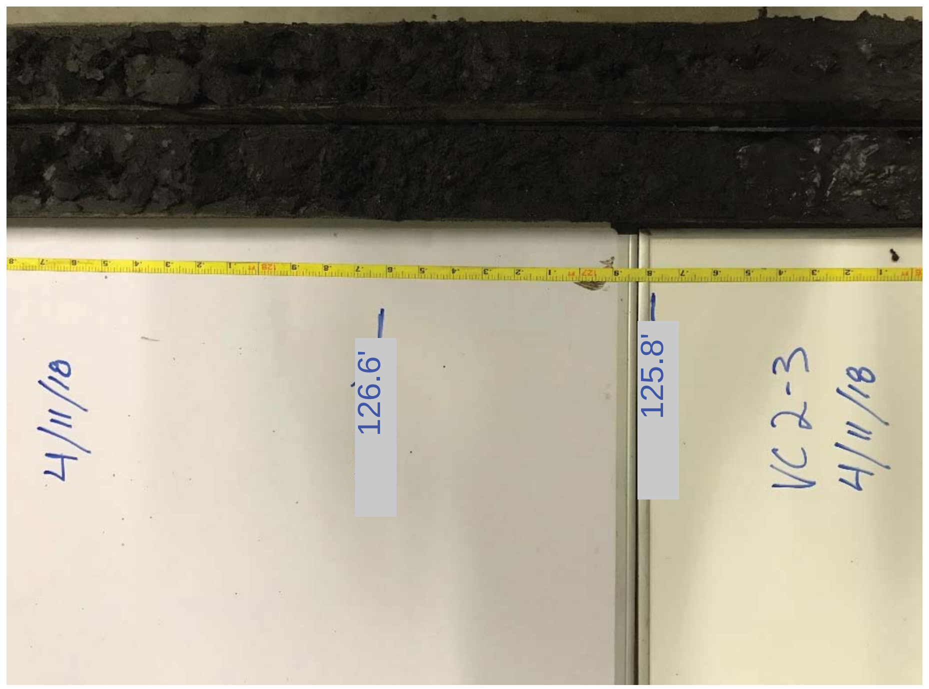
Vibracore: 2-3

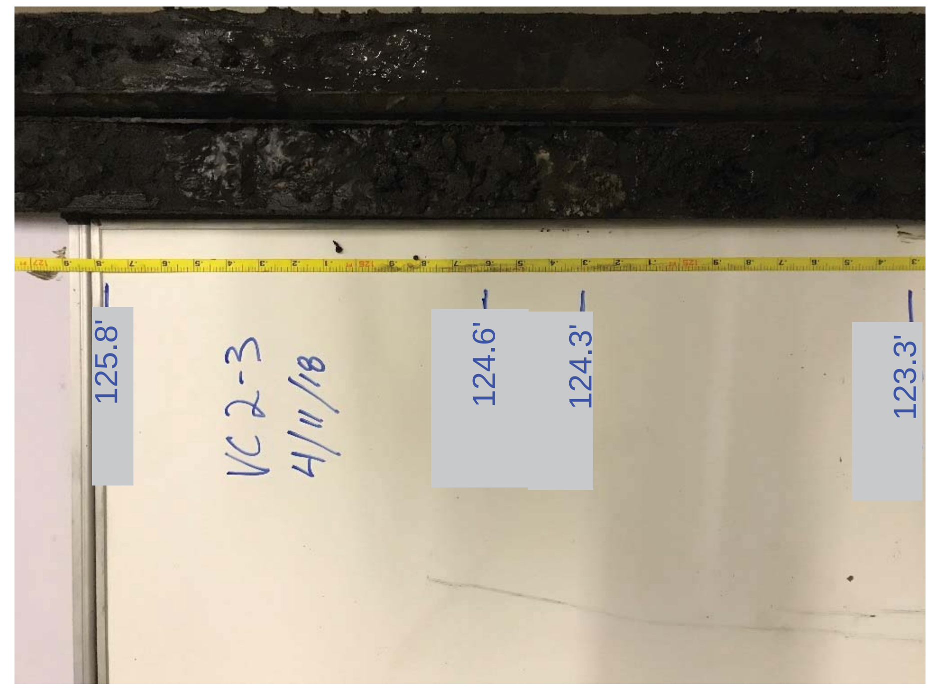
Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 138.5 ft / Top of Hard Stratum Elevation: 123.3 ft / Vibracore Recovery Bottom Elevation: 120.4 ft

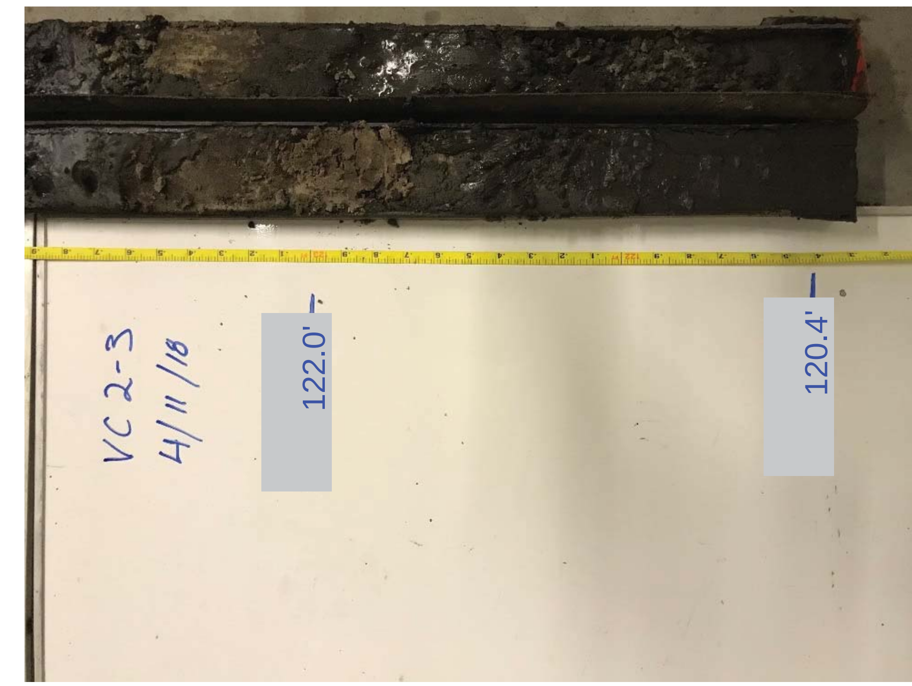


Vibracore 2-3

Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 138.5 ft / Top of Hard Stratum Elevation: 123.3 ft / Vibracore Recovery Bottom Elevation: 120.4 ft

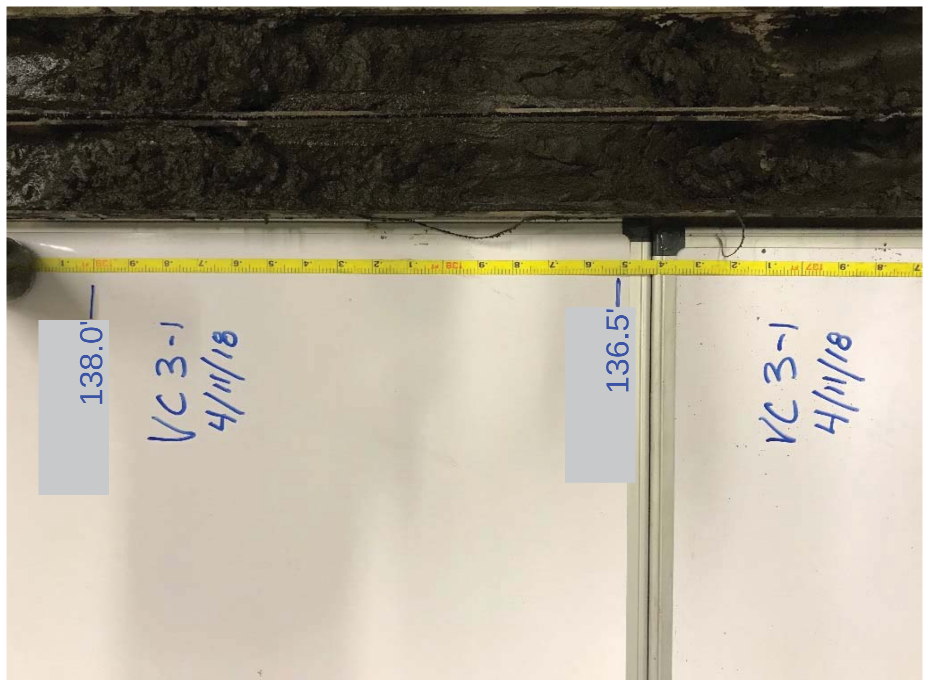


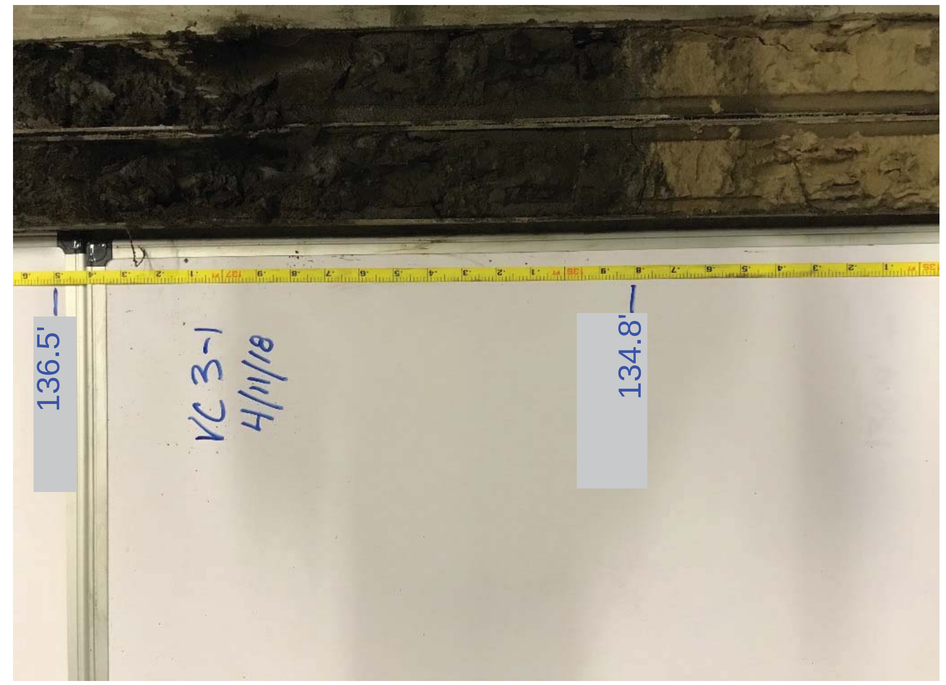


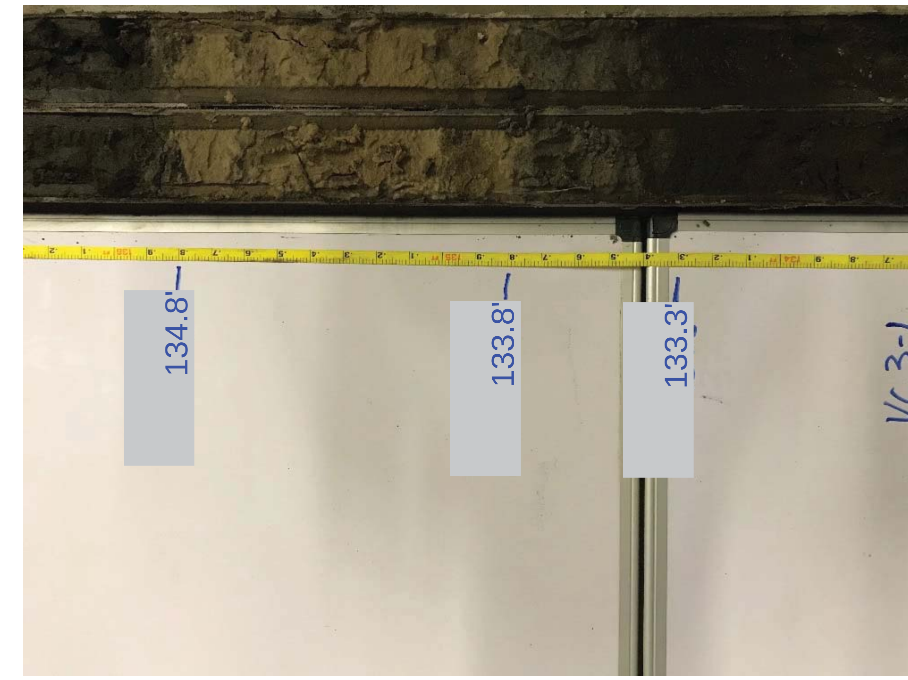


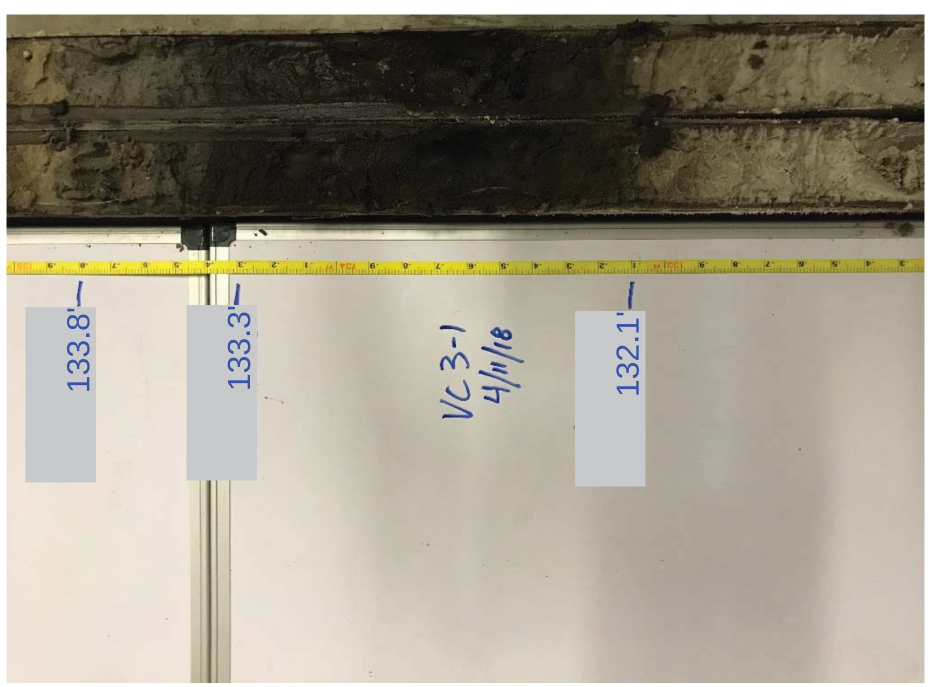
Vibracore: 3-1

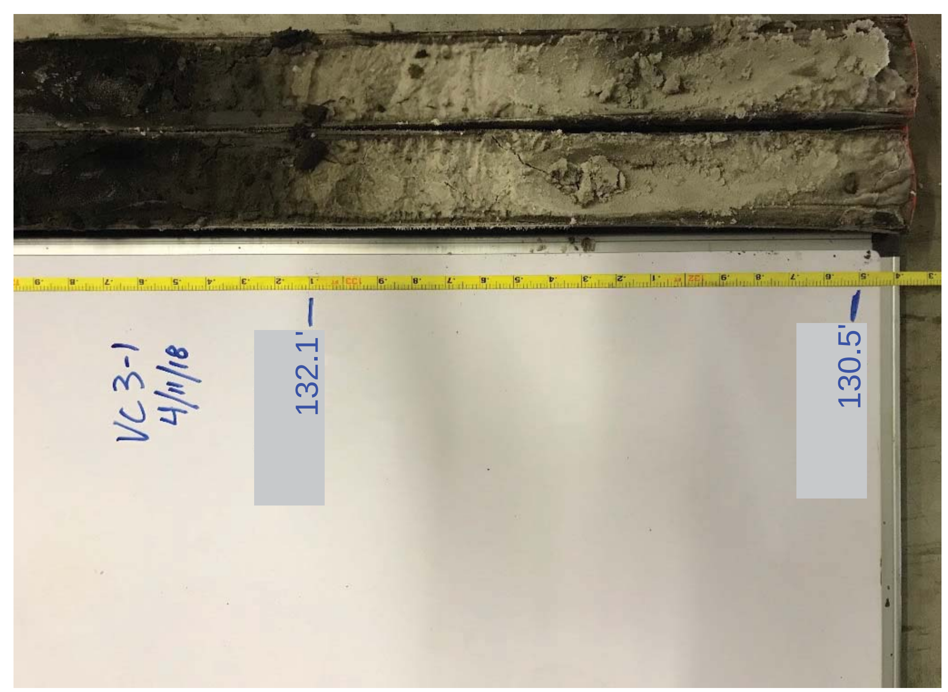
Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 138.0 ft / Top of Hard Stratum Elevation: 134.8 ft / Vibracore Recovery Bottom Elevation: 130.5 ft







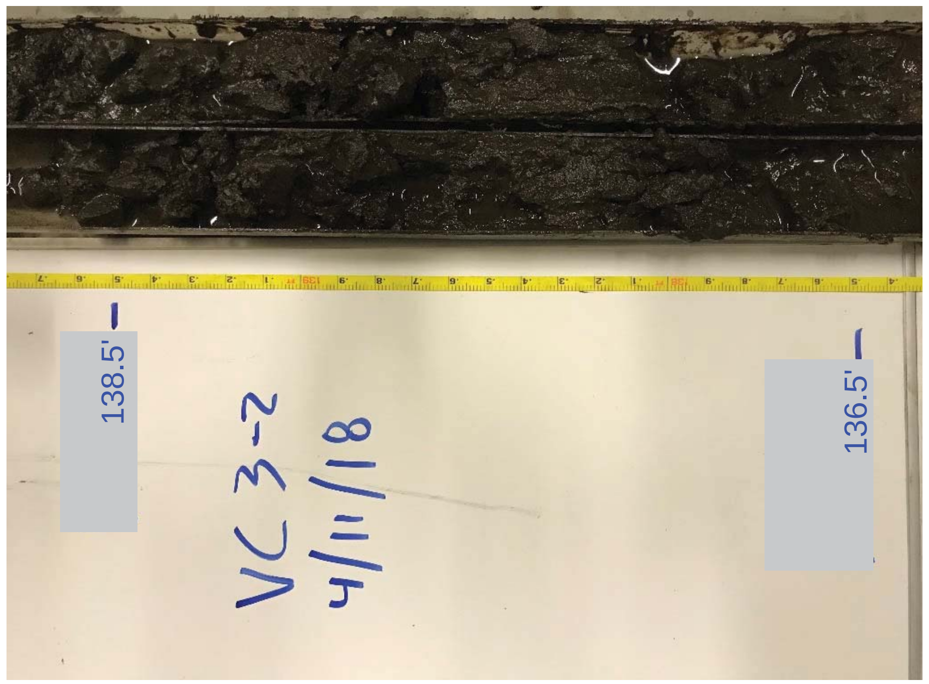


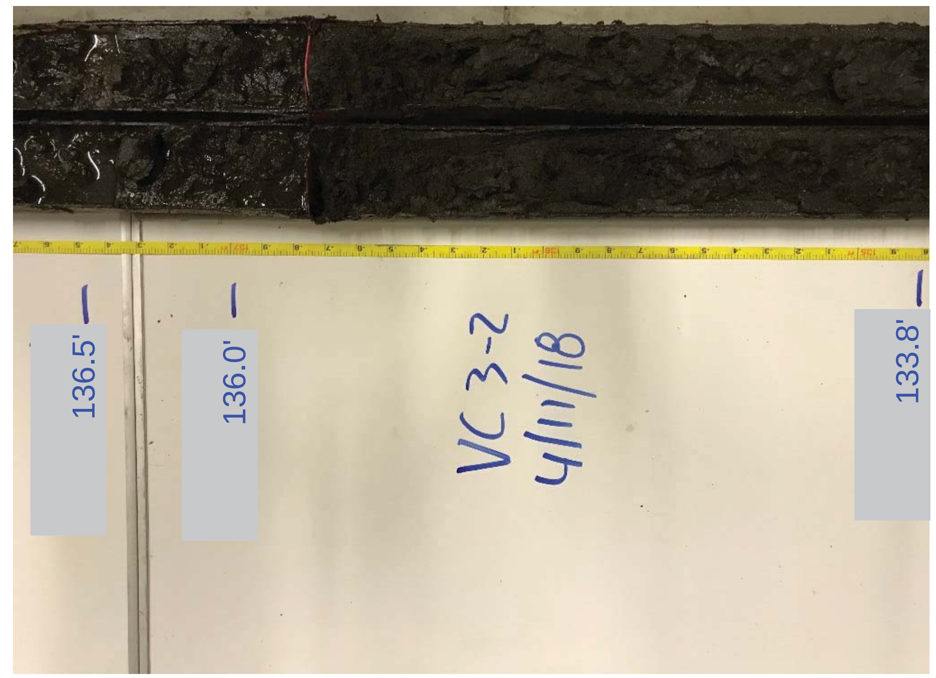


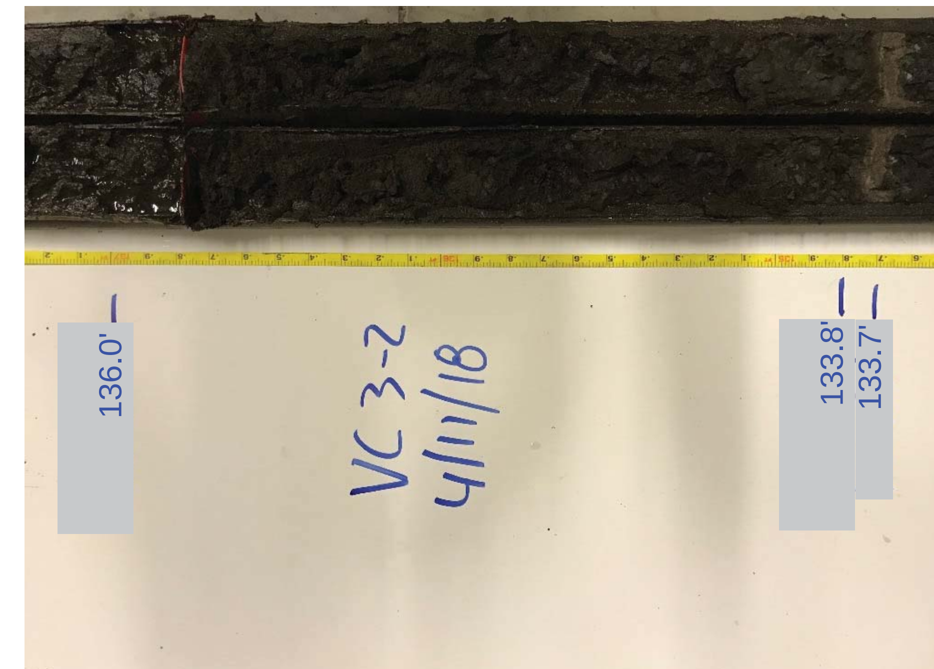
wood.

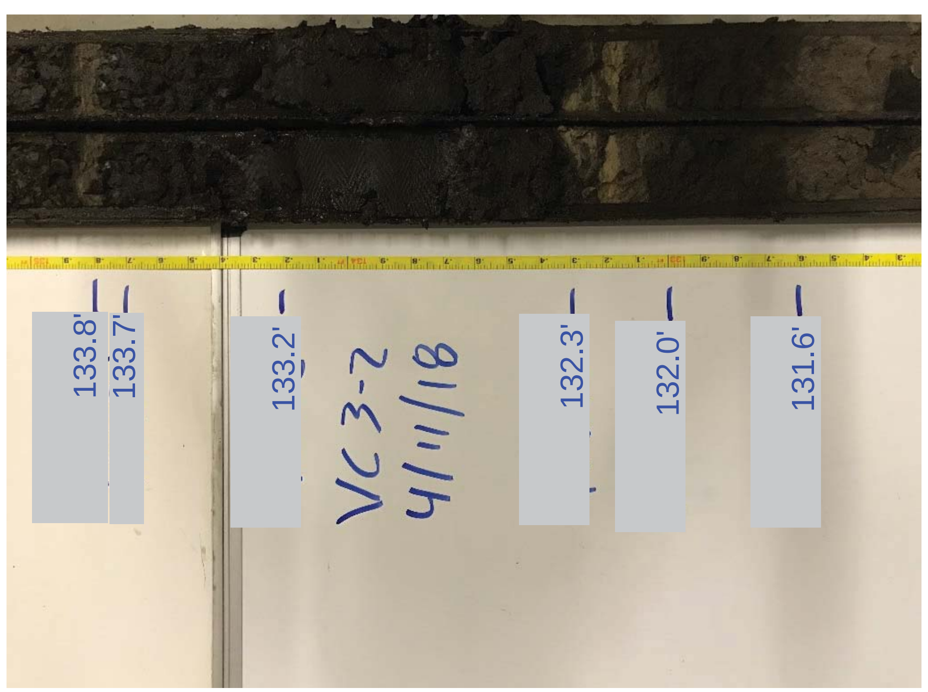
Vibracore: 3-2

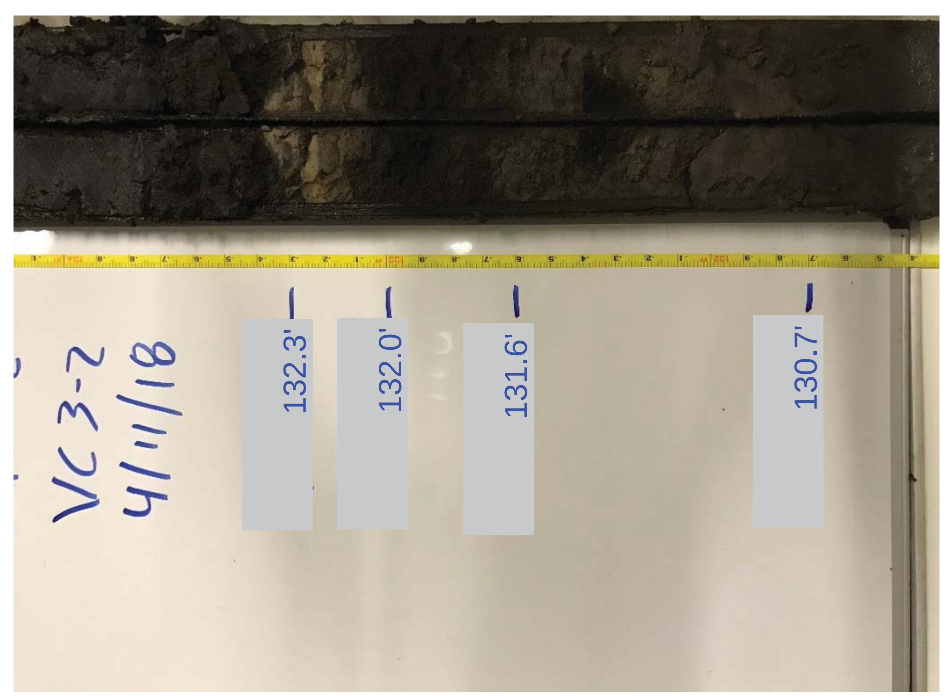
Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 138.5 ft / Top of Hard Stratum Elevation: 132.3 ft / Vibracore Recovery Bottom Elevation: 127.7 ft

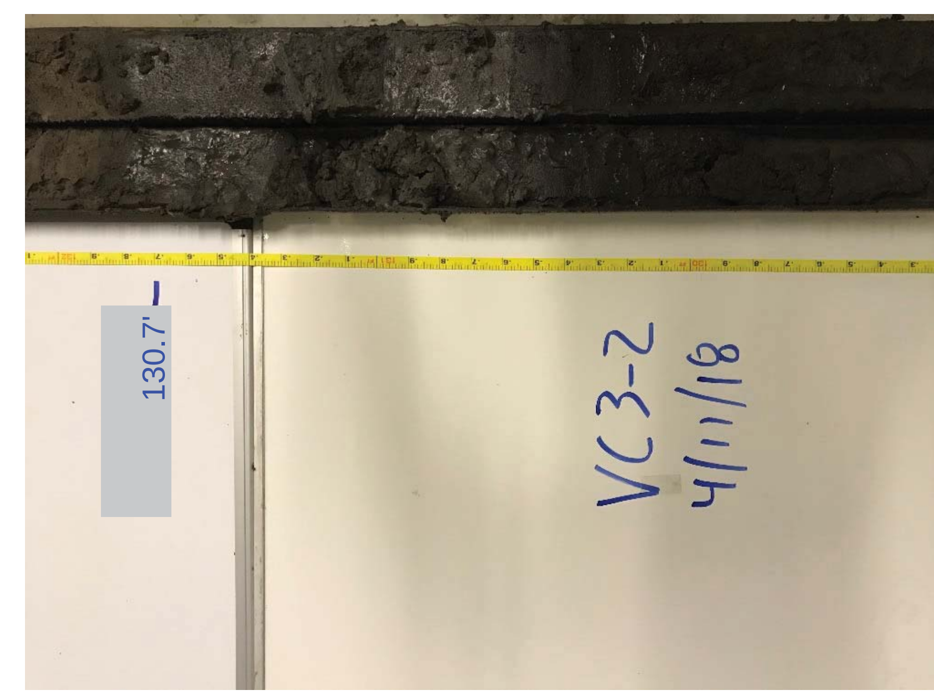






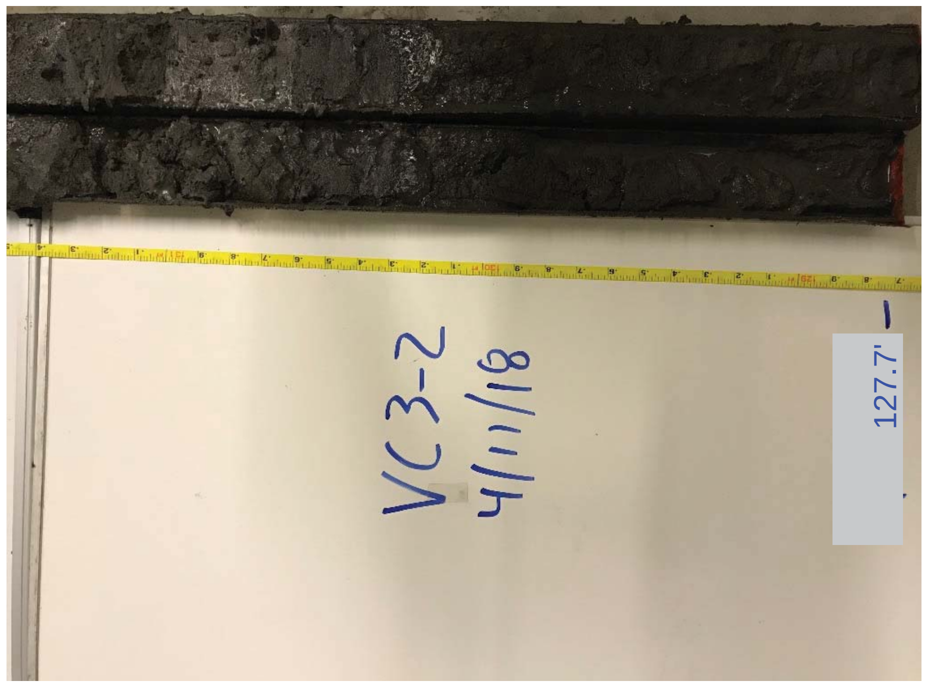






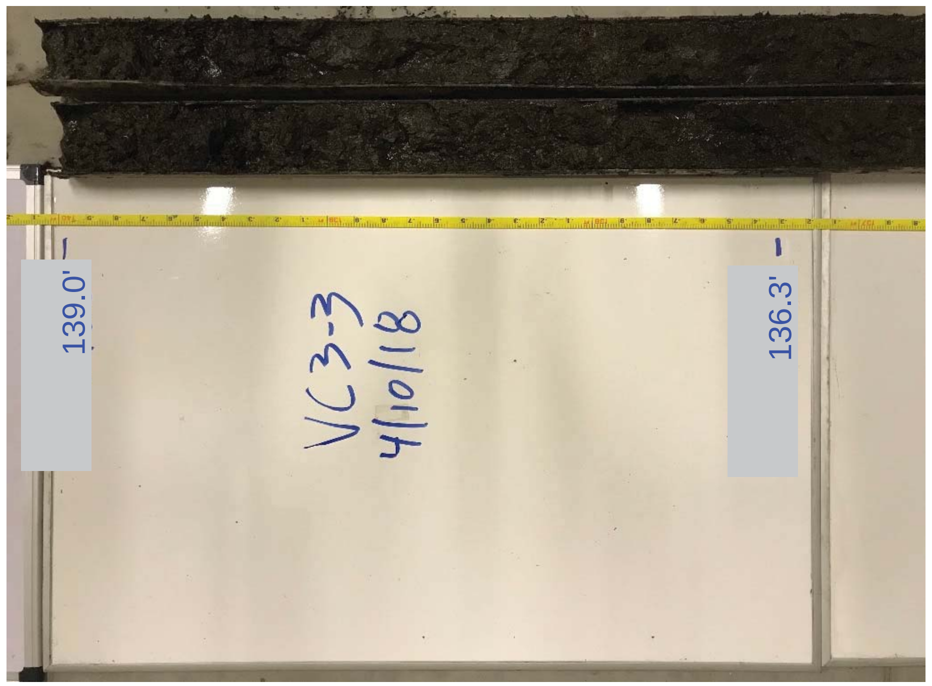
Vibracore: 3-2

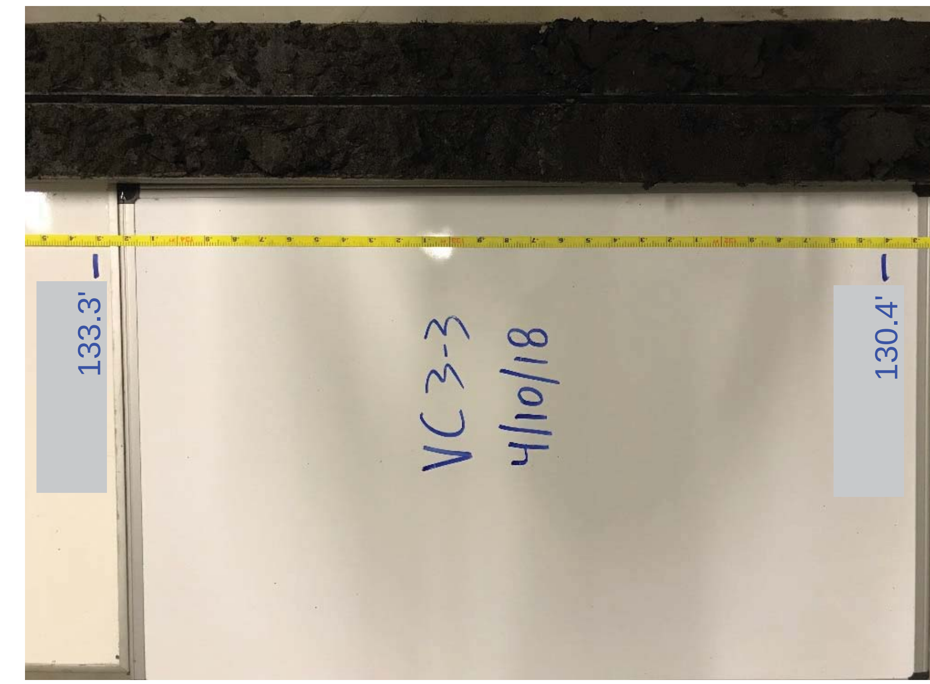
Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 138.5 ft / Top of Hard Stratum Elevation: 132.3 ft / Vibracore Recovery Bottom Elevation: 127.7 ft

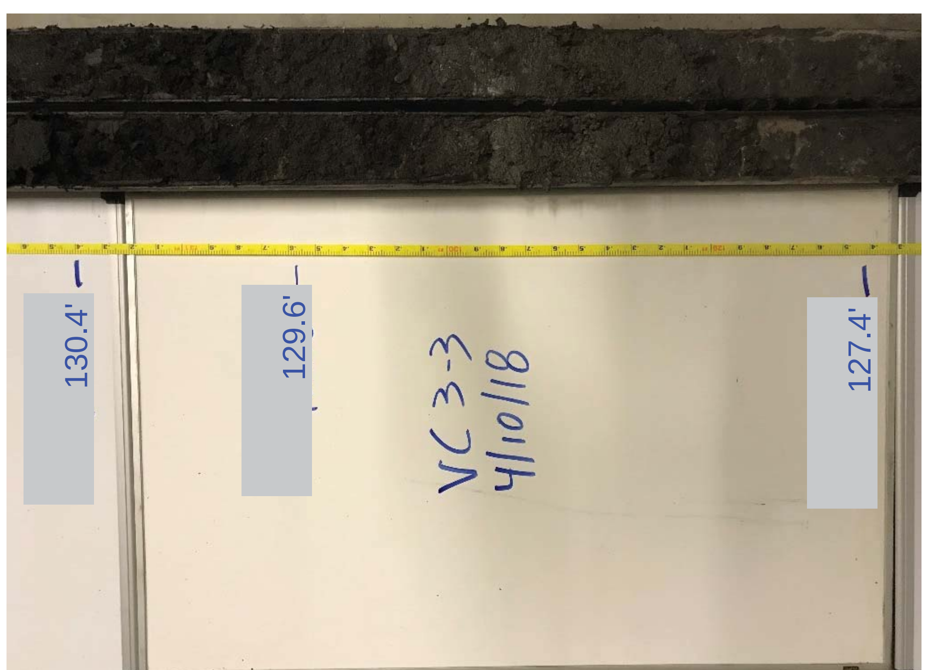


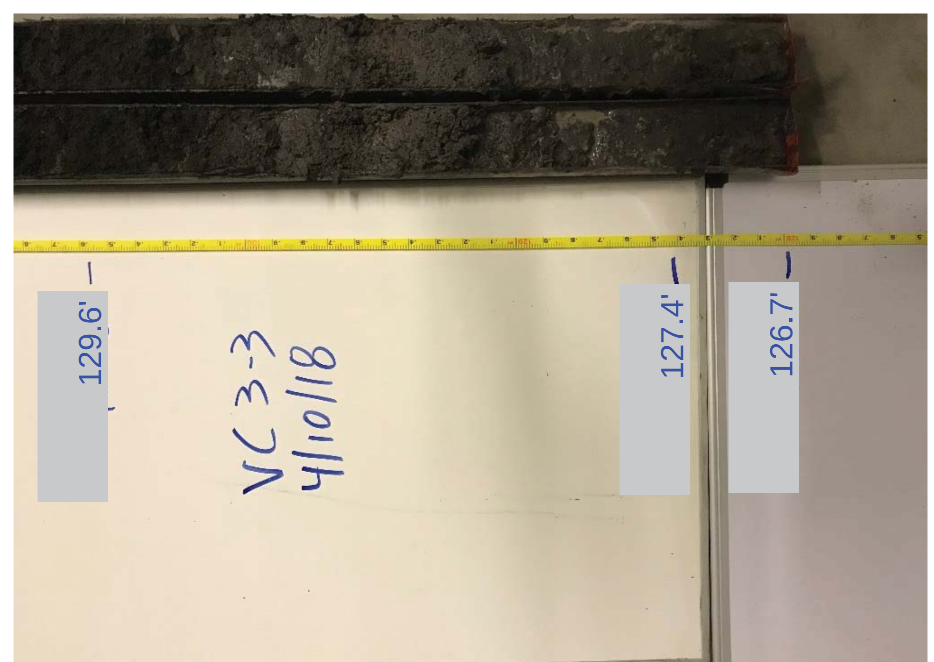
Vibracore: 3-3

Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 139.0 ft / Top of Hard Stratum Elevation: 129.5 ft / Vibracore Recovery Bottom Elevation: 126.7 ft





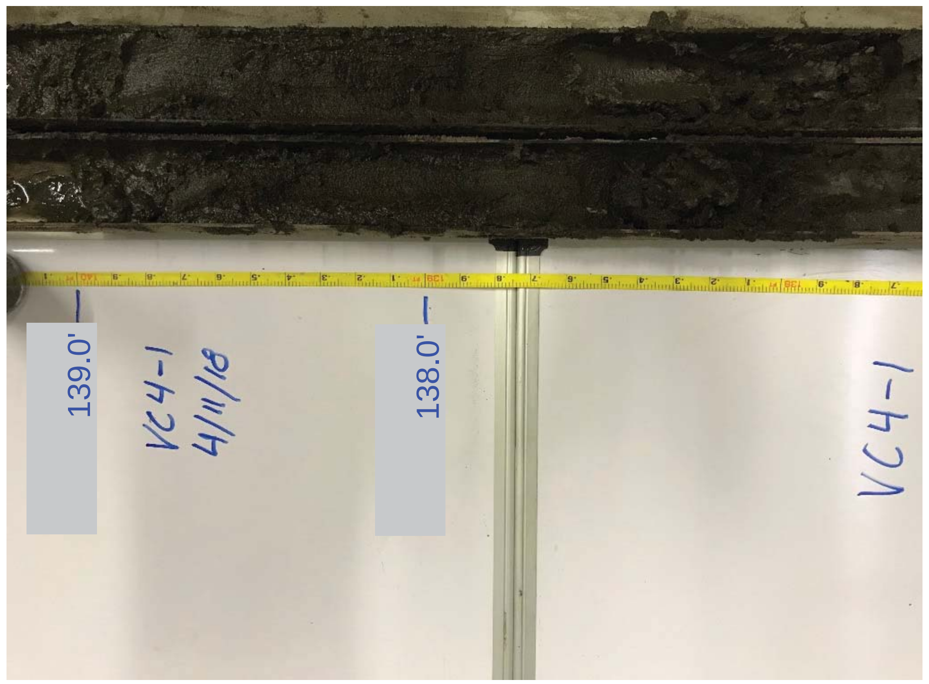


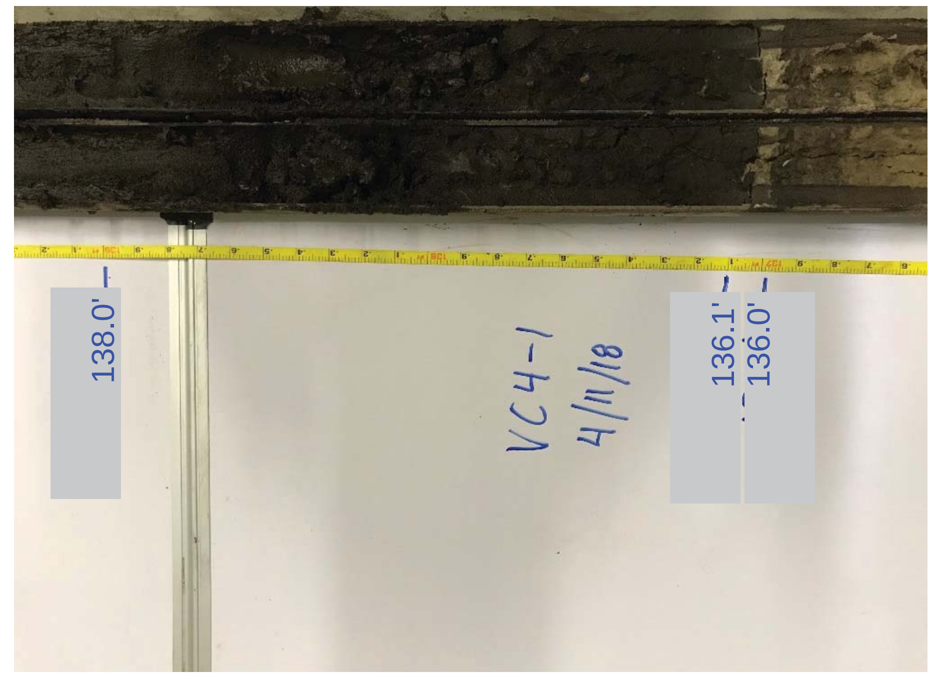


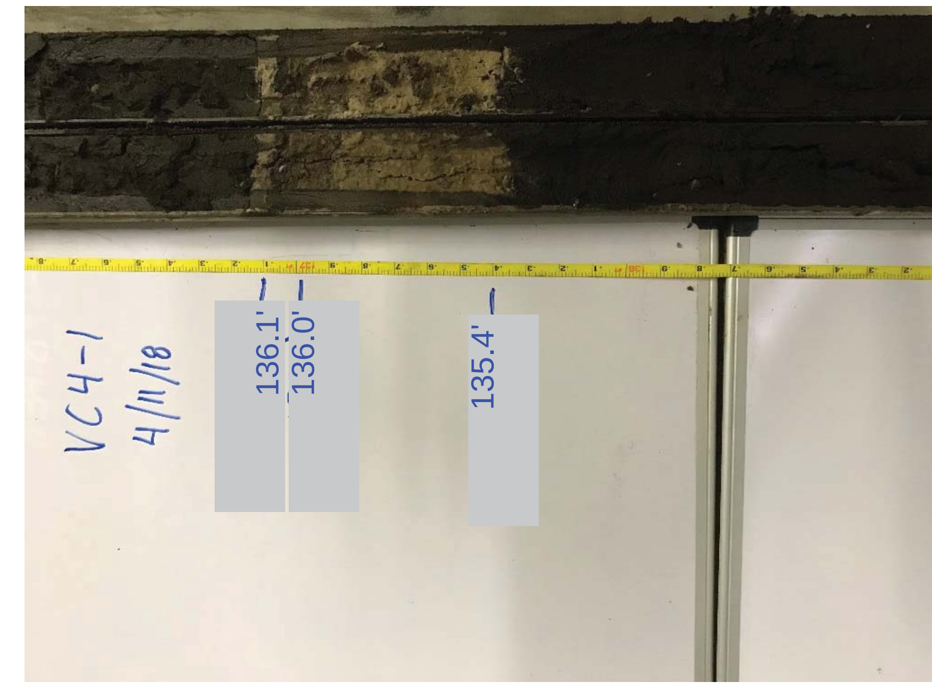
City of Lakeland - Lake Bonnet
Geotechnical Data Collection

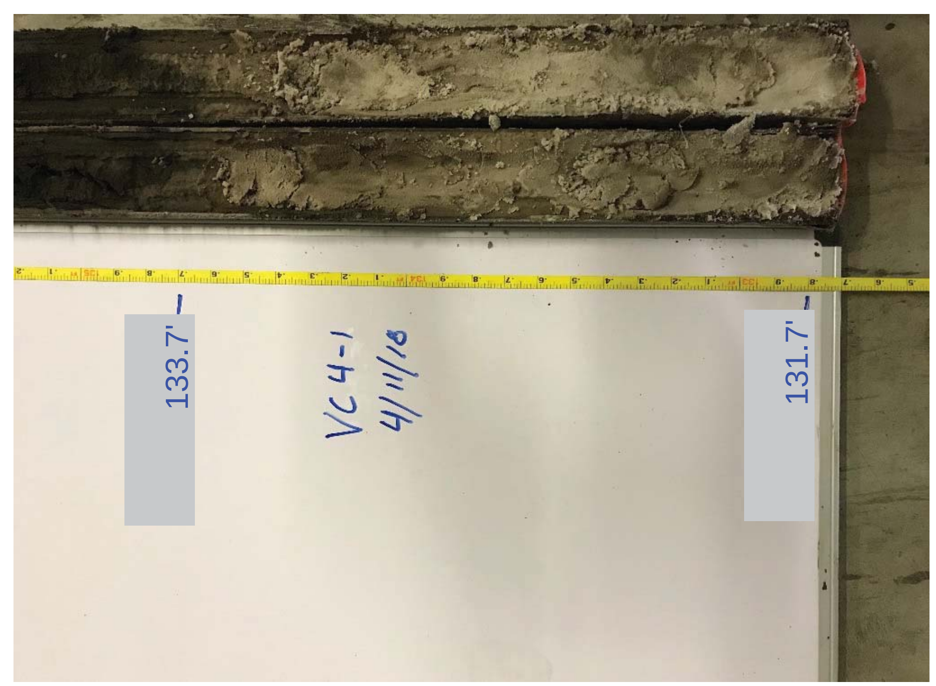
Vibracore: 4-1

Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 139.0 ft / Top of Hard Stratum Elevation: 136.0 ft / Vibracore Recovery Bottom Elevation: 131.7 ft





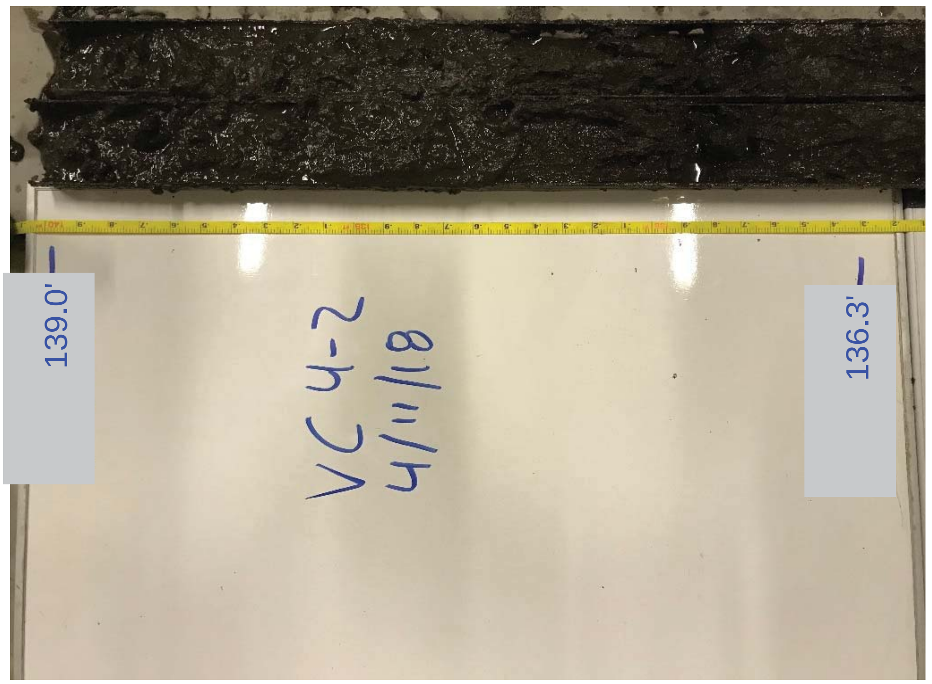


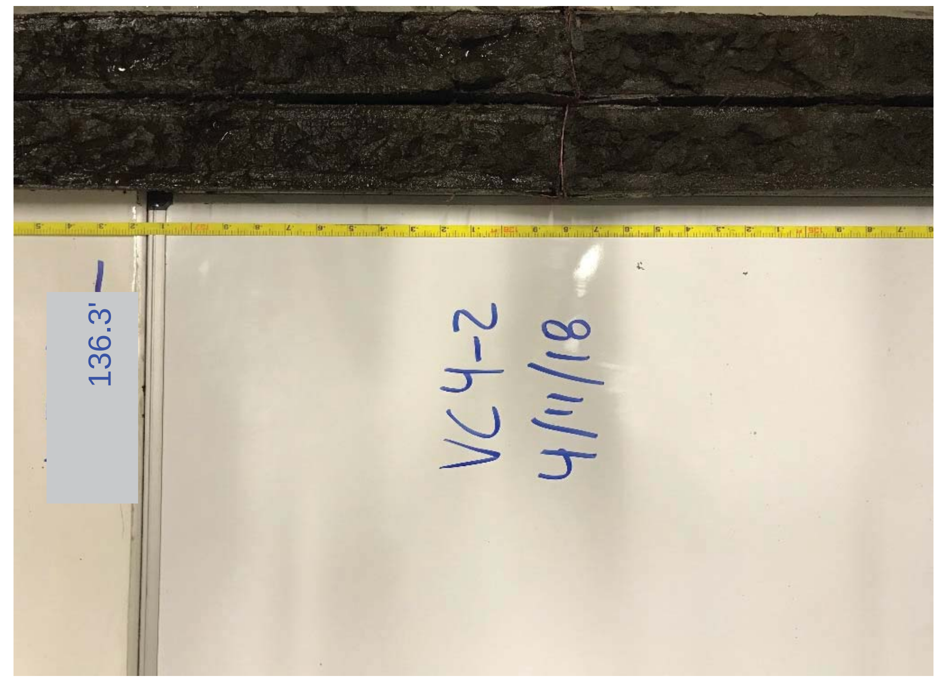


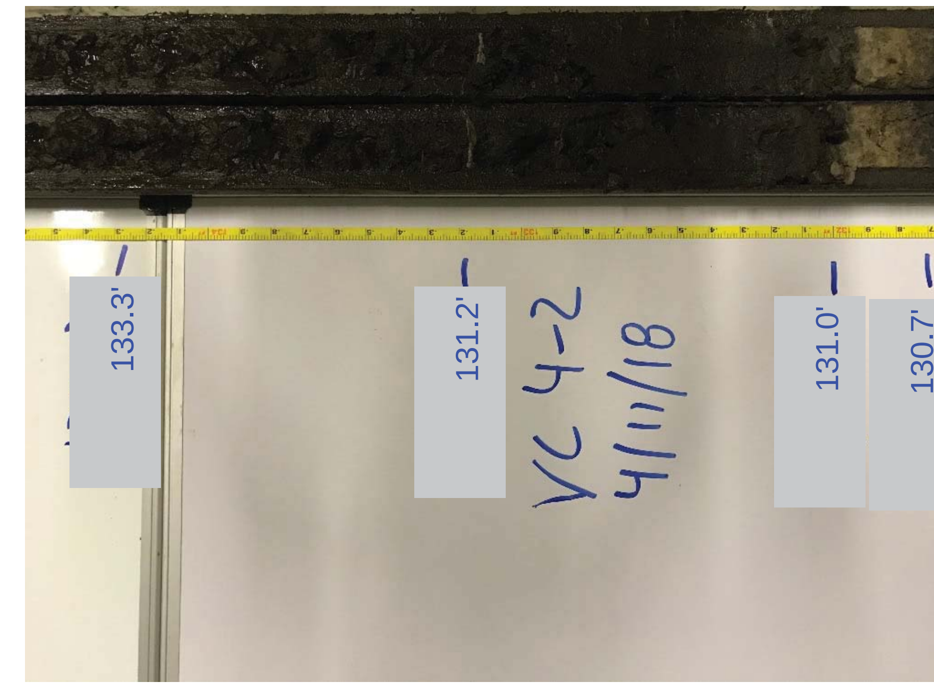
wood.

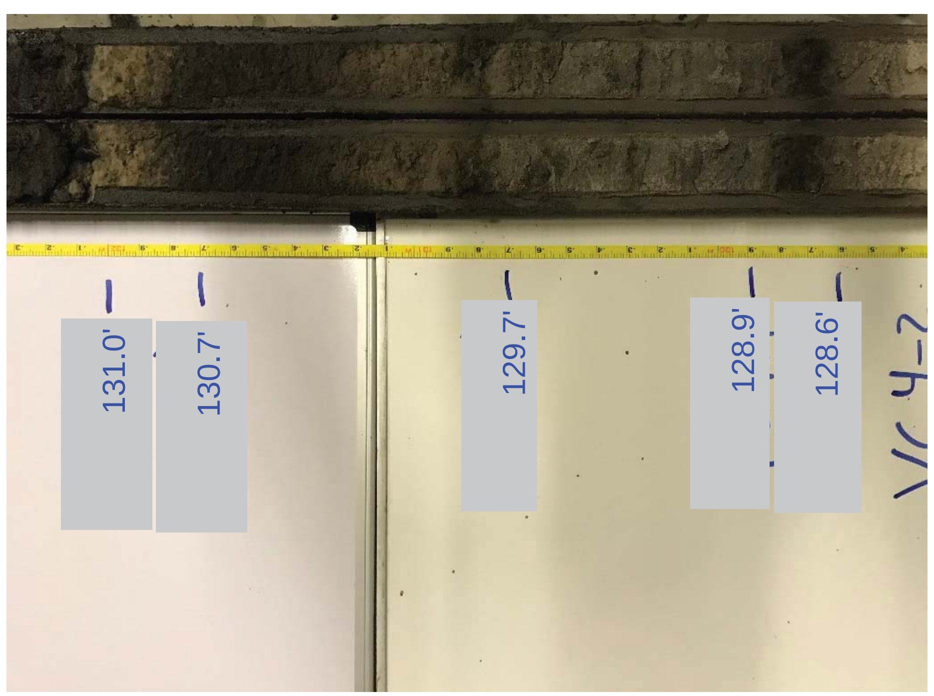
Vibracore: 4-2

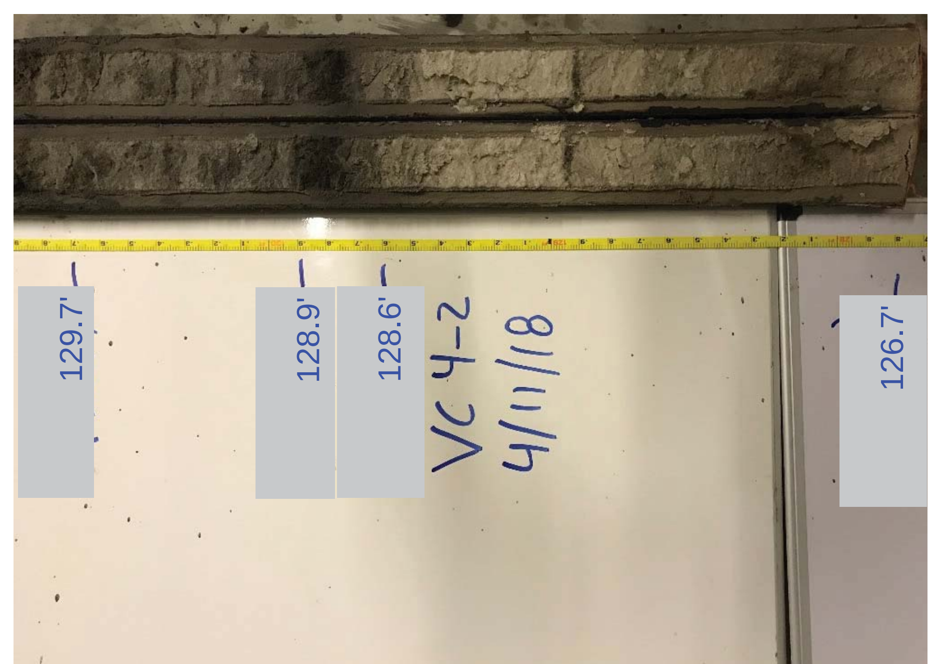
Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 139.0 ft / Top of Hard Stratum Elevation: 130.9 ft / Vibracore Recovery Bottom Elevation: 126.7 ft







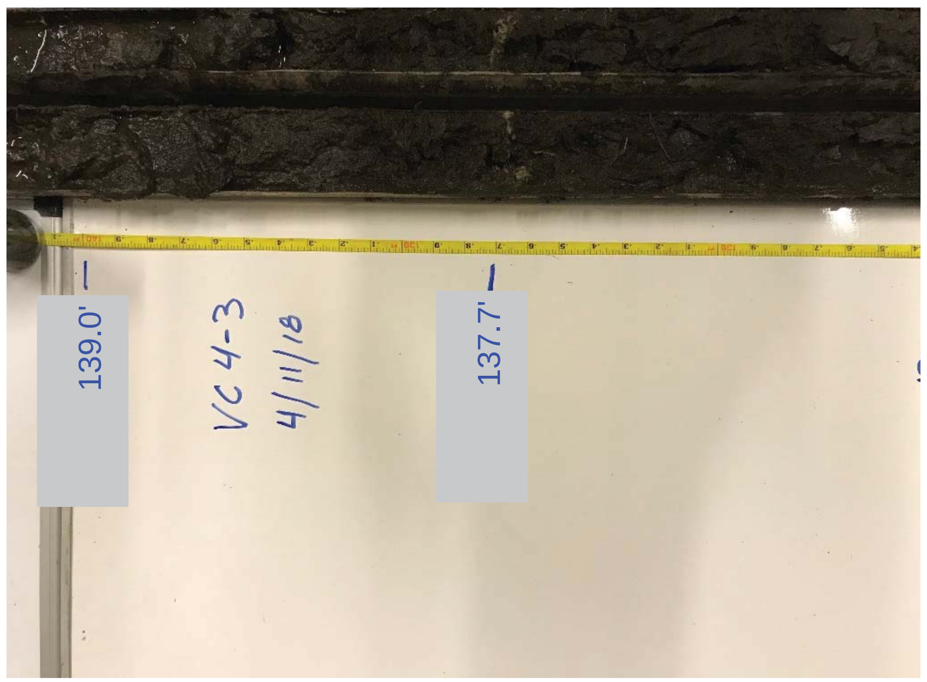


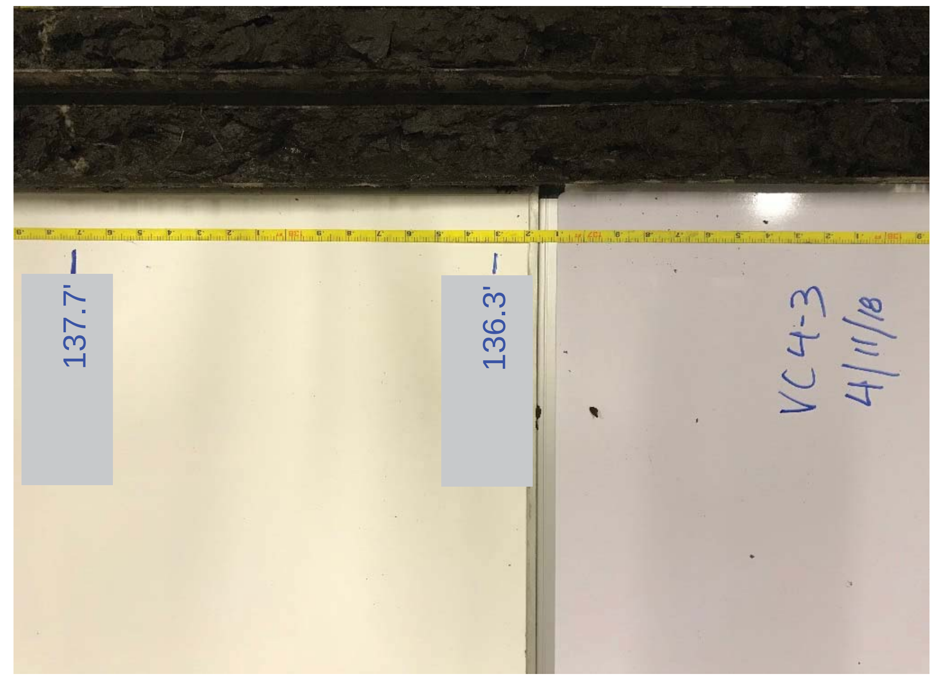


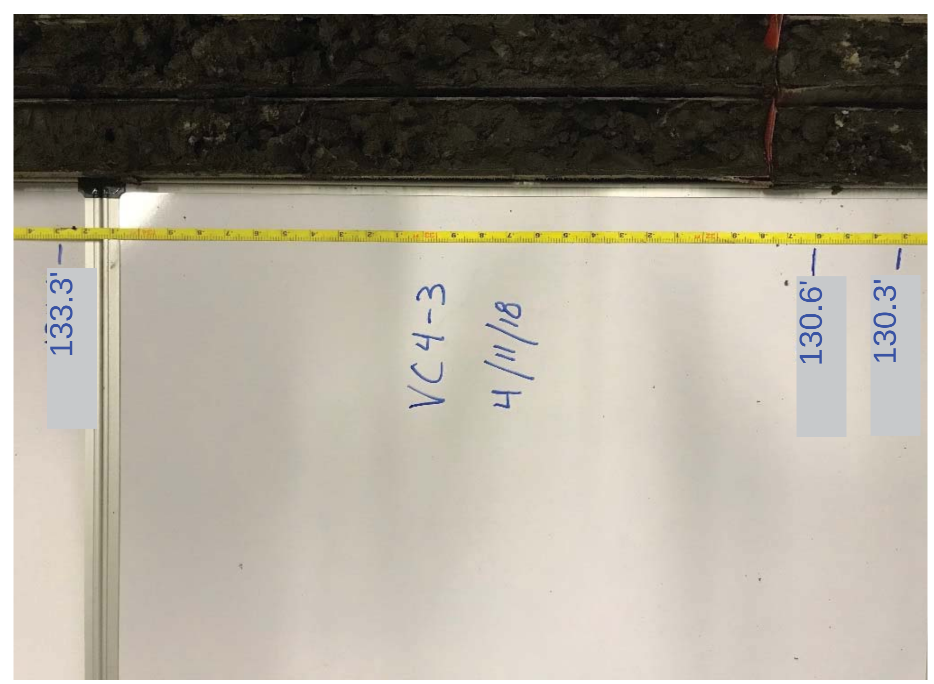
wood.

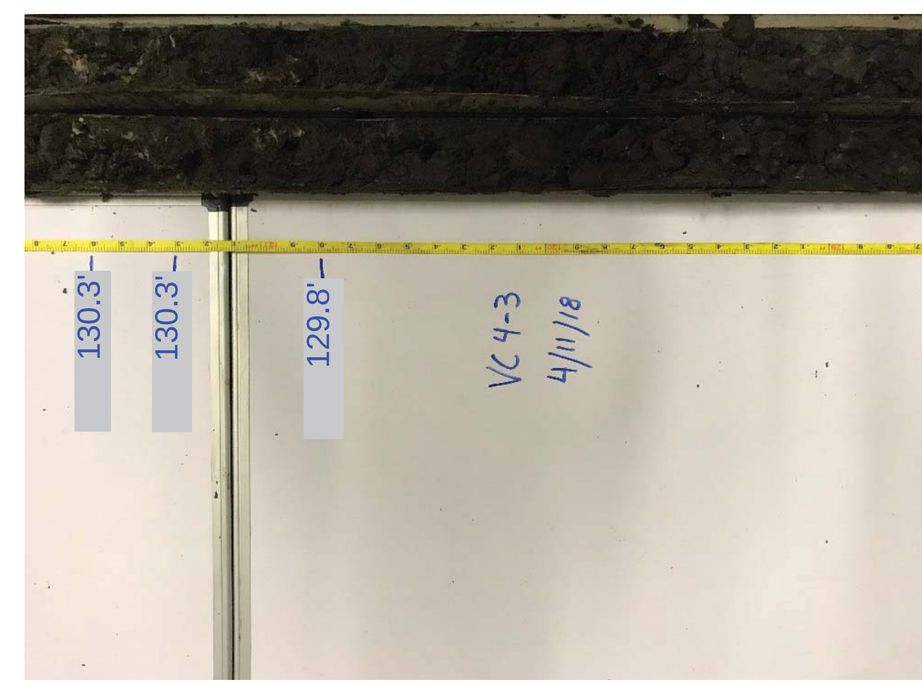
Vibracore: 4-3

Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 139.0 ft / Top of Hard Stratum Elevation: 124.7 ft / Vibracore Recovery Bottom Elevation: 121.9 ft



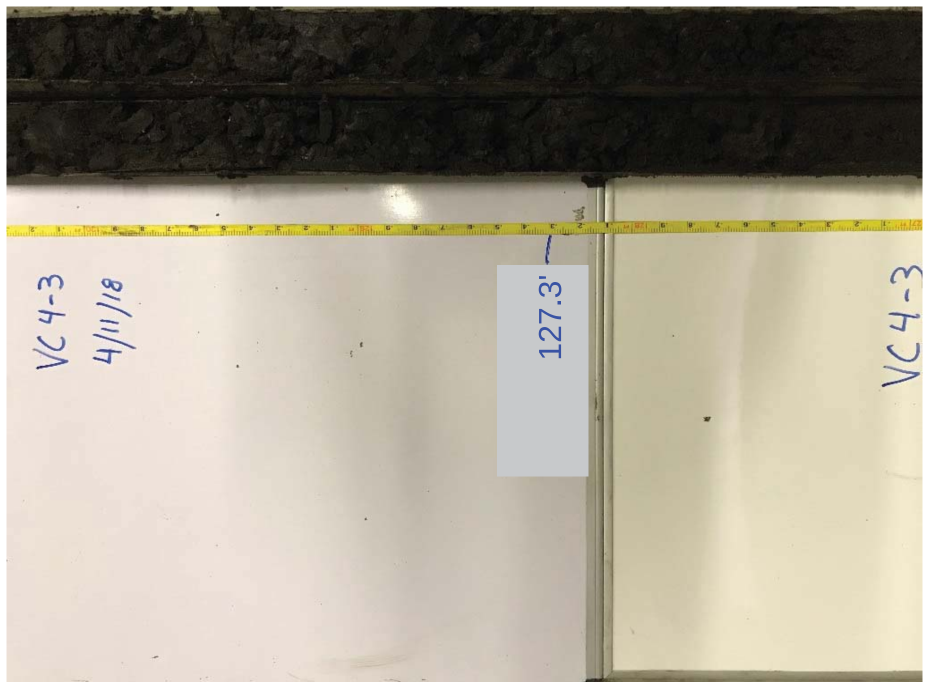


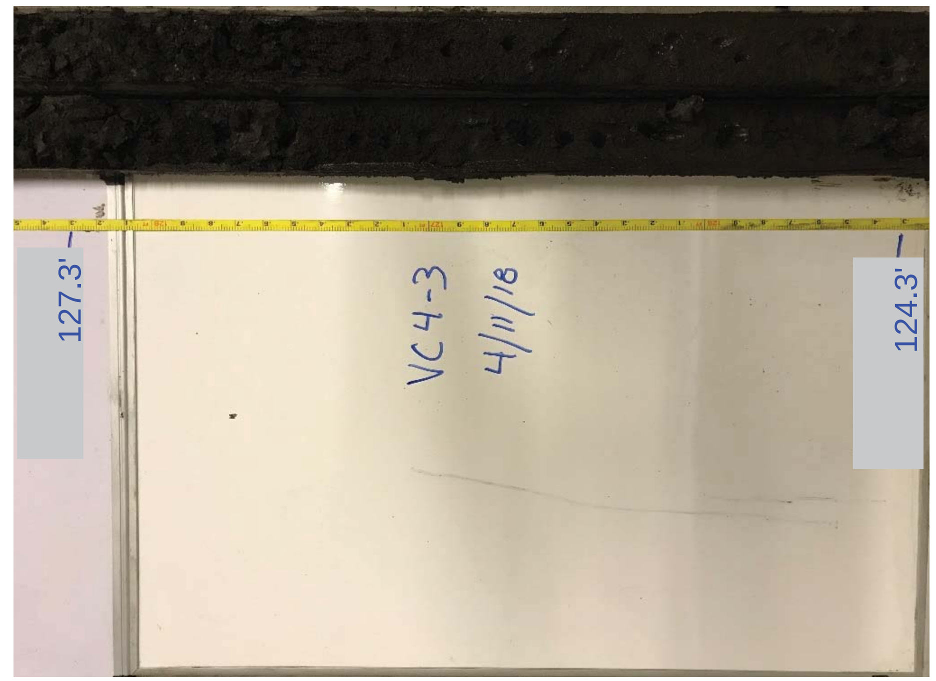


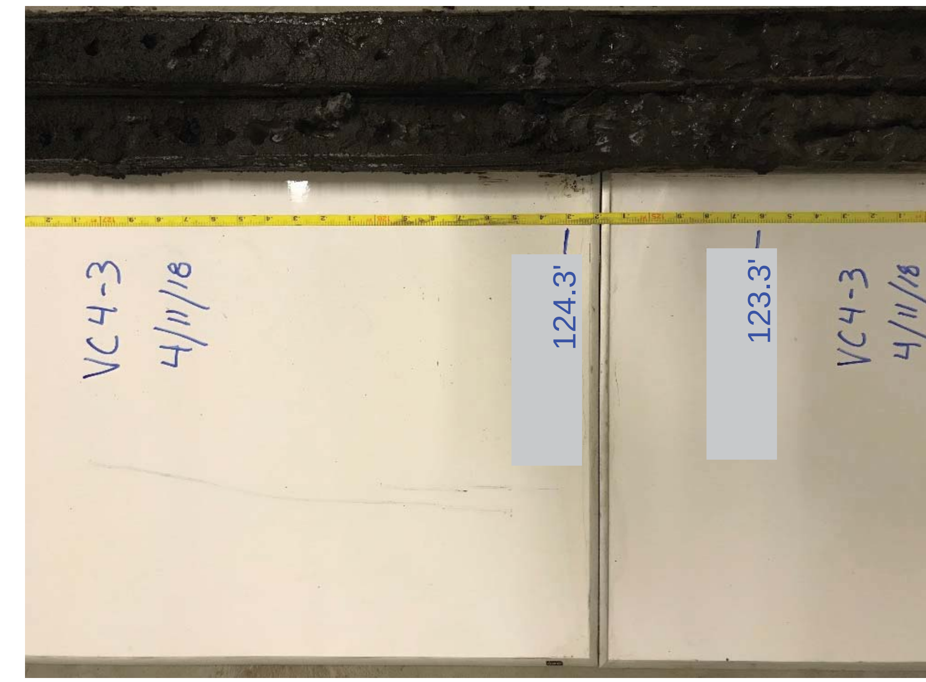


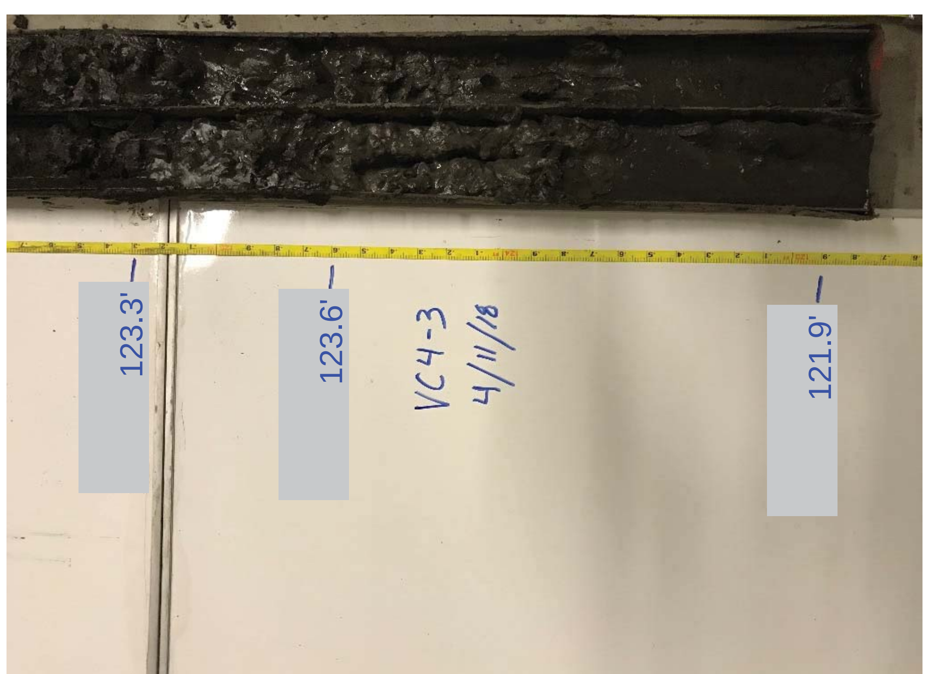
Vibracore: 4-3

Average Lake Water Elevation: 144.0 ft / Top of Sediment Elevation: 139.0 ft / Top of Hard Stratum Elevation: 124.7 ft / Vibracore Recovery Bottom Elevation: 121.9 ft









ATTACHMENT D

Piston Tube Survey Data and Logs

Lake Bonnet Pollutant Source Reduction Feasibility Study - Piston Tube Survey Data

Piston Tube No.	Location		Lake Water Level Average Elevation (ft) (2) (3)	Lake Water Level Depth (ft)	Estimated Top of Sediment Elevation (ft) (4)	Max Penetration Determined by Hand Probe (ft) (5)	Bottom Elevation of Sampling (ft)
	Northing (ft) (1)	Easting (ft) (1)					
PT 1-1	1349960.4	662699.9	144.0	6.0	138.0	7.0	137.0
PT 1-2 (6)	1349702.8	663138.0	144.0	6.0	138.0	6.5	137.5
PT 1-3 (6)	1349513.8	663615.4	144.0	6.0	138.0	9.0	135.0
PT 1-4 (6)	1349288.5	664112.2	144.0	5.5	138.5	12.5	131.5
PT 2-1 (6)	1350149.9	662796.1	144.0	6.0	138.0	6.5	137.5
PT 2-2	1350077.6	663418.5	144.0	6.0	138.0	10.0	134.0
PT 2-3 (6)	1349848.3	663902.5	144.0	6.0	138.0	12.0	132.0
PT 2-4 (6)	1349568.5	664463.7	144.0	5.0	139.0	29.0	115.0
PT 3-1 (6)	1350575.3	663237.9	144.0	6.0	138.0	9.5	134.5
PT 3-2 (6)	1350382.7	663689.5	144.0	6.0	138.0	14.0	130.0
PT 3-3	1350198.6	680429.1	144.0	6.0	138.0	17.0	127.0
PT 3-4 (6)	1350026.6	664641.1	144.0	5.0	139.0	20.0	124.0
PT 4-1 (6)	1350957.1	663512.0	144.0	5.0	139.0	11.0	133.0
PT 4-2 (6)	1350867.7	696137.0	144.0	5.0	139.0	13.0	131.0
PT 4-3 (6)	1350653.4	683600.0	144.0	5.5	138.5	21.0	123.0
PT 4-4	1350456.1	664627.5	144.0	6.0	138.0	23.0	121.0

Notes:
(1) Florida State Plane East (NAD 83)
(2) 1988 North American Vertical Datum (NAVD 88), State Plane System Zone: FLORIDA EAST.
(3) Based on the bathymetric survey performed between 03/06/2018 and 03/17/2018
(4) Vibracores experienced fluid sediment loss during coring works.
(5) Depth is refererence to water surface.
(6) Piston tube was sent to Advanced Environmental Laboratories (AEL) for geo-chemical testing

wood.

BORING NUMBER PT1-1

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/5/18 **COMPLETED** 4/5/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1349960.4 , E662699.9
DRILLING METHOD Piston Tube Sampling
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					▽ Average lake water level (Elev. 144.0 ft)	
5						
6.0'	B	MC = 520% #200 = 53% OC=20%	OL		Very soft, spongy, black organic SILT. (Munsell 10YR2/1) Sampler refusal (SAND)	138.0
7.0'						137.0

Bottom of borehole at 7.0 feet.

BORING NUMBER PT1-2

wood.

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/5/18 **COMPLETED** 4/5/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1349702.8 , E663138
DRILLING METHOD Piston Tube Sampling
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES This piston Tube was sent to Advanced Environmental Laboratories (AEL) for geo-chemical testing.

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					▽ Average lake water level (Elev. 144.0 ft)	
5						
6.0'						138.0
6.5'	B		OL		Very soft, spongy, black organic SILT. (Munsell 10YR2/1)	137.5
					Sampler refusal (SAND)	

Bottom of borehole at 6.5 feet.

LAKE BONNET - C-44 GINT STD US LABS.GDT - 6/18/18 11:41 - Z:\WATER\PROJECTS\600537X5 CITY OF LAKELAND LAKE BONNET\GEOTECHNICAL\GINT\CITY OF LAKELAND - LAKE BONNET PISTON TUBE AND VIBRACORE LOGS.GPJ

BORING NUMBER PT1-3

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/5/18 **COMPLETED** 4/5/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1349513.8 , E663615.4
DRILLING METHOD Piston Tube Sampling
GROUND WATER LEVEL AT TIME OF DRILLING 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES This piston Tube was sent to Advanced Environmental Laboratories (AEL) for geo-chemical testing.

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					Average lake water level (Elev. 144.0 ft)	
5						
6.0'	B		OL		Very soft, spongy, black organic SILT. (Munsell 10YR2/1)	138.0
	B				Sampler refusal (SAND)	
9.0'						135.0

Bottom of borehole at 9.0 feet.

wood.

BORING NUMBER PT1-4

CLIENT City of Lakeland		**PROJECT NAME** Lake Bonnet Pollutant Source Reduction Feasibility Study	
PROJECT NUMBER 600537		**PROJECT LOCATION** Lakeland, Polk County, Florida	
DATE STARTED 4/5/18	**COMPLETED** 4/5/18	**WATER ELEVATION** 144 ft	**HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler		**DRILLING LOCATION** N1349288.5 , E664112.2	
DRILLING METHOD Piston Tube Sampling		∇ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft	
LOGGED BY CS	**CHECKED BY** LG	**HOLE COMPLETION**	

NOTES This piston Tube was sent to Advanced Environmental Laboratories (AEL) for geo-chemical testing.

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					∇ Average lake water level (Elev. 144.0 ft)	
5						
5.5'	B		OL		Very soft, spongy, black organic SILT. (Munsell 10YR2/1)	138.5
	B		OL			
	B		OL			
10	B		OL			
12.5'	B		OL		Sampler refusal (SAND)	131.5

Bottom of borehole at 12.5 feet.

BORING NUMBER PT2-1

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/5/18 **COMPLETED** 4/5/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1350149.9 , E662796.1
DRILLING METHOD Piston Tube Sampling
GROUND WATER LEVEL AT TIME OF DRILLING 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES This piston Tube was sent to Advanced Environmental Laboratories (AEL) for geo-chemical testing.

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					▽ Average lake water level (Elev. 144.0 ft)	
5						
6.0'	B		OL		Very soft, spongy, black organic SILT. (Munsell 10YR2/1)	138.0
6.5'					Sampler refusal (SAND)	137.5

Bottom of borehole at 6.5 feet.

LAKE BONNET - C-44 GINT STD US LABS.GDT - 6/18/18 15:51 - Z:\WATER\PROJECTS\600537X5 CITY OF LAKELAND LAKE BONNET\GEOTECHNICAL\GINT\CITY OF LAKELAND - LAKE BONNET PISTON TUBE AND VIBRACORE LOGS.GPJ

BORING NUMBER PT2-2

wood.

CLIENT City of Lakeland	**PROJECT NAME** Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537	**PROJECT LOCATION** Lakeland, Polk County, Florida
DATE STARTED 4/5/18 **COMPLETED** 4/5/18	**WATER ELEVATION** 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler	**DRILLING LOCATION** N1350077.6 , E663418.5
DRILLING METHOD Piston Tube Sampling	▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG	**HOLE COMPLETION**
NOTES	

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					▽ Average lake water level (Elev. 144.0 ft)	
5						
6.0'	B		OL		Very soft, spongy, black organic SILT. (Munsell 10YR2/1)	138.0
7.0'	B	MC = 878% #200 = 60% OC=33%	OL		Very soft, spongy, black organic SILT. (Munsell 10YR2/1)	137.0
8.0'	B		OL		Very soft, spongy, black organic SILT. (Munsell 10YR2/1)	136.0
	B					
10.0'					Sampler refusal (SAND)	134.0

Bottom of borehole at 10.0 feet.

BORING NUMBER PT2-3

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/6/18 **COMPLETED** 4/6/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1349848.3 , E663902.5
DRILLING METHOD Piston Tube Sampling
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES This piston Tube was sent to Advanced Environmental Laboratories (AEL) for geo-chemical testing.

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					▽ Average lake water level (Elev. 144.0 ft)	
5						
6.0'	B		OL		Very soft, spongy, black organic SILT. (Munsell 10YR2/1)	138.0
	B					
10	B					
	B					
12.0'					Sampler refusal (SAND)	132.0

Bottom of borehole at 12.0 feet.

wood.

BORING NUMBER PT2-4

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/6/18 **COMPLETED** 4/6/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1349568.5 , E664463.7
DRILLING METHOD Piston Tube Sampling
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES This piston Tube was sent to Advanced Environmental Laboratories (AEL) for geo-chemical testing.

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					▽ Average lake water level (Elev. 144.0 ft)	
5					5.0' Very soft, spongy, black organic SILT. (Munsell 10YR2/1)	139.0
	B		OL			
	B					
	B					
10	B					
	B					
	B					
15	B					
	B					
	B					
20	B					

(Continued Next Page)

CLIENT City of Lakeland

PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study

PROJECT NUMBER 600537

PROJECT LOCATION Lakeland, Polk County, Florida

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
20	B		OL		Very soft, spongy, black organic SILT. (Munsell 10YR2/1) *(continued)*	
	B					
	B					
25	B					
	B					
	B			29.0'	Sampler refusal (SAND)	115.0

Bottom of borehole at 29.0 feet.

BORING NUMBER PT3-1

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/6/18 **COMPLETED** 4/6/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1350575.3 , E663237.9
DRILLING METHOD Piston Tube Sampling
GROUND WATER LEVEL AT TIME OF DRILLING 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES This piston Tube was sent to Advanced Environmental Laboratories (AEL) for geo-chemical testing.

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					▽ Average lake water level (Elev. 144.0 ft)	
5						
6.0'	B		OL		Very soft, spongy, black organic SILT. (Munsell 10YR2/1)	138.0
	B					
9.5'	B				Sampler refusal (SAND)	134.5

Bottom of borehole at 9.5 feet.

wood.

BORING NUMBER PT3-2

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/6/18 **COMPLETED** 4/6/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1350382.7 , E663689.5
DRILLING METHOD Piston Tube Sampling
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES This piston Tube was sent to Advanced Environmental Laboratories (AEL) for geo-chemical testing.

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					▽ Average lake water level (Elev. 144.0 ft)	
5						
6.0'	B		OL		Very soft, spongy, black organic SILT. (Munsell 10YR2/1)	138.0
	B					
10	B					
	B					
	B					
14.0'	B				Sampler refusal (SAND)	130.0

Bottom of borehole at 14.0 feet.

BORING NUMBER PT3-3

wood.

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/6/18 **COMPLETED** 4/6/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1350198.6 , E680429.1
DRILLING METHOD Piston Tube Sampling
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					▽ Average lake water level (Elev. 144.0 ft)	
5						
6.0'	B		OL		Very soft, spongy, black organic SILT. (Munsell 10YR2/1)	138.0
	B					
10	B	MC = 1171% #200 = 56% OC=39%				
	B					
	B					
15	B					
	B					
17.0'	B				Sampler refusal (CLAYEY SAND)	127.0

Bottom of borehole at 17.0 feet.

BORING NUMBER PT3-4

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/6/18 **COMPLETED** 4/6/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1350026.6 , E664641.1
DRILLING METHOD Piston Tube Sampling
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES This piston Tube was sent to Advanced Environmental Laboratories (AEL) for geo-chemical testing.

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					▽ Average lake water level (Elev. 144.0 ft)	
5	B		OL		5.0' Very soft, spongy, black organic SILT. (Munsell 10YR2/1)	139.0
	B					
	B					
10	B					
	B					
	B					
15	B					
	B					
	B					
	B					
20					20.0' Sampler refusal (CLAY)	124.0

Bottom of borehole at 20.0 feet.

BORING NUMBER PT4-1

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/9/18 **COMPLETED** 4/9/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1350957.1 , E663512
DRILLING METHOD Piston Tube Sampling
GROUND WATER LEVEL AT TIME OF DRILLING 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES This piston Tube was sent to Advanced Environmental Laboratories (AEL) for geo-chemical testing.

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					▽ Average lake water level (Elev. 144.0 ft)	
5	B		OL		5.0' Very soft, spongy, black ORGANIC SILT. (Munsell 10YR2/1)	139.0
	B					
	B					
10	B				11.0' Sampler refusal (SAND)	133.0

Bottom of borehole at 11.0 feet.

BORING NUMBER PT4-2

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/9/18 **COMPLETED** 4/9/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1350867.7 , E696137
DRILLING METHOD Piston Tube Sampling
GROUND WATER LEVEL AT TIME OF DRILLING 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES This piston Tube was sent to Advanced Environmental Laboratories (AEL) for geo-chemical testing.

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					▽ Average lake water level (Elev. 144.0 ft)	
5	B		OL		5.0' Very soft, spongy, black ORGANIC SILT. (Munsell 10YR2/1)	139.0
	B					
	B					
10	B					
	B					
	B				13.0' Sampler refusal (SAND)	131.0

Bottom of borehole at 13.0 feet.

BORING NUMBER PT4-3

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/9/18 **COMPLETED** 4/9/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1350653.4 , E683600
DRILLING METHOD Piston Tube Sampling
▽ **GROUND WATER LEVEL AT TIME OF DRILLING** 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES This piston Tube was sent to Advanced Environmental Laboratories (AEL) for geo-chemical testing.

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					▽ Average lake water level (Elev. 144.0 ft)	
5						
5.5'					Very soft, spongy, black ORGANIC SILT. (Munsell 10YR2/1)	138.5
	B		OL			
	B					
10	B					
	B					
	B					
	B					
15	B					
	B					
	B					
20	B					

(Continued Next Page)

BORING NUMBER PT4-3

CLIENT City of Lakeland

PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study

PROJECT NUMBER 600537

PROJECT LOCATION Lakeland, Polk County, Florida

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
20						
			OL		Very soft, spongy, black ORGANIC SILT. (Munsell 10YR2/1) *(continued)*	
	B			21.0'	Sampler refusal (SANDY CLAY)	123.0

Bottom of borehole at 21.0 feet.

BORING NUMBER PT4-4

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida
DATE STARTED 4/9/18 **COMPLETED** 4/9/18
WATER ELEVATION 144 ft **HOLE SIZE** 2 inches
DRILLING CONTRACTOR Amec Foster Wheeler
DRILLING LOCATION N1350456.1 , E664627.5
DRILLING METHOD Piston Tube Sampling
GROUND WATER LEVEL AT TIME OF DRILLING 0.00 ft / Elev 144.00 ft
LOGGED BY CS **CHECKED BY** LG
HOLE COMPLETION
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0					Average lake water level (Elev. 144.0 ft)	
5						
6.0'	B		OL		Very soft, spongy, black ORGANIC SILT. (Munsell 10YR2/1)	138.0
	B					
10	B					
	B					
	B	MC = 1196% #200 = 68% OC=45%				
15	B					
	B					
	B					
	B					
20						

(Continued Next Page)

BORING NUMBER PT4-4

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida

DEPTH (ft)	SAMPLE TYPE NUMBER	TEST AND REMARKS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
20	B		OL		Very soft, spongy, black ORGANIC SILT. (Munsell 10YR2/1) *(continued)*	
	B					
	B			23.0'	Sampler refusal (CLAYEY SAND)	121.0

Bottom of borehole at 23.0 feet.

ATTACHMENT E

Laboratory Test Data

Laboratory Summary Results

Vibracore / Piston Tube No.	Stratum No.	Depth Range (ft) [1]	Moisture Content (%)	% Finer #200 Sieve (%)	Atterberg Limits			Organic Content (%)	Hydrometer	
					LL (%)	PL (%)	PI (%)		Silt Content (%)	Clay Content (%)
VC 1-1	2	6 - 7	37	4	-	-	-	1	-	-
VC 1-1	2	8 - 9	17	15	-	-	-	-	-	-
VC 1-1	2	9 - 9.5	18	6	-	-	-	-	-	-
VC 1-1	2	10 - 10.4	-	26	NP	NP	NP	-	-	-
VC 1-2	1	6 - 6.7	402	72	-	-	-	15	-	-
VC 1-2	2	8 - 8.5	20	6	-	-	-	-	-	-
VC 1-2	2	8.5 - 8.9	18	3	-	-	-	-	-	-
VC 1-2	3	9.5 - 10.5	-	-	61	21	40	-	-	-
VC 1-3	1	6 - 8	541	62	-	-	-	25	-	-
VC 1-3	2	8.5 - 9	21	4	-	-	-	-	-	-
VC 1-3	2	9.5 - 9.9	19	11	-	-	-	-	-	-
VC 1-3	2	10 - 11	19	3	-	-	-	-	-	-
VC 2-1	1	6 - 7	352	61	-	-	-	11	-	-
VC 2-1	2	9 - 9.5	17	4	-	-	-	-	-	-
VC 2-1	2	10 - 11	14	10	-	-	-	-	-	-
VC 2-1	3	12 - 13	-	-	38	11	27	-	-	-
VC 2-2	1	6 - 6.25	459	30	-	-	-	30	-	-
VC 2-2	2	7 - 7.7	20	9	-	-	-	-	-	-
VC 2-2	3	9.7 - 10	21	65	52	20	32	-	-	-
VC 2-3	1	8.5 - 9.5	521	72	-	-	-	28	-	-
VC 2-3	1	16 - 17	324	50	-	-	-	-	-	-
VC 2-3	1	18 - 19	575	50	-	-	-	-	-	-
VC 2-3	1	20 - 20.5	87	92	-	-	-	18	80	12
VC 2-3	2	21.5 - 22.5	11	20	-	-	-	-	-	-
VC 3-1	1	7 - 8	323	75	-	-	-	17	-	-
VC 3-1	2	11 - 11.5	28	20	-	-	-	-	-	-
VC 3-1	2	12.5 - 13.5	21	2	-	-	-	-	-	-
VC 3-2	1	8 - 9	424	72	-	-	-	37	66	6
VC 3-2	1	10 - 11	300	54	-	-	-	21	-	-

Laboratory Summary Results

Vibracore / Piston Tube No.	Stratum No.	Depth Range (ft) (1)	Moisture Content (%)	% Finer #200 Sieve (%)	Atterberg Limits			Organic Content (%)	Hydrometer	
					LL (%)	PL (%)	PI (%)		Silt Content (%)	Clay Content (%)
VC 3-2	2	12 - 13	20	23	-	-	-	-	-	-
VC 3-2	2	14.5 - 15	22	42	-	-	-	-	-	-
VC 3-3	1	8 - 9	531	61	-	-	-	23	55	8
VC 3-3	1	12 - 13	494	43	-	-	-	28	38	5
VC 3-3	3	16 - 17	21	45	-	-	-	-	-	-
VC 4-1	1	7 - 8	534	49	-	-	-	25	40	9
VC 4-1	2	9 - 10	25	6	-	-	-	2	-	-
VC 4-1	2	10.3 - 10.8	20	5	-	-	-	-	-	-
VC 4-1	2	11 - 12	20	5	-	-	-	-	-	-
VC 4-2	1	9 - 10	482	53	-	-	-	8	-	-
VC 4-2	1	12.5 - 13	394	49	-	-	-	26	-	-
VC 4-2	2	14 - 15	19	38	-	-	-	-	-	-
VC 4-2	2	16 - 17	18	2	-	-	-	-	-	-
VC 4-3	1	5 - 6	601	73	-	-	-	45	58	15
VC 4-3	1	10 - 11	765	70	-	-	-	40	62	8
VC 4-3	1	16 - 17	558	65	-	-	-	38	53	12
VC 4-3	1	21.5 - 22	68	89	-	-	-	-	-	-
PT 1-1	1	6 - 7	520	53	-	-	-	20	-	-
PT 2-2	1	7 - 8	878	60	-	-	-	33	-	-
PT 3-3	1	10 - 11	1171	56	-	-	-	39	-	-
PT 4-4	1	12 - 13	1196	68	-	-	-	45	-	-

(1) Depths are referenced to lake water surface

TOTAL ORGANIC CONTENT ANALYSIS

ASTM D 2974

CLIENT: City of Lakeland
Address: 407 Fairway Avenue
Lakeland, FL 33801

Date: April 25, 2018
Project #: 600537x5.05A
Requested By: L. Garcia
Tested By: CM / CR
Checked By: L. Garcia

Project: Lake Bonnet Pollutant Source Reduction Feasibility Study
Location: Lakeland, FL

Sample No.	Depth (ft)	Weight of Container + Wet Soil (grams)	Weight of Container + Dry Soil (grams)	Weight of Container (grams)	Weight of Container + Furnace Ash (grams)	Organic Loss (grams)	Moisture Content (%)	Organic Content (%)
VC 1-1	6	126.27	115.28	85.81	115.04	0.24	37.3	0.8
VC 1-2	6	132.63	94.47	84.97	93.06	1.41	401.7	14.8
VC 1-3	7	101.79	71.27	65.63	69.85	1.42	541.1	25.2
VC 2-1	6	124.90	92.23	82.96	91.24	0.99	352.4	10.7
VC 2-2	5	101.72	70.07	63.17	68.01	2.06	458.7	29.9
VC 2-3	8.5	99.63	62.62	55.51	60.60	2.02	520.5	28.4
VC 2-3	20	141.24	119.82	95.13	115.33	4.49	86.8	18.2
VC 3-1	8	108.55	74.09	63.43	72.29	1.80	323.3	16.9
VC 3-2	8.5	100.82	71.15	62.61	68.03	3.12	347.4	36.5
VC 3-2	10.5	98.28	68.34	58.37	66.25	2.09	300.3	21.0
VC 3-3	8	145.50	110.03	103.35	108.48	1.55	531.0	23.2
VC 3-3	12	146.87	114.07	107.43	112.20	1.87	494.0	28.2
VC 4-1	7	122.66	91.61	85.80	90.15	1.46	534.4	25.1
VC 4-1	9	96.02	95.43	58.35	94.73	0.70	1.6	1.9
VC 4-2	9	100.54	69.57	63.14	69.07	0.50	481.6	7.8
VC 4-2	12.5	95.57	63.65	55.54	61.51	2.14	393.6	26.4
VC 4-3	6	132.39	94.95	92.01	93.64	1.31	1273.5	44.6
VC 4-3	10	152.01	117.66	113.34	115.92	1.74	795.1	40.3
VC 4-3	16	164.70	124.30	117.06	121.56	2.74	558.0	37.8
PT 1-1	6	153.99	114.91	107.39	113.44	1.47	519.7	19.5
PT 2-2	7	98.94	63.82	59.82	62.52	1.30	878.0	32.5
PT 3-3	10	87.13	57.04	54.47	56.04	1.00	1170.8	38.9
PT 4-4	12	153.12	117.97	115.03	116.64	1.33	1195.6	45.2

Notes: Depths are referenced to lake water surface

wood.

MOISTURE CONTENT and WET SIEVE ANALYSIS

Client City of Lakeland
Address: 407 Fairway Avenue
Lakeland, FL 33801

Project: Lake Bonnet Pollutant Source Reduction Feasibility Study
Location: Lakeland, FL

Test Date: April 10, 2018
Project #: 600573x5.5A
Requested By: L. Garcia
Tested By: M. Hall
Checked By: L. Garcia

% Solids, Moisture Content							Wet Sieve Test		
Sample No. and Depth	Depth (ft)	Weight of Container (g)	Weight of Container + Wet Soil (g)	Weight of Container + Dry Soil (g)	Solids Content (%)	Moisture Content (%)	Weight of Container + Dry Soil (g)	Weight of Container + Dry washed Soil (g)	% Finer than #200 Sieve (%)
VC 3-3	8.0	84.80	612.95	168.50	15.85	531.0	168.5	117.40	61.1
VC 3-3	12.0	86.50	924.66	227.70	16.85	493.6	227.7	168.11	42.2
VC 3-3	16.0	88.10	775.40	657.60	82.86	20.7	657.6	402.20	44.8
VC 1-3	7.0	85.50	1216.29	261.80	15.59	541.4	261.8	152.20	62.2
VC 1-3	8.5	85.40	954.90	804.80	82.74	20.9	804.8	773.40	4.4
VC 1-3	9.5	88.50	782.90	673.20	84.20	18.8	673.2	608.70	11.0
VC 1-3	10.0	85.80	682.00	587.00	84.07	19.0	587	571.80	3.0
VC 2-2	5.0	85.20	881.62	227.80	17.91	458.5	227.8	185.30	29.8
VC 2-2	6.0	86.00	701.40	597.80	83.17	20.2	597.8	553.90	8.6
VC 2-2	8.0	84.90	656.50	557.40	82.66	21.0	557.4	251.22	64.8
PT 1-1	6.0	85.60	364.02	130.50	16.13	520.1	130.5	106.60	53.2
PT 2-2	7.0	85.60	325.01	110.10	10.23	877.2	110.1	95.30	60.4
PT 3-3	10.0	85.60	398.12	110.20	7.87	1170.4	110.2	96.40	56.1
PT 4-4	12.0	85.60	407.06	110.40	7.71	1196.2	110.4	93.60	67.7
VC 3-2	8.5	8.10	247.40	53.80	19.10	423.6	53.80	20.90	72.0
VC 3-2	10.5	8.20	202.25	56.70	24.99	300.1	56.7	30.50	54.0
VC 3-2	14.5	8.20	630.70	520.30	82.27	21.6	520.3	304.20	42.2
VC 4-2	9.0	8.20	225.72	45.60	17.19	481.6	45.6	25.70	53.2
VC 4-2	12.5	8.20	211.89	49.40	20.23	394.4	49.4	29.20	49.0
VC 4-2	14.0	8.20	273.30	231.20	84.12	18.9	231.2	146.50	38.0
VC 4-2	16.0	8.20	261.80	223.60	84.94	17.7	223.6	218.40	2.4
VC 1-2	6.0	8.10	237.29	53.80	19.94	401.5	53.8	20.80	72.2
VC 2-1	6.0	8.20	234.70	58.30	22.12	352.1	58.3	27.70	61.1
VC 2-3	8.5	8.30	183.79	36.60	16.13	520.1	36.6	16.10	72.4
VC 2-3	18.5	8.20	289.50	49.90	14.82	574.6	49.9	28.90	50.4

MOISTURE CONTENT and WET SIEVE ANALYSIS

Client City of Lakeland
Address: 407 Fairway Avenue
Lakeland, FL 33801

Project: Lake Bonnet Pollutant Source Reduction Feasibility Study
Location: Lakeland, FL

Test Date: April 10, 2018
Project #: 600573x5.5A
Requested By: L. Garcia
Tested By: M. Hall
Checked By: L. Garcia

% Solids, Moisture Content							Wet Sieve Test		
Sample No. and Depth	Depth (ft)	Weight of Container (g)	Weight of Container + Wet Soil (g)	Weight of Container + Dry Soil (g)	Solids Content (%)	Moisture Content (%)	Weight of Container + Dry Soil (g)	Weight of Container + Dry washed Soil (g)	% Finer than #200 Sieve (%)
VC 2-3	20	8.20	181.09	100.90	53.62	86.5	100.9	15.90	91.7
VC 1-1	6	8.30	425.10	312.20	72.91	37.2	312.2	300.00	4.0
VC 4-3	6	8.20	312.10	51.50	14.25	601.8	51.5	20.10	72.5
VC 4-3	10	8.20	304.80	42.50	11.56	764.7	42.5	18.60	69.7
VC 4-3	16	8.20	229.19	41.80	15.20	557.7	41.8	20.10	64.6
VC 3-1	8	8.20	318.68	81.60	23.64	323.0	81.6	26.50	75.1
VC 3-1	11.5	8.20	537.90	423.50	78.40	27.5	423.5	340.60	20.0
VC 3-1	13	8.20	469.50	390.80	82.94	20.6	390.8	384.80	1.6
VC 4-1	7	8.20	408.19	71.30	15.78	533.9	71.3	40.50	48.8
VC 4-1	9	8.20	262.80	211.30	79.77	25.4	211.3	199.10	6.0
VC 4-1	10.5	8.20	378.70	316.80	83.29	20.1	316.8	302.50	4.6
VC 4-1	12	8.20	376.20	316.00	83.64	19.6	316	302.20	4.5
VC 1-2	8	8.20	500.30	417.90	83.26	20.1	417.9	395.30	5.5
VC 1-2	8.5	8.20	428.80	363.60	84.50	18.3	363.6	352.00	3.3
VC 2-1	9	8.20	324.90	278.50	85.35	17.2	278.5	268.90	3.6
VC 2-1	11	8.20	362.40	320.10	88.06	13.6	320.1	288.90	10.0
VC 2-3	16.5	8.20	210.50	55.90	23.58	324.1	55.9	32.10	49.9
VC 2-3	21.5	8.20	295.80	267.40	90.13	11.0	267.4	216.50	19.6
VC 4-3	21.5	8.20	471.40	283.50	59.43	68.3	283.5	37.70	89.3
VC 1-1	8	8.20	346.70	296.60	85.20	17.4	296.6	254.50	14.6
VC 1-1	9	8.20	400.50	342.10	85.11	17.5	342.1	322.40	5.9

Notes: Depths are referenced to lake water surface

wood.

MECHANICAL GRADATION SIEVE ANALYSIS

ASTM C136, D421 & D422

CLIENT: **City of Lakeland**
Address: 407 Fairway Avenue
Lakeland, FL 33801

Project: Lake Bonnet Pollutant Source Reduction Feasibility Study
Location: Lakeland, FL

Sample ID: VC 1-1, Depth = 10 ft
Visual Description: Light Greenish gray Clayey SAND
USCS Classification: SC

Remarks:

Test Date: April 28, 2018
Project #: 600537x05
Requested By: Luis Garcia
Tested By: Michael Hall
Checked By: Luis Garcia

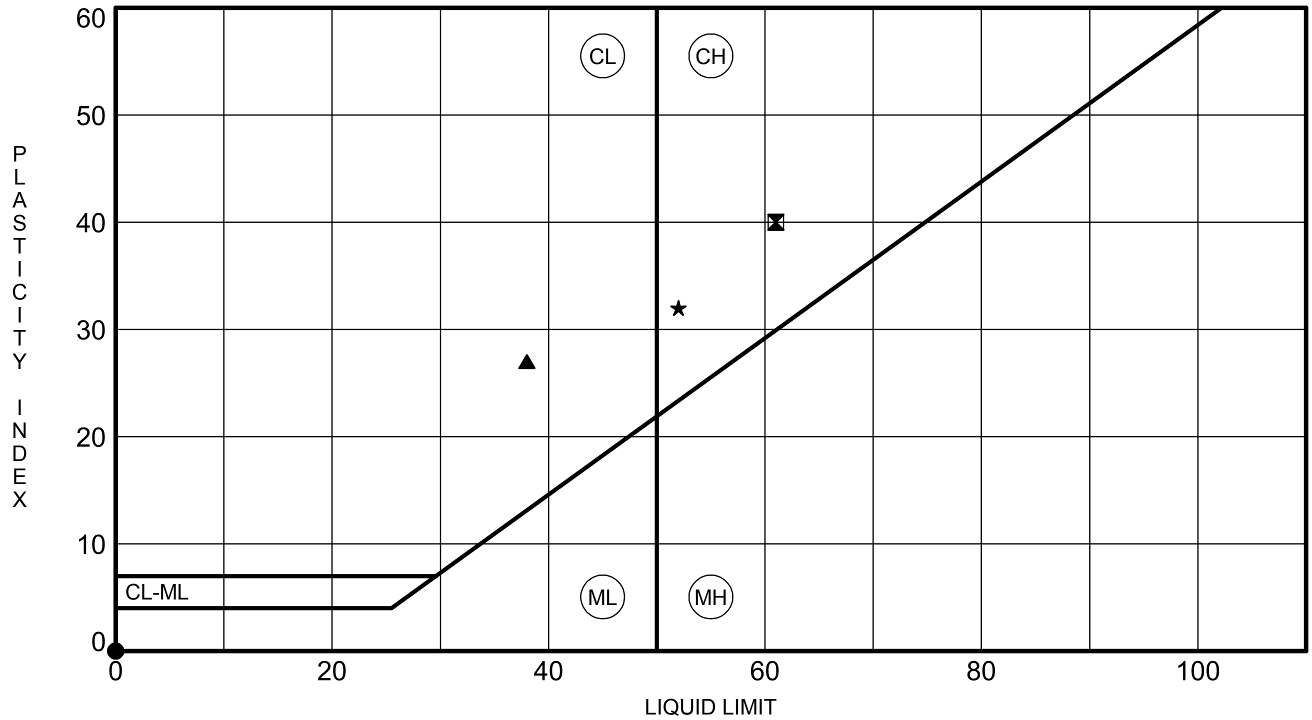
Dry Soil + Container: 209.80
Container Weight.: 8.50 grams
Dry Soil: 201.30 grams
Dry Wash + Cont.: 159.40 grams
Dry Washed Soil: 150.90 grams

Grain Size Distribution Data

Sieve Number	Sieve Opening (mm)	Sieve Weight (grams)	Sieve Weight + Soil (grams)	Sieve Weight + Retained Soil (grams)	Accumulative Retained Weight (grams)	Accumulative Percentage Retained (%)	Percent Finer (%)
1/2	12.500	0.0	5.5	5.5	5.50	3	97.3
3/8	9.500	0	5.8	5.8	11.30	6	94.4
#4	4.750	0	15.0	15.0	26.30	13	86.9
#8	2.360	0	11.1	11.1	37.40	19	81.4
#10	2.000	0	2.6	2.6	40.00	20	80.1
#16	1.180	0	8.4	8.4	48.40	24	76.0
#20	0.850	0	3.6	3.6	52.00	26	74.2
#60	0.250	0	38.0	38.0	90.00	45	55.3
#100	0.150	0	42.4	42.4	132.40	66	34.2
#140	0.106	0	14.5	14.5	146.90	73	27.0
#200	0.750	0	2.7	2.7	149.60	74	25.7
PAN		0	0.6	0.6	150.20	75	25.4

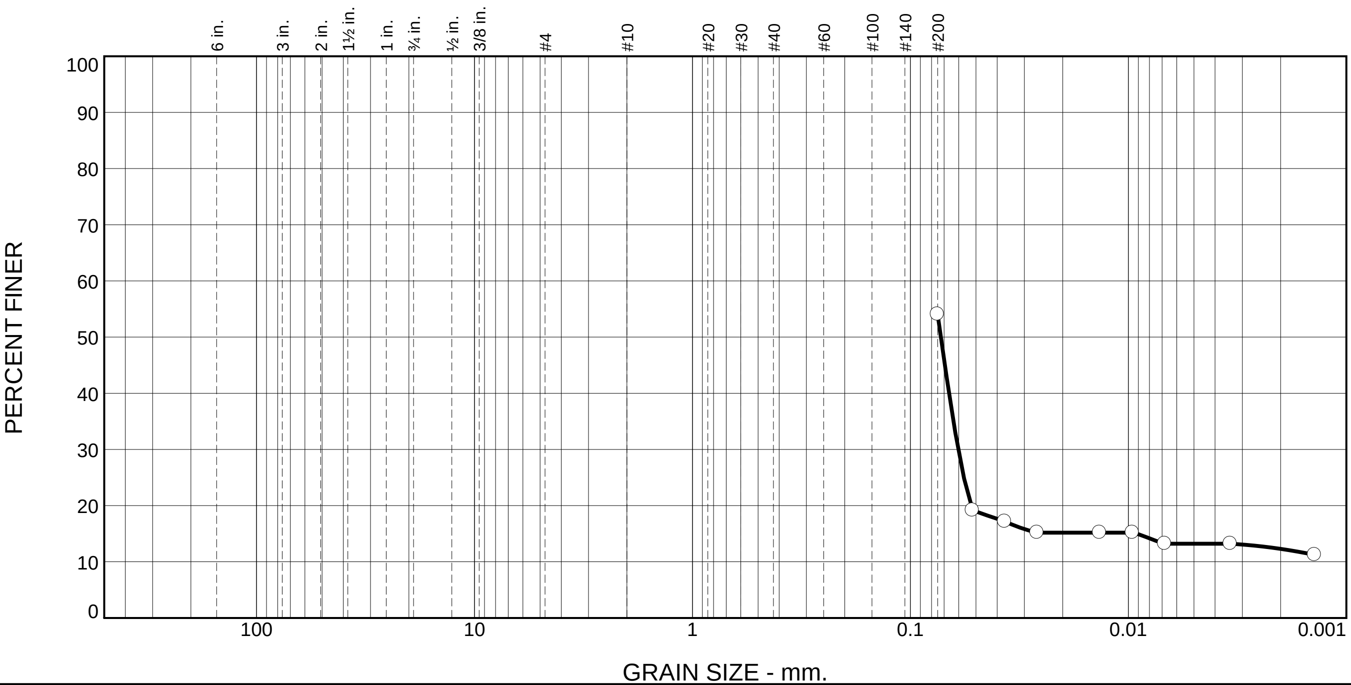
ATTERBERG LIMITS' RESULTS

CLIENT City of Lakeland
PROJECT NAME Lake Bonnet Pollutant Source Reduction Feasibility Study
PROJECT NUMBER 600537
PROJECT LOCATION Lakeland, Polk County, Florida



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**VC 1-1**	**10.0**	**NP**	**NP**	**NP**	**26**	**SILTY SAND(SM)**
⧗	**VC 1-2**	**10.0**	**61**	**21**	**40**	**63**	**SANDY FAT CLAY(CH)**
▲	**VC 2-1**	**12.0**	**38**	**11**	**27**	**51**	**SANDY LEAN CLAY(CL)**
★	**VC 2-2**	**9.7**	**52**	**20**	**32**	**65**	**SANDY LEAN CLAY(CL)**

Grain Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						40.8	13.2

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	54.0		
0.0518 mm.	19.1		
0.0368 mm.	17.2		
0.0262 mm.	15.2		
0.0135 mm.	15.2		
0.0096 mm.	15.2		
0.0068 mm.	13.2		
0.0034 mm.	13.2		
0.0014 mm.	11.2		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}=		D_{85}=		D_{60}=	
D_{50}=	0.0725	D_{30}=	0.0603	D_{15}=	0.0092
D_{10}=		C_u=		C_c=	

Remarks

Date Received: ______ **Date Tested:** ______

Tested By: ______

Checked By: ______

Title: ______

Source of Sample: Hydrometer **Depth:** 20 ft **Date Sampled:**

Sample Number: VC 2-3

WOOD

Lakeland, Florida

Client:

Project: Lake Bonnet

Project No: 600573x.05A **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

6/21/2018

Project: Lake Bonnet
Project Number: 600573x.05A
Location: Hydrometer
Depth: 20 ft **Sample Number:** VC 2-3

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 23.49
Tare Wt. = 0.00
Minus #200 from wash = 54.0%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
51.12	0.00	0.00			

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =51.12
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = 1
Meniscus correction only = 0.0
Specific gravity of solids = 2.596
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	23.0	8.0	9.7	0.0134	8.0	15.0	0.0518	19.1
2.00	23.0	7.0	8.7	0.0134	7.0	15.1	0.0368	17.2
4.00	23.0	6.0	7.7	0.0134	6.0	15.3	0.0262	15.2
15.00	23.0	6.0	7.7	0.0134	6.0	15.3	0.0135	15.2
30.00	23.0	6.0	7.7	0.0134	6.0	15.3	0.0096	15.2
60.00	23.0	5.0	6.7	0.0134	5.0	15.5	0.0068	13.2
240.00	23.0	5.0	6.7	0.0134	5.0	15.5	0.0034	13.2
1440.00	23.0	4.0	5.7	0.0134	4.0	15.6	0.0014	11.2

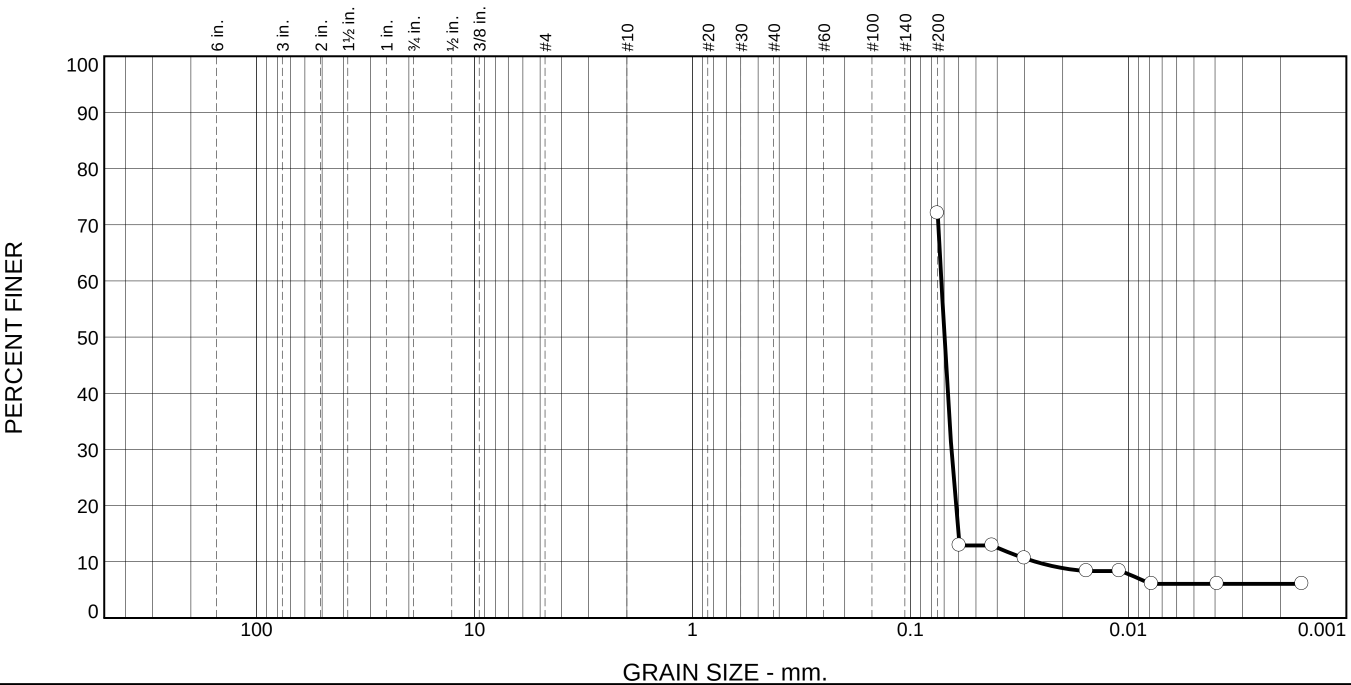
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
								40.8	13.2	54.0

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0092	0.0527	0.0603	0.0665	0.0725					

WOOD

Grain Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						65.9	6.1

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	72.0		
0.0595 mm.	12.9		
0.0421 mm.	12.9		
0.0299 mm.	10.6		
0.0155 mm.	8.3		
0.0110 mm.	8.3		
0.0078 mm.	6.1		
0.0039 mm.	6.1		
0.0016 mm.	6.1		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}= 0.0721
D_{50}= 0.0698 D_{30}= 0.0648 D_{15}= 0.0603
D_{10}= 0.0266 C_u= 2.71 C_c= 2.19

Remarks

Date Received: **Date Tested:**
Tested By:
Checked By:
Title:

Source of Sample: Hydrometer **Depth:** 8.5 ft **Date Sampled:**
Sample Number: VC 3-2

WOOD

Lakeland, Florida

Client:
Project: Lake Bonnet
Project No: 600573x.05A **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

6/21/2018

Project: Lake Bonnet
Project Number: 600573x.05A
Location: Hydrometer
Depth: 8.5 ft **Sample Number:** VC 3-2

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 13.56
Tare Wt. = 0.00
Minus #200 from wash = 72.0%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
48.51	0.00	0.00			

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 99.0
Weight of hydrometer sample =48.51
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = 1
Meniscus correction only = 0.0
Specific gravity of solids = 2.261
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	23.0	4.0	5.7	0.0150	4.0	15.6	0.0595	12.9
2.00	23.0	4.0	5.7	0.0150	4.0	15.6	0.0421	12.9
4.00	23.0	3.0	4.7	0.0150	3.0	15.8	0.0299	10.6
15.00	23.0	2.0	3.7	0.0150	2.0	16.0	0.0155	8.3
30.00	23.0	2.0	3.7	0.0150	2.0	16.0	0.0110	8.3
60.00	23.0	1.0	2.7	0.0150	1.0	16.1	0.0078	6.1
240.00	23.0	1.0	2.7	0.0150	1.0	16.1	0.0039	6.1
1440.00	23.0	1.0	2.7	0.0150	1.0	16.1	0.0016	6.1

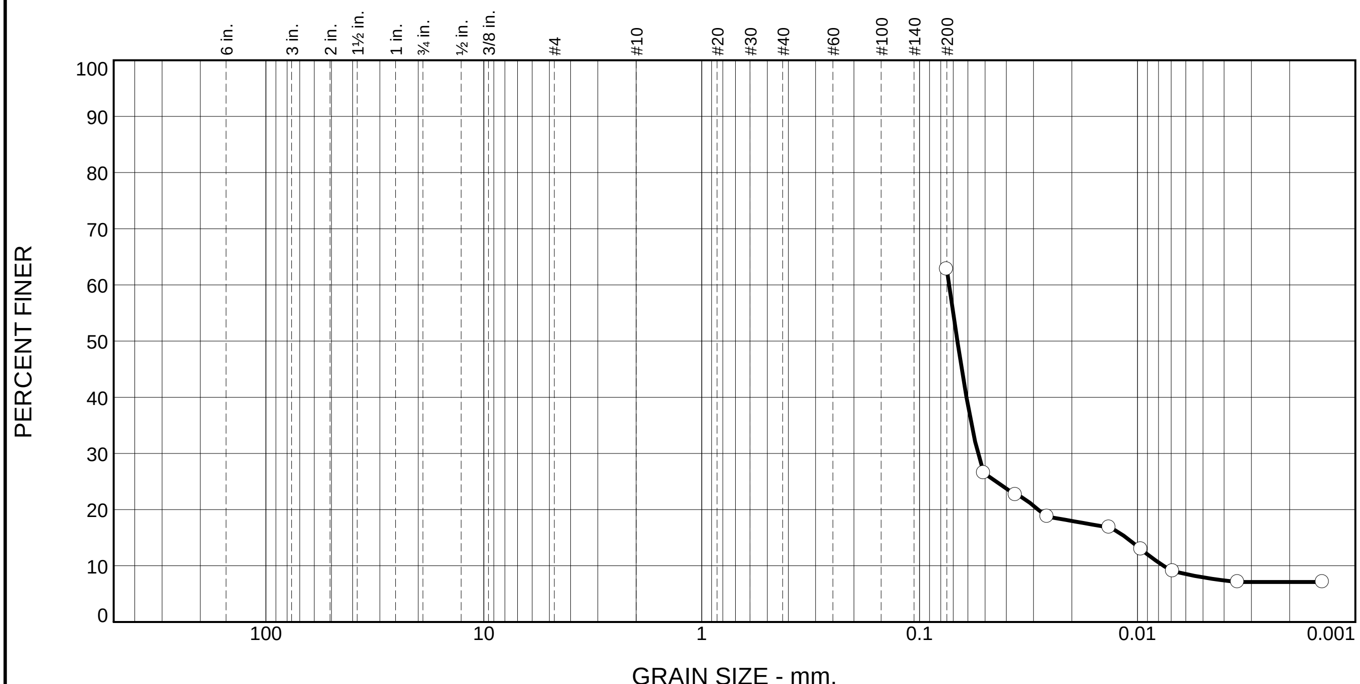
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
								65.9	6.1	72.0

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0266	0.0603	0.0620	0.0648	0.0674	0.0698	0.0721				

C_u	C_c
2.71	2.19

Grain Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						54.9	7.9

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	62.8		
0.0507 mm.	26.5		
0.0363 mm.	22.6		
0.0259 mm.	18.7		
0.0135 mm.	16.8		
0.0096 mm.	12.9		
0.0069 mm.	9.0		
0.0035 mm.	7.1		
0.0014 mm.	7.1		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= D_{85}= D_{60}= 0.0732
D_{50}= 0.0670 D_{30}= 0.0539 D_{15}= 0.0112
D_{10}= 0.0076 C_u= 9.64 C_c= 5.24

Remarks

Date Received: **Date Tested:**
Tested By:
Checked By:
Title:

Source of Sample: Hydrometer **Depth:** 8 ft **Date Sampled:**
Sample Number: VC 3-3

WOOD

Lakeland, Florida

Client:
Project: Lake Bonnet

Project No: 600573x.05A **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

6/21/2018

Project: Lake Bonnet
Project Number: 600573x.05A
Location: Hydrometer
Depth: 8 ft **Sample Number:** VC 3-3

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 19.45
Tare Wt. = 0.00
Minus #200 from wash = 62.8%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
52.28	0.00	0.00			

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =52.28
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = 1
Meniscus correction only = 0.0
Specific gravity of solids = 2.591
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	23.0	12.0	13.7	0.0134	12.0	14.3	0.0507	26.5
2.00	23.0	10.0	11.7	0.0134	10.0	14.7	0.0363	22.6
4.00	23.0	8.0	9.7	0.0134	8.0	15.0	0.0259	18.7
15.00	23.0	7.0	8.7	0.0134	7.0	15.1	0.0135	16.8
30.00	23.0	5.0	6.7	0.0134	5.0	15.5	0.0096	12.9
60.00	23.0	3.0	4.7	0.0134	3.0	15.8	0.0069	9.0
240.00	23.0	2.0	3.7	0.0134	2.0	16.0	0.0035	7.1
1440.00	23.0	2.0	3.7	0.0134	2.0	16.0	0.0014	7.1

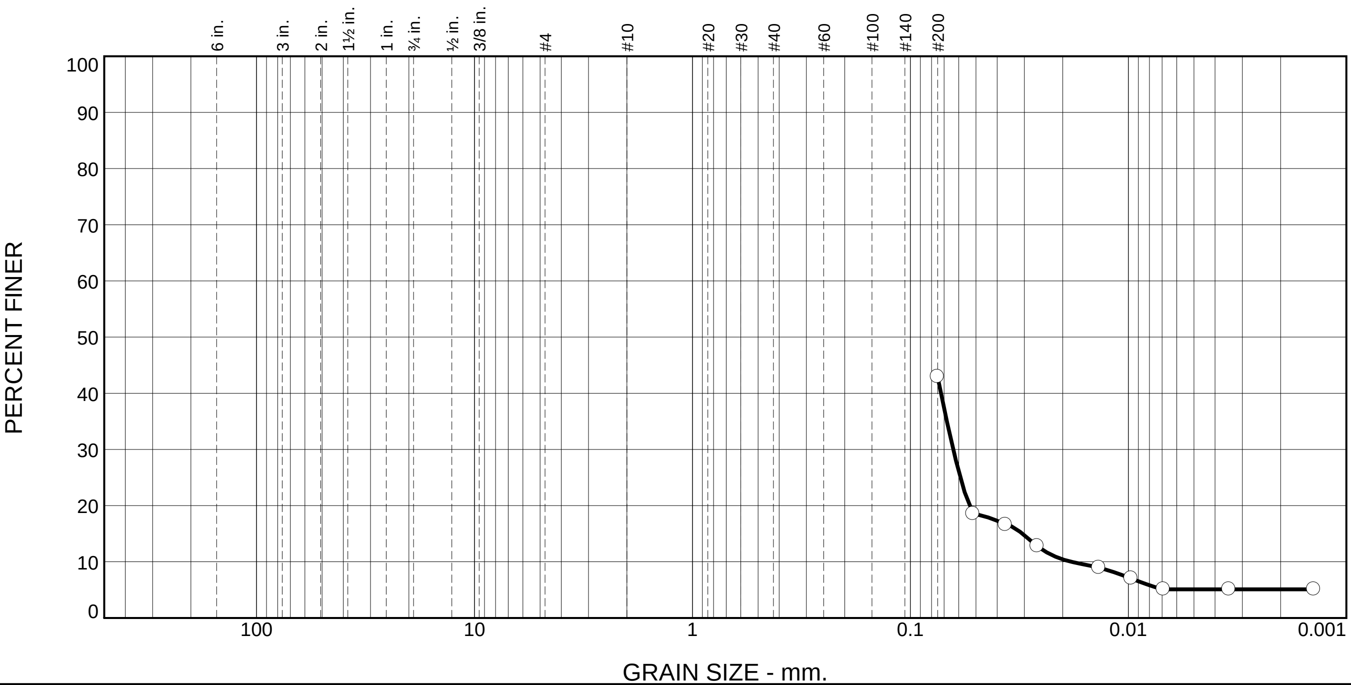
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
								54.9	7.9	62.8

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0076	0.0112	0.0286	0.0539	0.0609	0.0670	0.0732				

C_u	C_c
9.64	5.24

Grain Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						37.8	5.1

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	42.9		
0.0515 mm.	18.5		
0.0366 mm.	16.6		
0.0262 mm.	12.8		
0.0136 mm.	8.9		
0.0097 mm.	7.0		
0.0069 mm.	5.1		
0.0034 mm.	5.1		
0.0014 mm.	5.1		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= 0.0636 D_{15}= 0.0306
D_{10}= 0.0183 C_u= C_c=

Remarks

Date Received: **Date Tested:**
Tested By:
Checked By:
Title:

Source of Sample: Hydrometer **Depth:** 12 ft **Date Sampled:**
Sample Number: VC 3-3

WOOD

Lakeland, Florida

Client:
Project: Lake Bonnet
Project No: 600573x.05A **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

6/21/2018

Project: Lake Bonnet
Project Number: 600573x.05A
Location: Hydrometer
Depth: 12 ft **Sample Number:** VC 3-3

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 30.02
Tare Wt. = 0.00
Minus #200 from wash = 42.9%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
52.61	0.00	0.00			

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =52.61
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = 1
Meniscus correction only = 0.0
Specific gravity of solids = 2.615
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

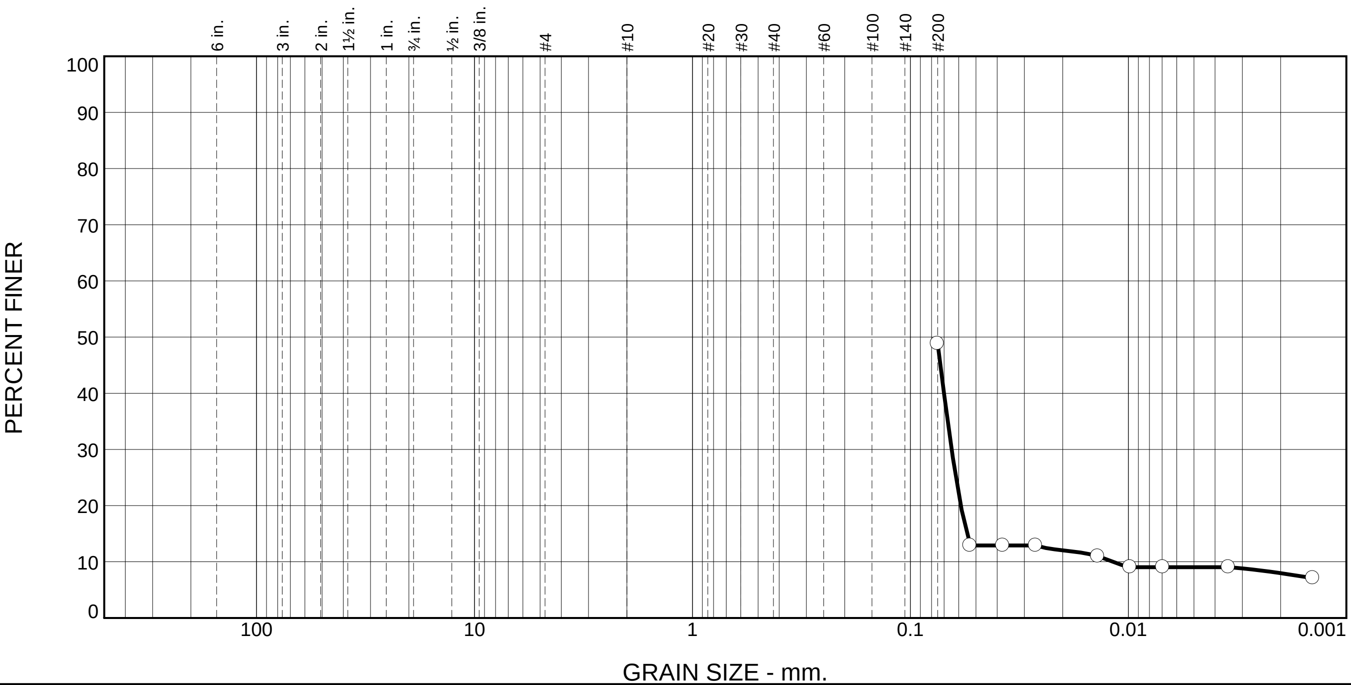
Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	23.0	8.0	9.7	0.0133	8.0	15.0	0.0515	18.5
2.00	23.0	7.0	8.7	0.0133	7.0	15.1	0.0366	16.6
4.00	23.0	5.0	6.7	0.0133	5.0	15.5	0.0262	12.8
15.00	23.0	3.0	4.7	0.0133	3.0	15.8	0.0136	8.9
30.00	23.0	2.0	3.7	0.0133	2.0	16.0	0.0097	7.0
60.00	23.0	1.0	2.7	0.0133	1.0	16.1	0.0069	5.1
240.00	23.0	1.0	2.7	0.0133	1.0	16.1	0.0034	5.1
1440.00	23.0	1.0	2.7	0.0133	1.0	16.1	0.0014	5.1

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
								37.8	5.1	42.9

D_{5}	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0183	0.0306	0.0536	0.0636	0.0724						

Grain Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						39.8	9.0

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	48.8		
0.0531 mm.	12.9		
0.0375 mm.	12.9		
0.0265 mm.	12.9		
0.0138 mm.	11.0		
0.0098 mm.	9.0		
0.0069 mm.	9.0		
0.0035 mm.	9.0		
0.0014 mm.	7.1		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= 0.0646 D_{15}= 0.0551
D_{10}= 0.0118 C_u= C_c=

Remarks

Date Received: **Date Tested:**
Tested By:
Checked By:
Title:

Source of Sample: Hydrometer **Depth:** 7 ft **Date Sampled:**
Sample Number: VC 4-1

WOOD

Lakeland, Florida

Client:
Project: Lake Bonnet
Project No: 600573x.05A **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

6/21/2018

Project: Lake Bonnet
Project Number: 600573x.05A
Location: Hydrometer
Depth: 7 ft **Sample Number:** VC 4-1

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 26.98
Tare Wt. = 0.00
Minus #200 from wash = 48.8%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
52.71	0.00	0.00			

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =52.71
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = 1
Meniscus correction only = 0.0
Specific gravity of solids = 2.567
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 **-** 0.164 **x Rm**

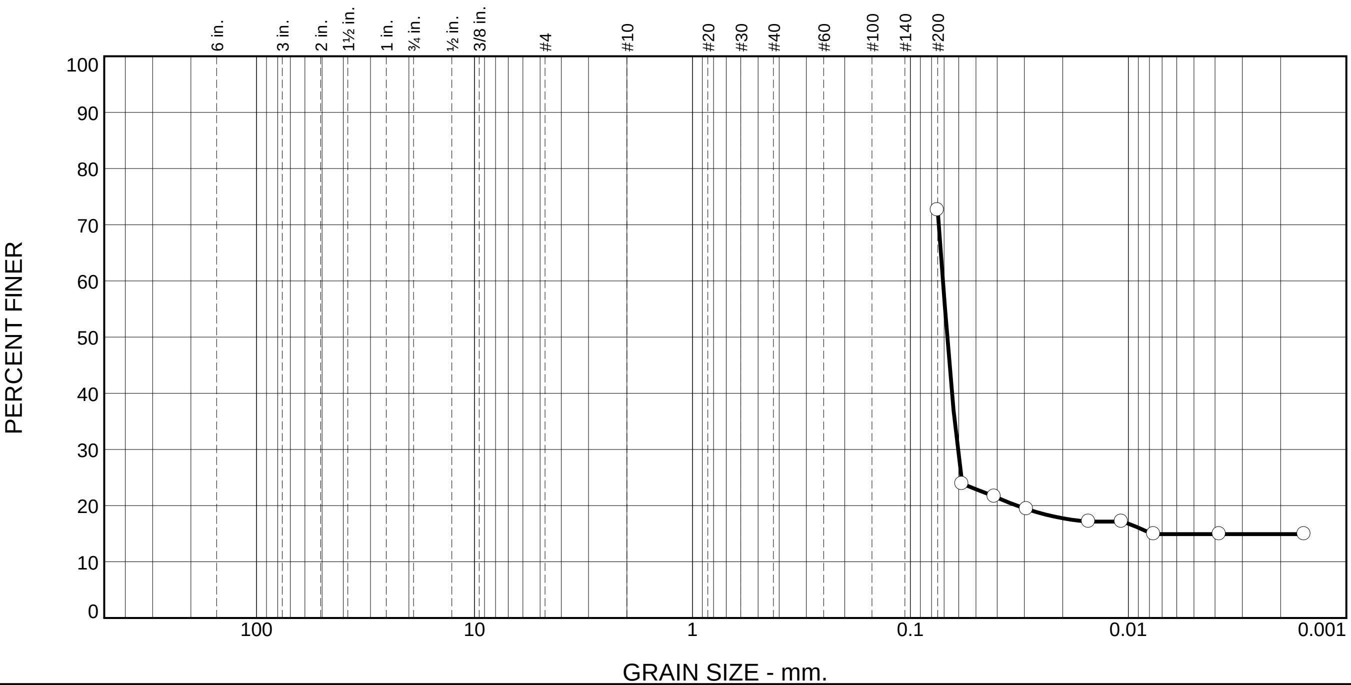
Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	23.0	5.0	6.7	0.0135	5.0	15.5	0.0531	12.9
2.00	23.0	5.0	6.7	0.0135	5.0	15.5	0.0375	12.9
4.00	23.0	5.0	6.7	0.0135	5.0	15.5	0.0265	12.9
15.00	23.0	4.0	5.7	0.0135	4.0	15.6	0.0138	11.0
30.00	23.0	3.0	4.7	0.0135	3.0	15.8	0.0098	9.0
60.00	23.0	3.0	4.7	0.0135	3.0	15.8	0.0069	9.0
240.00	23.0	3.0	4.7	0.0135	3.0	15.8	0.0035	9.0
1440.00	23.0	2.0	3.7	0.0135	2.0	16.0	0.0014	7.1

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
								39.8	9.0	48.8

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0118	0.0551	0.0587	0.0646	0.0701						

Grain Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						57.7	14.9

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	72.6		
0.0578 mm.	23.9		
0.0411 mm.	21.6		
0.0292 mm.	19.4		
0.0152 mm.	17.2		
0.0107 mm.	17.2		
0.0076 mm.	14.9		
0.0038 mm.	14.9		
0.0016 mm.	14.9		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}= 0.0710
D_{50}= 0.0678 D_{30}= 0.0607 D_{15}= 0.0077
D_{10}= C_u= C_c=

Remarks

Date Received: **Date Tested:**
Tested By:
Checked By:
Title:

Source of Sample: Hydrometer **Depth:** 6 ft **Date Sampled:**
Sample Number: VC 4-3

WOOD

Lakeland, Florida

Client:
Project: Lake Bonnet
Project No: 600573x.05A **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

6/21/2018

Project: Lake Bonnet
Project Number: 600573x.05A
Location: Hydrometer
Depth: 6 ft **Sample Number:** VC 4-3

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 13.65
Tare Wt. = 0.00
Minus #200 from wash = 72.6%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
49.82	0.00	0.00			

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =49.82
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = 1
Meniscus correction only = 0.0
Specific gravity of solids = 2.264
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 **-** 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	23.0	9.0	10.7	0.0150	9.0	14.8	0.0578	23.9
2.00	23.0	8.0	9.7	0.0150	8.0	15.0	0.0411	21.6
4.00	23.0	7.0	8.7	0.0150	7.0	15.1	0.0292	19.4
15.00	23.0	6.0	7.7	0.0150	6.0	15.3	0.0152	17.2
30.00	23.0	6.0	7.7	0.0150	6.0	15.3	0.0107	17.2
60.00	23.0	5.0	6.7	0.0150	5.0	15.5	0.0076	14.9
240.00	23.0	5.0	6.7	0.0150	5.0	15.5	0.0038	14.9
1440.00	23.0	5.0	6.7	0.0150	5.0	15.5	0.0016	14.9

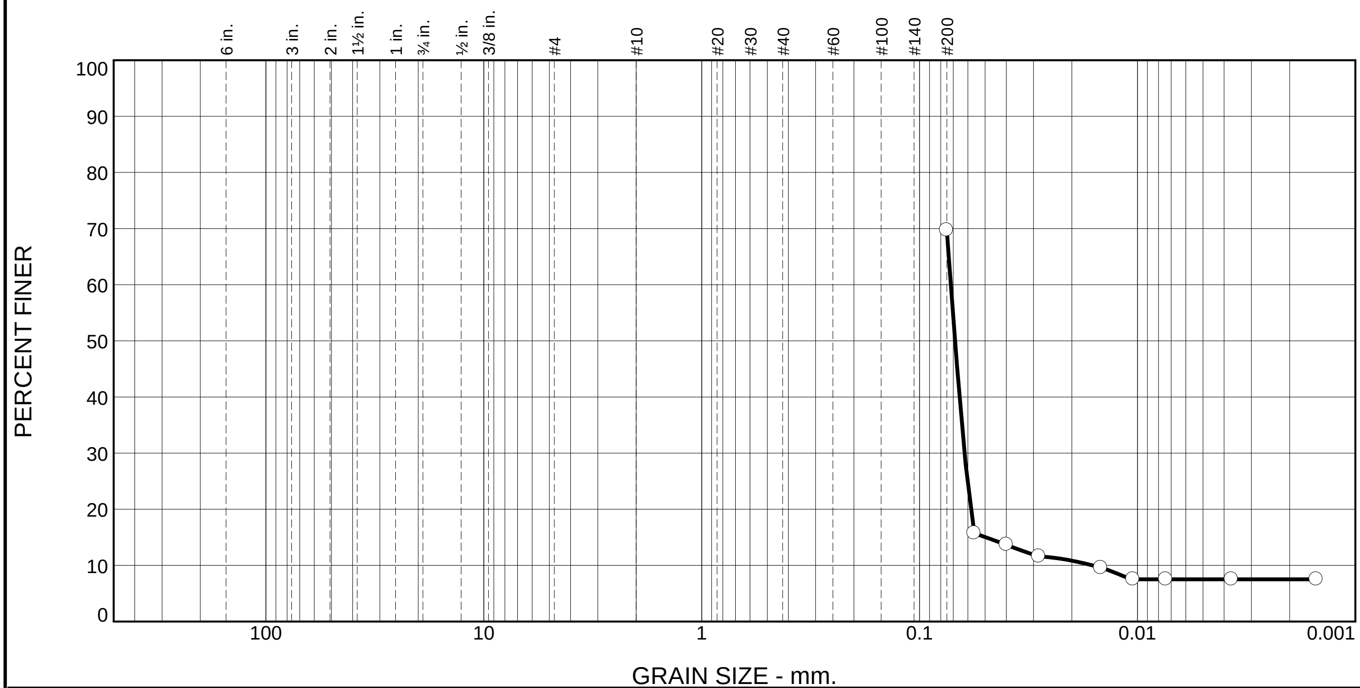
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
								57.7	14.9	72.6

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0077	0.0324	0.0607	0.0645	0.0678	0.0710				

WOOD

Grain Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						62.2	7.5

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	69.7		
0.0560 mm.	15.7		
0.0398 mm.	13.7		
0.0283 mm.	11.6		
0.0147 mm.	9.6		
0.0104 mm.	7.5		
0.0074 mm.	7.5		
0.0037 mm.	7.5		
0.0015 mm.	7.5		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= D_{85}= D_{60}= 0.0719
D_{50}= 0.0687 D_{30}= 0.0621 D_{15}= 0.0497
D_{10}= 0.0161 C_u= 4.46 C_c= 3.34

Remarks

Date Received: **Date Tested:**
Tested By:
Checked By:
Title:

Source of Sample: Hydrometer **Depth:** 10 ft **Date Sampled:**
Sample Number: VC 4-3

WOOD

Lakeland, Florida

Client:
Project: Lake Bonnet
Project No: 600573x.05A **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

6/21/2018

Project: Lake Bonnet
Project Number: 600573x.05A
Location: Hydrometer
Depth: 10 ft **Sample Number:** VC 4-3

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 15.65
Tare Wt. = 0.00
Minus #200 from wash = 69.7%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
51.65	0.00	0.00			

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 99.0
Weight of hydrometer sample =51.65
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = 1
Meniscus correction only = 0.0
Specific gravity of solids = 2.3916
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	23.0	6.0	7.7	0.0143	6.0	15.3	0.0560	15.7
2.00	23.0	5.0	6.7	0.0143	5.0	15.5	0.0398	13.7
4.00	23.0	4.0	5.7	0.0143	4.0	15.6	0.0283	11.6
15.00	23.0	3.0	4.7	0.0143	3.0	15.8	0.0147	9.6
30.00	23.0	2.0	3.7	0.0143	2.0	16.0	0.0104	7.5
60.00	23.0	2.0	3.7	0.0143	2.0	16.0	0.0074	7.5
240.00	23.0	2.0	3.7	0.0143	2.0	16.0	0.0037	7.5
1440.00	23.0	2.0	3.7	0.0143	2.0	16.0	0.0015	7.5

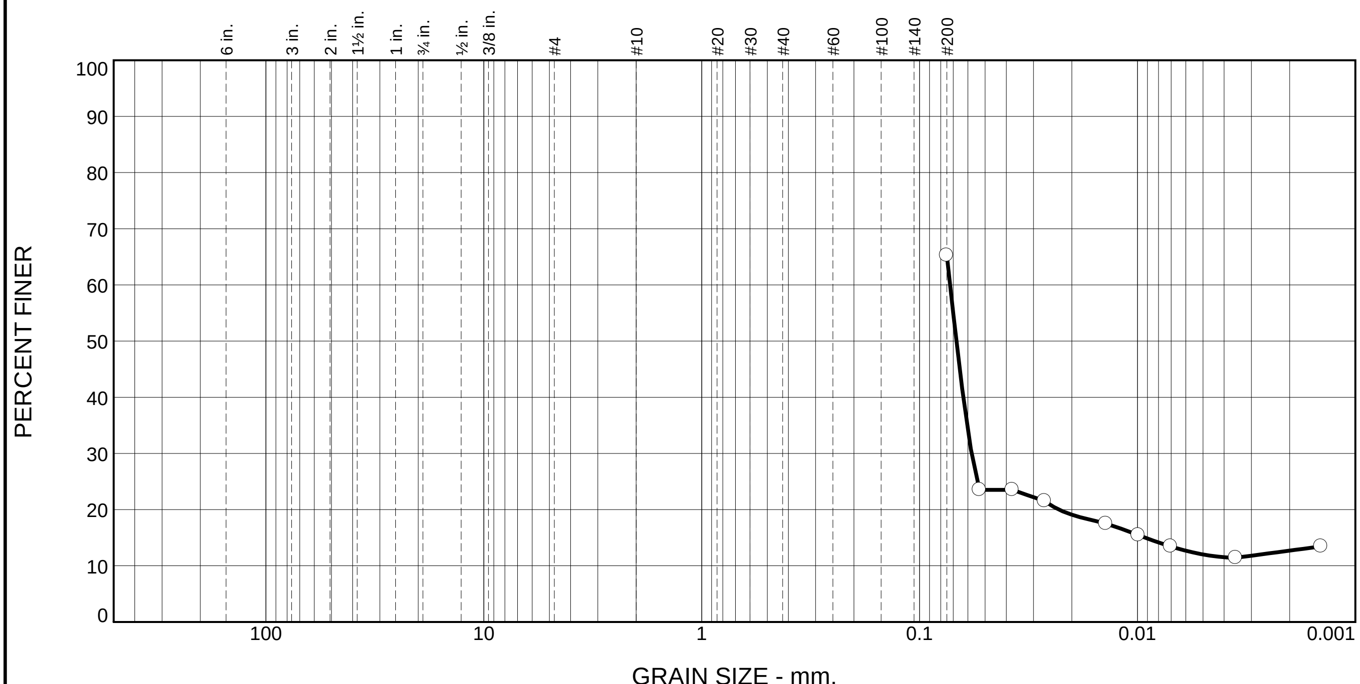
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
								62.2	7.5	69.7

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0161	0.0497	0.0582	0.0621	0.0655	0.0687	0.0719				

C_u	C_c
4.46	3.34

Grain Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						53.2	12.0

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#200	65.2		
0.0531 mm.	23.5		
0.0375 mm.	23.5		
0.0267 mm.	21.5		
0.0139 mm.	17.5		
0.0099 mm.	15.5		
0.0070 mm.	13.4		
0.0035 mm.	11.4		
0.0014 mm.	13.4		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= D_{85}= D_{60}= 0.0725
D_{50}= 0.0678 D_{30}= 0.0577 D_{15}= 0.0092
D_{10}= C_u= C_c=

Remarks

Date Received: **Date Tested:**
Tested By:
Checked By:
Title:

Source of Sample: Hydrometer **Depth:** 16 ft **Date Sampled:**
Sample Number: VC 4-3

WOOD

Lakeland, Florida

Client:
Project: Lake Bonnet
Project No: 600573x.05A **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

6/21/2018

Project: Lake Bonnet
Project Number: 600573x.05A
Location: Hydrometer
Depth: 16 ft **Sample Number:** VC 4-3

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare =** 17.95
Tare Wt. = 0.00
Minus #200 from wash = 65.2%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
51.65	0.00	0.00			

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =51.65
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = 1
Meniscus correction only = 0.0
Specific gravity of solids = 2.486
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	23.0	10.0	11.7	0.0139	10.0	14.7	0.0531	23.5
2.00	23.0	10.0	11.7	0.0139	10.0	14.7	0.0375	23.5
4.00	23.0	9.0	10.7	0.0139	9.0	14.8	0.0267	21.5
15.00	23.0	7.0	8.7	0.0139	7.0	15.1	0.0139	17.5
30.00	23.0	6.0	7.7	0.0139	6.0	15.3	0.0099	15.5
60.00	23.0	5.0	6.7	0.0139	5.0	15.5	0.0070	13.4
240.00	23.0	4.0	5.7	0.0139	4.0	15.6	0.0035	11.4
1440.00	23.0	5.0	6.7	0.0139	5.0	15.5	0.0014	13.4

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
								53.2	12.0	65.2

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0092	0.0229	0.0577	0.0630	0.0678	0.0725				

APPENDIX B

Laboratory Analytical Reports & Plots of Sediment Chemistry Data

APPENDIX B

DIRECTORY

APPENDIX B1

Sediment Samples – Chemical Analysis Graphs

Figure B1-1 - Arsenic Concentrations within Sediment Samples Collected from Lake Bonnet

Figure B1-2 - Copper Concentrations within Sediment Samples Collected from Lake Bonnet

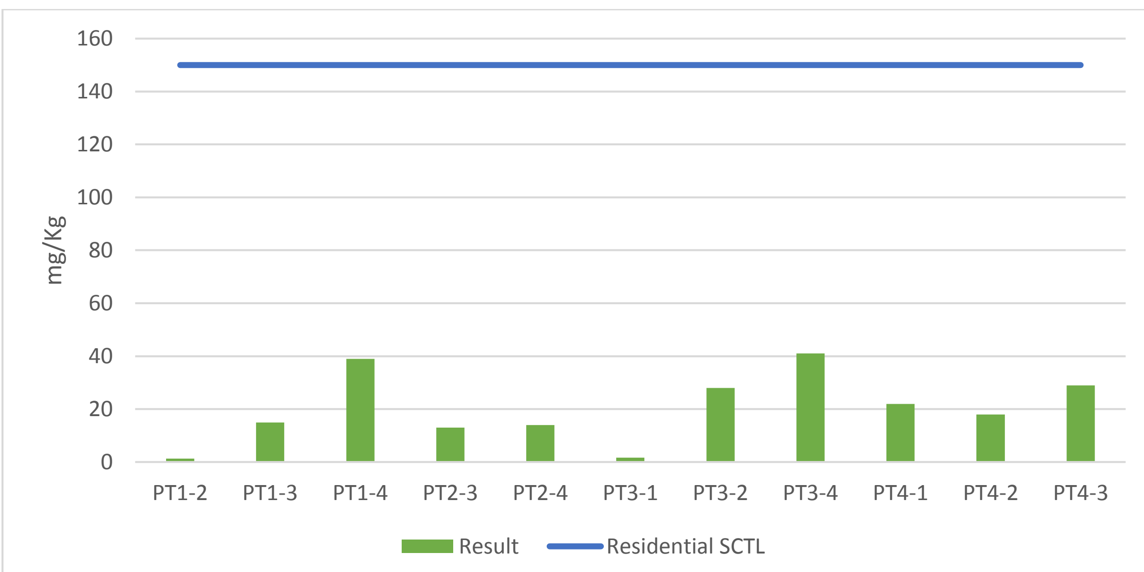


Figure B1-3 - Nickel Concentrations within Sediment Samples Collected from Lake Bonnet

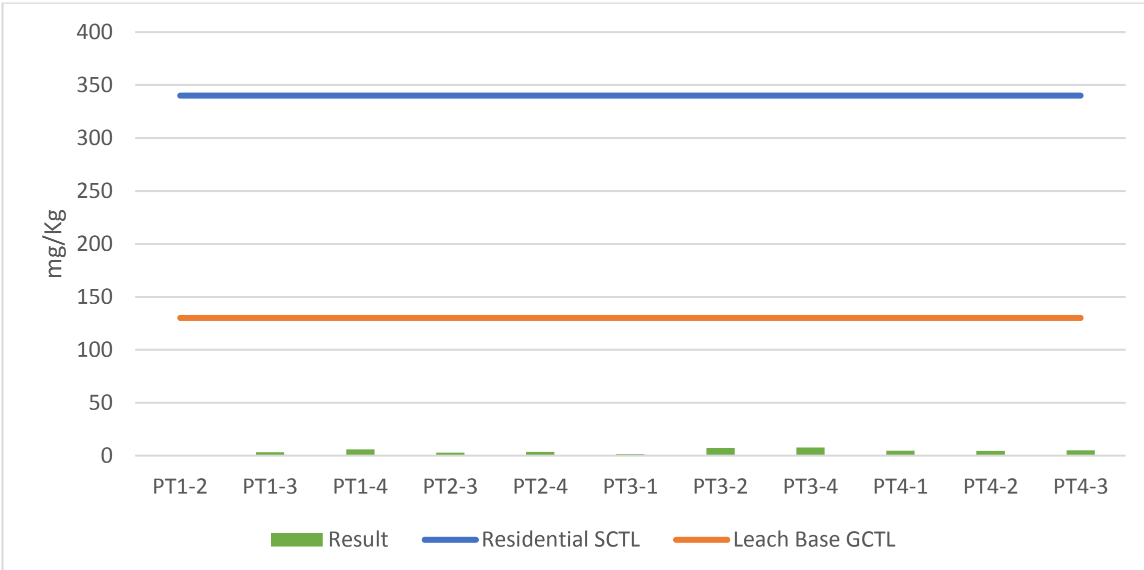


Figure B1-4 - Cadmium Concentrations within Sediment Samples Collected from Lake Bonnet

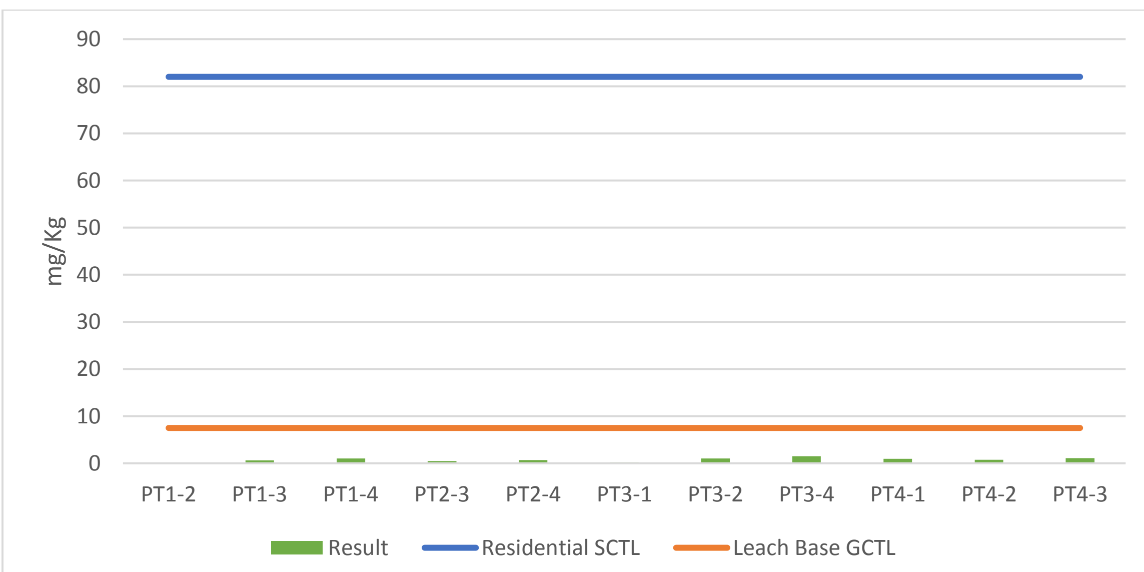


Figure B1-5 - Lead Concentrations within Sediment Samples Collected from Lake Bonnet

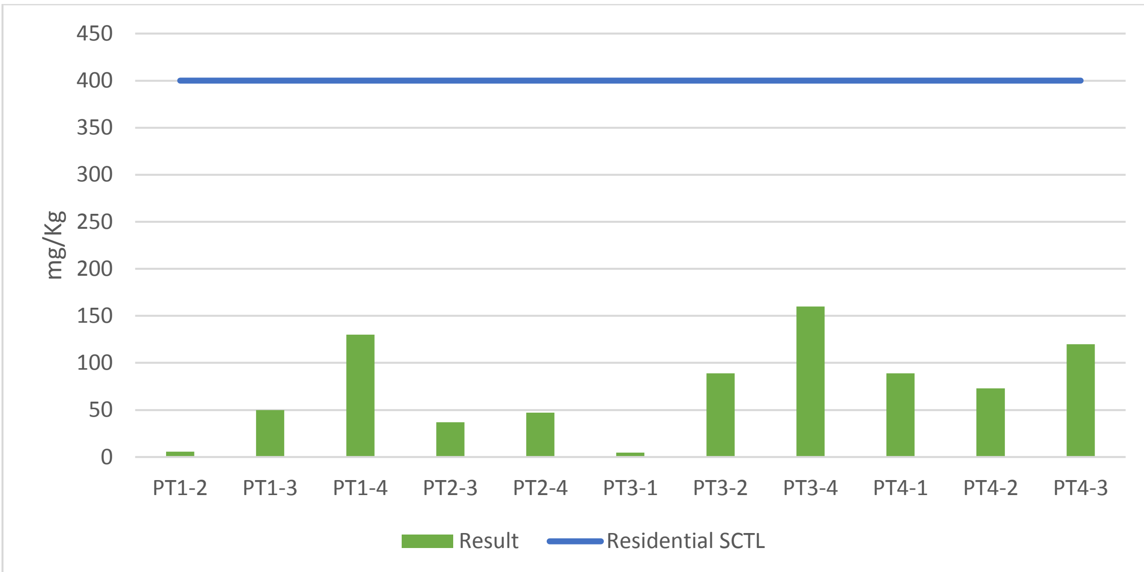


Figure B1-6 - Silver Concentrations within Sediment Samples Collected from Lake Bonnet

Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-7 - Chromium Concentrations within Sediment Samples Collected from Lake Bonnet

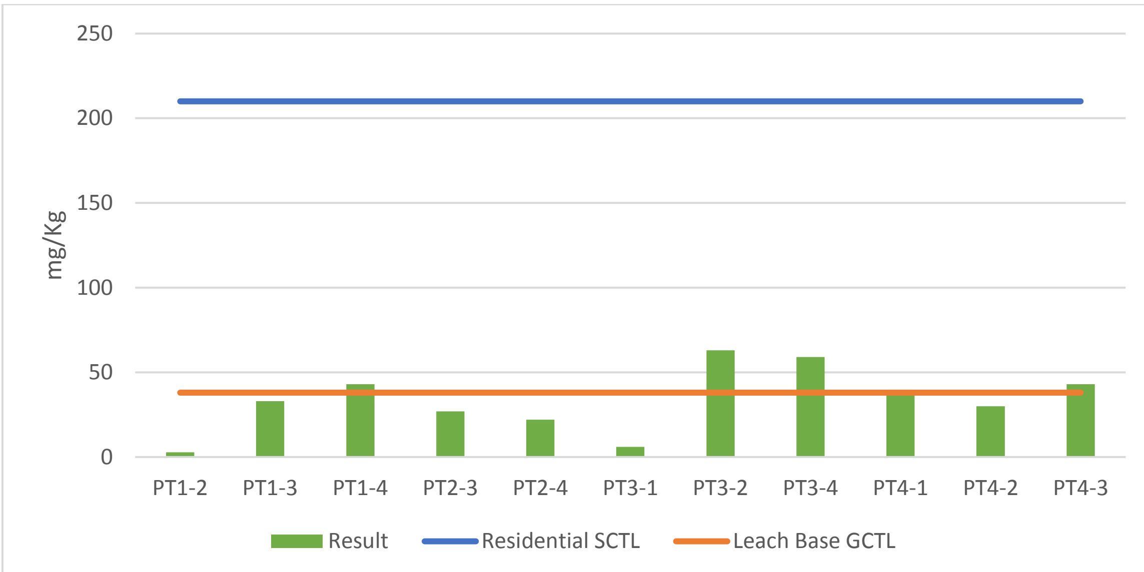


Figure B1-8 - Mercury Concentrations within Sediment Samples Collected from Lake Bonnet

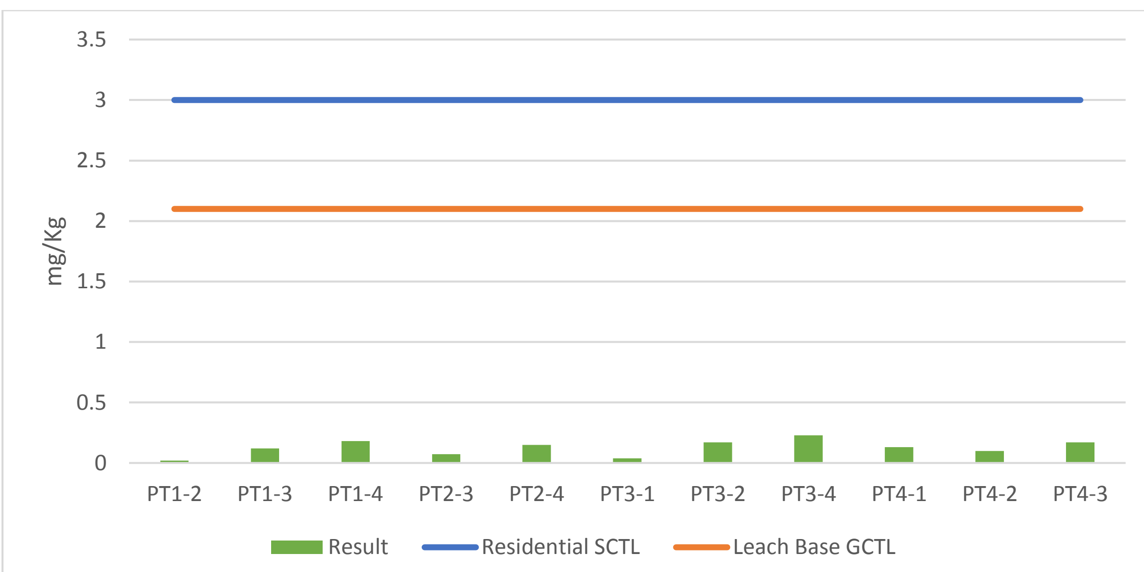


Figure B1-9 - Zinc Concentrations within Sediment Samples Collected from Lake Bonnet

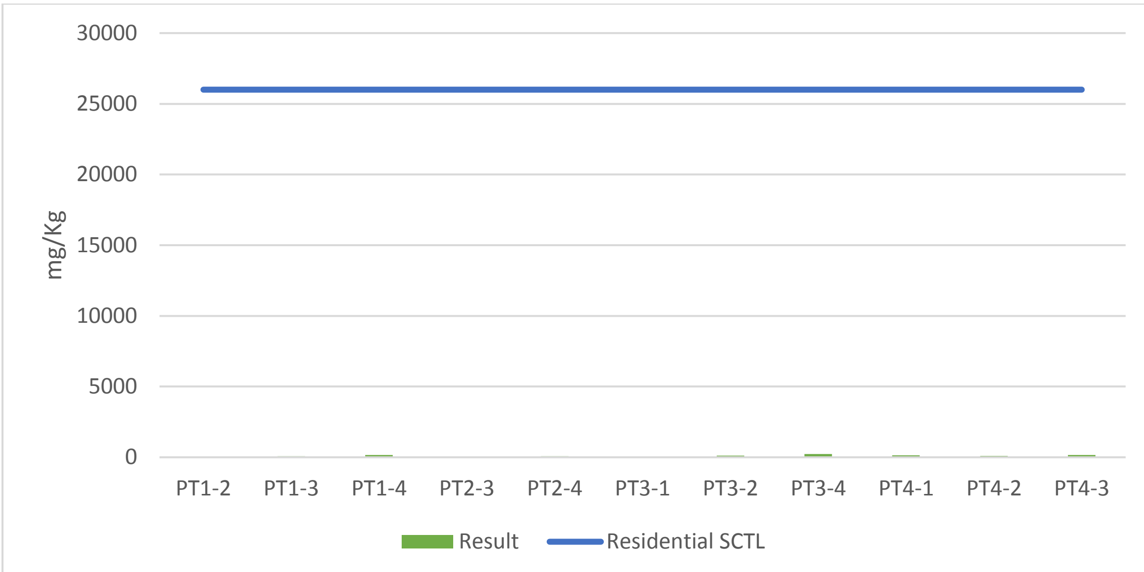
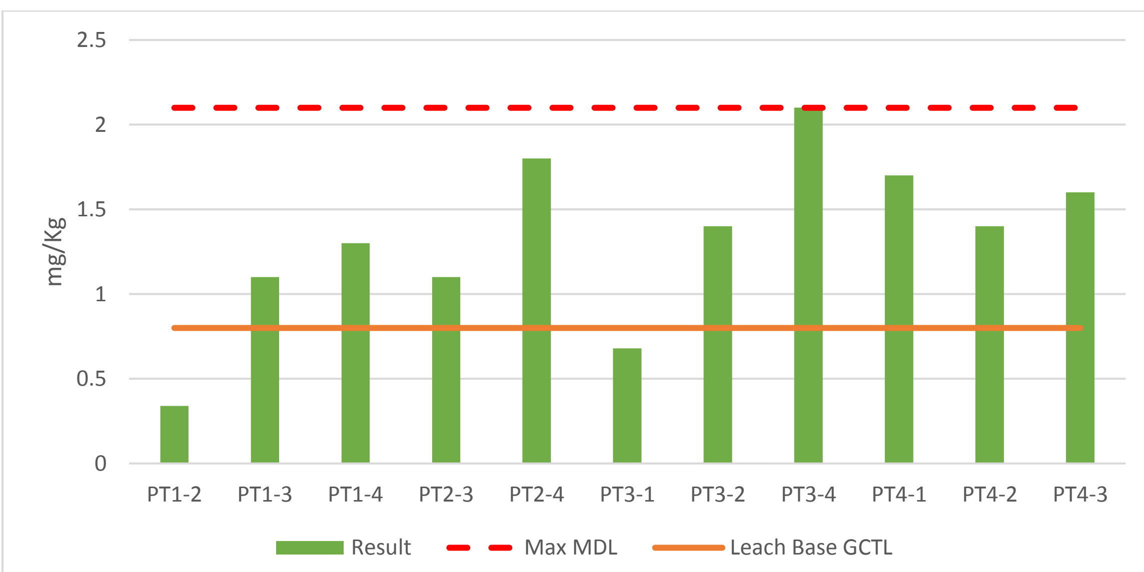
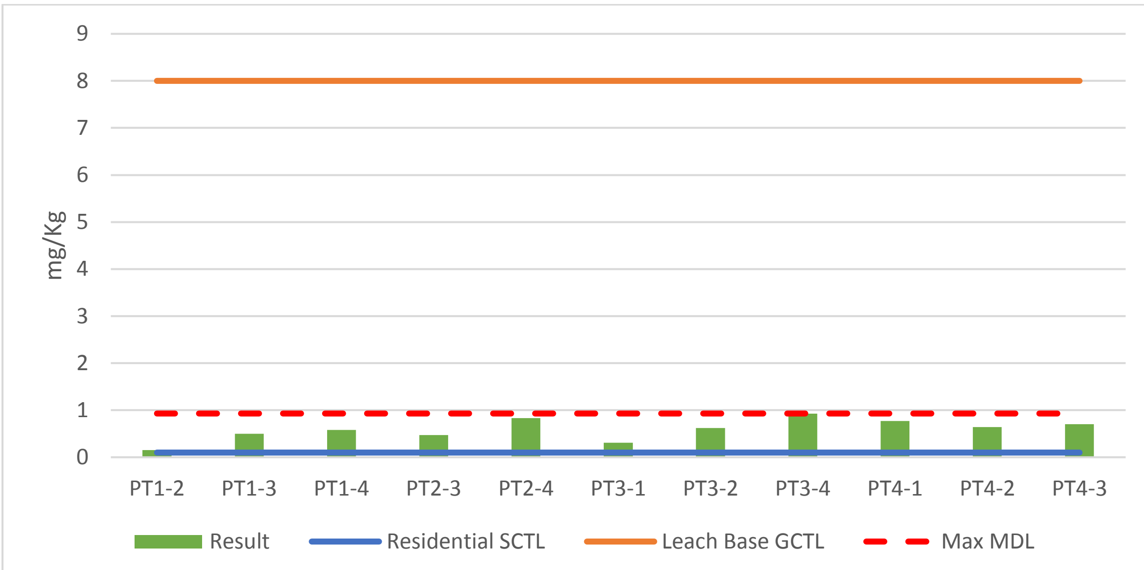


Figure B1-10 – Benzo[a]anthracene Concentrations within Sediment Samples Collected from Lake Bonnet



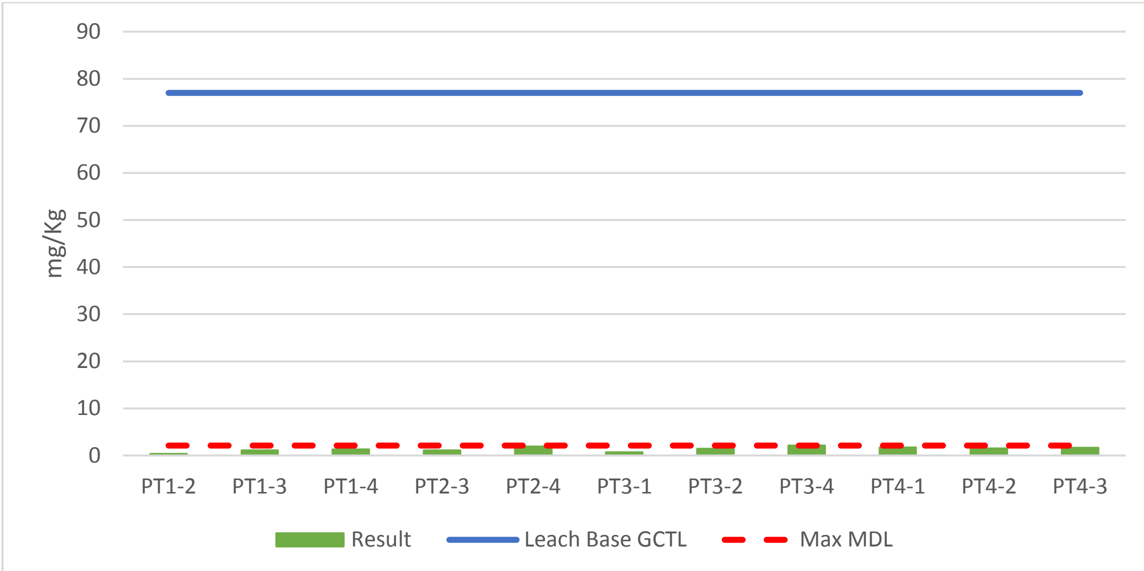
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-11 – Benzo[a]pyrene Concentrations within Sediment Samples Collected from Lake Bonnet



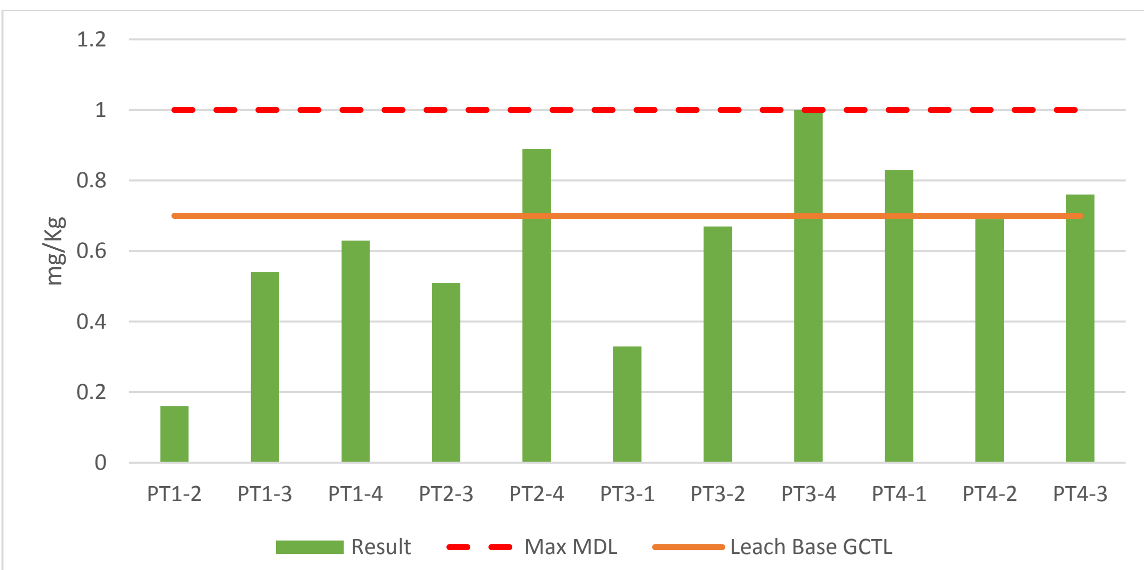
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-12 - Chrysene Concentrations within Sediment Samples Collected from Lake Bonnet



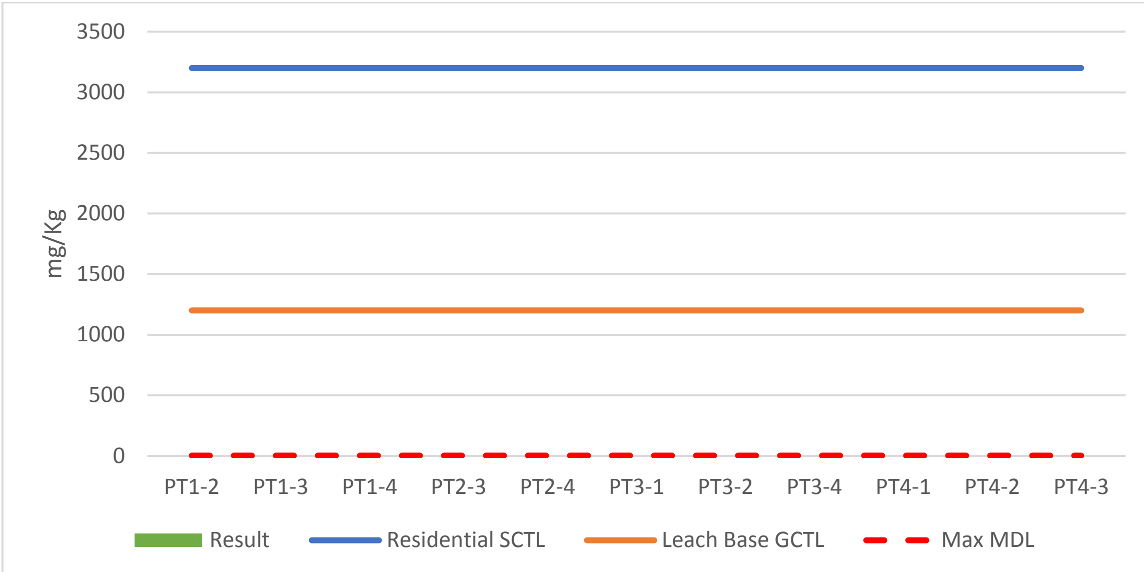
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-13 – Dibenzo[a,h]anthracene Concentrations within Sediment Samples Collected from Lake Bonnet



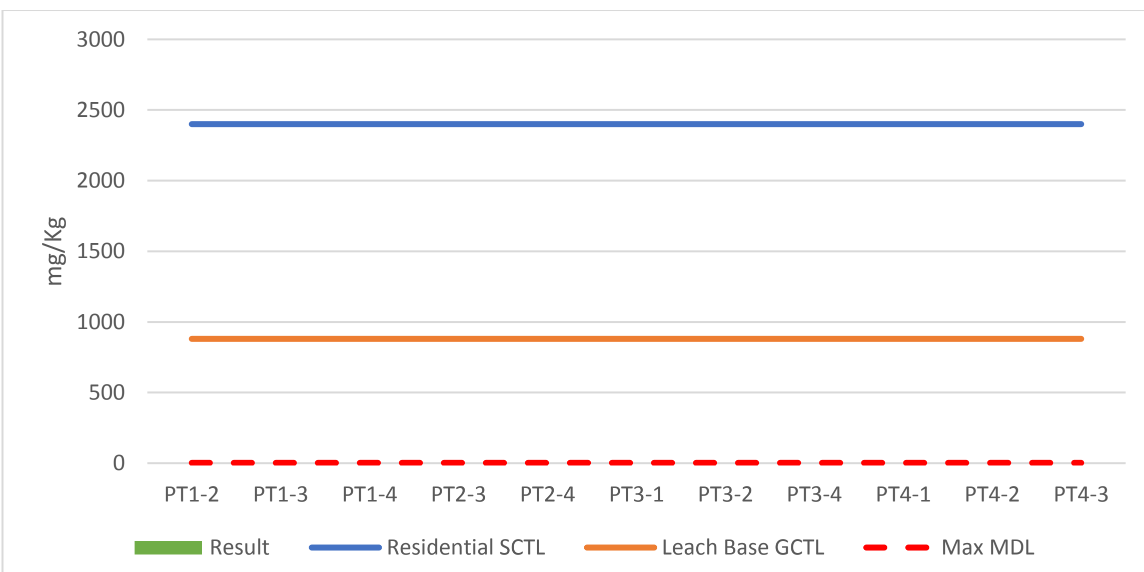
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-14 - Fluoranthene Concentrations within Sediment Samples Collected from Lake Bonnet



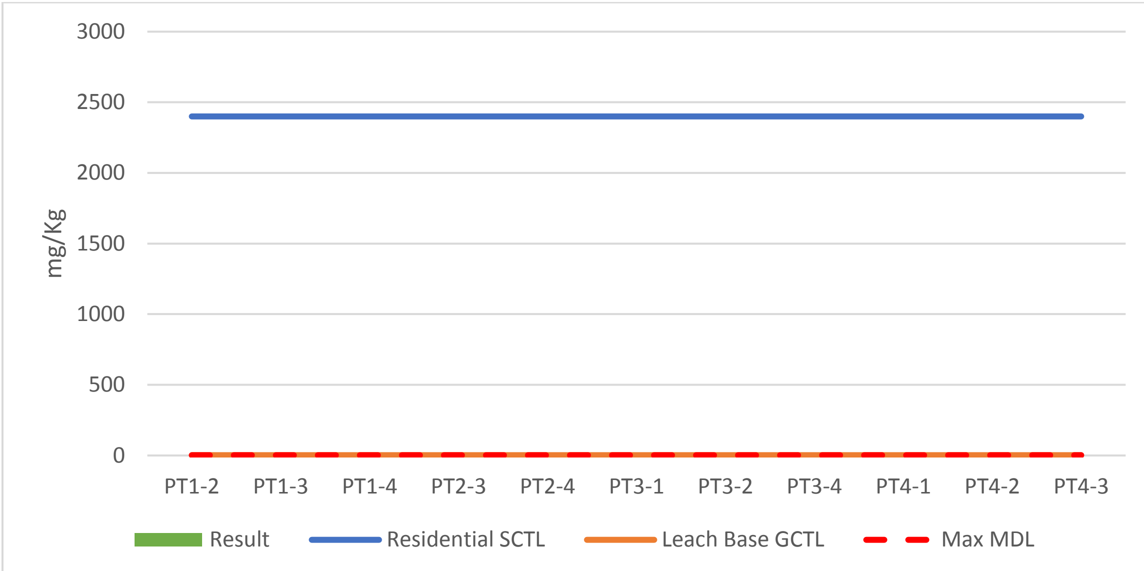
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-15 - Pyrene Concentrations within Sediment Samples Collected from Lake Bonnet



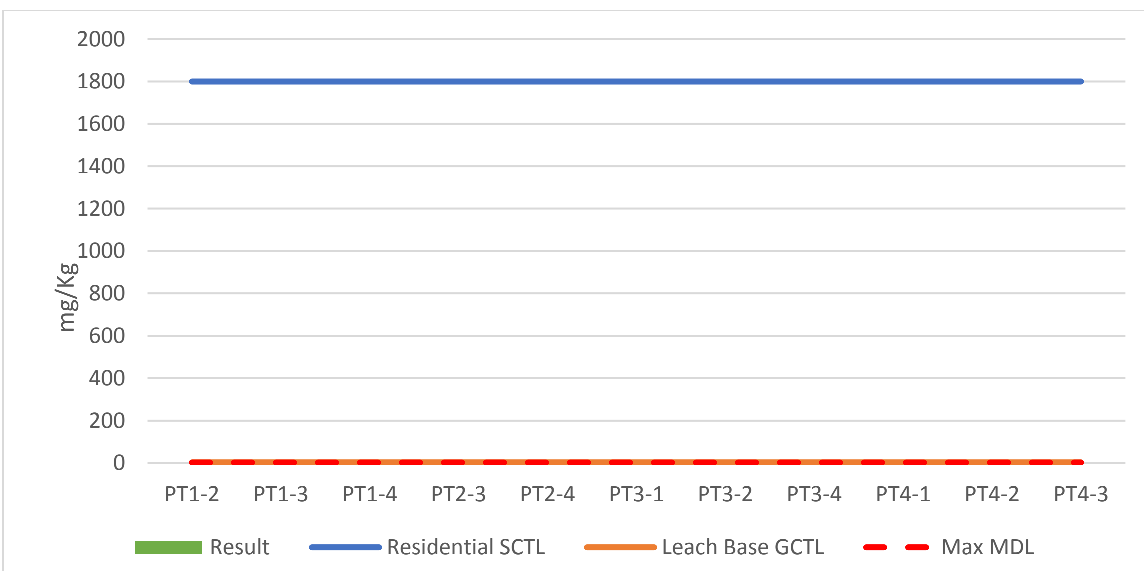
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-16 - Acenaphthene Concentrations within Sediment Samples Collected from Lake Bonnet



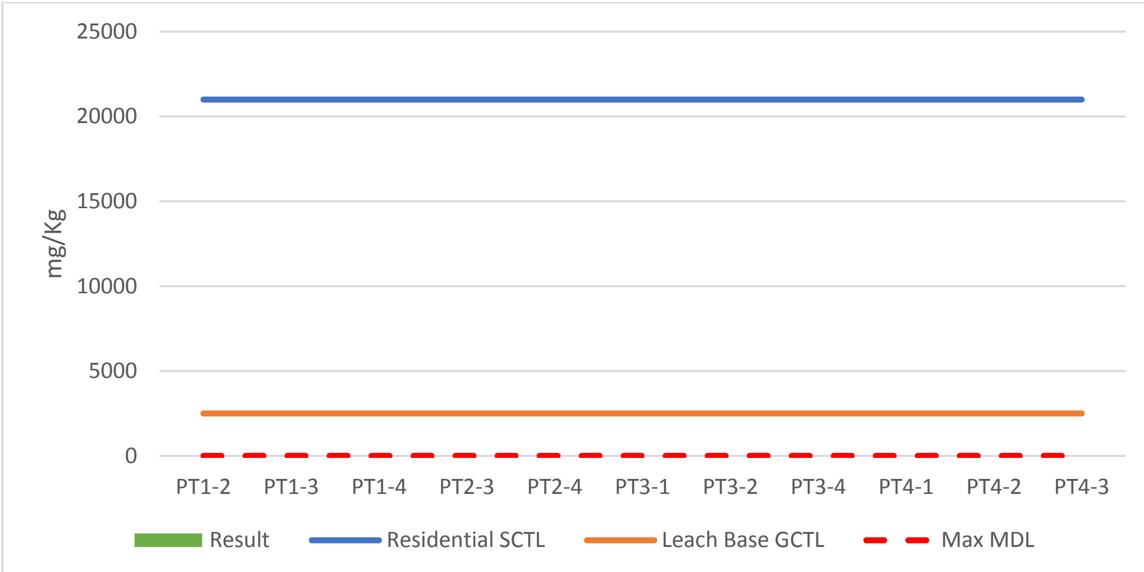
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-17 - Acenaphthylene Concentrations within Sediment Samples Collected from Lake Bonnet



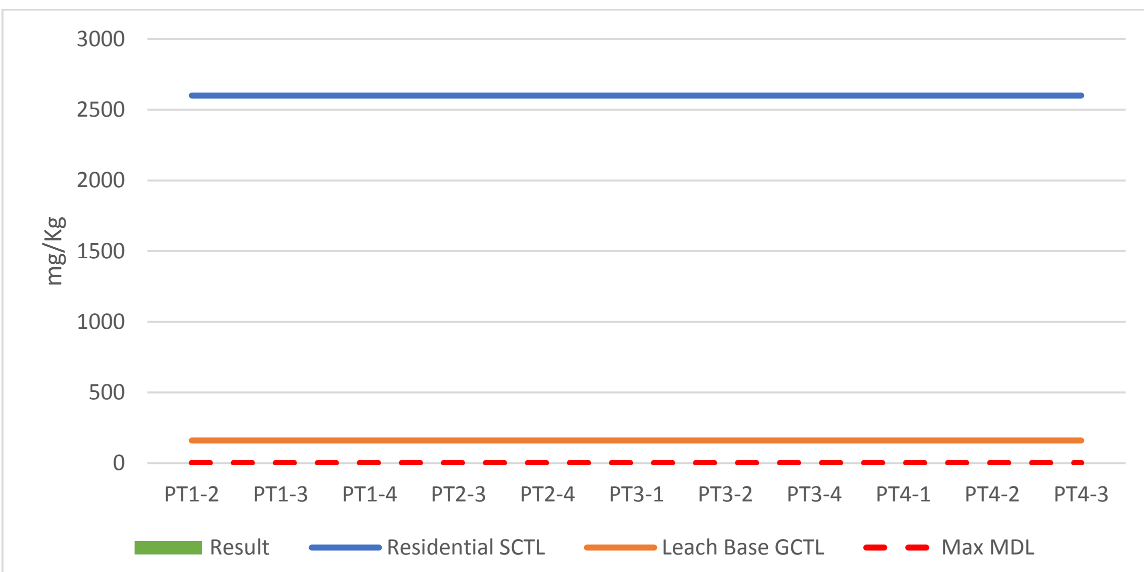
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-18 - Anthracene Concentrations within Sediment Samples Collected from Lake Bonnet



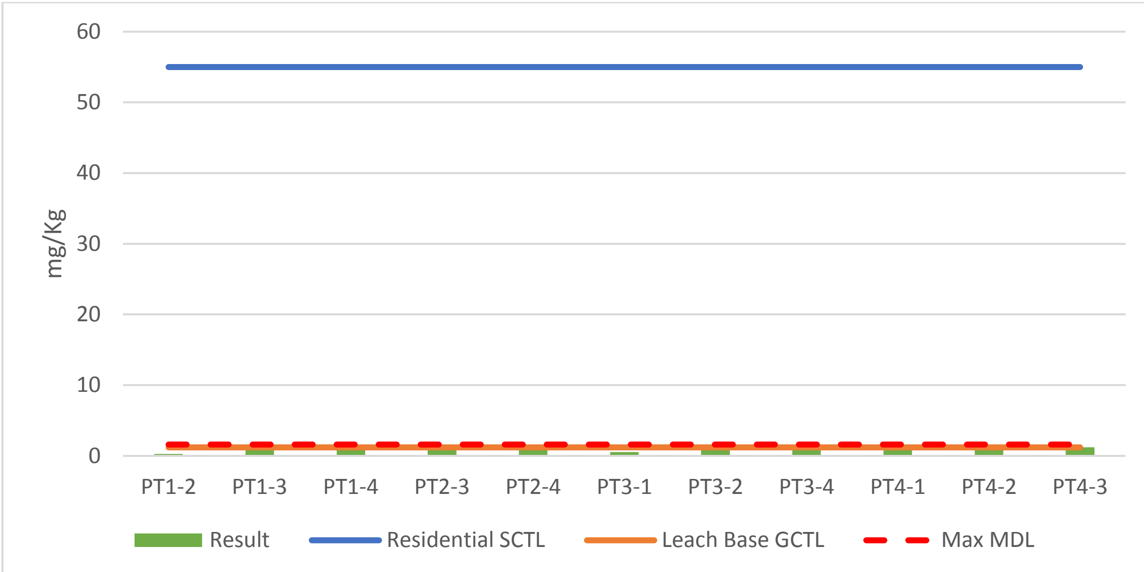
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-19 - Fluorene Concentrations within Sediment Samples Collected from Lake Bonnet



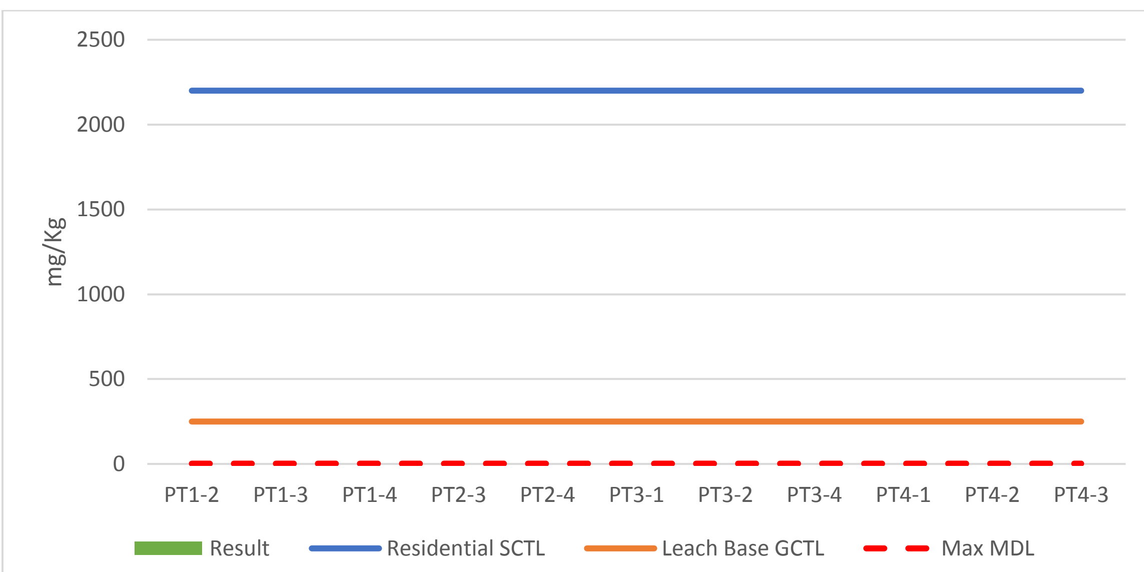
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-20 - Naphthalene Concentrations within Sediment Samples Collected from Lake Bonnet



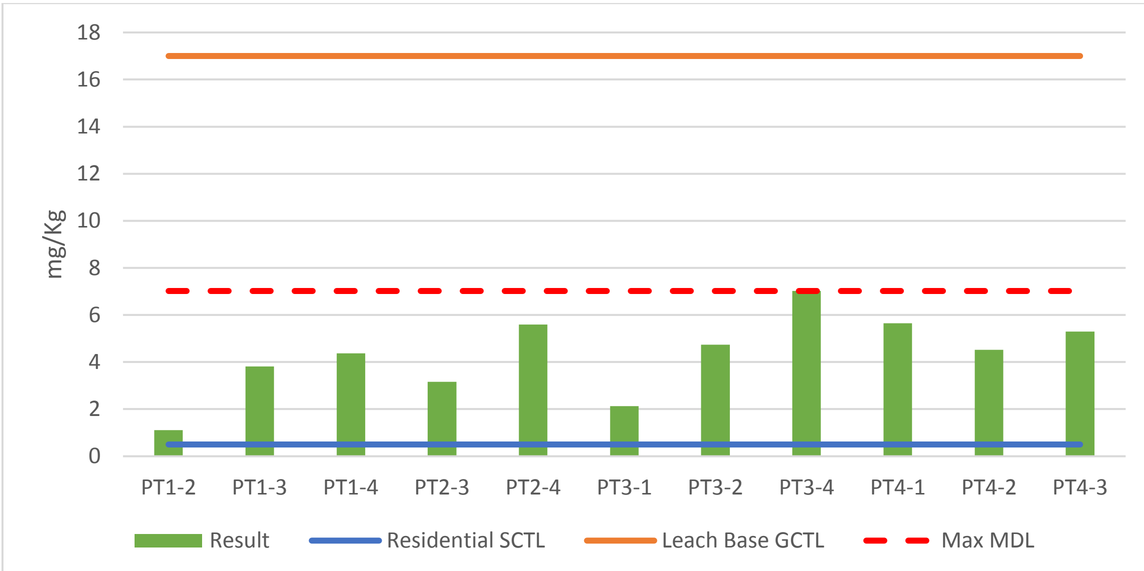
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-21 - Phenanthrene Concentrations within Sediment Samples Collected from Lake Bonnet



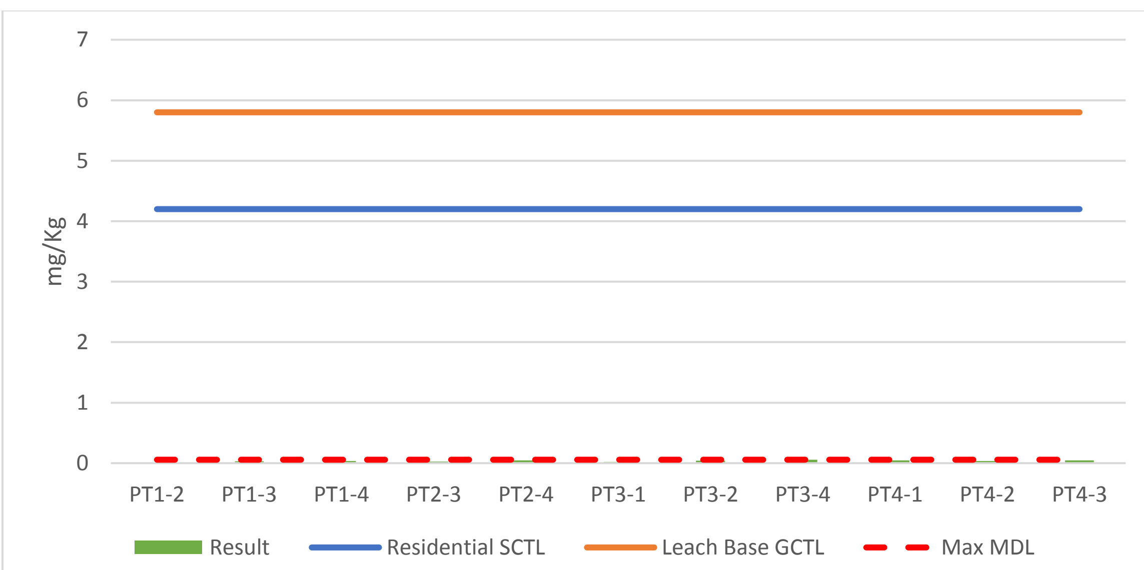
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-22 – Total PCBs (Aroclor mixture) Concentrations within Sediment Samples Collected from Lake Bonnet



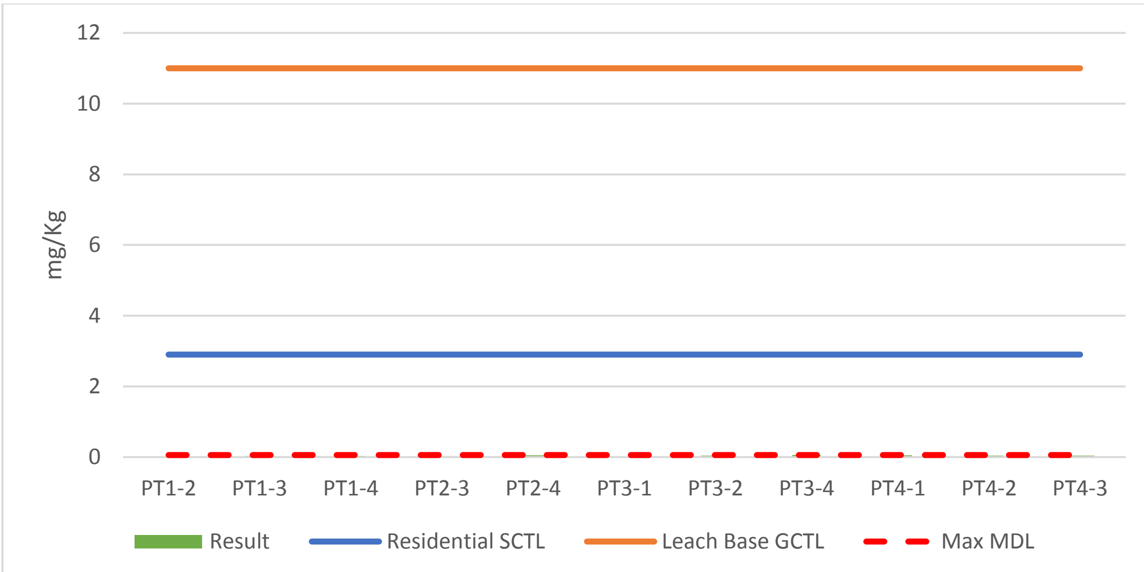
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-23 – 4,4'-DDD Concentrations within Sediment Samples Collected from Lake Bonnet



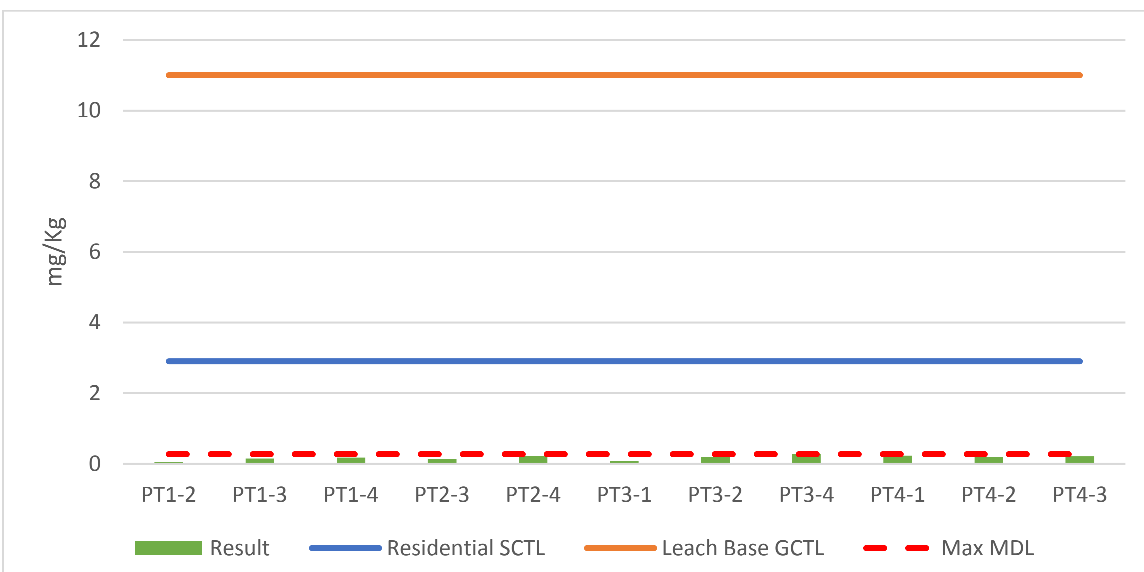
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-24 – 4,4'-DDE Concentrations within Sediment Samples Collected from Lake Bonnet



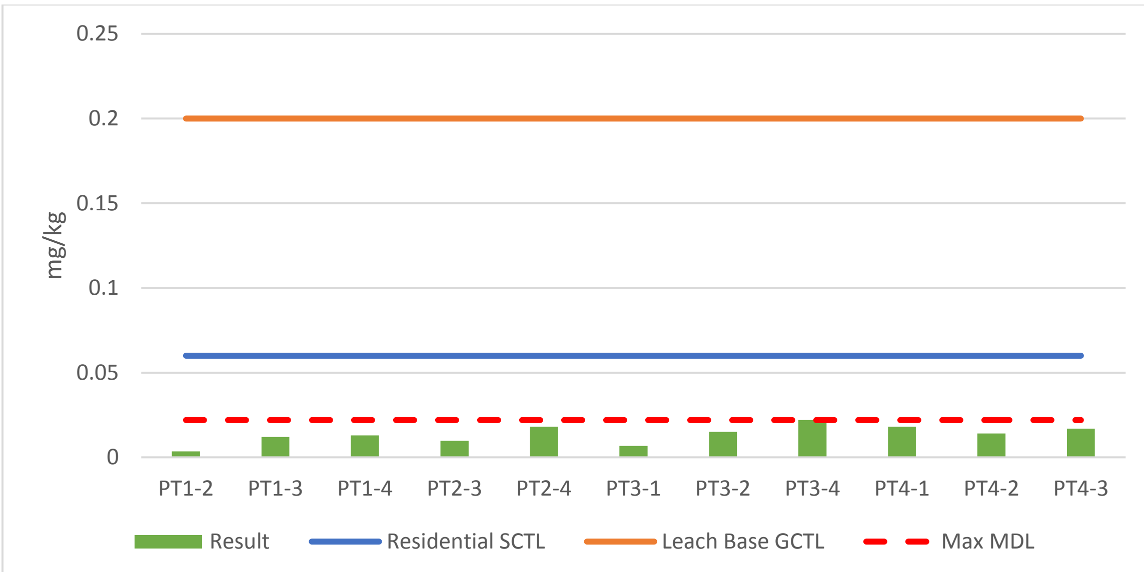
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-25 – 4,4'-DDT Concentrations within Sediment Samples Collected from Lake Bonnet



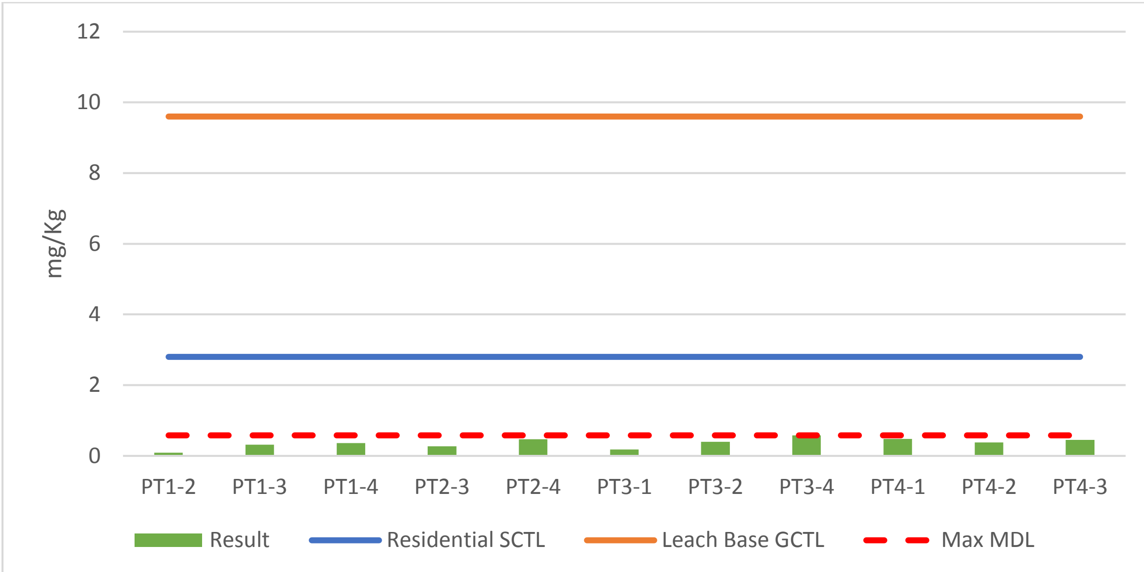
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-26 - Aldrin Concentrations within Sediment Samples Collected from Lake Bonnet



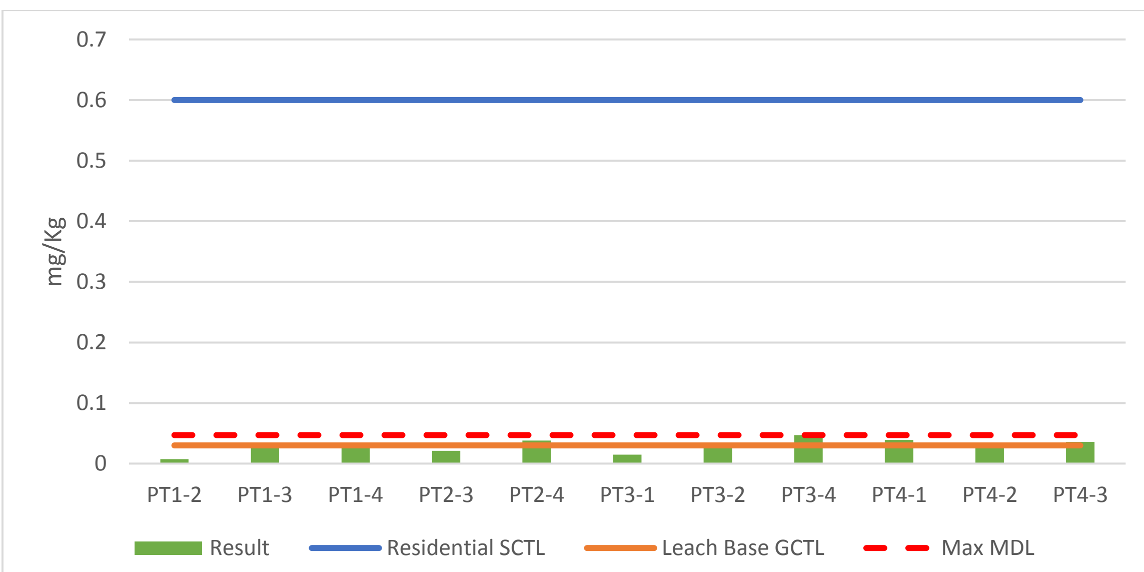
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-27 – Chlordane (total) Concentrations within Sediment Samples Collected from Lake Bonnet



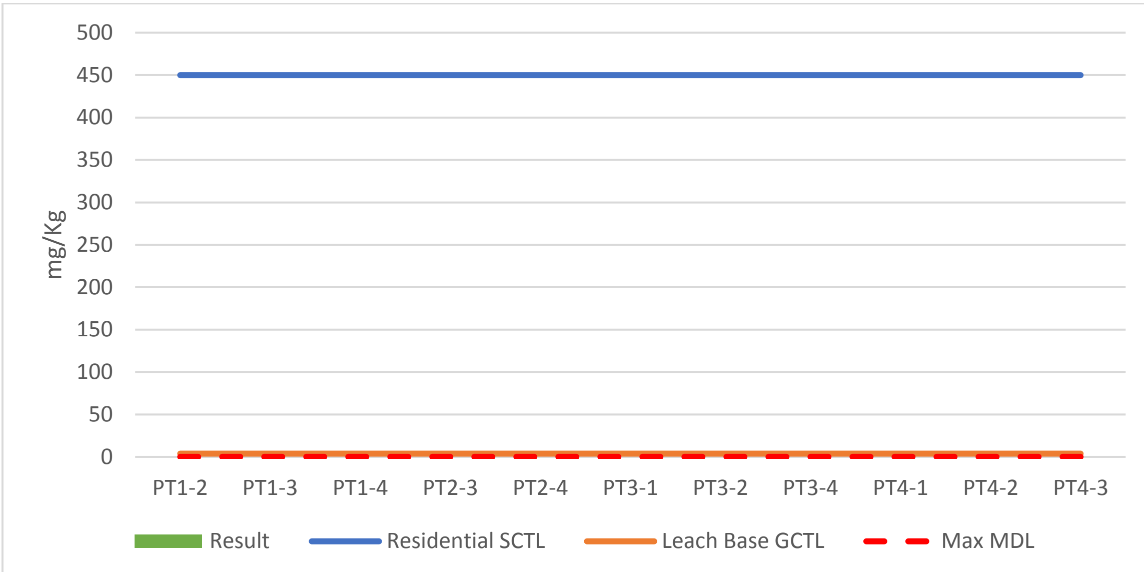
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-28 - Dieldrin Concentrations within Sediment Samples Collected from Lake Bonnet



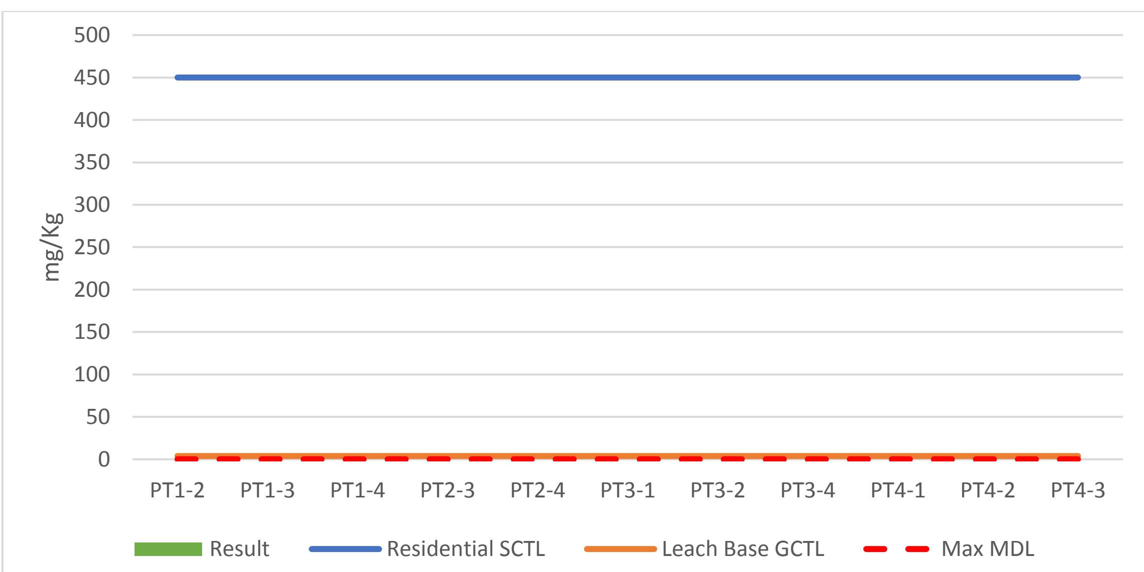
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-29 – Endosulfan I Concentrations within Sediment Samples Collected from Lake Bonnet



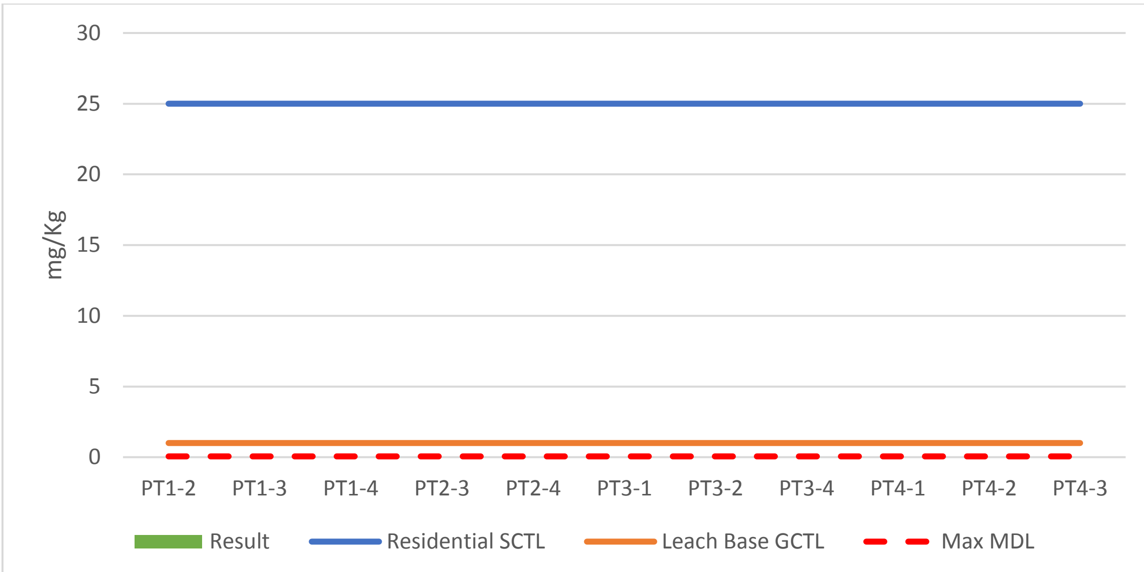
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-30 – Endosulfan II Concentrations within Sediment Samples Collected from Lake Bonnet



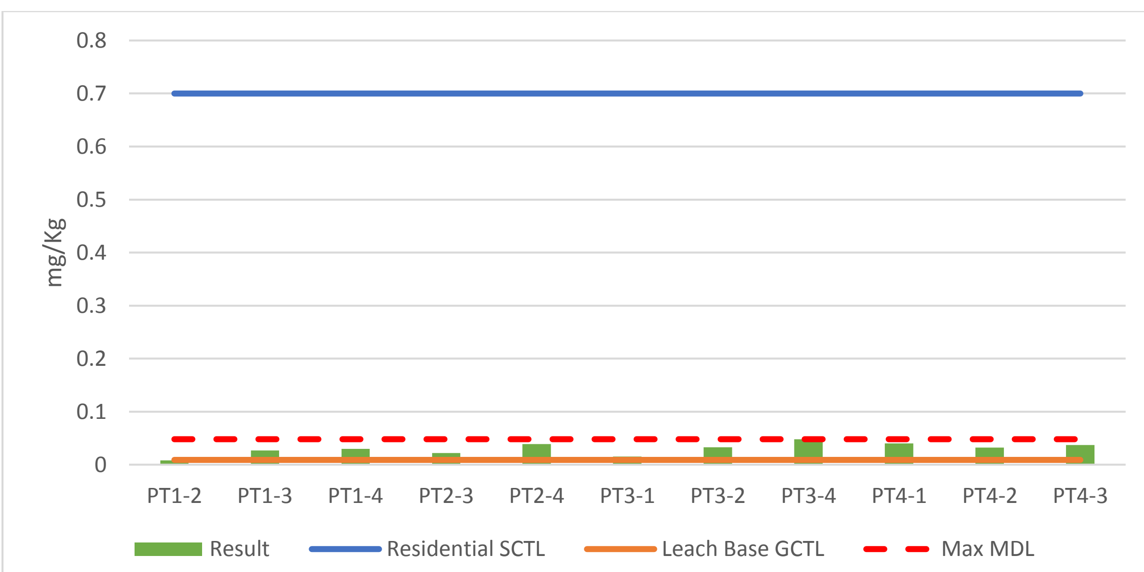
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-31 - Endrin Concentrations within Sediment Samples Collected from Lake Bonnet



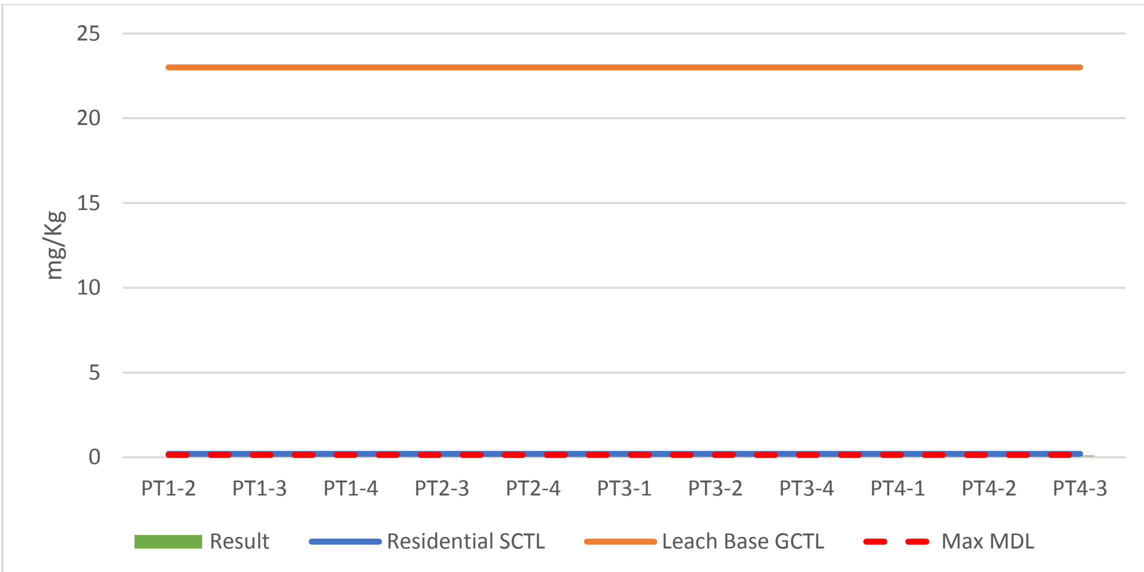
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-32 – Gamma-BCH (Lindane) Concentrations within Sediment Samples Collected from Lake Bonnet



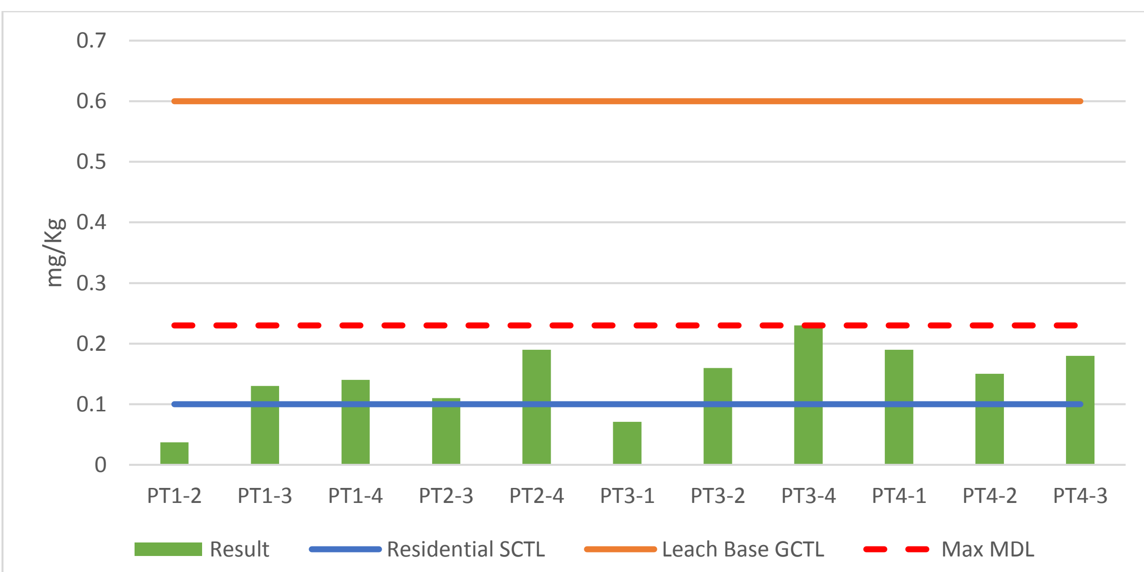
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-33 - Heptachlor Concentrations within Sediment Samples Collected from Lake Bonnet



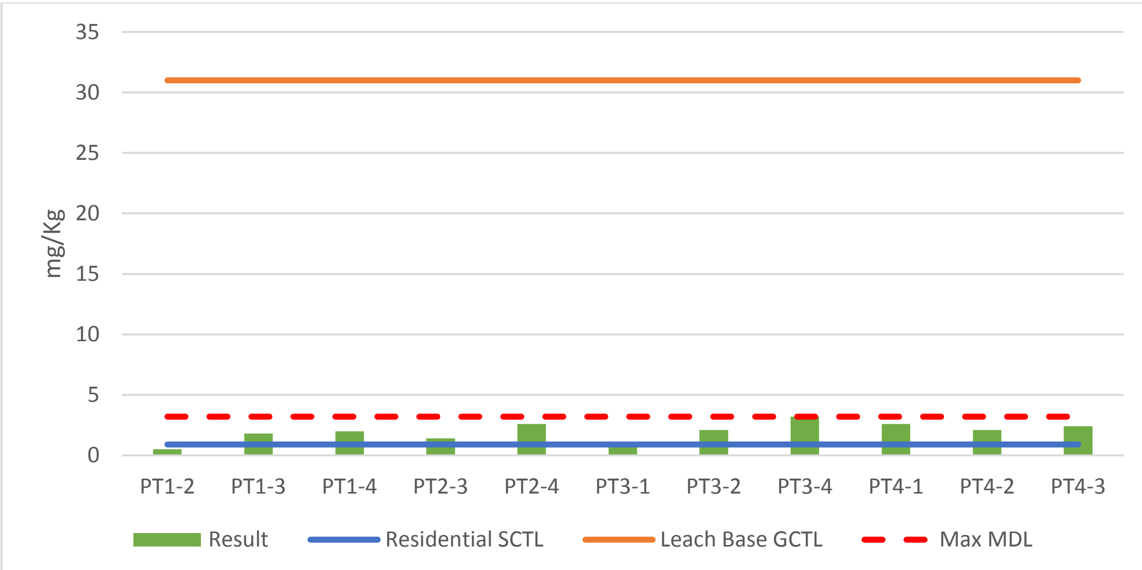
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-34 – Heptachlor Epoxide Concentrations within Sediment Samples Collected from Lake Bonnet



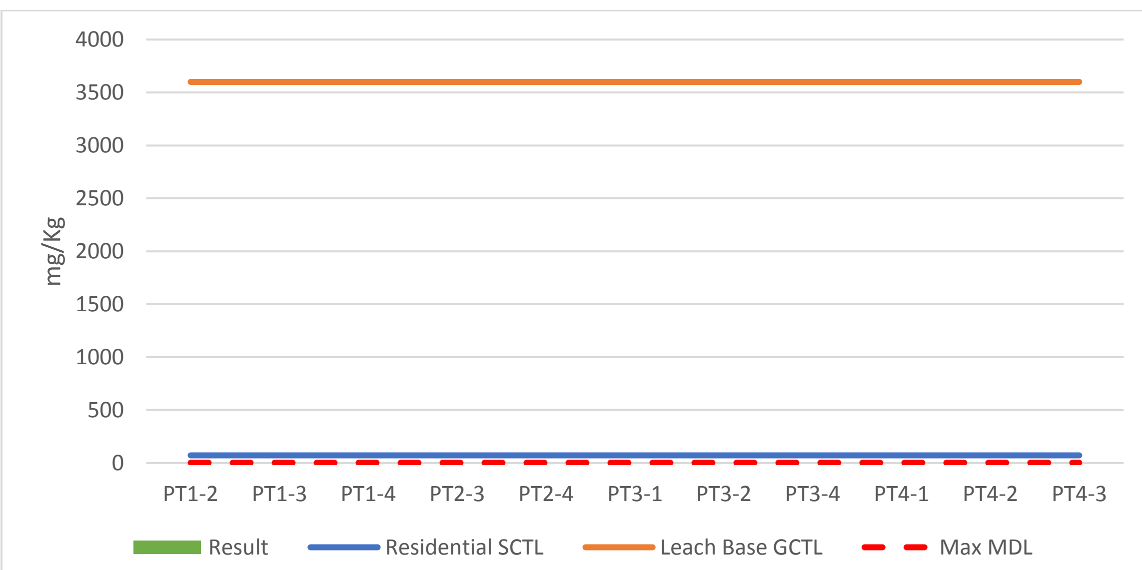
Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-35 - Toxaphene Concentrations within Sediment Samples Collected from Lake Bonnet



Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

Figure B1-36 – Bis (2-Ethylhexyl phthalate Concentrations within Sediment Samples Collected from Lake Bonnet



Note: All values for this analyte were reported with a "U" qualifier code, indicating that the values were below the minimum detection limit (MDL). The MDLs ranged per station depending on the level of dilution needed to meet quality control requirements. The maximum MDL from the range is shown with the red dotted line.

APPENDIX B2

Laboratory Results for Sediment Analysis

Appendix B2 - Laboratory Results for Sediment Analysis

Group	Parameter	Units	Result			
			Mean	Min	Max	Median
Metals	Arsenic	mg/Kg	1.96091	0.17	3.8	1.7
	Cadmium	mg/Kg	0.75836	0.072	1.5	0.74
	Chromium	mg/Kg	33.3364	2.8	63	33
	Copper	mg/Kg	20.1818	1.3	41	18
	Lead	mg/Kg	73.2091	4.6	160	73
	Mercury	mg/Kg	0.12555	0.019	0.23	0.13
	Nickel	mg/Kg	4.07364	0.31	7.5	4.3
	Silver	mg/Kg	0.32682	0.075	0.53	0.34
	Zinc	mg/Kg	100.127	4.7	220	95
PAH HMW	Benzo[a]anthracene	mg/Kg	1.32	0.34	2.1	1.4
	Benzo[a]pyrene	mg/Kg	0.59091	0.15	0.93	0.62
	Chrysene	mg/Kg	1.34091	0.35	2.1	1.4
	Dibenzo[a,h]anthracene	mg/Kg	0.63727	0.16	1	0.67
	Fluoranthene	mg/Kg	1.20909	0.31	1.9	1.3
	Pyrene	mg/Kg	1.36909	0.35	2.2	1.4
	Sum HMW-PAHs	mg/Kg	6.46727	1.66	10.23	6.79
PAH LMW	2-Methylnaphthalene	mg/Kg	0.97455	0.25	1.5	1
	Acenaphthene	mg/Kg	1.15909	0.3	1.8	1.2
	Acenaphthylene	mg/Kg	1.14545	0.3	1.8	1.2
	Anthracene	mg/Kg	1.15727	0.3	1.8	1.2
	Fluorene	mg/Kg	1.16818	0.3	1.8	1.2
	Naphthalene	mg/Kg	1.03	0.27	1.6	1.1
	Phenanthrene	mg/Kg	1.22182	0.32	1.9	1.3
	Sum LMW-PAHs	mg/Kg	7.85636	2.04	12.2	8.2
PAH	Total PAHs	mg/Kg	14.3236	3.7	22.43	14.99
PCB	Aroclor 1016 (PCB-1016)	mg/Kg	0.54909	0.14	0.88	0.58
	Aroclor 1221 (PCB-1221)	mg/Kg	0.85636	0.22	1.4	0.9
	Aroclor 1232 (PCB-1232)	mg/Kg	1.15727	0.3	1.9	1.2
	Aroclor 1242 (PCB-1242)	mg/Kg	0.91545	0.24	1.5	0.97
	Aroclor 1248 (PCB-1248)	mg/Kg	0.43909	0.11	0.71	0.46
	Aroclor 1254 (PCB-1254)	mg/Kg	0.24582	0.064	0.39	0.26
	Aroclor 1260 (PCB-1260)	mg/Kg	0.14736	0.038	0.24	0.15
	Total PCBs	mg/Kg	4.31045	1.112	7.02	4.52
Pesticides	4,4`-DDD	mg/Kg	0.03556	0.0092	0.057	0.037
	4,4`-DDE	mg/Kg	0.03604	0.0094	0.058	0.038
	4,4`-DDT	mg/Kg	0.17082	0.044	0.27	0.18
	Aldrin	mg/Kg	0.01355	0.0035	0.022	0.014
	alpha-Chlordane	ug/Kg	27.5394	0.033	49	31
	Chlordane (technical)	mg/Kg	0.36218	0.094	0.58	0.38
	Dieldrin	mg/Kg	0.02924	0.0076	0.047	0.031
	Endosulfan I	mg/Kg	0.03054	0.0079	0.049	0.032
	Endosulfan II	mg/Kg	0.03604	0.0094	0.058	0.038
	Endrin	mg/Kg	0.03379	0.0087	0.054	0.035
	gamma-BHC (Lindane)	mg/Kg	0.03007	0.0078	0.048	0.032
	gamma-Chlordane	ug/Kg	62.1886	0.075	110	69
	Heptachlor	mg/Kg	0.08918	0.023	0.14	0.094
	Heptachlor Epoxide	mg/Kg	0.14436	0.037	0.23	0.15
	Toxaphene	mg/Kg	1.97091	0.51	3.2	2.1
Phthalates	bis(2-Ethylhexyl) phthalate	mg/Kg	1.69273	0.44	2.6	1.8

APPENDIX B3

Advanced Environmental Laboratory
Sediment Chemical Analysis Results

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9610 Princess Palm AveTampa, FL 33619
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April 20, 2018

Mary Szafraniec
AMEC Foster Wheeler Enviroment & Infrastructure, Inc.
1101 Channelside Dr
Suite 200
Tampa, FL 33602

RE: Workorder: T1805716 Lake Bonnet

Dear Mary Szafraniec:

Enclosed are the analytical results for sample(s) received by the laboratory on Friday, April 06, 2018. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report. The analytical results for the samples contained in this report were submitted for analysis as outlined by the Chain of Custody and results pertain only to these samples.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Heidi Parker - Project Manager
HParker@AELLab.com

Enclosures

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SAMPLE SUMMARY

Workorder: T1805716 Lake Bonnet

Lab ID	Sample ID	Matrix	Date Collected	Date Received
T1805716001	PT3-2	Soil	4/5/2018 13:20	4/6/2018 12:00
T1805716002	PT3-4	Soil	4/5/2018 12:55	4/6/2018 12:00
T1805716003	PT4-3	Soil	4/5/2018 12:20	4/6/2018 12:00
T1805716004	PT3-1	Soil	4/5/2018 13:40	4/6/2018 12:00
T1805716005	PT4-2	Soil	4/5/2018 11:20	4/6/2018 12:00
T1805716006	PT4-1	Soil	4/5/2018 11:30	4/6/2018 12:00
T1805716007	PT1-2	Soil	4/5/2018 13:40	4/6/2018 12:00
T1805716008	PT1-3	Soil	4/6/2018 11:45	4/6/2018 12:00
T1805716009	PT1-4	Soil	4/6/2018 10:55	4/6/2018 12:00
T1805716010	PT2-3	Soil	4/6/2018 09:20	4/6/2018 12:00
T1805716011	PT2-4	Soil	4/6/2018 10:15	4/6/2018 12:00

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716001** Date Received: 04/06/18 12:00 Matrix: Soil
Sample ID: **PT3-2** Date Collected: 04/05/18 13:20

Results for sample T1805716001 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
METALS								
Analysis Desc: SW846 6010B Analysis,Soils	Preparation Method: SW-846 3050B Analytical Method: SW-846 6010							
Arsenic	**3.8**		**mg/Kg**	**1**	2.6	0.55	4/10/2018 22:20	T
Cadmium	**1.0**		**mg/Kg**	**1**	0.23	0.065	4/10/2018 22:20	T
Chromium	**63**		**mg/Kg**	**1**	2.1	1.0	4/10/2018 22:20	T
Copper	**28**		**mg/Kg**	**1**	2.1	0.32	4/10/2018 22:20	T
Lead	**89**		**mg/Kg**	**1**	2.6	0.54	4/10/2018 22:20	T
Nickel	**7.0**		**mg/Kg**	**1**	2.3	0.71	4/10/2018 22:20	T
Silver	**0.36**	**U**	**mg/Kg**	**1**	1.3	0.36	4/10/2018 22:20	T
Zinc	**110**		**mg/Kg**	**1**	5.2	2.6	4/10/2018 22:20	T
Analysis Desc: SW846 7471A Analysis, Soil	Preparation Method: SW-846 7471A Analytical Method: SW-846 7471A							
Mercury	**0.17**		**mg/Kg**	**1**	0.051	0.0071	4/17/2018 12:49	J
SEMIVOLATILES								
Analysis Desc: 8081A Pesticide Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: EPA 8081							
4,4`-DDD	**0.039**	**U**	**mg/Kg**	**4**	0.13	0.039	4/12/2018 01:01	M
4,4`-DDE	**0.039**	**U**	**mg/Kg**	**4**	0.13	0.039	4/12/2018 01:01	M
4,4`-DDT	**0.19**	**U**	**mg/Kg**	**20**	0.67	0.19	4/16/2018 15:18	M
Aldrin	**0.015**	**U**	**mg/Kg**	**4**	0.13	0.015	4/12/2018 01:01	M
Chlordane (technical)	**0.40**	**U**	**mg/Kg**	**4**	1.3	0.40	4/12/2018 01:01	M
Dieldrin	**0.032**	**U**	**mg/Kg**	**4**	0.13	0.032	4/12/2018 01:01	M
Endosulfan I	**0.033**	**U**	**mg/Kg**	**4**	0.13	0.033	4/12/2018 01:01	M
Endosulfan II	**0.039**	**U**	**mg/Kg**	**4**	0.13	0.039	4/12/2018 01:01	M
Endrin	**0.037**	**U**	**mg/Kg**	**4**	0.13	0.037	4/12/2018 01:01	M
Heptachlor	**0.097**	**U**	**mg/Kg**	**20**	0.67	0.097	4/16/2018 15:18	M
Heptachlor Epoxide	**0.16**	**U**	**mg/Kg**	**4**	0.16	0.16	4/12/2018 01:01	M
Toxaphene	**2.1**	**U**	**mg/Kg**	**20**	6.7	2.1	4/16/2018 15:18	M
alpha-Chlordane	**0.033**	**U**	**mg/Kg**	**4**	0.13	0.033	4/12/2018 01:01	M
gamma-BHC (Lindane)	**0.033**	**U**	**mg/Kg**	**4**	0.13	0.033	4/12/2018 01:01	M
gamma-Chlordane	**0.075**	**U**	**mg/Kg**	**4**	0.13	0.075	4/12/2018 01:01	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	42-129		4/12/2018 01:01	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	63-130		4/12/2018 01:01	

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716001** Date Received: 04/06/18 12:00 Matrix: Soil

Sample ID: **PT3-2** Date Collected: 04/05/18 13:20

Results for sample T1805716001 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: 8082A PCB Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8082A							
Aroclor 1016 (PCB-1016)	**0.60**	**U**	**mg/Kg**	**4**	1.3	0.60	4/12/2018 01:01	M
Aroclor 1221 (PCB-1221)	**0.93**	**U**	**mg/Kg**	**4**	1.3	0.93	4/12/2018 01:01	M
Aroclor 1232 (PCB-1232)	**1.3**	**U**	**mg/Kg**	**4**	1.3	1.3	4/12/2018 01:01	M
Aroclor 1242 (PCB-1242)	**1.0**	**U**	**mg/Kg**	**4**	1.3	1.0	4/12/2018 01:01	M
Aroclor 1248 (PCB-1248)	**0.48**	**U**	**mg/Kg**	**4**	1.3	0.48	4/12/2018 01:01	M
Aroclor 1254 (PCB-1254)	**0.27**	**U**	**mg/Kg**	**4**	1.3	0.27	4/12/2018 01:01	M
Aroclor 1260 (PCB-1260)	**0.16**	**U**	**mg/Kg**	**4**	1.3	0.16	4/12/2018 01:01	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	44-130		4/12/2018 01:01	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	61-147		4/12/2018 01:01	
Analysis Desc: 8270C Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8270C							
2-Methylnaphthalene	**1.0**	**U**	**mg/Kg**	**1**	2.1	1.0	4/13/2018 21:22	T
Acenaphthene	**1.2**	**U**	**mg/Kg**	**1**	2.1	1.2	4/13/2018 21:22	T
Acenaphthylene	**1.2**	**U**	**mg/Kg**	**1**	2.1	1.2	4/13/2018 21:22	T
Anthracene	**1.2**	**U**	**mg/Kg**	**1**	2.1	1.2	4/13/2018 21:22	T
Benzo[a]anthracene	**1.4**	**U**	**mg/Kg**	**1**	2.1	1.4	4/13/2018 21:22	T
Benzo[a]pyrene	**0.62**	**U**	**mg/Kg**	**1**	2.1	0.62	4/13/2018 21:22	T
Chrysene	**1.4**	**U**	**mg/Kg**	**1**	2.1	1.4	4/13/2018 21:22	T
Dibenzo[a,h]anthracene	**0.67**	**U**	**mg/Kg**	**1**	2.1	0.67	4/13/2018 21:22	T
Fluoranthene	**1.3**	**U**	**mg/Kg**	**1**	2.1	1.3	4/13/2018 21:22	T
Fluorene	**1.2**	**U**	**mg/Kg**	**1**	2.1	1.2	4/13/2018 21:22	T
Naphthalene	**1.1**	**U**	**mg/Kg**	**1**	2.1	1.1	4/13/2018 21:22	T
Phenanthrene	**1.3**	**U**	**mg/Kg**	**1**	2.1	1.3	4/13/2018 21:22	T
Pyrene	**1.4**	**U**	**mg/Kg**	**1**	2.1	1.4	4/13/2018 21:22	T
bis(2-Ethylhexyl) phthalate	**1.8**	**U**	**mg/Kg**	**1**	2.1	1.8	4/13/2018 21:22	T
2-Fluorophenol (S)	**73**		**%**	**1**	35-115		4/13/2018 21:22	
Phenol-d6 (S)	**68**		**%**	**1**	33-122		4/13/2018 21:22	
Nitrobenzene-d5 (S)	**66**		**%**	**1**	37-122		4/13/2018 21:22	
2-Fluorobiphenyl (S)	**37**	**J1**	**%**	**1**	44-115		4/13/2018 21:22	
2,4,6-Tribromophenol (S)	**64**		**%**	**1**	39-132		4/13/2018 21:22	
p-Terphenyl-d14 (S)	**39**	**J4**	**%**	**1**	54-127		4/13/2018 21:22	
SEMIVOLATILES								
Analysis Desc: Percent Solids,SM2540G,Soil	Analytical Method: SM 2540G							
Percent Moisture	**90**		**%**	**1**	0.0010	0.0010	4/11/2018 11:36	T

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716002** Date Received: 04/06/18 12:00 Matrix: Soil
Sample ID: **PT3-4** Date Collected: 04/05/18 12:55
Results for sample T1805716002 are reported on a dry weight basis.
Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
METALS								
Analysis Desc: SW846 6010B Analysis,Soils	Preparation Method: SW-846 3050B Analytical Method: SW-846 6010							
Arsenic	**3.2**	**I**	**mg/Kg**	**1**	3.8	0.81	4/10/2018 22:31	T
Cadmium	**1.5**		**mg/Kg**	**1**	0.34	0.096	4/10/2018 22:31	T
Chromium	**59**		**mg/Kg**	**1**	3.1	1.5	4/10/2018 22:31	T
Copper	**41**		**mg/Kg**	**1**	3.1	0.47	4/10/2018 22:31	T
Lead	**160**		**mg/Kg**	**1**	3.8	0.80	4/10/2018 22:31	T
Nickel	**7.5**		**mg/Kg**	**1**	3.4	1.0	4/10/2018 22:31	T
Silver	**0.53**	**U**	**mg/Kg**	**1**	1.9	0.53	4/10/2018 22:31	T
Zinc	**220**		**mg/Kg**	**1**	7.6	3.8	4/10/2018 22:31	T
Analysis Desc: SW846 7471A Analysis, Soil	Preparation Method: SW-846 7471A Analytical Method: SW-846 7471A							
Mercury	**0.23**		**mg/Kg**	**1**	0.073	0.010	4/17/2018 12:52	J
SEMIVOLATILES								
Analysis Desc: 8081A Pesticide Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: EPA 8081							
4,4`-DDD	**0.057**	**U**	**mg/Kg**	**4**	0.20	0.057	4/12/2018 01:22	M
4,4`-DDE	**0.058**	**U**	**mg/Kg**	**4**	0.20	0.058	4/12/2018 01:22	M
4,4`-DDT	**0.27**	**U**	**mg/Kg**	**20**	0.98	0.27	4/16/2018 15:39	M
Aldrin	**0.022**	**U**	**mg/Kg**	**4**	0.20	0.022	4/12/2018 01:22	M
Chlordane (technical)	**0.58**	**U**	**mg/Kg**	**4**	2.0	0.58	4/12/2018 01:22	M
Dieldrin	**0.047**	**U**	**mg/Kg**	**4**	0.20	0.047	4/12/2018 01:22	M
Endosulfan I	**0.049**	**U**	**mg/Kg**	**4**	0.20	0.049	4/12/2018 01:22	M
Endosulfan II	**0.058**	**U**	**mg/Kg**	**4**	0.20	0.058	4/12/2018 01:22	M
Endrin	**0.054**	**U**	**mg/Kg**	**4**	0.20	0.054	4/12/2018 01:22	M
Heptachlor	**0.14**	**U**	**mg/Kg**	**20**	0.98	0.14	4/16/2018 15:39	M
Heptachlor Epoxide	**0.23**	**U**	**mg/Kg**	**4**	0.23	0.23	4/12/2018 01:22	M
Toxaphene	**3.2**	**U**	**mg/Kg**	**20**	9.8	3.2	4/16/2018 15:39	M
alpha-Chlordane	**49**	**U**	**ug/Kg**	**4**	200	49	4/12/2018 01:22	M
gamma-BHC (Lindane)	**0.048**	**U**	**mg/Kg**	**4**	0.20	0.048	4/12/2018 01:22	M
gamma-Chlordane	**110**	**U**	**ug/Kg**	**4**	200	110	4/12/2018 01:22	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	42-129		4/12/2018 01:22	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	63-130		4/12/2018 01:22	

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716002** Date Received: 04/06/18 12:00 Matrix: Soil
Sample ID: **PT3-4** Date Collected: 04/05/18 12:55

Results for sample T1805716002 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: 8082A PCB Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8082A							
Aroclor 1016 (PCB-1016)	**0.88**	**U**	**mg/Kg**	**4**	2.0	0.88	4/12/2018 01:22	M
Aroclor 1221 (PCB-1221)	**1.4**	**U**	**mg/Kg**	**4**	2.0	1.4	4/12/2018 01:22	M
Aroclor 1232 (PCB-1232)	**1.9**	**U**	**mg/Kg**	**4**	2.0	1.9	4/12/2018 01:22	M
Aroclor 1242 (PCB-1242)	**1.5**	**U**	**mg/Kg**	**4**	2.0	1.5	4/12/2018 01:22	M
Aroclor 1248 (PCB-1248)	**0.71**	**U**	**mg/Kg**	**4**	2.0	0.71	4/12/2018 01:22	M
Aroclor 1254 (PCB-1254)	**0.39**	**U**	**mg/Kg**	**4**	2.0	0.39	4/12/2018 01:22	M
Aroclor 1260 (PCB-1260)	**0.24**	**U**	**mg/Kg**	**4**	2.0	0.24	4/12/2018 01:22	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	44-130		4/12/2018 01:22	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	61-147		4/12/2018 01:22	
Analysis Desc: 8270C Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8270C							
2-Methylnaphthalene	**1.5**	**U**	**mg/Kg**	**1**	3.1	1.5	4/14/2018 07:03	T
Acenaphthene	**1.8**	**U**	**mg/Kg**	**1**	3.1	1.8	4/14/2018 07:03	T
Acenaphthylene	**1.8**	**U**	**mg/Kg**	**1**	3.1	1.8	4/14/2018 07:03	T
Anthracene	**1.8**	**U**	**mg/Kg**	**1**	3.1	1.8	4/14/2018 07:03	T
Benzo[a]anthracene	**2.1**	**U**	**mg/Kg**	**1**	3.1	2.1	4/14/2018 07:03	T
Benzo[a]pyrene	**0.93**	**U**	**mg/Kg**	**1**	3.1	0.93	4/14/2018 07:03	T
Chrysene	**2.1**	**U**	**mg/Kg**	**1**	3.1	2.1	4/14/2018 07:03	T
Dibenzo[a,h]anthracene	**1.0**	**U**	**mg/Kg**	**1**	3.1	1.0	4/14/2018 07:03	T
Fluoranthene	**1.9**	**U**	**mg/Kg**	**1**	3.1	1.9	4/14/2018 07:03	T
Fluorene	**1.8**	**U**	**mg/Kg**	**1**	3.1	1.8	4/14/2018 07:03	T
Naphthalene	**1.6**	**U**	**mg/Kg**	**1**	3.1	1.6	4/14/2018 07:03	T
Phenanthrene	**1.9**	**U**	**mg/Kg**	**1**	3.1	1.9	4/14/2018 07:03	T
Pyrene	**2.2**	**U**	**mg/Kg**	**1**	3.1	2.2	4/14/2018 07:03	T
bis(2-Ethylhexyl) phthalate	**2.6**	**U**	**mg/Kg**	**1**	3.1	2.6	4/14/2018 07:03	T
2-Fluorophenol (S)	**64**		**%**	**1**	35-115		4/14/2018 07:03	
Phenol-d6 (S)	**59**		**%**	**1**	33-122		4/14/2018 07:03	
Nitrobenzene-d5 (S)	**63**		**%**	**1**	37-122		4/14/2018 07:03	
2-Fluorobiphenyl (S)	**68**		**%**	**1**	44-115		4/14/2018 07:03	
2,4,6-Tribromophenol (S)	**87**		**%**	**1**	39-132		4/14/2018 07:03	
p-Terphenyl-d14 (S)	**68**		**%**	**1**	54-127		4/14/2018 07:03	
SEMIVOLATILES								
Analysis Desc: Percent Solids,SM2540G,Soil	Analytical Method: SM 2540G							
Percent Moisture	**94**		**%**	**1**	0.0010	0.0010	4/11/2018 11:36	T

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716003** Date Received: 04/06/18 12:00 Matrix: Soil
Sample ID: **PT4-3** Date Collected: 04/05/18 12:20

Results for sample T1805716003 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
METALS								
Analysis Desc: SW846 6010B Analysis,Soils	Preparation Method: SW-846 3050B Analytical Method: SW-846 6010							
Arsenic	**1.9**	**I**	**mg/Kg**	**1**	2.6	0.56	4/10/2018 22:35	T
Cadmium	**1.1**		**mg/Kg**	**1**	0.23	0.065	4/10/2018 22:35	T
Chromium	**43**		**mg/Kg**	**1**	2.1	1.0	4/10/2018 22:35	T
Copper	**29**		**mg/Kg**	**1**	2.1	0.32	4/10/2018 22:35	T
Lead	**120**		**mg/Kg**	**1**	2.6	0.55	4/10/2018 22:35	T
Nickel	**5.0**		**mg/Kg**	**1**	2.3	0.71	4/10/2018 22:35	T
Silver	**0.36**	**U**	**mg/Kg**	**1**	1.3	0.36	4/10/2018 22:35	T
Zinc	**170**		**mg/Kg**	**1**	5.2	2.6	4/10/2018 22:35	T
Analysis Desc: SW846 7471A Analysis, Soil	Preparation Method: SW-846 7471A Analytical Method: SW-846 7471A							
Mercury	**0.17**		**mg/Kg**	**1**	0.055	0.0076	4/17/2018 12:55	J
SEMIVOLATILES								
Analysis Desc: 8081A Pesticide Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: EPA 8081							
4,4`-DDD	**0.044**	**U**	**mg/Kg**	**4**	0.15	0.044	4/12/2018 01:43	M
4,4`-DDE	**0.045**	**U**	**mg/Kg**	**4**	0.15	0.045	4/12/2018 01:43	M
4,4`-DDT	**0.21**	**U**	**mg/Kg**	**20**	0.75	0.21	4/16/2018 16:01	M
Aldrin	**0.017**	**U**	**mg/Kg**	**4**	0.15	0.017	4/12/2018 01:43	M
Chlordane (technical)	**0.45**	**U**	**mg/Kg**	**4**	1.5	0.45	4/12/2018 01:43	M
Dieldrin	**0.036**	**U**	**mg/Kg**	**4**	0.15	0.036	4/12/2018 01:43	M
Endosulfan I	**0.038**	**U**	**mg/Kg**	**4**	0.15	0.038	4/12/2018 01:43	M
Endosulfan II	**0.045**	**U**	**mg/Kg**	**4**	0.15	0.045	4/12/2018 01:43	M
Endrin	**0.042**	**U**	**mg/Kg**	**4**	0.15	0.042	4/12/2018 01:43	M
Heptachlor	**0.11**	**U**	**mg/Kg**	**20**	0.75	0.11	4/16/2018 16:01	M
Heptachlor Epoxide	**0.18**	**U**	**mg/Kg**	**4**	0.18	0.18	4/12/2018 01:43	M
Toxaphene	**2.4**	**U**	**mg/Kg**	**20**	7.5	2.4	4/16/2018 16:01	M
alpha-Chlordane	**38**	**U**	**ug/Kg**	**4**	150	38	4/12/2018 01:43	M
gamma-BHC (Lindane)	**0.037**	**U**	**mg/Kg**	**4**	0.15	0.037	4/12/2018 01:43	M
gamma-Chlordane	**85**	**U**	**ug/Kg**	**4**	150	85	4/12/2018 01:43	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	42-129		4/12/2018 01:43	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	63-130		4/12/2018 01:43	

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716003** Date Received: 04/06/18 12:00 Matrix: Soil
Sample ID: **PT4-3** Date Collected: 04/05/18 12:20

Results for sample T1805716003 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: 8082A PCB Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8082A							
Aroclor 1016 (PCB-1016)	**0.68**	**U**	**mg/Kg**	**4**	1.5	0.68	4/12/2018 01:43	M
Aroclor 1221 (PCB-1221)	**1.1**	**U**	**mg/Kg**	**4**	1.5	1.1	4/12/2018 01:43	M
Aroclor 1232 (PCB-1232)	**1.4**	**U**	**mg/Kg**	**4**	1.5	1.4	4/12/2018 01:43	M
Aroclor 1242 (PCB-1242)	**1.1**	**U**	**mg/Kg**	**4**	1.5	1.1	4/12/2018 01:43	M
Aroclor 1248 (PCB-1248)	**0.54**	**U**	**mg/Kg**	**4**	1.5	0.54	4/12/2018 01:43	M
Aroclor 1254 (PCB-1254)	**0.30**	**U**	**mg/Kg**	**4**	1.5	0.30	4/12/2018 01:43	M
Aroclor 1260 (PCB-1260)	**0.18**	**U**	**mg/Kg**	**4**	1.5	0.18	4/12/2018 01:43	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	44-130		4/12/2018 01:43	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	61-147		4/12/2018 01:43	
Analysis Desc: 8270C Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8270C							
2-Methylnaphthalene	**1.2**	**U**	**mg/Kg**	**1**	2.4	1.2	4/14/2018 04:48	T
Acenaphthene	**1.4**	**U**	**mg/Kg**	**1**	2.4	1.4	4/14/2018 04:48	T
Acenaphthylene	**1.4**	**U**	**mg/Kg**	**1**	2.4	1.4	4/14/2018 04:48	T
Anthracene	**1.4**	**U**	**mg/Kg**	**1**	2.4	1.4	4/14/2018 04:48	T
Benzo[a]anthracene	**1.6**	**U**	**mg/Kg**	**1**	2.4	1.6	4/14/2018 04:48	T
Benzo[a]pyrene	**0.70**	**U**	**mg/Kg**	**1**	2.4	0.70	4/14/2018 04:48	T
Chrysene	**1.6**	**U**	**mg/Kg**	**1**	2.4	1.6	4/14/2018 04:48	T
Dibenzo[a,h]anthracene	**0.76**	**U**	**mg/Kg**	**1**	2.4	0.76	4/14/2018 04:48	T
Fluoranthene	**1.4**	**U**	**mg/Kg**	**1**	2.4	1.4	4/14/2018 04:48	T
Fluorene	**1.4**	**U**	**mg/Kg**	**1**	2.4	1.4	4/14/2018 04:48	T
Naphthalene	**1.2**	**U**	**mg/Kg**	**1**	2.4	1.2	4/14/2018 04:48	T
Phenanthrene	**1.5**	**U**	**mg/Kg**	**1**	2.4	1.5	4/14/2018 04:48	T
Pyrene	**1.6**	**U**	**mg/Kg**	**1**	2.4	1.6	4/14/2018 04:48	T
bis(2-Ethylhexyl) phthalate	**2.0**	**U**	**mg/Kg**	**1**	2.4	2.0	4/14/2018 04:48	T
2-Fluorophenol (S)	**72**		**%**	**1**	35-115		4/14/2018 04:48	
Phenol-d6 (S)	**64**		**%**	**1**	33-122		4/14/2018 04:48	
Nitrobenzene-d5 (S)	**69**		**%**	**1**	37-122		4/14/2018 04:48	
2-Fluorobiphenyl (S)	**72**		**%**	**1**	44-115		4/14/2018 04:48	
2,4,6-Tribromophenol (S)	**90**		**%**	**1**	39-132		4/14/2018 04:48	
p-Terphenyl-d14 (S)	**66**		**%**	**1**	54-127		4/14/2018 04:48	

SEMIVOLATILES

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: Percent Solids,SM2540G,Soil	Analytical Method: SM 2540G							
Percent Moisture	**92**		**%**	**1**	0.0010	0.0010	4/10/2018 11:56	T

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716004** Date Received: 04/06/18 12:00 Matrix: Soil
Sample ID: **PT3-1** Date Collected: 04/05/18 13:40
Results for sample T1805716004 are reported on a dry weight basis.
Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
METALS								
Analysis Desc: SW846 6010B Analysis,Soils	Preparation Method: SW-846 3050B Analytical Method: SW-846 6010							
Arsenic	**1.0**	**I**	**mg/Kg**	**1**	1.3	0.27	4/10/2018 22:38	T
Cadmium	**0.18**		**mg/Kg**	**1**	0.11	0.032	4/10/2018 22:38	T
Chromium	**5.9**		**mg/Kg**	**1**	1.0	0.51	4/10/2018 22:38	T
Copper	**1.7**		**mg/Kg**	**1**	1.0	0.15	4/10/2018 22:38	T
Lead	**4.6**		**mg/Kg**	**1**	1.3	0.26	4/10/2018 22:38	T
Nickel	**1.2**		**mg/Kg**	**1**	1.1	0.34	4/10/2018 22:38	T
Silver	**0.17**	**U**	**mg/Kg**	**1**	0.63	0.17	4/10/2018 22:38	T
Zinc	**4.7**		**mg/Kg**	**1**	2.5	1.3	4/10/2018 22:38	T
Analysis Desc: SW846 7471A Analysis, Soil	Preparation Method: SW-846 7471A Analytical Method: SW-846 7471A							
Mercury	**0.039**		**mg/Kg**	**1**	0.026	0.0036	4/17/2018 13:04	J
SEMIVOLATILES								
Analysis Desc: 8081A Pesticide Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: EPA 8081							
4,4`-DDD	**0.018**	**U**	**mg/Kg**	**4**	0.061	0.018	4/12/2018 02:05	M
4,4`-DDE	**0.018**	**U**	**mg/Kg**	**4**	0.061	0.018	4/12/2018 02:05	M
4,4`-DDT	**0.085**	**U**	**mg/Kg**	**20**	0.30	0.085	4/16/2018 16:22	M
Aldrin	**0.0067**	**U**	**mg/Kg**	**4**	0.061	0.0067	4/12/2018 02:05	M
Chlordane (technical)	**0.18**	**U**	**mg/Kg**	**4**	0.61	0.18	4/12/2018 02:05	M
Dieldrin	**0.015**	**U**	**mg/Kg**	**4**	0.061	0.015	4/12/2018 02:05	M
Endosulfan I	**0.015**	**U**	**mg/Kg**	**4**	0.061	0.015	4/12/2018 02:05	M
Endosulfan II	**0.018**	**U**	**mg/Kg**	**4**	0.061	0.018	4/12/2018 02:05	M
Endrin	**0.017**	**U**	**mg/Kg**	**4**	0.061	0.017	4/12/2018 02:05	M
Heptachlor	**0.044**	**U**	**mg/Kg**	**20**	0.30	0.044	4/16/2018 16:22	M
Heptachlor Epoxide	**0.071**	**U**	**mg/Kg**	**4**	0.071	0.071	4/12/2018 02:05	M
Toxaphene	**0.97**	**U**	**mg/Kg**	**20**	3.0	0.97	4/16/2018 16:22	M
alpha-Chlordane	**15**	**U**	**ug/Kg**	**4**	61	15	4/12/2018 02:05	M
gamma-BHC (Lindane)	**0.015**	**U**	**mg/Kg**	**4**	0.061	0.015	4/12/2018 02:05	M
gamma-Chlordane	**34**	**U**	**ug/Kg**	**4**	61	34	4/12/2018 02:05	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	42-129		4/12/2018 02:05	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	63-130		4/12/2018 02:05	

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716004** Date Received: 04/06/18 12:00 Matrix: Soil

Sample ID: **PT3-1** Date Collected: 04/05/18 13:40

Results for sample T1805716004 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: 8082A PCB Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8082A							
Aroclor 1016 (PCB-1016)	**0.27**	**U**	**mg/Kg**	**4**	0.61	0.27	4/12/2018 02:05	M
Aroclor 1221 (PCB-1221)	**0.42**	**U**	**mg/Kg**	**4**	0.61	0.42	4/12/2018 02:05	M
Aroclor 1232 (PCB-1232)	**0.58**	**U**	**mg/Kg**	**4**	0.61	0.58	4/12/2018 02:05	M
Aroclor 1242 (PCB-1242)	**0.45**	**U**	**mg/Kg**	**4**	0.61	0.45	4/12/2018 02:05	M
Aroclor 1248 (PCB-1248)	**0.22**	**U**	**mg/Kg**	**4**	0.61	0.22	4/12/2018 02:05	M
Aroclor 1254 (PCB-1254)	**0.12**	**U**	**mg/Kg**	**4**	0.61	0.12	4/12/2018 02:05	M
Aroclor 1260 (PCB-1260)	**0.073**	**U**	**mg/Kg**	**4**	0.61	0.073	4/12/2018 02:05	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	44-130		4/12/2018 02:05	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	61-147		4/12/2018 02:05	
Analysis Desc: 8270C Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8270C							
2-Methylnaphthalene	**0.51**	**U**	**mg/Kg**	**1**	1.0	0.51	4/14/2018 05:22	T
Acenaphthene	**0.61**	**U**	**mg/Kg**	**1**	1.0	0.61	4/14/2018 05:22	T
Acenaphthylene	**0.60**	**U**	**mg/Kg**	**1**	1.0	0.60	4/14/2018 05:22	T
Anthracene	**0.61**	**U**	**mg/Kg**	**1**	1.0	0.61	4/14/2018 05:22	T
Benzo[a]anthracene	**0.68**	**U**	**mg/Kg**	**1**	1.0	0.68	4/14/2018 05:22	T
Benzo[a]pyrene	**0.31**	**U**	**mg/Kg**	**1**	1.0	0.31	4/14/2018 05:22	T
Chrysene	**0.70**	**U**	**mg/Kg**	**1**	1.0	0.70	4/14/2018 05:22	T
Dibenzo[a,h]anthracene	**0.33**	**U**	**mg/Kg**	**1**	1.0	0.33	4/14/2018 05:22	T
Fluoranthene	**0.63**	**U**	**mg/Kg**	**1**	1.0	0.63	4/14/2018 05:22	T
Fluorene	**0.61**	**U**	**mg/Kg**	**1**	1.0	0.61	4/14/2018 05:22	T
Naphthalene	**0.54**	**U**	**mg/Kg**	**1**	1.0	0.54	4/14/2018 05:22	T
Phenanthrene	**0.64**	**U**	**mg/Kg**	**1**	1.0	0.64	4/14/2018 05:22	T
Pyrene	**0.71**	**U**	**mg/Kg**	**1**	1.0	0.71	4/14/2018 05:22	T
bis(2-Ethylhexyl) phthalate	**0.88**	**U**	**mg/Kg**	**1**	1.0	0.88	4/14/2018 05:22	T
2-Fluorophenol (S)	**82**		**%**	**1**	35-115		4/14/2018 05:22	
Phenol-d6 (S)	**75**		**%**	**1**	33-122		4/14/2018 05:22	
Nitrobenzene-d5 (S)	**75**		**%**	**1**	37-122		4/14/2018 05:22	
2-Fluorobiphenyl (S)	**78**		**%**	**1**	44-115		4/14/2018 05:22	
2,4,6-Tribromophenol (S)	**97**		**%**	**1**	39-132		4/14/2018 05:22	
p-Terphenyl-d14 (S)	**84**		**%**	**1**	54-127		4/14/2018 05:22	
SEMIVOLATILES								
Analysis Desc: Percent Solids,SM2540G,Soil	Analytical Method: SM 2540G							
Percent Moisture	**81**		**%**	**1**	0.0010	0.0010	4/11/2018 11:36	T

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716005** Date Received: 04/06/18 12:00 Matrix: Soil
Sample ID: **PT4-2** Date Collected: 04/05/18 11:20

Results for sample T1805716005 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
METALS								
Analysis Desc: SW846 6010B Analysis,Soils	Preparation Method: SW-846 3050B Analytical Method: SW-846 6010							
Arsenic	**1.7**	**I**	**mg/Kg**	**1**	2.5	0.53	4/10/2018 22:42	T
Cadmium	**0.74**		**mg/Kg**	**1**	0.22	0.062	4/10/2018 22:42	T
Chromium	**30**		**mg/Kg**	**1**	2.0	0.99	4/10/2018 22:42	T
Copper	**18**		**mg/Kg**	**1**	2.0	0.30	4/10/2018 22:42	T
Lead	**73**		**mg/Kg**	**1**	2.5	0.52	4/10/2018 22:42	T
Nickel	**4.3**		**mg/Kg**	**1**	2.2	0.68	4/10/2018 22:42	T
Silver	**0.34**	**U**	**mg/Kg**	**1**	1.2	0.34	4/10/2018 22:42	T
Zinc	**95**		**mg/Kg**	**1**	5.0	2.5	4/10/2018 22:42	T
Analysis Desc: SW846 7471A Analysis, Soil	Preparation Method: SW-846 7471A Analytical Method: SW-846 7471A							
Mercury	**0.10**		**mg/Kg**	**1**	0.051	0.0071	4/17/2018 13:07	J
SEMIVOLATILES								
Analysis Desc: 8081A Pesticide Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: EPA 8081							
4,4`-DDD	**0.037**	**U**	**mg/Kg**	**4**	0.13	0.037	4/12/2018 02:26	M
4,4`-DDE	**0.038**	**U**	**mg/Kg**	**4**	0.13	0.038	4/12/2018 02:26	M
4,4`-DDT	**0.18**	**U**	**mg/Kg**	**20**	0.65	0.18	4/16/2018 16:43	M
Aldrin	**0.014**	**U**	**mg/Kg**	**4**	0.13	0.014	4/12/2018 02:26	M
Chlordane (technical)	**0.38**	**U**	**mg/Kg**	**4**	1.3	0.38	4/12/2018 02:26	M
Dieldrin	**0.031**	**U**	**mg/Kg**	**4**	0.13	0.031	4/12/2018 02:26	M
Endosulfan I	**0.032**	**U**	**mg/Kg**	**4**	0.13	0.032	4/12/2018 02:26	M
Endosulfan II	**0.038**	**U**	**mg/Kg**	**4**	0.13	0.038	4/12/2018 02:26	M
Endrin	**0.035**	**U**	**mg/Kg**	**4**	0.13	0.035	4/12/2018 02:26	M
Heptachlor	**0.094**	**U**	**mg/Kg**	**20**	0.65	0.094	4/16/2018 16:43	M
Heptachlor Epoxide	**0.15**	**U**	**mg/Kg**	**4**	0.15	0.15	4/12/2018 02:26	M
Toxaphene	**2.1**	**U**	**mg/Kg**	**20**	6.5	2.1	4/16/2018 16:43	M
alpha-Chlordane	**32**	**U**	**ug/Kg**	**4**	130	32	4/12/2018 02:26	M
gamma-BHC (Lindane)	**0.032**	**U**	**mg/Kg**	**4**	0.13	0.032	4/12/2018 02:26	M
gamma-Chlordane	**73**	**U**	**ug/Kg**	**4**	130	73	4/12/2018 02:26	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	42-129		4/12/2018 02:26	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	63-130		4/12/2018 02:26	

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716005** Date Received: 04/06/18 12:00 Matrix: Soil
Sample ID: **PT4-2** Date Collected: 04/05/18 11:20
Results for sample T1805716005 are reported on a dry weight basis.
Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: 8082A PCB Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8082A							
Aroclor 1016 (PCB-1016)	**0.58**	**U**	**mg/Kg**	**4**	1.3	0.58	4/12/2018 02:26	M
Aroclor 1221 (PCB-1221)	**0.90**	**U**	**mg/Kg**	**4**	1.3	0.90	4/12/2018 02:26	M
Aroclor 1232 (PCB-1232)	**1.2**	**U**	**mg/Kg**	**4**	1.3	1.2	4/12/2018 02:26	M
Aroclor 1242 (PCB-1242)	**0.97**	**U**	**mg/Kg**	**4**	1.3	0.97	4/12/2018 02:26	M
Aroclor 1248 (PCB-1248)	**0.46**	**U**	**mg/Kg**	**4**	1.3	0.46	4/12/2018 02:26	M
Aroclor 1254 (PCB-1254)	**0.26**	**U**	**mg/Kg**	**4**	1.3	0.26	4/12/2018 02:26	M
Aroclor 1260 (PCB-1260)	**0.15**	**U**	**mg/Kg**	**4**	1.3	0.15	4/12/2018 02:26	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	44-130		4/12/2018 02:26	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	61-147		4/12/2018 02:26	
Analysis Desc: 8270C Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8270C							
2-Methylnaphthalene	**1.0**	**U**	**mg/Kg**	**1**	2.1	1.0	4/13/2018 21:56	T
Acenaphthene	**1.3**	**U**	**mg/Kg**	**1**	2.1	1.3	4/13/2018 21:56	T
Acenaphthylene	**1.2**	**U**	**mg/Kg**	**1**	2.1	1.2	4/13/2018 21:56	T
Anthracene	**1.3**	**U**	**mg/Kg**	**1**	2.1	1.3	4/13/2018 21:56	T
Benzo[a]anthracene	**1.4**	**U**	**mg/Kg**	**1**	2.1	1.4	4/13/2018 21:56	T
Benzo[a]pyrene	**0.64**	**U**	**mg/Kg**	**1**	2.1	0.64	4/13/2018 21:56	T
Chrysene	**1.5**	**U**	**mg/Kg**	**1**	2.1	1.5	4/13/2018 21:56	T
Dibenzo[a,h]anthracene	**0.69**	**U**	**mg/Kg**	**1**	2.1	0.69	4/13/2018 21:56	T
Fluoranthene	**1.3**	**U**	**mg/Kg**	**1**	2.1	1.3	4/13/2018 21:56	T
Fluorene	**1.3**	**U**	**mg/Kg**	**1**	2.1	1.3	4/13/2018 21:56	T
Naphthalene	**1.1**	**U**	**mg/Kg**	**1**	2.1	1.1	4/13/2018 21:56	T
Phenanthrene	**1.3**	**U**	**mg/Kg**	**1**	2.1	1.3	4/13/2018 21:56	T
Pyrene	**1.5**	**U**	**mg/Kg**	**1**	2.1	1.5	4/13/2018 21:56	T
bis(2-Ethylhexyl) phthalate	**1.8**	**U**	**mg/Kg**	**1**	2.1	1.8	4/13/2018 21:56	T
2-Fluorophenol (S)	**79**		**%**	**1**	35-115		4/13/2018 21:56	
Phenol-d6 (S)	**70**		**%**	**1**	33-122		4/13/2018 21:56	
Nitrobenzene-d5 (S)	**68**		**%**	**1**	37-122		4/13/2018 21:56	
2-Fluorobiphenyl (S)	**37**	**J1**	**%**	**1**	44-115		4/13/2018 21:56	
2,4,6-Tribromophenol (S)	**69**		**%**	**1**	39-132		4/13/2018 21:56	
p-Terphenyl-d14 (S)	**35**	**J1**	**%**	**1**	54-127		4/13/2018 21:56	

SEMIVOLATILES

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: Percent Solids,SM2540G,Soil	Analytical Method: SM 2540G							
Percent Moisture	**91**		**%**	**1**	0.0010	0.0010	4/10/2018 11:56	T

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716006** Date Received: 04/06/18 12:00 Matrix: Soil

Sample ID: **PT4-1** Date Collected: 04/05/18 11:30

Results for sample T1805716006 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
METALS								
Analysis Desc: SW846 6010B Analysis,Soils	Preparation Method: SW-846 3050B; Analytical Method: SW-846 6010							
Arsenic	**1.6**	**I**	**mg/Kg**	**1**	3.2	0.69	4/10/2018 22:46	T
Cadmium	**0.95**		**mg/Kg**	**1**	0.29	0.081	4/10/2018 22:46	T
Chromium	**38**		**mg/Kg**	**1**	2.6	1.3	4/10/2018 22:46	T
Copper	**22**		**mg/Kg**	**1**	2.6	0.39	4/10/2018 22:46	T
Lead	**89**		**mg/Kg**	**1**	3.2	0.68	4/10/2018 22:46	T
Nickel	**4.7**		**mg/Kg**	**1**	2.9	0.88	4/10/2018 22:46	T
Silver	**0.45**	**U**	**mg/Kg**	**1**	1.6	0.45	4/10/2018 22:46	T
Zinc	**140**		**mg/Kg**	**1**	6.5	3.2	4/10/2018 22:46	T
Analysis Desc: SW846 7471A Analysis, Soil	Preparation Method: SW-846 7471A; Analytical Method: SW-846 7471A							
Mercury	**0.13**		**mg/Kg**	**1**	0.059	0.0083	4/17/2018 13:10	J
SEMIVOLATILES								
Analysis Desc: 8081A Pesticide Analysis, Soil	Preparation Method: SW-846 3550B; Analytical Method: EPA 8081							
4,4`-DDD	**0.047**	**U**	**mg/Kg**	**4**	0.16	0.047	4/12/2018 02:48	M
4,4`-DDE	**0.048**	**U**	**mg/Kg**	**4**	0.16	0.048	4/12/2018 02:48	M
4,4`-DDT	**0.23**	**U**	**mg/Kg**	**20**	0.81	0.23	4/16/2018 17:05	M
Aldrin	**0.018**	**U**	**mg/Kg**	**4**	0.16	0.018	4/12/2018 02:48	M
Chlordane (technical)	**0.48**	**U**	**mg/Kg**	**4**	1.6	0.48	4/12/2018 02:48	M
Dieldrin	**0.039**	**U**	**mg/Kg**	**4**	0.16	0.039	4/12/2018 02:48	M
Endosulfan I	**0.041**	**U**	**mg/Kg**	**4**	0.16	0.041	4/12/2018 02:48	M
Endosulfan II	**0.048**	**U**	**mg/Kg**	**4**	0.16	0.048	4/12/2018 02:48	M
Endrin	**0.045**	**U**	**mg/Kg**	**4**	0.16	0.045	4/12/2018 02:48	M
Heptachlor	**0.12**	**U**	**mg/Kg**	**20**	0.81	0.12	4/16/2018 17:05	M
Heptachlor Epoxide	**0.19**	**U**	**mg/Kg**	**4**	0.19	0.19	4/12/2018 02:48	M
Toxaphene	**2.6**	**U**	**mg/Kg**	**20**	8.1	2.6	4/16/2018 17:05	M
alpha-Chlordane	**41**	**U**	**ug/Kg**	**4**	160	41	4/12/2018 02:48	M
gamma-BHC (Lindane)	**0.040**	**U**	**mg/Kg**	**4**	0.16	0.040	4/12/2018 02:48	M
gamma-Chlordane	**92**	**U**	**ug/Kg**	**4**	160	92	4/12/2018 02:48	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	42-129		4/12/2018 02:48	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	63-130		4/12/2018 02:48	

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716006** Date Received: 04/06/18 12:00 Matrix: Soil

Sample ID: **PT4-1** Date Collected: 04/05/18 11:30

Results for sample T1805716006 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: 8082A PCB Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8082A							
Aroclor 1016 (PCB-1016)	**0.73**	**U**	**mg/Kg**	**4**	1.6	0.73	4/12/2018 02:48	M
Aroclor 1221 (PCB-1221)	**1.1**	**U**	**mg/Kg**	**4**	1.6	1.1	4/12/2018 02:48	M
Aroclor 1232 (PCB-1232)	**1.5**	**U**	**mg/Kg**	**4**	1.6	1.5	4/12/2018 02:48	M
Aroclor 1242 (PCB-1242)	**1.2**	**U**	**mg/Kg**	**4**	1.6	1.2	4/12/2018 02:48	M
Aroclor 1248 (PCB-1248)	**0.59**	**U**	**mg/Kg**	**4**	1.6	0.59	4/12/2018 02:48	M
Aroclor 1254 (PCB-1254)	**0.33**	**U**	**mg/Kg**	**4**	1.6	0.33	4/12/2018 02:48	M
Aroclor 1260 (PCB-1260)	**0.20**	**U**	**mg/Kg**	**4**	1.6	0.20	4/12/2018 02:48	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	44-130		4/12/2018 02:48	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	61-147		4/12/2018 02:48	
Analysis Desc: 8270C Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8270C							
2-Methylnaphthalene	**1.3**	**U**	**mg/Kg**	**1**	2.6	1.3	4/14/2018 05:55	T
Acenaphthene	**1.5**	**U**	**mg/Kg**	**1**	2.6	1.5	4/14/2018 05:55	T
Acenaphthylene	**1.5**	**U**	**mg/Kg**	**1**	2.6	1.5	4/14/2018 05:55	T
Anthracene	**1.5**	**U**	**mg/Kg**	**1**	2.6	1.5	4/14/2018 05:55	T
Benzo[a]anthracene	**1.7**	**U**	**mg/Kg**	**1**	2.6	1.7	4/14/2018 05:55	T
Benzo[a]pyrene	**0.77**	**U**	**mg/Kg**	**1**	2.6	0.77	4/14/2018 05:55	T
Chrysene	**1.7**	**U**	**mg/Kg**	**1**	2.6	1.7	4/14/2018 05:55	T
Dibenzo[a,h]anthracene	**0.83**	**U**	**mg/Kg**	**1**	2.6	0.83	4/14/2018 05:55	T
Fluoranthene	**1.6**	**U**	**mg/Kg**	**1**	2.6	1.6	4/14/2018 05:55	T
Fluorene	**1.5**	**U**	**mg/Kg**	**1**	2.6	1.5	4/14/2018 05:55	T
Naphthalene	**1.3**	**U**	**mg/Kg**	**1**	2.6	1.3	4/14/2018 05:55	T
Phenanthrene	**1.6**	**U**	**mg/Kg**	**1**	2.6	1.6	4/14/2018 05:55	T
Pyrene	**1.8**	**U**	**mg/Kg**	**1**	2.6	1.8	4/14/2018 05:55	T
bis(2-Ethylhexyl) phthalate	**2.2**	**U**	**mg/Kg**	**1**	2.6	2.2	4/14/2018 05:55	T
2-Fluorophenol (S)	**59**		**%**	**1**	35-115		4/14/2018 05:55	
Phenol-d6 (S)	**58**		**%**	**1**	33-122		4/14/2018 05:55	
Nitrobenzene-d5 (S)	**56**		**%**	**1**	37-122		4/14/2018 05:55	
2-Fluorobiphenyl (S)	**58**		**%**	**1**	44-115		4/14/2018 05:55	
2,4,6-Tribromophenol (S)	**89**		**%**	**1**	39-132		4/14/2018 05:55	
p-Terphenyl-d14 (S)	**73**		**%**	**1**	54-127		4/14/2018 05:55	
SEMIVOLATILES								
Analysis Desc: Percent Solids,SM2540G,Soil	Analytical Method: SM 2540G							
Percent Moisture	**92**		**%**	**1**	0.0010	0.0010	4/10/2018 11:56	T

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716007** Date Received: 04/06/18 12:00 Matrix: Soil

Sample ID: **PT1-2** Date Collected: 04/05/18 13:40

Results for sample T1805716007 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
METALS								
Analysis Desc: SW846 6010B Analysis,Soils	Preparation Method: SW-846 3050B Analytical Method: SW-846 6010							
Arsenic	**0.17**	**I**	**mg/Kg**	**1**	0.54	0.12	4/10/2018 22:50	T
Cadmium	**0.072**		**mg/Kg**	**1**	0.049	0.014	4/10/2018 22:50	T
Chromium	**2.8**		**mg/Kg**	**1**	0.44	0.22	4/10/2018 22:50	T
Copper	**1.3**		**mg/Kg**	**1**	0.44	0.066	4/10/2018 22:50	T
Lead	**5.7**		**mg/Kg**	**1**	0.54	0.11	4/10/2018 22:50	T
Nickel	**0.31**	**I**	**mg/Kg**	**1**	0.49	0.15	4/10/2018 22:50	T
Silver	**0.075**	**U**	**mg/Kg**	**1**	0.27	0.075	4/10/2018 22:50	T
Zinc	**7.7**		**mg/Kg**	**1**	1.1	0.54	4/10/2018 22:50	T
Analysis Desc: SW846 7471A Analysis, Soil	Preparation Method: SW-846 7471A Analytical Method: SW-846 7471A							
Mercury	**0.019**		**mg/Kg**	**1**	0.012	0.0016	4/17/2018 13:13	J
SEMIVOLATILES								
Analysis Desc: 8081A Pesticide Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: EPA 8081							
4,4`-DDD	**0.0092**	**U**	**mg/Kg**	**4**	0.032	0.0092	4/12/2018 03:09	M
4,4`-DDE	**0.0094**	**U**	**mg/Kg**	**4**	0.032	0.0094	4/12/2018 03:09	M
4,4`-DDT	**0.044**	**U**	**mg/Kg**	**20**	0.16	0.044	4/17/2018 13:05	M
Aldrin	**0.0035**	**U**	**mg/Kg**	**4**	0.032	0.0035	4/12/2018 03:09	M
Chlordane (technical)	**0.094**	**U**	**mg/Kg**	**4**	0.32	0.094	4/12/2018 03:09	M
Dieldrin	**0.0076**	**U**	**mg/Kg**	**4**	0.032	0.0076	4/12/2018 03:09	M
Endosulfan I	**0.0079**	**U**	**mg/Kg**	**4**	0.032	0.0079	4/12/2018 03:09	M
Endosulfan II	**0.0094**	**U**	**mg/Kg**	**4**	0.032	0.0094	4/12/2018 03:09	M
Endrin	**0.0087**	**U**	**mg/Kg**	**4**	0.032	0.0087	4/12/2018 03:09	M
Heptachlor	**0.023**	**U**	**mg/Kg**	**20**	0.16	0.023	4/17/2018 13:05	M
Heptachlor Epoxide	**0.037**	**U**	**mg/Kg**	**4**	0.037	0.037	4/12/2018 03:09	M
Toxaphene	**0.51**	**U**	**mg/Kg**	**20**	1.6	0.51	4/17/2018 13:05	M
alpha-Chlordane	**7.9**	**U**	**ug/Kg**	**4**	32	7.9	4/12/2018 03:09	M
gamma-BHC (Lindane)	**0.0078**	**U**	**mg/Kg**	**4**	0.032	0.0078	4/12/2018 03:09	M
gamma-Chlordane	**18**	**U**	**ug/Kg**	**4**	32	18	4/12/2018 03:09	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	42-129		4/12/2018 03:09	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	63-130		4/12/2018 03:09	

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716007** Date Received: 04/06/18 12:00 Matrix: Soil

Sample ID: **PT1-2** Date Collected: 04/05/18 13:40

Results for sample T1805716007 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: 8082A PCB Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8082A							
Aroclor 1016 (PCB-1016)	**0.14**	**U**	**mg/Kg**	**4**	0.32	0.14	4/12/2018 03:09	M
Aroclor 1221 (PCB-1221)	**0.22**	**U**	**mg/Kg**	**4**	0.32	0.22	4/12/2018 03:09	M
Aroclor 1232 (PCB-1232)	**0.30**	**U**	**mg/Kg**	**4**	0.32	0.30	4/12/2018 03:09	M
Aroclor 1242 (PCB-1242)	**0.24**	**U**	**mg/Kg**	**4**	0.32	0.24	4/12/2018 03:09	M
Aroclor 1248 (PCB-1248)	**0.11**	**U**	**mg/Kg**	**4**	0.32	0.11	4/12/2018 03:09	M
Aroclor 1254 (PCB-1254)	**0.064**	**U**	**mg/Kg**	**4**	0.32	0.064	4/12/2018 03:09	M
Aroclor 1260 (PCB-1260)	**0.038**	**U**	**mg/Kg**	**4**	0.32	0.038	4/12/2018 03:09	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	44-130		4/12/2018 03:09	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	61-147		4/12/2018 03:09	
Analysis Desc: 8270C Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8270C							
2-Methylnaphthalene	**0.25**	**U**	**mg/Kg**	**1**	0.51	0.25	4/14/2018 03:07	T
Acenaphthene	**0.30**	**U**	**mg/Kg**	**1**	0.51	0.30	4/14/2018 03:07	T
Acenaphthylene	**0.30**	**U**	**mg/Kg**	**1**	0.51	0.30	4/14/2018 03:07	T
Anthracene	**0.30**	**U**	**mg/Kg**	**1**	0.51	0.30	4/14/2018 03:07	T
Benzo[a]anthracene	**0.34**	**U**	**mg/Kg**	**1**	0.51	0.34	4/14/2018 03:07	T
Benzo[a]pyrene	**0.15**	**U**	**mg/Kg**	**1**	0.51	0.15	4/14/2018 03:07	T
Chrysene	**0.35**	**U**	**mg/Kg**	**1**	0.51	0.35	4/14/2018 03:07	T
Dibenzo[a,h]anthracene	**0.16**	**U**	**mg/Kg**	**1**	0.51	0.16	4/14/2018 03:07	T
Fluoranthene	**0.31**	**U**	**mg/Kg**	**1**	0.51	0.31	4/14/2018 03:07	T
Fluorene	**0.30**	**U**	**mg/Kg**	**1**	0.51	0.30	4/14/2018 03:07	T
Naphthalene	**0.27**	**U**	**mg/Kg**	**1**	0.51	0.27	4/14/2018 03:07	T
Phenanthrene	**0.32**	**U**	**mg/Kg**	**1**	0.51	0.32	4/14/2018 03:07	T
Pyrene	**0.35**	**U**	**mg/Kg**	**1**	0.51	0.35	4/14/2018 03:07	T
bis(2-Ethylhexyl) phthalate	**0.44**	**U**	**mg/Kg**	**1**	0.51	0.44	4/14/2018 03:07	T
2-Fluorophenol (S)	**65**		**%**	**1**	35-115		4/14/2018 03:07	
Phenol-d6 (S)	**59**		**%**	**1**	33-122		4/14/2018 03:07	
Nitrobenzene-d5 (S)	**54**		**%**	**1**	37-122		4/14/2018 03:07	
2-Fluorobiphenyl (S)	**35**	**J1**	**%**	**1**	44-115		4/14/2018 03:07	
2,4,6-Tribromophenol (S)	**83**		**%**	**1**	39-132		4/14/2018 03:07	
p-Terphenyl-d14 (S)	**44**	**J1**	**%**	**1**	54-127		4/14/2018 03:07	
SEMIVOLATILES								
Analysis Desc: Percent Solids,SM2540G,Soil	Analytical Method: SM 2540G							
Percent Moisture	**61**		**%**	**1**	0.0010	0.0010	4/11/2018 11:36	T

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716008** Date Received: 04/06/18 12:00 Matrix: Soil

Sample ID: **PT1-3** Date Collected: 04/06/18 11:45

Results for sample T1805716008 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
METALS								
Analysis Desc: SW846 6010B Analysis,Soils	Preparation Method: SW-846 3050B Analytical Method: SW-846 6010							
Arsenic	**2.0**	**I**	**mg/Kg**	**1**	2.1	0.46	4/10/2018 23:08	T
Cadmium	**0.63**		**mg/Kg**	**1**	0.19	0.054	4/10/2018 23:08	T
Chromium	**33**		**mg/Kg**	**1**	1.7	0.86	4/10/2018 23:08	T
Copper	**15**		**mg/Kg**	**1**	1.7	0.26	4/10/2018 23:08	T
Lead	**50**		**mg/Kg**	**1**	2.1	0.45	4/10/2018 23:08	T
Nickel	**3.0**		**mg/Kg**	**1**	1.9	0.58	4/10/2018 23:08	T
Silver	**0.30**	**U**	**mg/Kg**	**1**	1.1	0.30	4/10/2018 23:08	T
Zinc	**71**		**mg/Kg**	**1**	4.3	2.1	4/10/2018 23:08	T
Analysis Desc: SW846 7471A Analysis, Soil	Preparation Method: SW-846 7471A Analytical Method: SW-846 7471A							
Mercury	**0.12**		**mg/Kg**	**1**	0.041	0.0058	4/17/2018 13:16	J
SEMIVOLATILES								
Analysis Desc: 8081A Pesticide Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: EPA 8081							
4,4`-DDD	**0.032**	**U**	**mg/Kg**	**4**	0.11	0.032	4/12/2018 03:30	M
4,4`-DDE	**0.032**	**U**	**mg/Kg**	**4**	0.11	0.032	4/12/2018 03:30	M
4,4`-DDT	**0.15**	**U**	**mg/Kg**	**20**	0.55	0.15	4/17/2018 13:26	M
Aldrin	**0.012**	**U**	**mg/Kg**	**4**	0.11	0.012	4/12/2018 03:30	M
Chlordane (technical)	**0.32**	**U**	**mg/Kg**	**4**	1.1	0.32	4/12/2018 03:30	M
Dieldrin	**0.026**	**U**	**mg/Kg**	**4**	0.11	0.026	4/12/2018 03:30	M
Endosulfan I	**0.027**	**U**	**mg/Kg**	**4**	0.11	0.027	4/12/2018 03:30	M
Endosulfan II	**0.032**	**U**	**mg/Kg**	**4**	0.11	0.032	4/12/2018 03:30	M
Endrin	**0.030**	**U**	**mg/Kg**	**4**	0.11	0.030	4/12/2018 03:30	M
Heptachlor	**0.079**	**U**	**mg/Kg**	**20**	0.55	0.079	4/17/2018 13:26	M
Heptachlor Epoxide	**0.13**	**U**	**mg/Kg**	**4**	0.13	0.13	4/12/2018 03:30	M
Toxaphene	**1.8**	**U**	**mg/Kg**	**20**	5.5	1.8	4/17/2018 13:26	M
alpha-Chlordane	**27**	**U**	**ug/Kg**	**4**	110	27	4/12/2018 03:30	M
gamma-BHC (Lindane)	**0.027**	**U**	**mg/Kg**	**4**	0.11	0.027	4/12/2018 03:30	M
gamma-Chlordane	**62**	**U**	**ug/Kg**	**4**	110	62	4/12/2018 03:30	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	42-129		4/12/2018 03:30	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	63-130		4/12/2018 03:30	

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716008**	Date Received: 04/06/18 12:00	Matrix:	Soil
Sample ID: **PT1-3**	Date Collected: 04/06/18 11:45		

Results for sample T1805716008 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: 8082A PCB Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8082A							
Aroclor 1016 (PCB-1016)	**0.49**	**U**	**mg/Kg**	**4**	1.1	0.49	4/12/2018 03:30	M
Aroclor 1221 (PCB-1221)	**0.76**	**U**	**mg/Kg**	**4**	1.1	0.76	4/12/2018 03:30	M
Aroclor 1232 (PCB-1232)	**1.0**	**U**	**mg/Kg**	**4**	1.1	1.0	4/12/2018 03:30	M
Aroclor 1242 (PCB-1242)	**0.82**	**U**	**mg/Kg**	**4**	1.1	0.82	4/12/2018 03:30	M
Aroclor 1248 (PCB-1248)	**0.39**	**U**	**mg/Kg**	**4**	1.1	0.39	4/12/2018 03:30	M
Aroclor 1254 (PCB-1254)	**0.22**	**U**	**mg/Kg**	**4**	1.1	0.22	4/12/2018 03:30	M
Aroclor 1260 (PCB-1260)	**0.13**	**U**	**mg/Kg**	**4**	1.1	0.13	4/12/2018 03:30	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	44-130		4/12/2018 03:30	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	61-147		4/12/2018 03:30	
Analysis Desc: 8270C Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8270C							
2-Methylnaphthalene	**0.83**	**U**	**mg/Kg**	**1**	1.7	0.83	4/14/2018 04:14	T
Acenaphthene	**1.0**	**U**	**mg/Kg**	**1**	1.7	1.0	4/14/2018 04:14	T
Acenaphthylene	**0.98**	**U**	**mg/Kg**	**1**	1.7	0.98	4/14/2018 04:14	T
Anthracene	**0.99**	**U**	**mg/Kg**	**1**	1.7	0.99	4/14/2018 04:14	T
Benzo[a]anthracene	**1.1**	**U**	**mg/Kg**	**1**	1.7	1.1	4/14/2018 04:14	T
Benzo[a]pyrene	**0.50**	**U**	**mg/Kg**	**1**	1.7	0.50	4/14/2018 04:14	T
Chrysene	**1.1**	**U**	**mg/Kg**	**1**	1.7	1.1	4/14/2018 04:14	T
Dibenzo[a,h]anthracene	**0.54**	**U**	**mg/Kg**	**1**	1.7	0.54	4/14/2018 04:14	T
Fluoranthene	**1.0**	**U**	**mg/Kg**	**1**	1.7	1.0	4/14/2018 04:14	T
Fluorene	**1.0**	**U**	**mg/Kg**	**1**	1.7	1.0	4/14/2018 04:14	T
Naphthalene	**0.89**	**U**	**mg/Kg**	**1**	1.7	0.89	4/14/2018 04:14	T
Phenanthrene	**1.0**	**U**	**mg/Kg**	**1**	1.7	1.0	4/14/2018 04:14	T
Pyrene	**1.2**	**U**	**mg/Kg**	**1**	1.7	1.2	4/14/2018 04:14	T
bis(2-Ethylhexyl) phthalate	**1.4**	**U**	**mg/Kg**	**1**	1.7	1.4	4/14/2018 04:14	T
2-Fluorophenol (S)	**64**		**%**	**1**	35-115		4/14/2018 04:14	
Phenol-d6 (S)	**59**		**%**	**1**	33-122		4/14/2018 04:14	
Nitrobenzene-d5 (S)	**64**		**%**	**1**	37-122		4/14/2018 04:14	
2-Fluorobiphenyl (S)	**68**		**%**	**1**	44-115		4/14/2018 04:14	
2,4,6-Tribromophenol (S)	**91**		**%**	**1**	39-132		4/14/2018 04:14	
p-Terphenyl-d14 (S)	**76**		**%**	**1**	54-127		4/14/2018 04:14	
SEMIVOLATILES								
Analysis Desc: Percent Solids,SM2540G,Soil	Analytical Method: SM 2540G							
Percent Moisture	**88**		**%**	**1**	0.0010	0.0010	4/11/2018 11:36	T

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716009** Date Received: 04/06/18 12:00 Matrix: Soil

Sample ID: **PT1-4** Date Collected: 04/06/18 10:55

Results for sample T1805716009 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
METALS								
Analysis Desc: SW846 6010B Analysis,Soils	Preparation Method: SW-846 3050B Analytical Method: SW-846 6010							
Arsenic	**3.3**		**mg/Kg**	**1**	2.4	0.51	4/10/2018 23:12	T
Cadmium	**1.0**		**mg/Kg**	**1**	0.21	0.060	4/10/2018 23:12	T
Chromium	**43**		**mg/Kg**	**1**	1.9	0.95	4/10/2018 23:12	T
Copper	**39**		**mg/Kg**	**1**	1.9	0.29	4/10/2018 23:12	T
Lead	**130**		**mg/Kg**	**1**	2.4	0.50	4/10/2018 23:12	T
Nickel	**5.7**		**mg/Kg**	**1**	2.1	0.65	4/10/2018 23:12	T
Silver	**0.33**	**U**	**mg/Kg**	**1**	1.2	0.33	4/10/2018 23:12	T
Zinc	**160**		**mg/Kg**	**1**	4.8	2.4	4/10/2018 23:12	T
Analysis Desc: SW846 7471A Analysis, Soil	Preparation Method: SW-846 7471A Analytical Method: SW-846 7471A							
Mercury	**0.18**		**mg/Kg**	**1**	0.048	0.0067	4/17/2018 13:20	J
SEMIVOLATILES								
Analysis Desc: 8081A Pesticide Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: EPA 8081							
4,4`-DDD	**0.036**	**U**	**mg/Kg**	**4**	0.12	0.036	4/12/2018 03:52	M
4,4`-DDE	**0.036**	**U**	**mg/Kg**	**4**	0.12	0.036	4/12/2018 03:52	M
4,4`-DDT	**0.17**	**U**	**mg/Kg**	**20**	0.61	0.17	4/17/2018 13:47	M
Aldrin	**0.013**	**U**	**mg/Kg**	**4**	0.12	0.013	4/12/2018 03:52	M
Chlordane (technical)	**0.36**	**U**	**mg/Kg**	**4**	1.2	0.36	4/12/2018 03:52	M
Dieldrin	**0.029**	**U**	**mg/Kg**	**4**	0.12	0.029	4/12/2018 03:52	M
Endosulfan I	**0.031**	**U**	**mg/Kg**	**4**	0.12	0.031	4/12/2018 03:52	M
Endosulfan II	**0.036**	**U**	**mg/Kg**	**4**	0.12	0.036	4/12/2018 03:52	M
Endrin	**0.034**	**U**	**mg/Kg**	**4**	0.12	0.034	4/12/2018 03:52	M
Heptachlor	**0.089**	**U**	**mg/Kg**	**20**	0.61	0.089	4/17/2018 13:47	M
Heptachlor Epoxide	**0.14**	**U**	**mg/Kg**	**4**	0.14	0.14	4/12/2018 03:52	M
Toxaphene	**2.0**	**U**	**mg/Kg**	**20**	6.1	2.0	4/17/2018 13:47	M
alpha-Chlordane	**31**	**U**	**ug/Kg**	**4**	120	31	4/12/2018 03:52	M
gamma-BHC (Lindane)	**0.030**	**U**	**mg/Kg**	**4**	0.12	0.030	4/12/2018 03:52	M
gamma-Chlordane	**69**	**U**	**ug/Kg**	**4**	120	69	4/12/2018 03:52	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	42-129		4/12/2018 03:52	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	63-130		4/12/2018 03:52	

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716009** Date Received: 04/06/18 12:00 Matrix: Soil

Sample ID: **PT1-4** Date Collected: 04/06/18 10:55

Results for sample T1805716009 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: 8082A PCB Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8082A							
Aroclor 1016 (PCB-1016)	**0.55**	**U**	**mg/Kg**	**4**	1.2	0.55	4/12/2018 03:52	M
Aroclor 1221 (PCB-1221)	**0.86**	**U**	**mg/Kg**	**4**	1.2	0.86	4/12/2018 03:52	M
Aroclor 1232 (PCB-1232)	**1.2**	**U**	**mg/Kg**	**4**	1.2	1.2	4/12/2018 03:52	M
Aroclor 1242 (PCB-1242)	**0.92**	**U**	**mg/Kg**	**4**	1.2	0.92	4/12/2018 03:52	M
Aroclor 1248 (PCB-1248)	**0.44**	**U**	**mg/Kg**	**4**	1.2	0.44	4/12/2018 03:52	M
Aroclor 1254 (PCB-1254)	**0.25**	**U**	**mg/Kg**	**4**	1.2	0.25	4/12/2018 03:52	M
Aroclor 1260 (PCB-1260)	**0.15**	**U**	**mg/Kg**	**4**	1.2	0.15	4/12/2018 03:52	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	44-130		4/12/2018 03:52	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	61-147		4/12/2018 03:52	
Analysis Desc: 8270C Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8270C							
2-Methylnaphthalene	**0.95**	**U**	**mg/Kg**	**1**	1.9	0.95	4/14/2018 03:40	T
Acenaphthene	**1.1**	**U**	**mg/Kg**	**1**	1.9	1.1	4/14/2018 03:40	T
Acenaphthylene	**1.1**	**U**	**mg/Kg**	**1**	1.9	1.1	4/14/2018 03:40	T
Anthracene	**1.1**	**U**	**mg/Kg**	**1**	1.9	1.1	4/14/2018 03:40	T
Benzo[a]anthracene	**1.3**	**U**	**mg/Kg**	**1**	1.9	1.3	4/14/2018 03:40	T
Benzo[a]pyrene	**0.58**	**U**	**mg/Kg**	**1**	1.9	0.58	4/14/2018 03:40	T
Chrysene	**1.3**	**U**	**mg/Kg**	**1**	1.9	1.3	4/14/2018 03:40	T
Dibenzo[a,h]anthracene	**0.63**	**U**	**mg/Kg**	**1**	1.9	0.63	4/14/2018 03:40	T
Fluoranthene	**1.2**	**U**	**mg/Kg**	**1**	1.9	1.2	4/14/2018 03:40	T
Fluorene	**1.2**	**U**	**mg/Kg**	**1**	1.9	1.2	4/14/2018 03:40	T
Naphthalene	**1.0**	**U**	**mg/Kg**	**1**	1.9	1.0	4/14/2018 03:40	T
Phenanthrene	**1.2**	**U**	**mg/Kg**	**1**	1.9	1.2	4/14/2018 03:40	T
Pyrene	**1.3**	**U**	**mg/Kg**	**1**	1.9	1.3	4/14/2018 03:40	T
bis(2-Ethylhexyl) phthalate	**1.7**	**U**	**mg/Kg**	**1**	1.9	1.7	4/14/2018 03:40	T
2-Fluorophenol (S)	**62**		**%**	**1**	35-115		4/14/2018 03:40	
Phenol-d6 (S)	**60**		**%**	**1**	33-122		4/14/2018 03:40	
Nitrobenzene-d5 (S)	**57**		**%**	**1**	37-122		4/14/2018 03:40	
2-Fluorobiphenyl (S)	**38**	**J1**	**%**	**1**	44-115		4/14/2018 03:40	
2,4,6-Tribromophenol (S)	**69**		**%**	**1**	39-132		4/14/2018 03:40	
p-Terphenyl-d14 (S)	**51**	**J1**	**%**	**1**	54-127		4/14/2018 03:40	
SEMIVOLATILES								
Analysis Desc: Percent Solids,SM2540G,Soil	Analytical Method: SM 2540G							
Percent Moisture	**90**		**%**	**1**	0.0010	0.0010	4/11/2018 11:36	T

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716010** Date Received: 04/06/18 12:00 Matrix: Soil

Sample ID: **PT2-3** Date Collected: 04/06/18 09:20

Results for sample T1805716010 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
METALS								
Analysis Desc: SW846 6010B Analysis,Soils	Preparation Method: SW-846 3050B Analytical Method: SW-846 6010							
Arsenic	**1.4**	**I**	**mg/Kg**	**1**	1.8	0.38	4/10/2018 23:16	T
Cadmium	**0.46**		**mg/Kg**	**1**	0.16	0.044	4/10/2018 23:16	T
Chromium	**27**		**mg/Kg**	**1**	1.4	0.71	4/10/2018 23:16	T
Copper	**13**		**mg/Kg**	**1**	1.4	0.22	4/10/2018 23:16	T
Lead	**37**		**mg/Kg**	**1**	1.8	0.37	4/10/2018 23:16	T
Nickel	**2.8**		**mg/Kg**	**1**	1.6	0.48	4/10/2018 23:16	T
Silver	**0.24**	**U**	**mg/Kg**	**1**	0.89	0.24	4/10/2018 23:16	T
Zinc	**50**		**mg/Kg**	**1**	3.5	1.8	4/10/2018 23:16	T
Analysis Desc: SW846 7471A Analysis, Soil	Preparation Method: SW-846 7471A Analytical Method: SW-846 7471A							
Mercury	**0.073**		**mg/Kg**	**1**	0.039	0.0055	4/17/2018 13:23	J
SEMIVOLATILES								
Analysis Desc: 8081A Pesticide Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: EPA 8081							
4,4`-DDD	**0.026**	**U**	**mg/Kg**	**4**	0.089	0.026	4/12/2018 04:13	M
4,4`-DDE	**0.026**	**U**	**mg/Kg**	**4**	0.089	0.026	4/12/2018 04:13	M
4,4`-DDT	**0.13**	**U**	**mg/Kg**	**20**	0.45	0.13	4/17/2018 14:09	M
Aldrin	**0.0098**	**U**	**mg/Kg**	**4**	0.089	0.0098	4/12/2018 04:13	M
Chlordane (technical)	**0.27**	**U**	**mg/Kg**	**4**	0.89	0.27	4/12/2018 04:13	M
Dieldrin	**0.021**	**U**	**mg/Kg**	**4**	0.089	0.021	4/12/2018 04:13	M
Endosulfan I	**0.022**	**U**	**mg/Kg**	**4**	0.089	0.022	4/12/2018 04:13	M
Endosulfan II	**0.026**	**U**	**mg/Kg**	**4**	0.089	0.026	4/12/2018 04:13	M
Endrin	**0.025**	**U**	**mg/Kg**	**4**	0.089	0.025	4/12/2018 04:13	M
Heptachlor	**0.065**	**U**	**mg/Kg**	**20**	0.45	0.065	4/17/2018 14:09	M
Heptachlor Epoxide	**0.11**	**U**	**mg/Kg**	**4**	0.11	0.11	4/12/2018 04:13	M
Toxaphene	**1.4**	**U**	**mg/Kg**	**20**	4.5	1.4	4/17/2018 14:09	M
alpha-Chlordane	**22**	**U**	**ug/Kg**	**4**	89	22	4/12/2018 04:13	M
gamma-BHC (Lindane)	**0.022**	**U**	**mg/Kg**	**4**	0.089	0.022	4/12/2018 04:13	M
gamma-Chlordane	**51**	**U**	**ug/Kg**	**4**	89	51	4/12/2018 04:13	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	42-129		4/12/2018 04:13	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	63-130		4/12/2018 04:13	

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716010** Date Received: 04/06/18 12:00 Matrix: Soil
Sample ID: **PT2-3** Date Collected: 04/06/18 09:20
Results for sample T1805716010 are reported on a dry weight basis.
Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: 8082A PCB Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8082A							
Aroclor 1016 (PCB-1016)	**0.40**	**U**	**mg/Kg**	**4**	0.89	0.40	4/12/2018 04:13	M
Aroclor 1221 (PCB-1221)	**0.63**	**U**	**mg/Kg**	**4**	0.89	0.63	4/12/2018 04:13	M
Aroclor 1232 (PCB-1232)	**0.85**	**U**	**mg/Kg**	**4**	0.89	0.85	4/12/2018 04:13	M
Aroclor 1242 (PCB-1242)	**0.67**	**U**	**mg/Kg**	**4**	0.89	0.67	4/12/2018 04:13	M
Aroclor 1248 (PCB-1248)	**0.32**	**U**	**mg/Kg**	**4**	0.89	0.32	4/12/2018 04:13	M
Aroclor 1254 (PCB-1254)	**0.18**	**U**	**mg/Kg**	**4**	0.89	0.18	4/12/2018 04:13	M
Aroclor 1260 (PCB-1260)	**0.11**	**U**	**mg/Kg**	**4**	0.89	0.11	4/12/2018 04:13	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	44-130		4/12/2018 04:13	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	61-147		4/12/2018 04:13	
Analysis Desc: 8270C Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8270C							
2-Methylnaphthalene	**0.78**	**U**	**mg/Kg**	**1**	1.6	0.78	4/14/2018 06:29	T
Acenaphthene	**0.94**	**U**	**mg/Kg**	**1**	1.6	0.94	4/14/2018 06:29	T
Acenaphthylene	**0.92**	**U**	**mg/Kg**	**1**	1.6	0.92	4/14/2018 06:29	T
Anthracene	**0.93**	**U**	**mg/Kg**	**1**	1.6	0.93	4/14/2018 06:29	T
Benzo[a]anthracene	**1.1**	**U**	**mg/Kg**	**1**	1.6	1.1	4/14/2018 06:29	T
Benzo[a]pyrene	**0.47**	**U**	**mg/Kg**	**1**	1.6	0.47	4/14/2018 06:29	T
Chrysene	**1.1**	**U**	**mg/Kg**	**1**	1.6	1.1	4/14/2018 06:29	T
Dibenzo[a,h]anthracene	**0.51**	**U**	**mg/Kg**	**1**	1.6	0.51	4/14/2018 06:29	T
Fluoranthene	**0.96**	**U**	**mg/Kg**	**1**	1.6	0.96	4/14/2018 06:29	T
Fluorene	**0.94**	**U**	**mg/Kg**	**1**	1.6	0.94	4/14/2018 06:29	T
Naphthalene	**0.83**	**U**	**mg/Kg**	**1**	1.6	0.83	4/14/2018 06:29	T
Phenanthrene	**0.98**	**U**	**mg/Kg**	**1**	1.6	0.98	4/14/2018 06:29	T
Pyrene	**1.1**	**U**	**mg/Kg**	**1**	1.6	1.1	4/14/2018 06:29	T
bis(2-Ethylhexyl) phthalate	**1.4**	**U**	**mg/Kg**	**1**	1.6	1.4	4/14/2018 06:29	T
2-Fluorophenol (S)	**79**		**%**	**1**	35-115		4/14/2018 06:29	
Phenol-d6 (S)	**68**		**%**	**1**	33-122		4/14/2018 06:29	
Nitrobenzene-d5 (S)	**74**		**%**	**1**	37-122		4/14/2018 06:29	
2-Fluorobiphenyl (S)	**77**		**%**	**1**	44-115		4/14/2018 06:29	
2,4,6-Tribromophenol (S)	**93**		**%**	**1**	39-132		4/14/2018 06:29	
p-Terphenyl-d14 (S)	**76**		**%**	**1**	54-127		4/14/2018 06:29	

SEMIVOLATILES

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: Percent Solids,SM2540G,Soil	Analytical Method: SM 2540G							
Percent Moisture	**87**		**%**	**1**	0.0010	0.0010	4/11/2018 11:36	T

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID:	**T1805716011**	Date Received:	04/06/18 12:00	Matrix:	Soil
Sample ID:	**PT2-4**	Date Collected:	04/06/18 10:15		

Results for sample T1805716011 are reported on a dry weight basis.

Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
METALS								
Analysis Desc: SW846 6010B Analysis,Soils	Preparation Method: SW-846 3050B Analytical Method: SW-846 6010							
Arsenic	**1.5**	**I**	**mg/Kg**	**1**	3.2	0.68	4/10/2018 23:19	T
Cadmium	**0.71**		**mg/Kg**	**1**	0.29	0.079	4/10/2018 23:19	T
Chromium	**22**		**mg/Kg**	**1**	2.5	1.3	4/10/2018 23:19	T
Copper	**14**		**mg/Kg**	**1**	2.5	0.39	4/10/2018 23:19	T
Lead	**47**		**mg/Kg**	**1**	3.2	0.66	4/10/2018 23:19	T
Nickel	**3.3**		**mg/Kg**	**1**	2.9	0.86	4/10/2018 23:19	T
Silver	**0.44**	**U**	**mg/Kg**	**1**	1.6	0.44	4/10/2018 23:19	T
Zinc	**73**		**mg/Kg**	**1**	6.4	3.2	4/10/2018 23:19	T
Analysis Desc: SW846 7471A Analysis, Soil	Preparation Method: SW-846 7471A Analytical Method: SW-846 7471A							
Mercury	**0.15**		**mg/Kg**	**1**	0.066	0.0092	4/17/2018 13:26	J
SEMIVOLATILES								
Analysis Desc: 8081A Pesticide Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: EPA 8081							
4,4`-DDD	**0.046**	**U**	**mg/Kg**	**4**	0.16	0.046	4/12/2018 06:22	M
4,4`-DDE	**0.047**	**U**	**mg/Kg**	**4**	0.16	0.047	4/12/2018 06:22	M
4,4`-DDT	**0.22**	**U**	**mg/Kg**	**20**	0.80	0.22	4/17/2018 14:30	M
Aldrin	**0.018**	**U**	**mg/Kg**	**4**	0.16	0.018	4/12/2018 06:22	M
Chlordane (technical)	**0.47**	**U**	**mg/Kg**	**4**	1.6	0.47	4/12/2018 06:22	M
Dieldrin	**0.038**	**U**	**mg/Kg**	**4**	0.16	0.038	4/12/2018 06:22	M
Endosulfan I	**0.040**	**U**	**mg/Kg**	**4**	0.16	0.040	4/12/2018 06:22	M
Endosulfan II	**0.047**	**U**	**mg/Kg**	**4**	0.16	0.047	4/12/2018 06:22	M
Endrin	**0.044**	**U**	**mg/Kg**	**4**	0.16	0.044	4/12/2018 06:22	M
Heptachlor	**0.12**	**U**	**mg/Kg**	**20**	0.80	0.12	4/17/2018 14:30	M
Heptachlor Epoxide	**0.19**	**U**	**mg/Kg**	**4**	0.19	0.19	4/12/2018 06:22	M
Toxaphene	**2.6**	**U**	**mg/Kg**	**20**	8.0	2.6	4/17/2018 14:30	M
alpha-Chlordane	**40**	**U**	**ug/Kg**	**4**	160	40	4/12/2018 06:22	M
gamma-BHC (Lindane)	**0.039**	**U**	**mg/Kg**	**4**	0.16	0.039	4/12/2018 06:22	M
gamma-Chlordane	**90**	**U**	**ug/Kg**	**4**	160	90	4/12/2018 06:22	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	42-129		4/12/2018 06:22	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	63-130		4/12/2018 06:22	

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ANALYTICAL RESULTS

Workorder: T1805716 Lake Bonnet

Lab ID: **T1805716011** Date Received: 04/06/18 12:00 Matrix: Soil
Sample ID: **PT2-4** Date Collected: 04/06/18 10:15
Results for sample T1805716011 are reported on a dry weight basis.
Sample Description: Location:

Parameters	Results	Qual	Units	DF	Adjusted PQL	Adjusted MDL	Analyzed	Lab
Analysis Desc: 8082A PCB Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8082A							
Aroclor 1016 (PCB-1016)	**0.72**	**U**	**mg/Kg**	**4**	1.6	0.72	4/12/2018 06:22	M
Aroclor 1221 (PCB-1221)	**1.1**	**U**	**mg/Kg**	**4**	1.6	1.1	4/12/2018 06:22	M
Aroclor 1232 (PCB-1232)	**1.5**	**U**	**mg/Kg**	**4**	1.6	1.5	4/12/2018 06:22	M
Aroclor 1242 (PCB-1242)	**1.2**	**U**	**mg/Kg**	**4**	1.6	1.2	4/12/2018 06:22	M
Aroclor 1248 (PCB-1248)	**0.57**	**U**	**mg/Kg**	**4**	1.6	0.57	4/12/2018 06:22	M
Aroclor 1254 (PCB-1254)	**0.32**	**U**	**mg/Kg**	**4**	1.6	0.32	4/12/2018 06:22	M
Aroclor 1260 (PCB-1260)	**0.19**	**U**	**mg/Kg**	**4**	1.6	0.19	4/12/2018 06:22	M
Tetrachloro-m-xylene (S)	**0**	**1**	**%**	**4**	44-130		4/12/2018 06:22	
Decachlorobiphenyl (S)	**0**	**1**	**%**	**4**	61-147		4/12/2018 06:22	
Analysis Desc: 8270C Analysis, Soil	Preparation Method: SW-846 3550B Analytical Method: SW-846 8270C							
2-Methylnaphthalene	**1.4**	**U**	**mg/Kg**	**1**	2.8	1.4	4/13/2018 22:30	T
Acenaphthene	**1.6**	**U**	**mg/Kg**	**1**	2.8	1.6	4/13/2018 22:30	T
Acenaphthylene	**1.6**	**U**	**mg/Kg**	**1**	2.8	1.6	4/13/2018 22:30	T
Anthracene	**1.6**	**U**	**mg/Kg**	**1**	2.8	1.6	4/13/2018 22:30	T
Benzo[a]anthracene	**1.8**	**U**	**mg/Kg**	**1**	2.8	1.8	4/13/2018 22:30	T
Benzo[a]pyrene	**0.83**	**U**	**mg/Kg**	**1**	2.8	0.83	4/13/2018 22:30	T
Chrysene	**1.9**	**U**	**mg/Kg**	**1**	2.8	1.9	4/13/2018 22:30	T
Dibenzo[a,h]anthracene	**0.89**	**U**	**mg/Kg**	**1**	2.8	0.89	4/13/2018 22:30	T
Fluoranthene	**1.7**	**U**	**mg/Kg**	**1**	2.8	1.7	4/13/2018 22:30	T
Fluorene	**1.6**	**U**	**mg/Kg**	**1**	2.8	1.6	4/13/2018 22:30	T
Naphthalene	**1.5**	**U**	**mg/Kg**	**1**	2.8	1.5	4/13/2018 22:30	T
Phenanthrene	**1.7**	**U**	**mg/Kg**	**1**	2.8	1.7	4/13/2018 22:30	T
Pyrene	**1.9**	**U**	**mg/Kg**	**1**	2.8	1.9	4/13/2018 22:30	T
bis(2-Ethylhexyl) phthalate	**2.4**	**U**	**mg/Kg**	**1**	2.8	2.4	4/13/2018 22:30	T
2-Fluorophenol (S)	**74**		**%**	**1**	35-115		4/13/2018 22:30	
Phenol-d6 (S)	**66**		**%**	**1**	33-122		4/13/2018 22:30	
Nitrobenzene-d5 (S)	**66**		**%**	**1**	37-122		4/13/2018 22:30	
2-Fluorobiphenyl (S)	**37**	**J1**	**%**	**1**	44-115		4/13/2018 22:30	
2,4,6-Tribromophenol (S)	**82**		**%**	**1**	39-132		4/13/2018 22:30	
p-Terphenyl-d14 (S)	**39**	**J1**	**%**	**1**	54-127		4/13/2018 22:30	
SEMIVOLATILES								
Analysis Desc: Percent Solids,SM2540G,Soil	Analytical Method: SM 2540G							
Percent Moisture	**93**		**%**	**1**	0.0010	0.0010	4/11/2018 11:36	T

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ANALYTICAL RESULTS QUALIFIERS

Workorder: T1805716 Lake Bonnet

PARAMETER QUALIFIERS

U	The compound was analyzed for but not detected.
I	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
[1]	Surrogate diluted out.
J1	Surrogate Failure
J4	Estimated Result

LAB QUALIFIERS

J	DOH Certification #E82574(AEL-JAX)(FL NELAC Certification)
M	DOH Certification #E82535(AEL-M)(FL NELAC Certification)
T	DOH Certification #E84589(AEL-T)(FL NELAC Certification)

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QUALITY CONTROL DATA

Workorder: T1805716 Lake Bonnet

QC Batch: DGMt/1497 Analysis Method: SW-846 6010

QC Batch Method: SW-846 3050B Prepared: 04/09/2018 10:15

Associated Lab Samples: T1805716001, T1805716002, T1805716003, T1805716004, T1805716005, T1805716006, T1805716007,

METHOD BLANK: 2673596

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
METALS				
Silver	mg/Kg	0.034	0.034	U
Arsenic	mg/Kg	0.052	0.052	U
Copper	mg/Kg	0.030	0.030	U
Nickel	mg/Kg	0.067	0.067	U
Zinc	mg/Kg	0.25	0.25	U

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
METALS				
Cadmium	mg/Kg	0.0062	0.0062	U
Chromium	mg/Kg	0.099	0.099	U
Lead	mg/Kg	0.051	0.051	U

LABORATORY CONTROL SAMPLE: 2673597

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
METALS						
Silver	mg/Kg	9.8	8.4	86	80-120	
Arsenic	mg/Kg	9.8	8.2	84	80-120	
Cadmium	mg/Kg	9.8	8.2	83	80-120	
Chromium	mg/Kg	9.8	8.8	90	80-120	
Copper	mg/Kg	9.8	9.8	100	80-120	
Nickel	mg/Kg	9.8	8.3	84	80-120	
Lead	mg/Kg	9.8	8.1	82	80-120	
Zinc	mg/Kg	9.8	8.2	84	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2673598 2673599 Original: T1805716001

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
METALS											
Silver	mg/Kg	0	9.6	87	83	88	87	75-125	5	20	
Arsenic	mg/Kg	0.37	9.6	90	87	87	86	75-125	4	20	

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QUALITY CONTROL DATA

Workorder: T1805716 Lake Bonnet

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2673598 2673599 Original: T1805716001

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Cadmium	mg/Kg	0.097	9.6	87	83	86	85	75-125	4	20	
Chromium	mg/Kg	6	9.6	150	160	88	97	75-125	4	20	
Copper	mg/Kg	2.7	9.6	130	130	103	107	75-125	0	20	
Nickel	mg/Kg	0.67	9.6	96	93	89	90	75-125	3	20	
Lead	mg/Kg	8.6	9.6	160	170	73	87	75-125	7	20	J4
Zinc	mg/Kg	10	9.6	190	200	77	96	75-125	8	20	

QC Batch: EXTm/1325 Analysis Method: EPA 8081
QC Batch Method: SW-846 3550B Prepared: 04/10/2018 07:40
Associated Lab Samples: T1805716001, T1805716002, T1805716003, T1805716004, T1805716005, T1805716006, T1805716007,

METHOD BLANK: 2674653

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
SEMIVOLATILES				
gamma-BHC (Lindane)	mg/Kg	0.00075	0.00075	U
Heptachlor	mg/Kg	0.00044	0.00044	U
Aldrin	mg/Kg	0.00034	0.00034	U
Heptachlor Epoxide	mg/Kg	0.0036	0.0036	U
Endosulfan I	mg/Kg	0.00077	0.00077	U
4,4`-DDE	mg/Kg	0.00090	0.00090	U
Dieldrin	mg/Kg	0.00074	0.00074	U
Endrin	mg/Kg	0.00084	0.00084	U
4,4`-DDD	mg/Kg	0.00089	0.00089	U
Endosulfan II	mg/Kg	0.00090	0.00090	U
4,4`-DDT	mg/Kg	0.00086	0.00086	U
Chlordane (technical)	mg/Kg	0.0091	0.0091	U
Toxaphene	mg/Kg	0.0098	0.0098	U
Tetrachloro-m-xylene (S)	%	85	42-129	
Decachlorobiphenyl (S)	%	98	63-130	

LABORATORY CONTROL SAMPLE: 2674654

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
SEMIVOLATILES						
gamma-BHC (Lindane)	mg/Kg	0.015	0.011	77	49-135	
Heptachlor	mg/Kg	0.015	0.013	87	47-136	

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QUALITY CONTROL DATA

Workorder: T1805716 Lake Bonnet

LABORATORY CONTROL SAMPLE: 2674654

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Aldrin	mg/Kg	0.015	0.011	76	45-136	
Heptachlor Epoxide	mg/Kg	0.015	0.014	91	52-136	
Endosulfan I	mg/Kg	0.015	0.012	83	53-132	
4,4`-DDE	mg/Kg	0.015	0.013	90	56-134	
Dieldrin	mg/Kg	0.015	0.014	91	56-136	
Endrin	mg/Kg	0.015	0.011	75	57-140	
4,4`-DDD	mg/Kg	0.015	0.013	85	56-139	
Endosulfan II	mg/Kg	0.015	0.013	86	53-134	
4,4`-DDT	mg/Kg	0.015	0.013	85	50-141	
Chlordane (technical)	mg/Kg		0.0089			
Toxaphene	mg/Kg		0.0096			
Tetrachloro-m-xylene (S)	%			90	42-129	
Decachlorobiphenyl (S)	%			106	63-130	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2674655 2674656 Original: A1802550006

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
SEMIVOLATILES											
gamma-BHC (Lindane)	mg/Kg	0	0.016	0.016	0.014	78	76	49-135	14	30	
Heptachlor	mg/Kg	0	0.016	0.018	0.017	87	94	47-136	4	30	
Aldrin	mg/Kg	0	0.016	0.016	0.016	80	86	45-136	3	30	
Heptachlor Epoxide	mg/Kg	0	0.016	0.018	0.017	87	92	52-136	5	30	
Endosulfan I	mg/Kg	0	0.016	0.017	0.016	82	86	53-132	6	30	
4,4`-DDE	mg/Kg	0	0.016	0.018	0.017	91	93	56-134	9	30	
Dieldrin	mg/Kg	0	0.016	0.018	0.017	89	93	56-136	7	30	
Endrin	mg/Kg	0	0.016	0.015	0.014	72	78	57-140	3	30	
4,4`-DDD	mg/Kg	0	0.016	0.016	0.016	80	87	56-139	2	30	
Endosulfan II	mg/Kg	0	0.016	0.018	0.017	89	92	53-134	6	30	
4,4`-DDT	mg/Kg	0	0.016	0.017	0.017	86	95	50-141	1	30	
Chlordane (technical)	mg/Kg			0.012	0.011U				0	30	
Toxaphene	mg/Kg			0.013	0.012U				0	30	
Tetrachloro-m-xylene (S)	%	81				92	94	42-129	8		
Decachlorobiphenyl (S)	%	92				107	108	63-130	9		

QC Batch: EXTm/1329 Analysis Method: SW-846 8082A

QC Batch Method: SW-846 3550B Prepared: 04/10/2018 15:25

Associated Lab Samples: T1805716001, T1805716002, T1805716003, T1805716004, T1805716005, T1805716006, T1805716007,

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QUALITY CONTROL DATA

Workorder: T1805716 Lake Bonnet

METHOD BLANK: 2675910

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
SEMIVOLATILES				
Aroclor 1016 (PCB-1016)	mg/Kg	0.0030	0.0030	U
Aroclor 1221 (PCB-1221)	mg/Kg	0.0047	0.0047	U
Aroclor 1232 (PCB-1232)	mg/Kg	0.0063	0.0063	U
Aroclor 1242 (PCB-1242)	mg/Kg	0.0050	0.0050	U
Aroclor 1248 (PCB-1248)	mg/Kg	0.0024	0.0024	U
Aroclor 1254 (PCB-1254)	mg/Kg	0.0013	0.0013	U
Aroclor 1260 (PCB-1260)	mg/Kg	0.00080	0.00080	U
Tetrachloro-m-xylene (S)	%	89	44-130	
Decachlorobiphenyl (S)	%	99	61-147	

LABORATORY CONTROL SAMPLE: 2675911

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
SEMIVOLATILES						
Aroclor 1016 (PCB-1016)	mg/Kg	0.033	0.042	125	47-134	
Aroclor 1221 (PCB-1221)	mg/Kg		0.0047			
Aroclor 1232 (PCB-1232)	mg/Kg		0.0063			
Aroclor 1242 (PCB-1242)	mg/Kg		0.0050			
Aroclor 1248 (PCB-1248)	mg/Kg		0.0024			
Aroclor 1254 (PCB-1254)	mg/Kg		0.0013			
Aroclor 1260 (PCB-1260)	mg/Kg	0.033	0.043	128	53-140	
Tetrachloro-m-xylene (S)	%			85	44-130	
Decachlorobiphenyl (S)	%			91	61-147	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2675912 2675913 Original: A1802550006

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
SEMIVOLATILES											
Aroclor 1016 (PCB-1016)	mg/Kg	0	0.033	0.052	0.064	123	153	47-134	21	30	J4
Aroclor 1221 (PCB-1221)	mg/Kg			0.0059	0.0059U				0	30	
Aroclor 1232 (PCB-1232)	mg/Kg			0.0080	0.0080U				0	30	
Aroclor 1242 (PCB-1242)	mg/Kg			0.0063	0.0063U				0	30	
Aroclor 1248 (PCB-1248)	mg/Kg			0.0030	0.0030U				0	30	
Aroclor 1254 (PCB-1254)	mg/Kg			0.0017	0.0017U				0	30	
Aroclor 1260 (PCB-1260)	mg/Kg	0	0.033	0.055	0.071	130	169	53-140	26	30	J4
Tetrachloro-m-xylene (S)	%	85				83	102	44-130	21		

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QUALITY CONTROL DATA

Workorder: T1805716 Lake Bonnet

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2675912 2675913 Original: A1802550006

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Decachlorobiphenyl (S)	%	93				91	114	61-147	22		

QC Batch: EXTt/1312 Analysis Method: SW-846 8270C
QC Batch Method: SW-846 3550B Prepared: 04/11/2018 09:00
Associated Lab Samples: T1805716001, T1805716002, T1805716003, T1805716004, T1805716005, T1805716006, T1805716007,

METHOD BLANK: 2676418

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
SEMIVOLATILES				
Naphthalene	mg/Kg	0.10	0.10	U
2-Methylnaphthalene	mg/Kg	0.098	0.098	U
Acenaphthylene	mg/Kg	0.12	0.12	U
Acenaphthene	mg/Kg	0.12	0.12	U
Fluorene	mg/Kg	0.12	0.12	U
Phenanthrene	mg/Kg	0.12	0.12	U
Anthracene	mg/Kg	0.12	0.12	U
Fluoranthene	mg/Kg	0.12	0.12	U
Pyrene	mg/Kg	0.14	0.14	U
Benzo[a]anthracene	mg/Kg	0.13	0.13	U
Chrysene	mg/Kg	0.14	0.14	U
bis(2-Ethylhexyl) phthalate	mg/Kg	0.17	0.17	U
Benzo[a]pyrene	mg/Kg	0.060	0.060	U
Dibenzo[a,h]anthracene	mg/Kg	0.065	0.065	U
2-Fluorophenol (S)	%	80	35-115	
Phenol-d6 (S)	%	71	33-122	
Nitrobenzene-d5 (S)	%	75	37-122	
2-Fluorobiphenyl (S)	%	77	44-115	
2,4,6-Tribromophenol (S)	%	102	39-132	
p-Terphenyl-d14 (S)	%	96	54-127	

LABORATORY CONTROL SAMPLE: 2676419

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
SEMIVOLATILES						
Naphthalene	mg/Kg		1.4			
2-Methylnaphthalene	mg/Kg		1.3			

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QUALITY CONTROL DATA

Workorder: T1805716 Lake Bonnet

LABORATORY CONTROL SAMPLE: 2676419

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Acenaphthylene	mg/Kg		1.5			
Acenaphthene	mg/Kg	1.6	1.4	89	40-123	
Fluorene	mg/Kg	1.6	1.5	93	43-125	
Phenanthrene	mg/Kg		1.7			
Anthracene	mg/Kg		1.7			
Fluoranthene	mg/Kg	1.6	1.7	109	50-127	
Pyrene	mg/Kg		1.7			
Benzo[a]anthracene	mg/Kg		1.8			
Chrysene	mg/Kg		1.7			
bis(2-Ethylhexyl) phthalate	mg/Kg	1.6	1.7	106	51-133	
Benzo[a]pyrene	mg/Kg	1.6	1.3	82	45-129	
Dibenzo[a,h]anthracene	mg/Kg		1.3			
2-Fluorophenol (S)	%			80	35-115	
Phenol-d6 (S)	%			72	33-122	
Nitrobenzene-d5 (S)	%			77	37-122	
2-Fluorobiphenyl (S)	%			80	44-115	
2,4,6-Tribromophenol (S)	%			116	39-132	
p-Terphenyl-d14 (S)	%			96	54-127	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2676420 2676421 Original: T1805716011

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
SEMIVOLATILES											
Naphthalene	mg/Kg			15	16				9	30	
2-Methylnaphthalene	mg/Kg			14	15				8	30	
Acenaphthylene	mg/Kg			19	20				4	30	
Acenaphthene	mg/Kg	0	1.6	19	20	86	90	40-123	5	30	
Fluorene	mg/Kg	0	1.6	19	19	86	86	43-125	1	30	
Phenanthrene	mg/Kg			20	20				1	30	
Anthracene	mg/Kg			21	20				4	30	
Fluoranthene	mg/Kg	0.0032	1.6	21	20	95	93	50-127	1	30	
Pyrene	mg/Kg			20	21				3	30	
Benzo[a]anthracene	mg/Kg			21	22				4	30	
Chrysene	mg/Kg			21	22				5	30	
bis(2-Ethylhexyl) phthalate	mg/Kg	0	1.6	20	21	94	97	51-133	4	30	
Benzo[a]pyrene	mg/Kg	0.0063	1.6	16	17	75	78	45-129	5	30	
Dibenzo[a,h]anthracene	mg/Kg			17	17				3	30	
2-Fluorophenol (S)	%	74				66	68	35-115	4	30	
Phenol-d6 (S)	%	66				63	65	33-122	4		
Nitrobenzene-d5 (S)	%	66				56	68	37-122	21		

CERTIFICATE OF ANALYSIS

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QUALITY CONTROL DATA

Workorder: T1805716 Lake Bonnet

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2676420 2676421 Original: T1805716011

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
2-Fluorobiphenyl (S)	%	37				42	48	44-115	13	30	J1
2,4,6-Tribromophenol (S)	%	82				82	81	39-132	0	30	
p-Terphenyl-d14 (S)	%	39				53	55	54-127	5		J1

QC Batch: DGMj/1402 Analysis Method: SW-846 7471A

QC Batch Method: SW-846 7471A Prepared: 04/17/2018 11:15

Associated Lab Samples: T1805716001, T1805716002, T1805716003, T1805716004, T1805716005, T1805716006, T1805716007,

METHOD BLANK: 2681523

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
METALS				
Mercury	mg/Kg	0.00070	0.00070	U

LABORATORY CONTROL SAMPLE: 2681524

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
METALS						
Mercury	mg/Kg	0.1	0.086	86	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2681525 2681526 Original: M1801430001

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
METALS											
Mercury	mg/Kg	0.00013	0.098	0.10	0.10	95	94	80-120	1	20	

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QUALITY CONTROL DATA QUALIFIERS

Workorder: T1805716 Lake Bonnet

QUALITY CONTROL PARAMETER QUALIFIERS

U	The compound was analyzed for but not detected.
I	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
J1	Surrogate Failure
J4	Estimated Result

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Workorder: T1805716 Lake Bonnet

Lab ID	Sample ID	Prep Method	Prep Batch	Analysis Method	Analysis Batch
T1805716001	PT3-2	SW-846 3050B	DGMt/1497	SW-846 6010	ICPt/1331
T1805716002	PT3-4	SW-846 3050B	DGMt/1497	SW-846 6010	ICPt/1331
T1805716003	PT4-3	SW-846 3050B	DGMt/1497	SW-846 6010	ICPt/1331
T1805716004	PT3-1	SW-846 3050B	DGMt/1497	SW-846 6010	ICPt/1331
T1805716005	PT4-2	SW-846 3050B	DGMt/1497	SW-846 6010	ICPt/1331
T1805716006	PT4-1	SW-846 3050B	DGMt/1497	SW-846 6010	ICPt/1331
T1805716007	PT1-2	SW-846 3050B	DGMt/1497	SW-846 6010	ICPt/1331
T1805716008	PT1-3	SW-846 3050B	DGMt/1497	SW-846 6010	ICPt/1331
T1805716009	PT1-4	SW-846 3050B	DGMt/1497	SW-846 6010	ICPt/1331
T1805716010	PT2-3	SW-846 3050B	DGMt/1497	SW-846 6010	ICPt/1331
T1805716011	PT2-4	SW-846 3050B	DGMt/1497	SW-846 6010	ICPt/1331
T1805716001	PT3-2	SW-846 3550B	EXTm/1325	EPA 8081	GCSm/1187
T1805716002	PT3-4	SW-846 3550B	EXTm/1325	EPA 8081	GCSm/1187
T1805716003	PT4-3	SW-846 3550B	EXTm/1325	EPA 8081	GCSm/1187
T1805716004	PT3-1	SW-846 3550B	EXTm/1325	EPA 8081	GCSm/1187
T1805716005	PT4-2	SW-846 3550B	EXTm/1325	EPA 8081	GCSm/1187
T1805716006	PT4-1	SW-846 3550B	EXTm/1325	EPA 8081	GCSm/1187
T1805716007	PT1-2	SW-846 3550B	EXTm/1325	EPA 8081	GCSm/1187
T1805716008	PT1-3	SW-846 3550B	EXTm/1325	EPA 8081	GCSm/1187
T1805716009	PT1-4	SW-846 3550B	EXTm/1325	EPA 8081	GCSm/1187
T1805716010	PT2-3	SW-846 3550B	EXTm/1325	EPA 8081	GCSm/1187
T1805716011	PT2-4	SW-846 3550B	EXTm/1325	EPA 8081	GCSm/1187
T1805716003	PT4-3			SM 2540G	WCAt/2836
T1805716005	PT4-2			SM 2540G	WCAt/2836
T1805716006	PT4-1			SM 2540G	WCAt/2836
T1805716001	PT3-2	SW-846 3550B	EXTm/1329	SW-846 8082A	GCSm/1189
T1805716002	PT3-4	SW-846 3550B	EXTm/1329	SW-846 8082A	GCSm/1189
T1805716003	PT4-3	SW-846 3550B	EXTm/1329	SW-846 8082A	GCSm/1189
T1805716004	PT3-1	SW-846 3550B	EXTm/1329	SW-846 8082A	GCSm/1189
T1805716005	PT4-2	SW-846 3550B	EXTm/1329	SW-846 8082A	GCSm/1189
T1805716006	PT4-1	SW-846 3550B	EXTm/1329	SW-846 8082A	GCSm/1189

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Workorder: T1805716 Lake Bonnet

Lab ID	Sample ID	Prep Method	Prep Batch	Analysis Method	Analysis Batch
T1805716007	PT1-2	SW-846 3550B	EXTm/1329	SW-846 8082A	GCSm/1189
T1805716008	PT1-3	SW-846 3550B	EXTm/1329	SW-846 8082A	GCSm/1189
T1805716009	PT1-4	SW-846 3550B	EXTm/1329	SW-846 8082A	GCSm/1189
T1805716010	PT2-3	SW-846 3550B	EXTm/1329	SW-846 8082A	GCSm/1189
T1805716011	PT2-4	SW-846 3550B	EXTm/1329	SW-846 8082A	GCSm/1189
T1805716001	PT3-2	SW-846 3550B	EXTt/1312	SW-846 8270C	MSSt/1185
T1805716002	PT3-4	SW-846 3550B	EXTt/1312	SW-846 8270C	MSSt/1185
T1805716003	PT4-3	SW-846 3550B	EXTt/1312	SW-846 8270C	MSSt/1185
T1805716004	PT3-1	SW-846 3550B	EXTt/1312	SW-846 8270C	MSSt/1185
T1805716005	PT4-2	SW-846 3550B	EXTt/1312	SW-846 8270C	MSSt/1185
T1805716006	PT4-1	SW-846 3550B	EXTt/1312	SW-846 8270C	MSSt/1185
T1805716007	PT1-2	SW-846 3550B	EXTt/1312	SW-846 8270C	MSSt/1185
T1805716008	PT1-3	SW-846 3550B	EXTt/1312	SW-846 8270C	MSSt/1185
T1805716009	PT1-4	SW-846 3550B	EXTt/1312	SW-846 8270C	MSSt/1185
T1805716010	PT2-3	SW-846 3550B	EXTt/1312	SW-846 8270C	MSSt/1185
T1805716011	PT2-4	SW-846 3550B	EXTt/1312	SW-846 8270C	MSSt/1185
T1805716001	PT3-2			SM 2540G	WCAt/2868
T1805716002	PT3-4			SM 2540G	WCAt/2868
T1805716004	PT3-1			SM 2540G	WCAt/2868
T1805716007	PT1-2			SM 2540G	WCAt/2868
T1805716008	PT1-3			SM 2540G	WCAt/2868
T1805716009	PT1-4			SM 2540G	WCAt/2868
T1805716010	PT2-3			SM 2540G	WCAt/2868
T1805716011	PT2-4			SM 2540G	WCAt/2868
T1805716001	PT3-2	SW-846 7471A	DGMj/1402	SW-846 7471A	CVAj/1103
T1805716002	PT3-4	SW-846 7471A	DGMj/1402	SW-846 7471A	CVAj/1103
T1805716003	PT4-3	SW-846 7471A	DGMj/1402	SW-846 7471A	CVAj/1103
T1805716004	PT3-1	SW-846 7471A	DGMj/1402	SW-846 7471A	CVAj/1103
T1805716005	PT4-2	SW-846 7471A	DGMj/1402	SW-846 7471A	CVAj/1103
T1805716006	PT4-1	SW-846 7471A	DGMj/1402	SW-846 7471A	CVAj/1103
T1805716007	PT1-2	SW-846 7471A	DGMj/1402	SW-846 7471A	CVAj/1103

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Workorder: T1805716 Lake Bonnet

Lab ID	Sample ID	Prep Method	Prep Batch	Analysis Method	Analysis Batch
T1805716008	PT1-3	SW-846 7471A	DGMj/1402	SW-846 7471A	CVAj/1103
T1805716009	PT1-4	SW-846 7471A	DGMj/1402	SW-846 7471A	CVAj/1103
T1805716010	PT2-3	SW-846 7471A	DGMj/1402	SW-846 7471A	CVAj/1103
T1805716011	PT2-4	SW-846 7471A	DGMj/1402	SW-846 7471A	CVAj/1103

T805716

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Page_____ of _____

Client Name: AMEC FW
Address: 1100 CHANNELSIDE DR TAMPA FL
Phone: 813 455 9780
FAX:
Contact: ERIK OJI
Sampled By: DR / JM
Turn Around Time: ☐ STANDARD ☐ RUSH
AEL Profile #:

Project Name: LAKE BONNET
Project Number: 600537 x 5.05A.xxxx
PO Number:
FDEP Facility No:
FDEP Facility Address:
Special Instructions:
☐ ADaPT ☐ EQuIS ☐ Other

BOTTLE SIZE & TYPE | ANALYSIS REQUIRED | Preservation | Field-Filtered?

SAMPLE ID	SAMPLE DESCRIPTION	Grab Comp	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. COUNT	LABORATORY I.D. NUMBER
PT3-2	ORGANIC MUCK		APR 5	1320	SL	3	001
PT3-4				1255		3	002
PT4-3				1220		3	003
PT3-1				1340		3	004
PT4-2				1120		3	005
PT4-1			APR 5	1130	SL	3	006
PT1-2	dtP per client	Apr 5	~~APR 6~~	~~1340~~		3	007
~~PT1-3~~			APR 6	~~1145~~		3	~~008~~
~~PT1-4~~				~~1055~~		3	~~009~~
PT2-1	NO RECOVERY						~~010~~
PT2-3				0920		3	010 ~~011~~
PT2-4	ORGANIC MUCK		APR 6	1015	SL	3	011 ~~012~~

Matrix Code: WW = wastewater SW = surface water GW = ground water DW = drinking water O = oil A = air SO = soil SL = sludge
Preservation Code: I = ice H=(HCl) S = (H2SO4) N = (HNO3) T = (Sodium Thiosulfate)

Received on Ice ☑ Yes ☐ No ☑ Temp taken from sample ☐ Temp from blank ☐ Where required, pH checked
Temp. when received (observed) 4.0 °C Temp. when received (corrected) 4.0 °C
DCN: AD-051 Form last revised 06/19/2017
Device used for measuring Temp by unique identifier (circle IR temp gun used) J: 9A G: LT-1 LT-2 (T: 10A) A: 3A M: 3A S: 1V F: 1A

	Relinquished by:	Date	Time	Received by:	Date	Time
1	DEREK RICHCREEK	6APR18	1140	[signature]	04-6-18	12:00
2						
3						
4						

FOR DRINKING WATER USE:
(When PWS Information not otherwise supplied) PWS ID:
Contact Person: Phone :
Supplier of Water:
Site-Address:

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Jacksonville, Florida 32216
Office (904) 363-9350
Fax (904) 363-9354

Queue: MSSt

Batch Number: 1185

I. Receipt

No Exceptions were encountered.

II. Holding Times

Preparation: All holding times were met.

Analysis: All holding times were met.

III. Method

Analysis: SW-846 8270C

Preparation: SW-846 3550B

IV. Preparation

Sample preparation proceeded normally.

V. Analysis

A. Calibration: All acceptance criteria were met.

B. Blanks: All acceptance criteria were met.

C. Surrogates: T1805716001,005,007,009,011, MS:
The lower control criteria for 2-fluorobiphenyl and p-terphenyl-d14 in the above samplea were exceeded. The remaining surrogates, 2-fluorophenol, phenol-d6, nitrobenzene-d5, and 2,4,6-tribromophenol, were within control criteria. The affected surrogates were qualified accordingly. No further corrective action was required.

D. Spikes: LCS:
The laboratory control spike (LCS) recovery of pentachlorophenol was outside control criteria, biased high. No samples contained hits for these analytes, indicating the analytical batch is in control. No further corrective action is required.

E. Internal Standard: All acceptance criteria were met.

F. Samples: Sample analyses proceeded normally.

G. Other:

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Queue: GCSm

Batch Number: 1187

I. Receipt

No Exceptions were encountered.

II. Holding Times

Preparation: All holding times were met.

Analysis: All holding times were met.

III. Method

Analysis: EPA 8081

Preparation: SW-846 3550B

IV. Preparation

Sample preparation proceeded normally.

V. Analysis

A. Calibration: The lower control criterion was not met for the following analytes in the ending bracketing Continuing Calibration Verification (CCV) standard associated with T1805716001, T1805716002, T1805716003, T1805716004, T1805716005, T1805716006, T1805716007, T1805716008, T1805716009, T1805716010, and T1805716011 due to difficult sample matrix: Heptachlor, 4,4-DDT, Methoxychlor, Endrin Ketone, and Toxaphene. The sample matrices caused a low bias for the analytes in question in the original 4X analysis of the samples. The samples were analyzed a second time at a 20X dilution to reduce the effects of the sample matrix interferences on the ending bracketing CCV recoveries. The bracketing CCV standard in the 20X re-analysis met QC criteria. The 20X re-analysis results were reported for Heptachlor, 4,4-DDT, Methoxychlor, Endrin Ketone, and Toxaphene.

The upper control criterion was exceeded for 4,4DDD in Continuing Calibration Verification (CCV) standards for analytical batch GCSm 1187, indicating increased sensitivity. The client samples reported in this batch did not contain the analytes in question. Since the apparent problem equates to a potential high bias, the data quality is not affected. No further corrective action was required.

B. Blanks: All acceptance criteria were met.

C. Surrogates: The control criteria for the following surrogates in T1805716001, T1805716002, T1805716003, T1805716004, T1805716005, T1805716006, T1805716007, T1805716008, T1805716009, T1805716010, and T1805716011 are not applicable: Tetrachloro-m-xylene and Decachlorobiphenyl. The analysis of the sample required a dilution, which results in an undetected surrogate concentration. No further corrective action was required.

The control criteria were exceeded for surrogate Decachlorobiphenyl in M1801440002. The associated QC analysis recoveries of target compounds were in control, indicating the analysis was in control. The surrogate outliers were flagged accordingly. No further corrective action was required.

D. Spikes: The relative percent difference (RPD) for the following analyte(s) in the replicate matrix spike analyses of A1802550006 was outside control criteria: Endosulfan Sulfate. Failing RPD indicates inconsistency in the parent sample matrix. All spike recoveries in the MS,

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MSD and associated LCS were within acceptable limits, indicating the analytical batch was in control. No further corrective action was needed.

E. Internal Standard: All acceptance criteria were met.

F. Samples: The samples T1805716001, T1805716002, T1805716003, T1805716004, T1805716005, T1805716006, T1805716007, T1805716008, T1805716009, T1805716010, and T1805716011 were diluted prior to instrumental analysis. The extracts were highly colored and viscous which indicated the need to perform a dilution prior to injection into the instrument.

G. Other:

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Queue: GCSm

Batch Number: 1189

I. Receipt

No Exceptions were encountered.

II. Holding Times

Preparation: All holding times were met.

Analysis: All holding times were met.

III. Method

Analysis: SW-846 8082A

Preparation: SW-846 3550B

IV. Preparation

Sample preparation proceeded normally.

V. Analysis

A. Calibration: All acceptance criteria were met.

B. Blanks: All acceptance criteria were met.

C. Surrogates: The control criteria for the following surrogates in T1805716001, T1805716002, T1805716003, T1805716004, T1805716005, T1805716006, T1805716007, T1805716008, T1805716009, T1805716010, and T1805716011 are not applicable: Tetrachloro-m-xylene and Decachlorobiphenyl. The analysis of the sample required a dilution, which results in an undetected surrogate concentration. No further corrective action was required.

D. Spikes: The upper control criterion was exceeded for the following analyte in the Matrix Spike Duplicate (MSD) for analytical batch GCSm 1189: Aroclor 1016 (PCB-1016) and Aroclor 1260 (PCB-1260). The analytes in question were not detected in the associated client samples. The error associated with elevated recovery equates to a high bias. The quality of the data is not affected. No further corrective action was required.

E. Internal Standard: All acceptance criteria were met.

F. Samples: The samples T1805716001, T1805716002, T1805716003, T1805716004, T1805716005, T1805716006, T1805716007, T1805716008, T1805716009, T1805716010, and T1805716011 were diluted prior to instrumental analysis. The extracts were highly colored and viscous which indicated the need to perform a dilution prior to injection into the instrument.

G. Other:

Advanced Environmental Laboratories, Inc.

6681 Southpoint Parkway
Jacksonville, Florida 32216
Office (904) 363-9350
Fax (904) 363-9354

Queue: ICPt

Batch Number: 1331

I. Receipt

No Exceptions were encountered.

II. Holding Times

Preparation: All holding times were met.

Analysis: All holding times were met.

III. Method

Analysis: SW-846 6010

Preparation: SW-846 3050B

IV. Preparation

Sample preparation proceeded normally.

V. Analysis

A. Calibration: All acceptance criteria were met.

B. Blanks: All acceptance criteria were met.

C. Duplicates: All acceptance criteria were met.

D. Spikes: The matrix spike recovery of Pb for T1805716001 was outside control criteria. Recoveries in the Laboratory Control Sample (LCS), Matrix Spike Duplicate (MSD) and %RPD were acceptable, which indicates the analytical batch was in control. The matrix spike outlier suggests a potential low bias in this matrix.

E. Serial Diluion: All acceptance criteria were met.

F. Samples: Sample analyses proceeded normally.

G. Other:

APPENDIX B4

DB Environmental

P Fractionation Laboratory Results

DB Environmental

May 21, 2018

AMEC Foster Wheeler
Mary Szafraniec
2000 E. Edgewood Dr., Suite 215
Lakeland, Fl 33803

PO #: T015578
Project Name: Lake Bonnet
Project No. : 600537x5 Task 6
Batch ID: 348854

Dear Mary Szafraniec:

DB Environmental received 3 samples on April 10, 2018 @ 10:10 for the analyses presented in the following report.

Analyses are performed with method required calibration and QA/QC samples whenever applicable. Method performance, which is based on the calibration and QA/QC samples, establishes the validity and certainty of the reported sample results This data is provided along with the sample results when requested. These results are calculated on a dry-weight basis, unless otherwise noted. These results relate only to the samples as received. The report shall not be reproduced except in full, without the written approval of the laboratory.

This report contains a total of 7 pages:

cover letter	1	case narrative	1	report	2
QC summary	1	COC	1	analytical results	Ø
correspondence	Ø	invoice	1		

Please note that any unused portion of the samples will be disposed of 30 days following issuance of report, unless you have requested otherwise.

If you have any questions regarding the analytical results, please feel free to call me at 321-639-4896.

Sincerely,

Nancy Chan
Project Manager

Enclosure

THIS DOCUMENT MEETS NELAC STANDARDS
NELAP Certification #E 83330

DB Environmental

CASE NARRATIVE

May 21, 2018

AMEC Foster Wheeler
Mary Szafraniec
2000 E. Edgewood Dr., Suite 215
Lakeland, Fl 33803

PO #: T015578
Project Name: Lake Bonnet
Project No. : 600537x5 Task 6
Batch ID: 348854

Parameter: HCl TSP
Lab Log #: 348854

The extraction dup was outside the 0-40% acceptance range for %rsd. The data was accepted because the associated laboratory check standard results were acceptable. The result has been qualified.

Nancy Chan
Project Manager

DB Environmental, Inc., 365 Gus Hipp Blvd., Rockledge, FL 32955 - (321) 639-4896
NELAP/FDOH# E 83330

Date: May 21, 2018

REPORT OF ANALYSIS

Client: AMEC Foster Wheeler
Attention: Mary Szafraniec
2000 E. Edgewood Dr., Suite 215
Lakeland, FL 33803

Date and Time Received: 4/10/2018 10:10

PO #: T015578
Project Name : Lake Bonnet
Project No. : 600537x5 Task 6
Matrix: Sediment

SAMPLE ID	LAB LOG NUMBER	DATE SAMPLED	TIME SAMPLED	PARAMETER	METHOD NUMBER	RESULTS	UNITS	METHOD DETECTION LIMIT	DATE/TIME OF ANALYSIS	QUALIFIER CODE
PT 1-3	348854	4/9/2018	n/a	% Dry Weight	ASA 21-2	8.46	%	0.01	4/12/2018	
PT 3-2	348855	4/9/2018	n/a	% Dry Weight	ASA 21-2	5.43	%	0.01	4/12/2018	
PT 4-3	348856	4/9/2018	n/a	% Dry Weight	ASA 21-2	2.67	%	0.01	4/12/2018	
PT 1-3	348854	4/9/2018	n/a	Bulk Density	ASA 13	0.088	g/cc	0.001	4/12/2018	
PT 3-2	348855	4/9/2018	n/a	Bulk Density	ASA 13	0.057	g/cc	0.001	4/12/2018	
PT 4-3	348856	4/9/2018	n/a	Bulk Density	ASA 13	0.028	g/cc	0.001	4/12/2018	
PT 1-3	348854	4/9/2018	n/a	Volatile Solids	EPA/COE 3-59	28.8	%	1.35	4/26/2018	A
PT 3-2	348855	4/9/2018	n/a	Volatile Solids	EPA/COE 3-59	38.2	%	1.35	4/26/2018	
PT 4-3	348856	4/9/2018	n/a	Volatile Solids	EPA/COE 3-59	56.1	%	1.35	4/26/2018	
PT 1-3	348854	4/9/2018	n/a	Total Phosphorus	EPA 365.2/COE 3-227	3740	mg/kg dry	50	4/30/2018	
PT 3-2	348855	4/9/2018	n/a	Total Phosphorus	EPA 365.2/COE 3-227	6540	mg/kg dry	100	4/30/2018	
PT 4-3	348856	4/9/2018	n/a	Total Phosphorus	EPA 365.2/COE 3-227	5740	mg/kg dry	100	4/30/2018	
PT 1-3	348854	4/9/2018	n/a	Porewater SRP	DBE SOP OPO4	22.1	mg/kg dry	0.2	4/10/2018 13:28	A
PT 3-2	348855	4/9/2018	n/a	Porewater SRP	DBE SOP OPO4	21.5	mg/kg dry	0.3	4/10/2018 13:28	
PT 4-3	348856	4/9/2018	n/a	Porewater SRP	DBE SOP OPO4	41.8	mg/kg dry	0.7	4/10/2018 13:28	A
PT 1-3	348854	4/9/2018	n/a	Porewater NH3-N	SM 4500-NH3 (18th ed.)	325	mg/kg dry	4.2	4/29/2018	A
PT 3-2	348855	4/9/2018	n/a	Porewater NH3-N	SM 4500-NH3 (18th ed.)	276	mg/kg dry	6.6	4/29/2018	
PT 4-3	348856	4/9/2018	n/a	Porewater NH3-N	SM 4500-NH3 (18th ed.)	1020	mg/kg dry	13.9	4/29/2018	A
PT 1-3	348854	4/9/2018	n/a	NH_4Cl TSP*	EPA 365.2/COE 3-227	35.8	mg/kg dry	1.7	4/27/2018	A
PT 3-2	348855	4/9/2018	n/a	NH_4Cl TSP*	EPA 365.2/COE 3-227	33.2	mg/kg dry	1.8	4/27/2018	A
PT 4-3	348856	4/9/2018	n/a	NH_4Cl TSP*	EPA 365.2/COE 3-227	54.7	mg/kg dry	2.0	4/27/2018	

SAMPLE ID	LAB LOG NUMBER	DATE SAMPLED	TIME SAMPLED	PARAMETER	METHOD NUMBER	RESULTS	UNITS	METHOD DETECTION LIMIT	DATE/TIME OF ANALYSIS	QUALIFIER CODE
PT 1-3	348854	4/9/2018	n/a	$NaHCO_3/Na_2S_2O_4$ TSP**	EPA 365.2/COE 3-227	63.4	mg/kg dry	3.2	4/27/2018	A
PT 3-2	348855	4/9/2018	n/a	$NaHCO_3/Na_2S_2O_4$ TSP**	EPA 365.2/COE 3-227	79.2	mg/kg dry	3.4	4/27/2018	A
PT 4-3	348856	4/9/2018	n/a	$NaHCO_3/Na_2S_2O_4$ TSP**	EPA 365.2/COE 3-227	137	mg/kg dry	3.6	4/27/2018	
PT 1-3	348854	4/9/2018	n/a	NaOH SRP***	DBE SOP OPO4	789	mg/kg dry	16.9	4/12/18 16:33	A
PT 3-2	348855	4/9/2018	n/a	NaOH SRP***	DBE SOP OPO4	1130	mg/kg dry	17.9	4/12/18 16:33	
PT 4-3	348856	4/9/2018	n/a	NaOH SRP***	DBE SOP OPO4	822	mg/kg dry	18.9	4/12/18 16:33	A
PT 1-3	348854	4/9/2018	n/a	NaOH TSP	EPA 365.2/COE 3-227	1170	mg/kg dry	6.7	4/30/2018	A
PT 3-2	348855	4/9/2018	n/a	NaOH TSP	EPA 365.2/COE 3-227	1690	mg/kg dry	7.1	4/30/2018	
PT 4-3	348856	4/9/2018	n/a	NaOH TSP	EPA 365.2/COE 3-227	1850	mg/kg dry	7.5	4/30/2018	A
PT 1-3	348854	4/9/2018	n/a	NaOH TSP minus NaOH SRP†	Calculation	381	mg/kg dry	16.9	n/a	A
PT 3-2	348855	4/9/2018	n/a	NaOH TSP minus NaOH SRP†	Calculation	560	mg/kg dry	17.9	n/a	
PT 4-3	348856	4/9/2018	n/a	NaOH TSP minus NaOH SRP†	Calculation	1028	mg/kg dry	18.9	n/a	A
PT 1-3	348854	4/9/2018	n/a	HCl TSP††	EPA 365.2/COE 3-227	436	mg/kg dry	3.2	4/30/2018	A J
PT 3-2	348855	4/9/2018	n/a	HCl TSP††	EPA 365.2/COE 3-227	755	mg/kg dry	3.4	4/30/2018	
PT 4-3	348856	4/9/2018	n/a	HCl TSP††	EPA 365.2/COE 3-227	488	mg/kg dry	3.5	4/30/2018	A
PT 1-3	348854	4/9/2018	n/a	Residual P	EPA 365.2/COE 3-227	1080	mg/kg dry	50	4/30/2018	A
PT 3-2	348855	4/9/2018	n/a	Residual P	EPA 365.2/COE 3-227	2980	mg/kg dry	50	4/30/2018	
PT 4-3	348856	4/9/2018	n/a	Residual P	EPA 365.2/COE 3-227	3300	mg/kg dry	50	4/30/2018	
PT 1-3	348854	4/9/2018	n/a	Total Organic Carbon	DBE SOP MVP/COE 3-73	157000	mg/kg dry	3030	5/11/2018	
PT 3-2	348855	4/9/2018	n/a	Total Organic Carbon	DBE SOP MVP/COE 3-73	217000	mg/kg dry	3030	5/11/2018	
PT 4-3	348856	4/9/2018	n/a	Total Organic Carbon	DBE SOP MVP/COE 3-73	310000	mg/kg dry	3030	5/11/2018	

Key to Qualifier Code

A Result based on the mean of two or more determinations; average of lab dup and/or extraction dup results.

J Estimated value. The extraction dup was outside the acceptance range for %rsd. The data was accepted because the associated laboratory check standard results were acceptable.

Project Manager: Nancy Chan
Nancy Chan

The information below is referenced in:

Meis, S., Spears, B.M., Maberly, S.C., O'Malley, M.B., Perkins, R.G. 2012. Sediment amendment with Phoslock® in Clatto Reservoir (Dundee, UK): Investigating changes in sediment elemental composition and phosphorus fractionation. *J. Environ. Manag.*; 93, 185-193.

*NH_4Cl TSP = Labile P

**$NaHCO_3/Na_2S_2O_4$ TSP = Reductant-Soluble P

***NaOH SRP = Metal-Oxide Adsorbed P

†NaOH TSP minus NaOH SRP = Organic P

††HCl TSP = Apatite Bound P

QC SUMMARY
AMEC Foster Wheeler
PO #. : T015578
Project Name: Lake Bonnet
Project No. : 600537x6 Task 6
(348854-348856)

PARAMETER	LAB DUPLICATES	% RSD	SPIKES	% RECOVERY	BLANKS
Volatile Solids	348854	0.6			<1.35 %
Total Phosphorus/Residual P	348854 348854 Ext Dup	6.3 1.5	W271244	106	<10 mg/kg dry
Porewater SRP	348854 Ext Dup 348856	0.0 1.0	348854	103	<0.03 mg/kg dry
Porewater NH3-N	348854 Ext Dup 348856	0.4 2.1	349330	109	<0.3 mg/kg dry
NH_4Cl TSP	348854 Ext Dup 348855	0.0 0.0	348854 ED	97	<1.5 mg/kg dry
$NaHCO_3/Na_2S_2O_4$ TSP	348854 Ext Dup 348855	15.4 1.6	348856	104	<3.0 mg/kg dry
NaOH SRP	348854 Ext Dup 348856	6.0 3.9	348855	98	<16.0 mg/kg dry
NaOH TSP	348854 Ext Dup 348856	3.9 0.5	348854	109	<6.4 mg/kg dry
HCl TSP	348854 Ext Dup 348856	43.9* 0.3	348855	95	<3.0 mg/kg dry
Total Organic Carbon	349330	4.4	348855	100	<3030 mg/kg dry

*** The extraction dup was outside the 0-40% acceptance range for % rsd.**

DB Environmental, Inc.
365 Gus Hipp Blvd. Rockledge, FL 32955
Ph: (321) 639-4896 Fax: (321) 631-3169
e-mail: info@dbenv.com

CHAIN OF CUSTODY

Revision 7.0, Effective 5/1/2017

Lab Certification #: E83330

Client:	Address:	City:	State:	Zip:	Phone:	Fax:
AMEC Foster Wheeler	2000 E Edge Wood Drive Suite 215	Lakeland	FL	33803		
Contact Person: Mary Szafraniec	**Contact Info**	**Invoice #:** 6756				
Project: Lake Bonnet	**Collected By:**					

Requested Analysis

Lab Log #:	Date	Time	Comp/ Grab	Matrix Code	Field- Filter Y/N	Preservative (Specify)	Sample ID:	Sample Description	%Dry Weight, Bulk Density	TP	Porewater SRP, Porewater NH3-N	Meis et al, 2012 Extraction *	Volatile Solids	TOC			Remarks
348854	4/9/2018	n/a	G	SE	N	4 deg C	PT 1-3		X	X	X	X	X	X			
348855	4/9/2018	n/a	G	SE	N	4 deg C	PT 3-2		X	X	X	X	X	X			
348856	4/9/2018	n/a	G	SE	N	4 deg C	PT 4-3		X	X	X	X	X	X			

Custody Transfer:

	Relinquished by: Signature	Date/Time	Received by: Signature	Date/Time
1	— Fed Ex —		Nancy [signature]	4/10/18 1010
2				
3				
4				

Matrix ID

F-Fish	DI- DI Water
G-Gas	DW-Drinking Water
I-Invertebrate	GW-Ground Water
L-Leachate	IW- Incubation Water
PE- Periphyton	PW-Porewater
PT-Plant/Veg	SW-Surface Water
SD-Sludge	WW-Waste Water
SE-Sediment	
SO-Soil	O-Other*

*If Other, describe:

Sample Receiving - For Lab Use Only

Method of Shipping/Delivery: Fed Ex

Received on ice or similar Yes X No____ N/A____

Receiving Temperature (°C) - *if applicable:* 4.1°C Initials: NC

pH checked Yes____ No X n/a Initials: NC

First Lab Log # (Batch ID): 348834

Comments:
* NH_4Cl TSP, $NaHCO_3$/~~Na_2S2O_4~~ TSP, NaOH SRP, NaOH TSP, HCl TSP, Residual P
$Na_2S_2O_4$
(4/10/18 NC)

DB Environmental

AMEC Foster Wheeler
Attention: Jackie Shields
2000 E Edgewood Dr. #215
Lakeland, FL 33803

Invoice Date: 21 May 2018
Invoice Number: 6756
Amount Due: **$1,530.75**

Sample Received	Description	Qty	Unit Price	Amount
10 Apr 2018	Grinding (Processing)	3	$15.00	$45.00
348854-348856	% Dry Weight	3	$9.00	$27.00
Batch ID: 348854	Bulk Density	3	$12.50	$37.50
	Volatile Solids	3	$13.75	$41.25
	Total Phosphorus	3	$19.25	$57.75
	Porewater Extraction	3	$18.00	$54.00
	Porewater SRP	3	$18.25	$54.75
	Porewater NH3-N	3	$26.50	$79.50
	NH_4Cl TSP*	3	$45.00	$135.00
	$NaHCO_3/Na_2S_2O_4$ TSP**	3	$123.00	$369.00
	NaOH SRP***	3	$48.25	$144.75
	NaOH TSP	3	$44.50	$133.50
	NaOH TSP minus NaOH SRP†	3	$0.00	$0.00
	HCl TSP††	3	$39.50	$118.50
	Residual P	3	$43.25	$129.75
	Total Organic Carbon	3	$34.50	$103.50
			Subtotal	$1,530.75
			Total	**$1,530.75**

Project Manager: Mary Szafraniec
AMEC PO# : T015578
AMEC Project Name: Lake Bonnet
AMEC Project No. : 600537x5 Task 6

*NH_4CI TSP = Labile P

**$NaHCO_3/Na_2S_2O_4$ TSP = Reductant-Soluble P

***NaOH SRP = Metal-Oxide Adsorbed P

†NaOH TSP minus NaOH SRP = Organic P

††HCI TSP = Apatite Bound P

Payment due within 30 days of invoice date.
If you have any questions concerning this invoice call, Suzie Larson.

THANK YOU FOR YOUR BUSINESS!

APPENDIX B5

Evaluation of Treatment Alternative Efficiencies through Direct Measurement of Diffusive Flux SOP

STANDARD OPERATING PROCEDURE
EVALUATION OF TREATMENT ALTERNATIVE EFFICIENCIESTHROUGH DIRECT MEASUREMENT OF DIFFUSIVE FLUX

Effective Date: June 11, 2018

Prepared by: Water Resources Technical Lead Scientist; Laboratory Scientist

Approved by: Quality Assurance Field Officer; Quality Assurance Laboratory Director

TABLE OF CONTENTS

1.0 Purpose

This SOP describes field and laboratory methods recommended to evaluate the potential internal nutrient loading from sediments that may occur in a waterbody, as part of the sediment nutrient flux assessment component of the subject Project. In addition, various treatment alternatives can also be evaluated by measuring the reduction of diffusive nutrient flux, which would directly relate to the alternative’s treatment efficiency.

The information gathered by this study could be used to assist in the selection of the most effective treatment alternative from the following list:

1) Clean Sand
2) Phoslock ®
3) Aluminum Sulfate (alum)

The flux study will aid in quantifying the potential beneficial impacts of adding a biological or chemical amendment or cap to improve water quality.

2.0 Scope, Application and Applicable Matrix

Sediment nutrient accumulations in waterbodies over time can contribute pollutant sources to the overlying water column, through biogeochemical processes such as adsorption, desorption and diffusion processes (Lijklema et al. 1993). Detailed physical and chemical characterizations of sediments are therefore essential to evaluate the nutrient exchange processes that occur at the sediment-water interface (Sahin et al. 2012).

Phosphorus is typically the limiting nutrient in lentic systems, and when found in excess, eutrophication can occur (Dorich et al. 1985). As a growing number of waterbodies worldwide suffer from cultural eutrophication, determination of the causes of water quality degradation is becoming increasingly important for water resource management and restoration (Ogdahl et al. 2014). Bottom sediments in waterbodies play a major role in releasing nutrients to the overlying water column during wind induced sediment resuspension and/or by constant flux due to diffusion (Reddy et al. 1996). Projects that include treatment alternatives to cap sediments containing high concentrations of biologically available nutrients are beneficial to the recovery of water quality and ecological conditions in waterbodies such as lakes and streams.

Nutrient bioavailability and reactivity in the sediments can be quantified by measuring different forms of nitrogen (N) and phosphorus (P) content in the sediment (Olila et al. 1995) and release from the sediments into the water column (Ogdahl et al. 2014). The amounts and forms of reactive and nonreactive P in sediments can be examined using chemical extraction procedures to differentiate between the P fraction's solubility when exposed to various chemical extractants (Psenner et al. 1988; Olila et al. 1995). Readily available P (i.e. labile P) is defined as the sum of water-soluble P and NH_4Cl or KCl extractable P. These labile P fractions are desorbed and hydrolyzed or loosely bound or adsorbed (Hieltjes and Lijklema 1980; Topcu and Pulatsu 2008). The NaOH-extractable P fraction is the reductant soluble P form that can be released under certain environmental conditions and is extracted from iron hydroxide and aluminum hydroxide surfaces in the laboratory (Hieltjes and Lijklema 1980; Topcu and Pulatsu 2008). The sum of labile P and reductant soluble P forms typically account for the total biologically available P (BAP), which can be used as fuel to promote growth by phytoplankton in the water column (Reddy et al. 1998). Nutrient loading rates that diffuse from the sediments are dependent on the geologic nature (i.e. high natural phosphorus content) and/or legacy point source inputs into the system.

Flux rates of biologically available nutrients from the sediments can be quantified in the laboratory by incubating intact sediment cores under controlled laboratory conditions and measuring changes in nutrient concentrations over time in the water column overlying the sediment cores (e.g., Schelske et al. 1991, Trefry et al. 1992, Moore et al. 1998, and Ogdahl et al. 2014,). The primary benefit of the laboratory incubation approach is that the experimental conditions and the range of factors affecting flux rates can be carefully controlled. A slight drawback is the possibility that laboratory studies cannot completely mimic *in-situ* waterbody conditions and are subject to laboratory artifacts if sufficient controls are not put in place.

Intact sediment core incubations to determine flux rates rely on careful sediment extraction in the field and minimum disturbance during laboratory incubations. At the lab, nutrient concentration changes in the overlying water are evaluated overtime. Flux rates could be highly variable, dependending on the conditions that were encountered before and during inclubation. Some important considerations include the following:

1) Depth of sediment profiles collected and analyzed in the core
2) Depth of water analyzed on top of the sediment in the core
3) Initiation of incubation after inclusion of source water
4) The number and distribution (on time scale) of data points to develop the flux rate
5) The beginning and end points, and the length of incubation and time spanning between data points and from beginning to end of the run
6) Whether the tests are conducted in aerobic, anoxic, quiescent and/or turbulent conditions.

Depending on the study objective, it is possible to conduct the flux tests in both aerobic and anoxic conditions in separate core profiles (with replicates) to limit error introduced from biogeochemical processes not regularly encountered in the waterbody. Therefore, maintenance of low oxygen concentrations at anoxic levels by gentle purging with N_2 gas mixture is necessary to maintain the appropriate anoxic conditions. In contrast, gentle purging of air gas mixture is needed to mainain aerobic conditions. In addition, an appropriate stirring rate may be desired to establish a representative diffusive boundary layer thickness similar to the level of turbulance of the subject waterbody.

The intact sediment core laboratory incubation approach was selected to take advantage of strictly controlled laboratory conditions that can be manipulated to answer specific resource management questions.

Details of the experimental design and methodology are provided below, which are applicable to sediment samples collected by Wood field technicians, processed and/or analyzed by the Wood Laboratory and/or other certified laboratories. Trained field technicians and laboratory technical staff with applicable training and experience are responsible for performance of this SOP.

3.0 **Materials and Methods**

3.1 **Field Sample Collection Procedures, Preservation and Storage**

Three different types of samples and analyses should be conducted at each sampling site. The three types are identified by letters **a** through **c** below and should be collected in the following order for quality control purposes:

a) Water Chemistry *In-situ* Vertical Profile
b) Sediment Depth (*In-situ*)
c) Intact Sediment Cores

Intact sediment cores should be transported to the Wood Flux Laboratory for set-up and immediately after core extrusion. Sampling methods and laboratory procedures for each of the different sampling types are described in the following sub-sections.

3.1.1 Field Equipment and Supplies

1) Safety plan
2) Boat with motor
3) GPS
4) Camera
5) Maps with access, site locations, and contact information
6) FDEP SOPs for water sampling
7) Field sheets
8) Fine point sharpies
9) Labels
10) Putty knife and screwdriver
11) Metric ruler
12) YSI MDS 550 multiparameter water quality sonde (calibrated and checked (ICV, CCV) documented on calibration logs per FDEP SOP)
13) Turbidimeter (calibrated and checked (ICV, CCV) documented on calibration logs per FDEP SOP)
14) Secchi disk
15) Levelling rod for muck depth and hard bottom depth
16) Peristaltic pump or submersible pump for collection of near-bottom ambient water for carboys/jugs for use in incubations
17) 24 X 3” outer diameter (OD) clean clear polycarbonate core tube, with 2 $^{7}/_{8}$” inner diameter (ID) and a $^{1}/_{16}$” wall thickness, cut into 2’ long pieces
18) Piston corer assembly for intact flux cores
19) Minimum of 16 rubber stoppers to serve as bottom core plug
20) Minimum of 16 rubber stoppers to serve as top core plug for transport
21) Plastic caps for sealing sediment cores modified with fittings and attachments for incubation

22) Duct tape, epoxy glue, or other material to prevent leakage from cores
23) Extra-large black garbage bags to cover and keep core samples in the dark
24) Coolers with upright frame for flux core storage and transport

3.1.2 Field Equipment Calibration

Staff generated documentation of initial calibration, initial calibration verification and continuing calibration verification of water quality multiparameter sondes used to collect *in-situ* water chemistry profiles, and other field data collection equipment, as applicable. The FDEP SOPs (FS1000, FT1000, FD1000, FT1100, FT1200, FT1300, FT1400, FT1500, and FT1600), should be used for pre and post-event instrument calibration and/or verification conducted prior to commencing sampling and at the end of each sampling day.

3.1.3 Field Sample Collection and QA/QC Procedures

Several SOPs such as the FDEP SOPs for water and sediment sampling (FS1000, FS2000, FS2100, and FS4000) should be kept on-hand during mobilization or pre-event preparation, and sampling. These SOPs should be followed to maintain a high level of accuracy in data collection and to ensure sound QA/QC management practices should be being followed.

3.1.3.1 Sample Type A: *In-situ* Vertical Profile of Water Chemistry

1) At each site, photographs should be taken showing the water column and habitat conditions of the site. In addition, photos should be taken of each of the sediment cores collected. The photographs taken should be noted on the field sheets.
2) Any notable field conditions should be noted such as weather or other environmental conditions that may affect sampling results.
3) At each site, *in-situ* water chemistry vertical depth profiles should be collected with a properly calibrated YSI multiparameter sonde.
4) The length of the YSI cord should be long enough to reach the bottom of the water column
5) At each site, YSI measurements should be recorded at three depths in the water column at the top, middle, and as near to the bottom as possible without disturbing the sediments (within 0.5 m of benthic surface).
6) Care must be taken to not disturb the sediments to cause error in the measurements.
7) The following parameters should be recorded for the overall site: total water depth, Secchi depth and measurement depth.
8) The following parameters should be recorded at each incremental depth: water temperature, dissolved oxygen (DO), pH, specific conductivity, salinity, ORP, and turbidity.

3.1.3.2 Sample Type B: Sediment Depth Collection

1) At each site, the top and bottom depth of flocculent sediment layer (muck), and the depth to hard bottom (refusal) should be measured with a levelling rod.
2) Sediment muck depths should be recorded on corresponding field sheets.

3.1.3.3 Sample Type C: Sediment Intact Cores Collection

1) At one predetermined site, intact undisturbed sediment cores should be collected with a coring assembly (2’ clear polycarbonate tube coupled with drive rods) to a depth of 20 cm from the top of sediment (0-20 cm).
    a. At one predetermined site 16 undisturbed sediment cores should be collected and will be used to test the amendments (i.e. alum, Phoslock, and clean sand).
    b. At the predetermined site 2 cores will be collected (one for anoxic and one for aerobic incubation controls).
    c. Two water controls (one aerobic, and one anoxic) will be incubated along with the treatment cores.
    d. Two clean sand controls (one aerobic, and one anoxic) will be incubated along with the treatment cores.

2) All core tubes must be labeled properly with site name, date, time, sampler names, and replicate number (1-24) on a piece of removable tape.
3) Care should be taken to ensure that homogenous replicate samples are collected from each site, which will require inspection of the replicates prior to placing the samples into the upright core racks (for storage and transportation). If the stratigraphy of the core samples differ, then a different, more homogeneous sediment strata should be located.
4) 25 to 40 cm of near-bottom ambient water should be included on top of the sediment core
5) After sediment is captured by the coring device, the core will be brought to the water's surface, sealed with a rubber stopper prior to breaking the water surface. Core retrieval approach may vary depending on the type of substrate. Slippage of sediments out of the bottom of the core must be stopped to avoid sample loss out of the bottom of the core and to avoid disturbing the sediments within the core.
6) The intact cores should be sealed with the appropriate top and bottom rubber stoppers.
7) The intact cores rubber stoppers will be wrapped with duct tape or an epoxy will be applied to the stopper to prevent leakage (epoxy is primarily needed for sandy samples with low organic matter content to prevent sample falling out the bottom of the core).
8) All cores must be,
    a. covered with a dark garbage bag to limit light affecting the cores, and
    b. transported in an upright position (using a rack) to the Wood Flux Lab for incubation and nutrient flux experiments
9) All COC paperwork must be filled out completely, and provided to the Wood lab
10) A copy of the COC signed by the laboratory must be received prior to departure

3.2 Sample Type C: Internal Laboratory Sample Preparation Procedure, Preservation and Storage for Intact Sediment Core Incubation Flux Measurement

3.2.1 Laboratory Equipment and Supplies

For set-up

1) Teflon tubing
2) Acid washed carboys
3) Deionized water (DI)
4) Labeling tape
5) 0.45 micron filtered ambient water

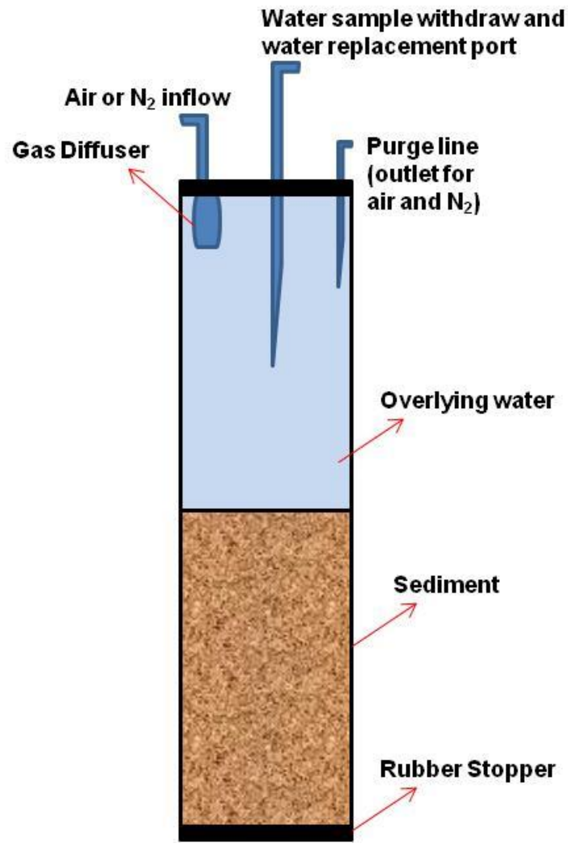
For nutrient flux experiment

1) Thermostat
2) Verification thermometer (ambient temperature)
3) pH meter
4) Oxygen meter with incorporated thermometer
5) Turbidity meter
6) Sterile polyethylene syringes
7) 0.45 μm membrane filters
8) Clean sample collection bottles (provided by analytical lab)
9) Diffuser
10) Teflon tubing
11) Labeling tape

3.2.2 Reagents and Standards

1) Nitrogen Gas

Figure 1. Intact Core Incubation Apparatus



3.2.3 Laboratory Procedure: Intact Sediment Core Preparation and Incubation

Near Bottom Ambient Water Preparation:

1) Prior to initialization of core incubation, the ambient water should be filtered using an in-line 0.45-micron capsule filter with a peristaltic pump. Once filtered, half of the containers should be bubbled with N_2 gas at a rapid rate to achieve and maintain anoxic conditions prior and during flux sampling. The other half will be stored until needed for water replacements on the intact cores. At that time, water containers will be bubbled with N_2 gas at room temperature until anoxic conditions are achieved and then used to refill intact cores.
2) The setup of the intact core apparatus is shown in **Figure 1**, and it includes fittings and tubing required for subsampling.

Adjustment of Sediment on Cores:

3) If cores are received with sediment depths that are not the desired amount (20 cm), then cores may be adjusted to the desired depth of sediment and overlying water column (~30 cm) prior to incubation.
4) To adjust sediment volumes on the cores, first remove overlaying water by siphoning with a Teflon tube, making sure not to disturb or remove the top layer of sediment, then remove the bottom stopper and carefully let the sediment out of the bottom of the core tube. Make sure to seal the bottom of the core well to prevent water leakage during flux study. Refill with filtered ambient water as described in step 5 below.

Replacing Overlying Water with Filtered Ambient Water:

5) If the sediments on the core do not require adjustment, remove the overlaying water and replace with ~30 cm of filtered near bottom ambient water from the carboy. The water should reach to the top of the core. The water must be added slowly to prevent disturbance of sediments. After the water is replaced on the core, it is time to begin the stabilization/equilibration period.

Sediment Core Equilibration:

6) The time necessary for sedimentation/equilibration to be achieved is dependent on the composition of the sediment in upper portion of the core. Flocculent sediment material will require a longer duration for complete settling (up to 24 hours), whereby, sandy sediment may be equilibrated within the 12 hour timeframe). Systematic monitoring of turbidity can inform the length of time needed to achieve full equilibration and sedimentation in the core. It is recommended to allow enough time for the equilibration period to achieve ca. 85-90% reduction of measured turbidity values (via settling) prior to commencing flux sampling.
7) Nutrient release dynamics can be variable at the start of the intact sediment cores incubation, and are influenced by the cores equilibration time (Ogdahl et al. 2014). Therefore, the cores should be allowed to stabilize/equilibrate for a minimum of 24 hours, to allow for complete sedimentation processes to occur (Ogdahl et al. 2014) prior to commencement of the flux measurements.

Sediment Core Incubation and Sampling:

8) Cores from each site should be incubated in the dark using a temperature range between 23 to 27^0C (with a target incubation temperature of 25^0C), which should be consistent with ambient water conditions at the collection site with a tolerance range of $\pm 4^0$C during median temperature ranges.
9) The cores should be exposed and incubated under anoxic and aerobic conditions with replicates.
10) For the anoxic redox treatment, it is imperative to prevent oxygen exposure to the water column at all times while preparing for and during flux incubation and sampling. The water column should be bubbled with N_2 gas at a consistent rate that does not disturb and resuspend the upper layer of sediment in the core. However, the bubbling rate must be rapid enough to achieve and maintain anoxic conditions in the water column and sediment prior to commencing flux sampling.
11) Dissolved oxygen (DO) should be systematically monitored (e.g. every 6-8 hours) to ensure that the appropriate redox treatment is being achieved and maintained at the beginning and throughout the incubation. A DO concentration of less than 1 mg/L is required to maintain anoxic conditions.
12) The cores should be incubated for a period of no less than 5 days (120 hours), and up to 10 days (240 hours) with at least three discrete sampling time intervals between time= 0 hr, and time= 240 (if 10 days is selected as the length of incubation). Typically, sampling intervals should occur at T= at 48 hr, 168 hr, and 240 hours. However, depending on the day that the samples are collected, and the analytical lab's operating schedule, these intervals may be adjusted as needed. On many occasions, at four to five sampling intervals will be collected for better data resolution and to fit the curve.
13) A water sample should be periodically removed for sample analysis with a polyethylene syringe fitted with a length of 1-mm polyethylene tubing positioned to withdraw samples at mid-lower water column from each core as part of the sampling interval collections. Critical parameters for flux sampling include iron, total phosphorus and ammonia (NH_3) to meet project objectives, which should only require 50 ml per parameter, for a total of 150 ml of water removed from each core for a sample. However, additional parameters could also be sampled. The number of parameters sampled is based on the study design and goals, but it must be understood that with each parameter sampled, additional water volume must be replaced on the core, which can potentially introduce dilution error into later sampling interval samples. It is recommended to sample as few parameters as possible to avoid introducing dilution error into the results.
    a. For the NH3 sample, sulfuric acid must be added to properly preserve the sample.
14) The depth of water on top of the core should be maintained throughout the incubation at ~30 cm. The volume of water (150 ml) that is removed if all three parameters are collected during each subsampling interval shall be replaced with an equal volume of ambient water (under the appropriate redox condition). Based on a 7.3 cm diameter core, and a depth of 30 cm, the volume of water on top of each sediment core will be maintained at approximately 1260 ml. The ~150 ml that would be removed if all three parameters are collected during each subsampling event represents less than 5% of the total volume of water on top of the sediment in the core, which

should not have an effect on dilution of the remaining volume. The replacement amount shall not exceed more than 5% during each sampling interval to minimize the effect of replacement water on the remaining core water nutrient concentrations.

15) Discrete interval subsamples will be placed into sample containers and transported to the analytical laboratory in coolers on ice for analysis.

4.0 **Data Analyses**

4.1 **Calculation of Nutrient Flux Rates**

Nutrient flux rates should be estimated using the nutrient release rate equation, which was calculated based on the change of nutrient concentration over time (see equation below) and also by calculating the slope by using the interval sampling data and time step. Annual internal load of nutrients should be estimated following the methods described by Ogdahl et al. (2014) by using the nutrient release rate calculation and by calculating the rate with the slope.

Nutrient Release Rate Calculation - The flux rates for nitrogen and phosphorus species can be calculated using the following equation:

Eq. 1 $Nrr = (Ct - Ci) \times V / A \times \text{delta } t$

Where:

Nrr = the gross nutrient release (positive values) or retention (negative values) rate per unit surface area of sediment ($mg / m^2 / d$),

Ct = the final nutrient concentration at time t, or near the end of the incubation,

Ci = the initial nutrient concentration at time i, near the beginning of the incubation,

V = the volume of water in the water column,

A = the surface area of the sediment core, and

delta t = change in time, from time t-i.

5.0 **Quality Control**

1) All equipment was calibrated before use in the field and laboratory per FDEP SOPs noted in previous sections. Continuing verification of calibration was performed at the end of the day. SOPs should be used as a reference during field and laboratory activities to maintain quality control.

6.0 **Safety and Waste Management**

1) Laboratory staff must use proper safety equipment (e.g., eye protection, gloves, close-toe shoes)
2) Staff will perform necessary leak checks on gas cylinders.
3) Gas cylinders will be secured at all times and capped when not in use.
4) Sediments in core will be disposed as a solid waste.

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APPENDIX C

Ecological Report

CITY OF LAKELAND
LAKE BONNET ECOLOGICAL EVALUATION REPORT
APPENDIX C

Prepared for

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Wood Project No. 600537.5

September 2018

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1.0 INTRODUCTION

Figure C-1 Project Location

Wood conducted a natural resources evaluation of the proposed project site, as required for an Environmental Resource Permit (ERP), in preparation for the water quality improvement project within Lake Bonnet in Lakeland, Florida (**Figure C-1**). This evaluation included wetland and upland habitats and a preliminary listed species impact assessment. The first phase of the evaluation included a literature search and desktop review of existing information. Known listed species occurrences, critical habitat, and regulatory consultation areas were mapped in relation to the project site. Wetland delineation information was provided by the adjacent Lake Bonnet Springs development. Wood scientists Kevin Shelton and Erik Oij conducted a field investigation of the site on March 29 and April 25, 2018. This included a brief wildlife survey, wetland evaluation, soil probes, and vegetation survey. Upland areas within the Park property were investigated for potential dredged material management area development.

2.0 LAKE BONNET

Review of available literature and historical aerial photographs indicate that Lake Bonnet has undergone significant changes over the last 70 years. The 1941 aerial (**Figure C-2**) shows the lake much smaller than current limits. A large berm, which later became Brunnell Parkway, was present and appears to have impounded water creating the larger lake. A defined channel can be seen extending through the forested wetland into the middle of Lake Bonnet before dispersing into a fluvial delta. Most of the area within the current lake limits appears to have been a scrubby marsh. The forested edge on the east side of Lake Bonnet was in nearly the same position as it is today. However, by 1970 (**Figure C-3**) Lake Bonnet reached its current surface water limits, although the forested wetland edge was in nearly the same position it is today.

Figure C-2 - 1941 Aerial Photograph

Figure C-3 - 1970 Aerial Photograph

During the ecological investigations, bottom sediments were probed for muck depth along the forested edge of the lake. Unconsolidated sediments were encountered at 3 to 4 feet below water surface. The survey rod was then pushed through the muck to significant refusal likely indicating a sandier natural lake bottom. This depth ranged from 7 to 12 feet below current water level indicating a muck layer of 3 to 9 feet in thickness. Bottom sediments were also examined and were found to be similar to the findings from the geotechnical investigation.

The current poor water clarity and lack of light availability at the lake bottom prevents the growth of submerged aquatic vegetation (SAV) within the lake. Secchi disc depths of less than one foot were noted during the field investigations, and the Polk Water Atlas data indicate an average Secchi disc depth of 0.9 foot over the past 30 years.

Emergent and floating vegetation currently grow along the edges of the lake. Most of this vegetation consists of cattails (*Typha sp.*) and spatterdock (*Nuphar advena*) with areas of water hyacinth (*Eichhornia crassipes*), water lettuce (*Pistia stratiotes*), and giant bulrush (*Schoenoplectus californicus*). Herbicide treatments minimize the presence of exotic species but there are a wide variety scattered along much of the shorelines including Peruvian primrosewillow (*Ludwigia peruviana*), taro (*Colocasia esculenta*), and torpedograss (*Panicum repens*).

4.0 FORESTED WETLAND

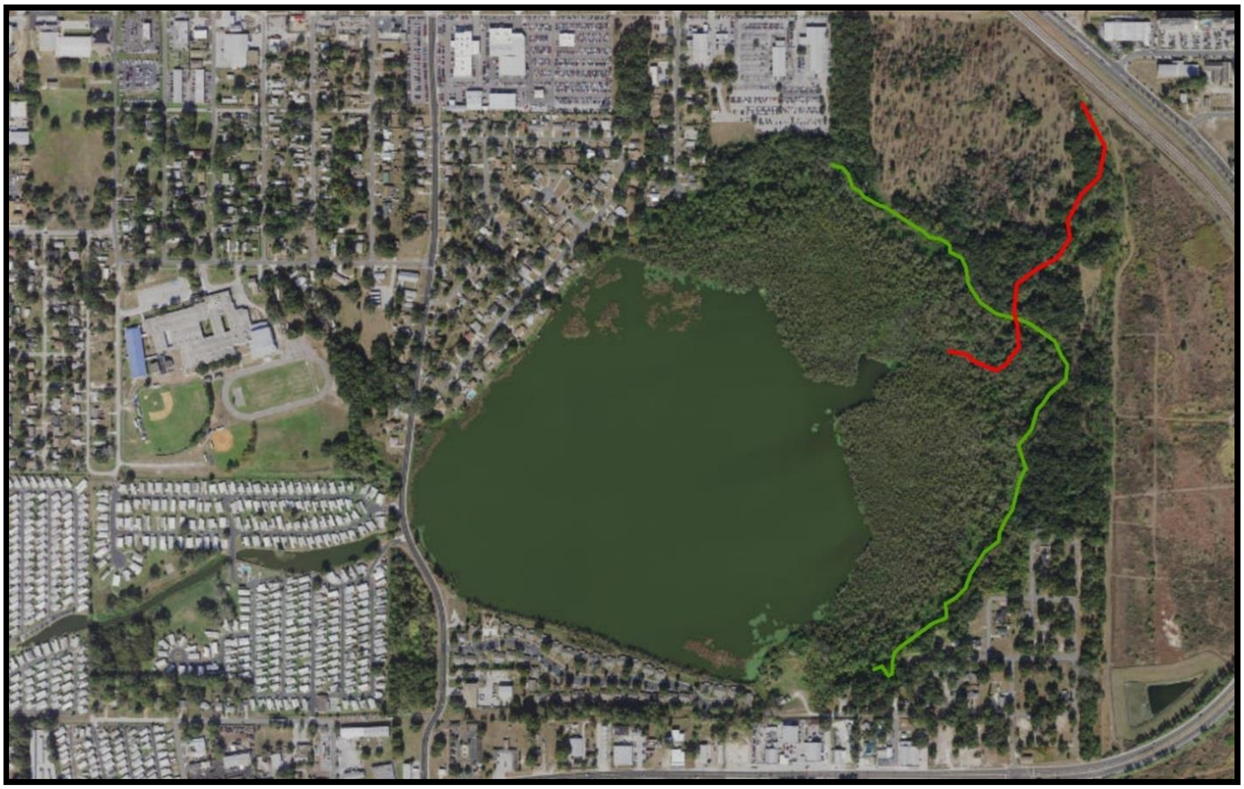
A forested wetland system dominates the eastern edge of Lake Bonnet. The forested area exhibits two distinct zones. The waterward side contains a shorter (<5 meters) canopy containing primarily red maple (*Acer rubrum*), wax myrtle (*Myrica cerifera*), and Carolina willow (*Salix caroliniana*) with an understory of Virginia chain fern (*Woodwardia virginica*). The landward side contains much larger (>10 meters) and mature trees with a mix of red maple, sweetbay (*Magnolia virginiana*), sweetgum (*Liquidambar styraciflua*), water oak (*Quercus nigra*), and laurel oak (*Quercus laurifolia*). Understory vegetation consists of marsh fern (*Thelypteris sp*.), Virginia chain fern (*Woodwardia virginica*), yaupon (*Ilex vomitoria*), swamp dogwood (*Cornus foemina*), Virginia willow (*Itea virginica*), arrow arum (*Peltandra sp*.), and elderberry (*Sambucus nigra*). Along the upland edge of the wetland woodbine (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), and Boston fern (*Nephrolepis exaltata*) become more prevalent.

A stream, seen in red in **Figure C-4**, enters the forested wetland from the northeast and is fed by a large drainage flume which conveys stormwater runoff from upgradient areas. The stream has a defined channel as it enters the wetland and becomes a braided channel transitioning to an alluvial delta as it meanders toward the open lake. At the time of the field investigation the stream had a low flow fed only by the seep. Alluvial sand deposits along the channel indicate much higher flows during storm events. This area has a large amount of trash throughout presumably washed in from the upstream drainage structures.

Wood scientists conducted soil probes from the upland edge into this wetland to ascertain the extent of the muck underlying the root structure of the wetland. A 5/16" fiberglass rod was used to probe for muck depth. At approximately 150 feet of the upland edge, the rod could be easily pushed to 6 feet deep below ground surface. Ground ripples were observed because of impacts to the ground surface which indicates that much of the forested wetland is "floating" above a muck layer. The floating nature of the forested wetland indicates that careful planning and monitoring of excavated sediment near the wetlands will be important to avoid physical collapse of the ground surface and subsequently the forested wetland tree canopy.

A wetland delineation was performed along the east half of the lake by Chastain-Skillman and later modified by Breedlove, Dennis and Associates. It is Wood's understanding that this is a preliminary line and has not yet been verified by the regulatory agencies. A depiction of the wetland line, shown in green, is included in **Figure C-4**.

Figure C-4 - Current Aerial Photograph and Preliminary Wetland Limits



5.0 UPLAND AREAS

Wood scientists conducted a limited investigation of the uplands to the northeast and east sides of Lake Bonnet to observe drainage patterns and determine suitable locations for a dredged material management area (DMMA). The northeast upland was under citrus production until the late 1980's and by early 1994 the site was cleared of trees. Since then, shrubs and trees have been colonizing the site. These consist primarily of black cherry (*Prunus serotina*) and cabbage palm (*Sabal palmetto*). The ground cover is largely bahiagrass (*Paspalum notatum*).

The upland immediately adjacent to the east side of Lake Bonnet is a live oak (*Quercus virginiana*) forest with scattered laurel oak (*Quercus laurifolia*) and chinaberry (*Melia azedarach*). The groundcover and shrub layer has been recently removed and mulched. Wood identified a large open field further east up a steep bank. This is the previous site of the CSX railway switchyard. The entire field appears to be upland although a complete wetland determination was not included in this scope of work. At least two ditches drain the field through the oak forest and have carved a deep-water course down the incline.

A large drainage structure enters the site from the north under Kathleen Road. The stormwater travels down a concrete flume through a large corrugated metal pipe to discharge into a ditch. The structure apparently carries high volumes of stormwater that has caused significant erosion of the ditch. This ditch eventually discharges into the forested wetland as described above.

6.0 WILDLIFE

Wood conducted a preliminary listed species impact assessment for the proposed project. Very little wildlife was observed during the site visits apart from a few songbirds and wading birds. The project lies within the consultation area of several listed species including crested caracara (*Caracara cheriway*), snail kite (*Rostrhamus sociabilis*), Florida grasshopper sparrow (*Ammodramus savannarum floridanus*), Florida scrub jay (*Aphelocoma coerulescens*), and it is within the core foraging area of six wood stork (*Mycteria americana*) colonies. The project area does not contain appropriate habitat for caracara, scrub jay, or sparrows. It has poor to moderate habitat for snail kite and wood stork. The temporary impacts associated with the proposed project will not have any permanent negative effects on these species and will improve habitat for them. There is no known American bald eagle (*Haliaeetus leucocephalus*) nests within the project or within a 660 feet disturbance buffer of the site. Therefore, the proposed project is not likely to adversely affect any of these listed species.

The upland to the northeast that is a potential DMMA, shown in red, is within the consultation area for Florida sand skink (*Neoseps reynoldsi*) and contains appropriate mapped soils for this species (**Figure C-5**). The relatively dense groundcover is not ideal habitat for this species which prefer deep loose sandy soils. The area's previous land use as a citrus grove, a skink habitat type, indicates the potential presence of this species. The site is isolated from other larger viable skink habitats, so it is doubtful that they persist on the proposed project site. Based on the elevation, soil type, and site conditions, the United States Fish and Wildlife Service may require a coverboard survey to confirm the presence or absence of sand skinks in this area before development.

Figure C-5 - Potential Sand Skink Habitat

APPENDIX D

Stormwater Tables

APPENDIX D

DIRECTORY

Table D-1
Published Runoff Coefficients (c) for Meteorological Zone 2 Based on Non-DCIA CN and Percent DCIA

NDCIA CN	PERCENT DCIA																				
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	0.002	0.043	0.083	0.123	0.164	0.204	0.244	0.285	0.325	0.366	0.406	0.446	0.487	0.527	0.567	0.608	0.648	0.688	0.729	0.769	0.809
35	0.004	0.044	0.085	0.125	0.165	0.205	0.246	0.286	0.326	0.366	0.407	0.447	0.487	0.528	0.568	0.608	0.648	0.689	0.729	0.769	0.809
40	0.007	0.047	0.087	0.127	0.167	0.207	0.248	0.288	0.328	0.368	0.408	0.448	0.488	0.528	0.569	0.609	0.649	0.689	0.729	0.769	0.809
45	0.01	0.05	0.09	0.13	0.17	0.21	0.25	0.29	0.33	0.37	0.41	0.45	0.49	0.53	0.57	0.61	0.65	0.69	0.729	0.769	0.809
50	0.015	0.055	0.095	0.134	0.174	0.214	0.254	0.293	0.333	0.373	0.412	0.452	0.492	0.531	0.571	0.611	0.651	0.69	0.73	0.77	0.809
55	0.022	0.061	0.101	0.14	0.179	0.219	0.258	0.298	0.337	0.376	0.416	0.455	0.494	0.534	0.573	0.613	0.652	0.691	0.731	0.77	0.809
60	0.03	0.069	0.108	0.147	0.186	0.225	0.264	0.303	0.342	0.381	0.42	0.459	0.498	0.537	0.576	0.615	0.654	0.693	0.731	0.77	0.809
65	0.042	0.08	0.119	0.157	0.195	0.234	0.272	0.311	0.349	0.387	0.426	0.464	0.502	0.541	0.579	0.618	0.656	0.694	0.733	0.771	0.809
70	0.057	0.095	0.133	0.17	0.208	0.245	0.283	0.321	0.358	0.396	0.433	0.471	0.509	0.546	0.584	0.621	0.659	0.697	0.734	0.772	0.809
75	0.079	0.116	0.152	0.189	0.225	0.262	0.298	0.335	0.371	0.408	0.444	0.481	0.517	0.554	0.59	0.627	0.663	0.7	0.736	0.773	0.809
80	0.111	0.146	0.181	0.216	0.251	0.285	0.32	0.355	0.39	0.425	0.46	0.495	0.53	0.565	0.6	0.635	0.67	0.705	0.74	0.774	0.809
85	0.16	0.192	0.225	0.257	0.29	0.322	0.355	0.387	0.42	0.452	0.485	0.517	0.55	0.582	0.614	0.647	0.679	0.712	0.744	0.777	0.809
90	0.242	0.27	0.299	0.327	0.355	0.384	0.412	0.44	0.469	0.497	0.526	0.554	0.582	0.611	0.639	0.667	0.696	0.724	0.753	0.781	0.809
95	0.404	0.424	0.444	0.464	0.485	0.505	0.525	0.546	0.566	0.586	0.606	0.627	0.647	0.667	0.688	0.708	0.728	0.749	0.769	0.789	0.809
98	0.595	0.605	0.616	0.627	0.638	0.648	0.659	0.67	0.68	0.691	0.702	0.713	0.723	0.734	0.745	0.756	0.766	0.777	0.788	0.799	0.809

Source: Stormwater Quality Applicant's Handbook, Design Requirements for storm water Treatment Systems in Florida, March 2010 Draft

Table D-2
Summary of Curve Numbers Based on Land use and Soil Group

FLUCCS	Generalized Land Use Description	Hydrologic Soils Group					
		A	B	B/D	C	D	W
1100	Residential-Low Density	39	61	61	74	80	99.8
1200	Residential-Med Density	39	61	61	74	80	99.8
1300	Residential-High Density	39	61	61	74	80	99.8
1400	Commercial	39	61	61	74	80	99.8
1500	Industrial	39	61	61	74	80	99.8
1600	Extractive	39	61	61	74	80	99.8
1700	Institutional	39	61	61	74	80	99.8
1800	Recreational	39	61	80	74	80	99.8
1900	Open Land	39	61	80	74	80	99.8
2100	Cropland and Pastureland	39	61	80	74	80	99.8
2200	Tree Crops - Citrus	32	58	79	72	79	99.8
2300	Feeding Operations	32	58	79	72	79	99.8
2400	Nurseries and Vineyards	67	78	89	85	89	99.8
2500	Specialty Farms	67	78	89	85	89	99.8
2600	Other Open Lands - Rural	39	61	80	74	80	99.8
3100	Herbaceous Rangeland	39	61	80	74	80	99.8
3200	Shrub and Brush Rangeland	30	48	73	65	73	99.8
3300	Mixed Rangeland	30	48	73	65	73	99.8
4100	Upland Coniferous Forest	32	58	79	72	79	99.8
4200	Upland Hardwood Forests	32	58	79	72	79	99.8
4300	Mixed Hardwood Forests	32	58	79	72	79	99.8

Table D-2 (Continued)
Summary of Curve Numbers Based on Land use and Soil Group

FLUCCS	Generalized Land Use Description	Hydrologic Soils Group					
		A	B	B/D	C	D	W
4400	Tree Plantations	32	58	79	72	79	99.8
5000	Water	99.8	99.8	99.8	99.8	99.8	99.8
5100	Streams and Waterways	99.8	99.8	99.8	99.8	99.8	99.8
5200	Lakes	99.8	99.8	99.8	99.8	99.8	99.8
5300	Reservoirs	99.8	99.8	99.8	99.8	99.8	99.8
6100	Wetland Hardwood Forests	99.8	99.8	99.8	99.8	99.8	99.8
6200	Wetland Coniferous Forests	99.8	99.8	99.8	99.8	99.8	99.8
6300	Wetland Forested Mixed	98	98	98	98	98	99.8
6400	Vegetated Non-Forested Wetlands	98	98	98	98	98	99.8
7400	Mining	39	61	80	74	80	99.8
8100	Transportation / Utilities	83	89	89	92	93	99.8
8200	Communications	83	89	89	92	93	99.8
8300	Utilities	83	89	89	92	93	99.8

Table D-3
Generalized Parameter Assignments for DCIA % and Impervious %

FLUCCS	Generalized Landuse Description	DCIA%	IMP %
1100	Residential Low Density	1	3
1200	Residential Medium Density	20	27
1300	Residential- High Density	40	50
1400	Commercial	40	71
1500	Industrial	72	77
1700	Institutional	20	27
1800	Recreational	10	10
1900	Open Land	0	0
2100	Cropland and Pastureland	0	0
4200	Upland Hardwood Forest	0	0
5000	Water	100	100
6100	Wetland Hardwood Forests	100	100
6300	Wetland Forested Mixed	100	100
6400	Vegetated Non-Forested Wetland	100	100
8100	Transportation/ Utilities	25	25

Table D-4
Summary of Literature-Based Runoff Characterization for General Land use Categories in Florida

Land Use Category	Typical Runoff Concentration (mg/l)						
	TN	TP	BOD	TSS	Cu	Pb	Zn
Low-Density Residential[1]	1.5	0.18	4.7	23	0.008[4]	0.002[4]	0.031[4]
Single-Family	1.85	0.31	7.9	37.5	0.016	0.004	0.062
Multi-Family	1.91	0.48	11.3	77.8	0.009	0.006	0.086
Low-Intensity Commercial	0.93	0.16	7.7	57.5	0.018	0.005	0.094
High-Intensity Commercial	2.48	0.23	11.3	69.7	0.015	--	0.16
Light Industrial	1.14	0.23	7.6	60	0.003	0.002	0.057
Highway	1.37	0.17	5.2	37.3	0.032	0.011	0.126
Pasture	2.48	0.7	5.1	94.3	--	--	--
Citrus	2.31	0.16	2.55	15.5	0.003	0.001	0.012
Row Crops	2.47	0.51	--	19.8	0.022	0.004	0.03
General Agriculture[2]	2.42	0.46	3.8	43.2	0.013	0.003	0.021
Undeveloped / Rangeland / Forest	1.15	0.055	1.4	8.4	--	--	--
Mining / Extractive	1.18	0.15	7.6[3]	60.0[3]	0.003[3]	0.002[3]	0.057[3]
Wetland	1.01	0.09	2.63	11.2	0.001	0.001	0.006
Open Water / Lake	1.6	0.067	1.6	3.1		0.025[5]	0.028

1. Average of single-family and undeveloped loading rates
2. Mean of pasture, citrus, and row crop land uses
3. Runoff concentrations assumed equal to industrial values for these parameters
4. Value assumed to be equal to 50% of single-family concentration
5. Runoff concentrations assumed equal to wetland values for these parameters

Notes: This table is a replica of the Table 4-17 in the Final Report of "Evaluation of Current Stormwater Design Criteria within the state of Florida" prepared for: Florida Department of Environmental Protection (June 2007). Prepared by Environmental Research & Design, Inc. Harvey H. Harper, Ph.D., P.E. & David M. Baker, P.E.

Total N and Total P EMC values are from the Table 3.4 in March 2010 Draft Department of Environmental Protection and Water Management Districts Environmental Resource Permit Stormwater Quality Applicant's Handbook Design Requirements for Stormwater Treatment Systems in Florida.

Wetland and Open Water/Lake EMC values are from Table 7 of the Final Report of "Evaluation of Alternative Stormwater Regulations for Southwest Florida". (Revised Sept 08, 2003) Submitted to Water Enhancement & Restoration Coalition, Inc. Prepared by Environmental Research & Design, Inc. Harvey H. Harper, Ph.D., P.E. & David M. Baker, P.E.

TABLE D-5
Summary of Event Mean Concentration Values used for Landuse Types

Land Use Category	Typical Runoff Concentration (mg/l)		
	TN	TP	TSS
Mixed Landuse or Single Family Residential	2.4	0.45	49

Values based on monitoring-specific data from Lake Hunter and Lake Bonny basins.

TABLE D-6

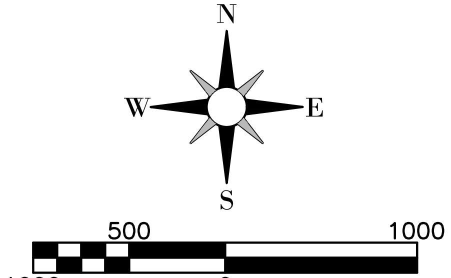
Mean Annual Mass Removal Efficiencies for 0.50-inches of Retention in Zone 2 Based on Non-DCIA CN and Percent DCIA

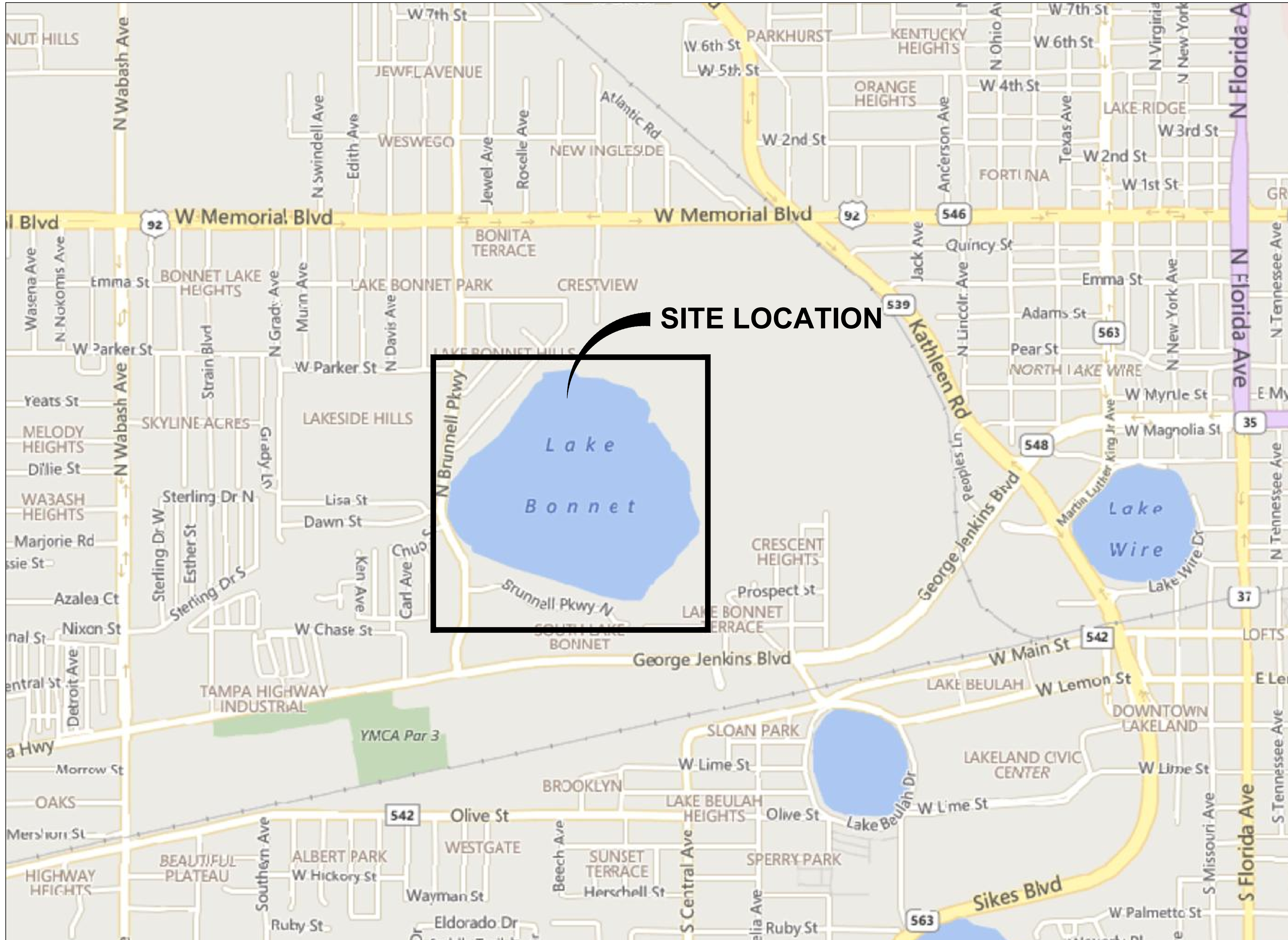
NDCIA	Percent DCIA																			
CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	97.0	96.7	94.8	91.7	87.9	83.8	79.7	75.7	71.9	68.4	65.2	62.1	59.4	56.9	54.5	52.3	50.3	48.4	46.7	45.1
35	95.2	95.5	93.8	90.9	87.3	83.4	79.3	75.4	71.7	68.3	65.0	62.1	59.3	56.8	54.4	52.3	50.3	48.4	46.7	45.1
40	92.9	94.0	92.5	89.9	86.5	82.7	78.9	75.1	71.4	68.0	64.9	61.9	59.2	56.7	54.4	52.2	50.2	48.4	46.7	45.1
45	90.2	91.9	90.9	88.6	85.5	81.9	78.2	74.6	71.1	67.7	64.6	61.7	59.1	56.6	54.3	52.2	50.2	48.4	46.7	45.1
50	86.7	89.2	88.9	87.0	84.2	80.9	77.4	73.9	70.5	67.3	64.3	61.5	58.9	56.5	54.2	52.1	50.2	48.3	46.6	45.1
55	82.7	86.1	86.4	84.9	82.6	79.6	76.4	73.1	69.9	66.8	63.9	61.2	58.6	56.3	54.1	52.0	50.1	48.3	46.6	45.1
60	78.5	82.6	83.4	82.5	80.6	78.0	75.1	72.1	69.1	66.1	63.4	60.8	58.3	56.0	53.9	51.9	50.0	48.2	46.6	45.1
65	74.2	78.6	79.8	79.5	78.1	76.0	73.5	70.7	68.0	65.3	62.7	60.2	57.9	55.7	53.6	51.7	49.9	48.2	46.6	45.1
70	69.8	74.2	75.8	76.0	75.2	73.5	71.4	69.1	66.6	64.2	61.8	59.5	57.3	55.3	53.3	51.4	49.7	48.1	46.5	45.1
75	65.4	69.6	71.4	71.9	71.5	70.4	68.8	66.9	64.9	62.7	60.6	58.6	56.6	54.7	52.8	51.1	49.5	47.9	46.5	45.1
80	61.4	64.9	66.6	67.3	67.2	66.5	65.5	64.1	62.5	60.8	59.0	57.3	55.5	53.9	52.2	50.7	49.2	47.7	46.4	45.1
85	57.6	60.1	61.6	62.2	62.3	62.0	61.3	60.4	59.3	58.1	56.8	55.4	54.0	52.7	51.3	50.0	48.7	47.4	46.2	45.1
90	54.1	55.4	56.2	56.7	56.8	56.7	56.4	55.9	55.2	54.5	53.6	52.8	51.8	50.9	49.9	48.9	47.9	46.9	46.0	45.1
95	50.1	50.5	50.7	50.8	50.8	50.8	50.6	50.4	50.2	49.9	49.5	49.1	48.7	48.2	47.7	47.2	46.7	46.1	45.6	45.1
98	47.8	47.7	47.7	47.6	47.6	47.5	47.4	47.2	47.1	46.9	46.8	46.6	46.5	46.3	46.1	45.9	45.7	45.5	45.3	45.1

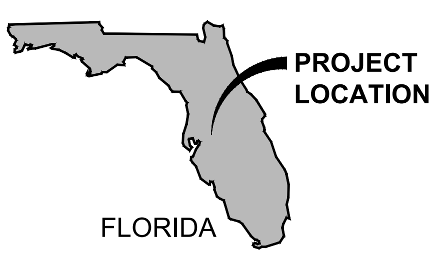
Source: Evaluation of Current Stormwater Design Criteria within the State of Florida- Final Report." FDEP Contract No. SO108

APPENDIX E

Dredge Concepts







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DRAWN BY:	M. VIVES	DATE:	11/30/2018
CHECKED BY:	L. GARCIA	PROJECT NO.	600537x5
APPROVED BY:	J. WAGNER		

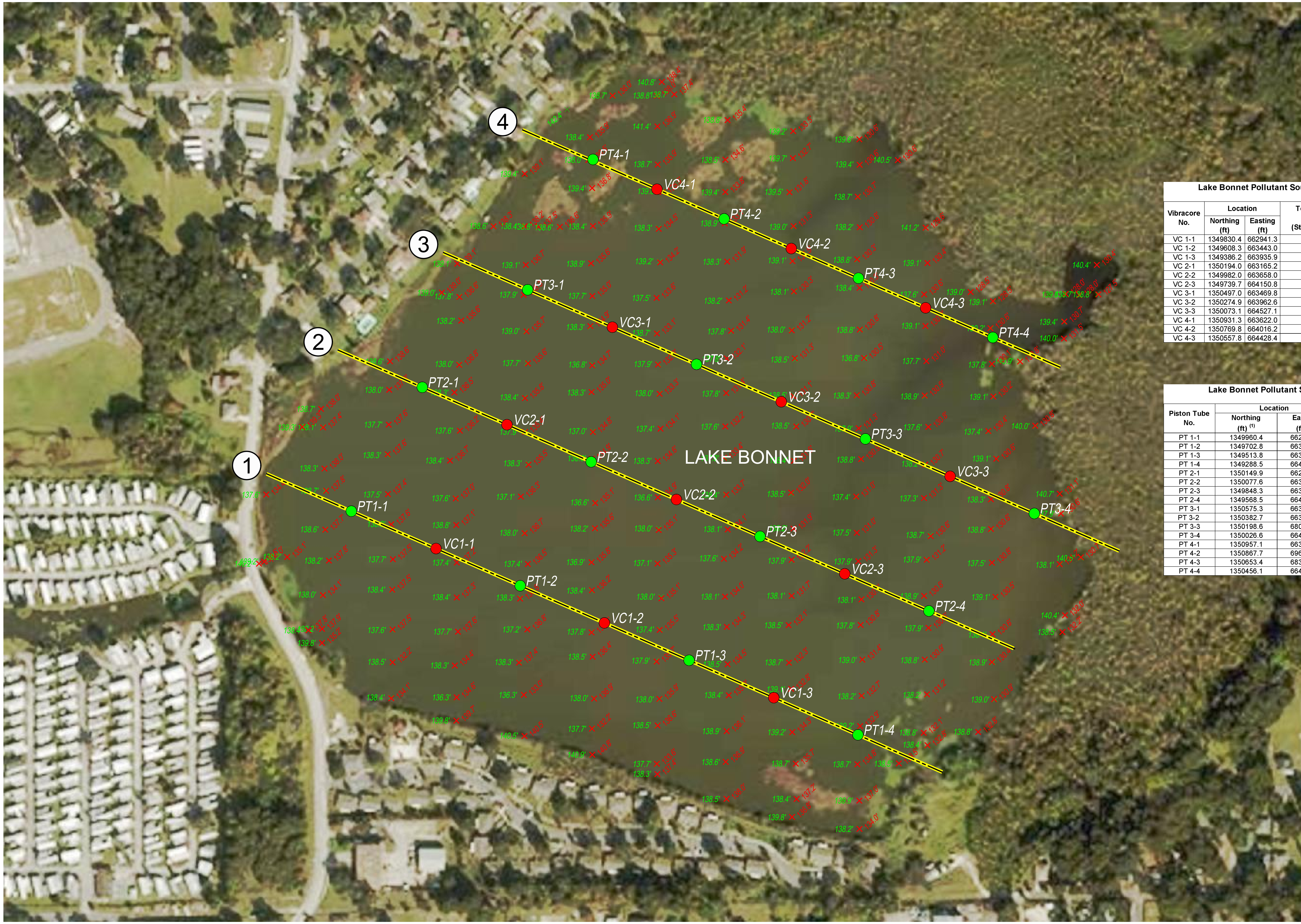
CITY OF LAKELAND

FIGURE E-1

SITE LOCATION MAP

LAKE BONNET POLLUTANT SOURCE REDUCTION FEASIBILITY STUDY

LAKELAND, POLK COUNTY, FLORIDA



LEGEND

× HARD BOTTOM

× TOP OF SEDIMENT

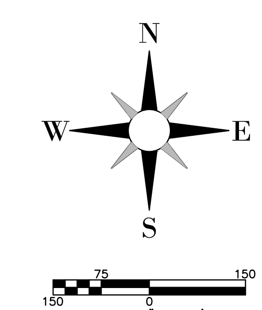
AVERAGE LAKE WATER ELEVATION = 144.0'
(MEASURED FROM 3/6/2018 TO 3/17/2018)
SURVEY DATA IS BASED ON STATE PLANE SYSTEM,
FLORIDA STATE PLANE EAST (NAD 83).
VERTICAL DATUM: FLORIDA EAST (NAVD 88).
ALL DIMENSIONS ARE IN FEET.

Lake Bonnet Pollutant Source Reduction Feasibility Study - Vibracore Data Summary

Vibracore No.	Location		Top of Muck Deposit (Stratum 1) (ft)	Top of Sandy Soil Elevation (Stratum 2) (ft)	Top of Clayey Soil Elevation (Stratum 3) (ft)	Bottom Elevation of Recovery (ft)
	Northing (ft)	Easting (ft)				
VC 1-1	1349830.4	662941.3	138.0	138.0	-	133.6
VC 1-2	1349608.3	663443.0	138.0	137.3	135.0	133.3
VC 1-3	1349386.2	663935.9	139.0	136.3	-	133.0
VC 2-1	1350194.0	663165.2	138.0	136.4	132.7	130.9
VC 2-2	1349982.0	663658.0	138.0	137.7	134.3	134.0
VC 2-3	1349739.7	664150.8	138.5	123.3	-	120.4
VC 3-1	1350497.0	663469.8	138.0	134.8	-	130.5
VC 3-2	1350274.9	663962.6	138.5	132.3	-	127.7
VC 3-3	1350073.1	664527.1	139.0	134.0	129.5	127.0
VC 4-1	1350931.3	663622.0	139.0	136.0	-	131.7
VC 4-2	1350769.8	664016.2	139.0	130.9	-	126.7
VC 4-3	1350557.8	664428.4	139.0	123.7	-	121.9

Lake Bonnet Pollutant Source Reduction Feasibility Study - Piston Tube Survey Data

Piston Tube No.	Location		Top of Muck Deposit (Stratum 1) (ft)	Top of Sandy Soil Elevation (Stratum 2) (ft)	Top of Clayey Soil Elevation (Stratum 3) (ft)	Bottom Elevation of Recovery (ft)
	Northing (ft) [(1)]	Easting (ft) [(1)]				
PT 1-1	1349960.4	662699.9	138.0	137.5	-	137.5
PT 1-2	1349702.8	663138.0	138.0	135.0	-	135.0
PT 1-3	1349513.8	663615.4	138.5	131.5	-	131.5
PT 1-4	1349288.5	664112.2	138.5	131.5	-	131.5
PT 2-1	1350149.9	662796.1	138.0	137.5	-	137.5
PT 2-2	1350077.6	663418.5	138.0	134.0	-	134.0
PT 2-3	1349848.3	663902.5	138.0	132.0	-	132.0
PT 2-4	1349568.5	664463.7	139.0	115.0	-	115.0
PT 3-1	1350575.3	663237.9	138.0	134.5	-	134.5
PT 3-2	1350382.7	663689.5	138.0	130.0	-	130.0
PT 3-3	1350198.6	680429.1	138.0	-	127.0	127.0
PT 3-4	1350026.6	664641.1	139.0	-	124.0	124.0
PT 4-1	1350957.1	663512.0	139.0	133.0	-	133.0
PT 4-2	1350867.7	696137.0	139.0	131.0	-	131.0
PT 4-3	1350653.4	683600.0	138.5	-	123.0	123.0
PT 4-4	1350456.1	664627.5	138.0	-	121.0	121.0



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CHECKED BY:	L. GARCIA
APPROVED BY:	J. WAGNER

SCALE:	AS SHOWN
DATE:	11/30/2018
PROJECT NO.	600537X5

CITY OF LAKELAND

FIGURE E-2

BATHYMETRIC DATA (SEDIMENT PROBES, VIBRACORES, PISTON-TUBES)
LAKE BONNET POLLUTANT SOURCE REDUCTION FEASIBILITY STUDY
LAKELAND, POLK COUNTY, FLORIDA

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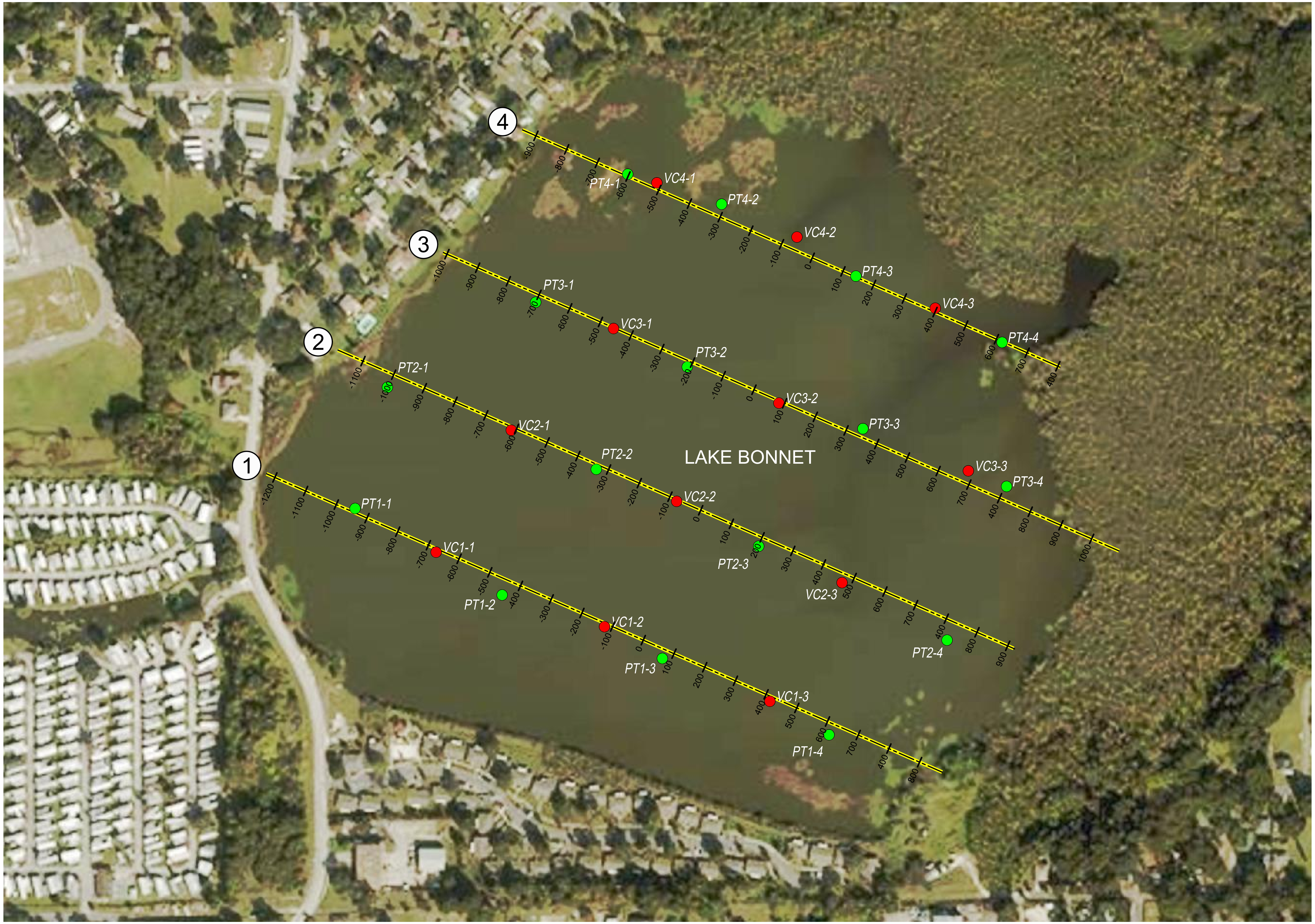
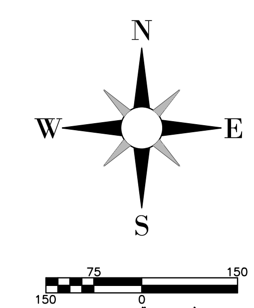


LEGEND

- APPROXIMATE LOCATION OF VIBRACORES
- APPROXIMATE LOCATION OF PISTON TUBES
- TRANSECT LOCATION

NOTE:
BATHYMETRIC SURVEY (SEDIMENT PROBES) PERFORMED ON MARCH 6 TO MARCH 14 OF 2018.
VIBRACORES WORKS PERFORMED ON APRIL 3 AND 4 OF 2018.
PISTON TUBES SAMPLES PERFORMED ON APRIL 6 TO 9 OF 2018.

AVERAGE LAKE WATER ELEVATION = 144.0'
(MEASURED FROM 3/6/2018 TO 3/17/2018)
SURVEY DATA IS BASED ON STATE PLANE SYSTEM, FLORIDA STATE PLANE EAST (NAD 83).
VERTICAL DATUM: FLORIDA EAST (NAVD 88).
ALL DIMENSIONS ARE IN FEET.



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APPROVED BY:	J. WAGNER		

CITY OF LAKELAND

FIGURE E-3

TRANSECTS & SAMPLE LOCATIONS

LAKE BONNET POLLUTANT SOURCE REDUCTION FEASIBILITY STUDY

LAKELAND, POLK COUNTY, FLORIDA

PROJECT NUMBER: 600537X5 CITY: TAMPA
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LEGEND

- APPROXIMATE LOCATION OF VIBRACORES
- APPROXIMATE LOCATION OF PISTON TUBES
- TRANSECT LOCATION

STATIONS EXCEEDING CLEANUP TARGET LEVELS

PT1-4

ARSENIC - 3.3 µg/kg (SCTL)

CHROMIUM - 43 mg/kg (GCTL)

PT3-2

ARSENIC - 3.8 µg/kg (SCTL)

CHROMIUM - 63 mg/kg (GCTL)

PT3-4

CHROMIUM - 59 mg/kg (GCTL)

PT4-3

CHROMIUM - 43 mg/kg (GCTL)

CONTAMINANT CLEANUP TARGET LEVELS

ARSENIC - SCTL RESIDENTIAL

2.1 µg/kg

CHROMIUM - GCTL CRITERIA (LEACH)

38 mg/kg

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SCALE:	AS SHOWN
DATE:	11/30/2018
PROJECT NO.	600537X5

CITY OF LAKELAND

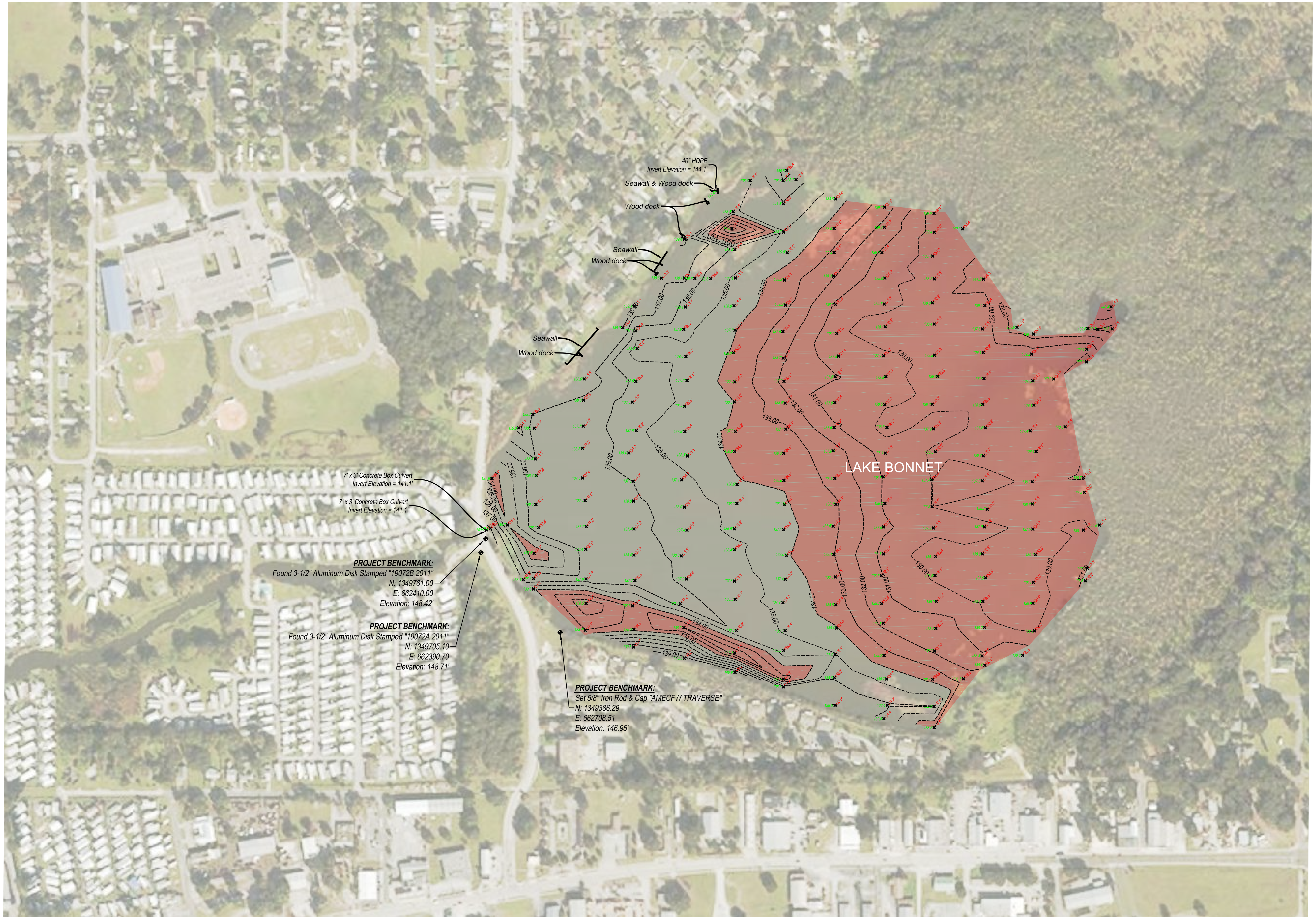
FIGURE E-4

MUCK THICKNESS (STRATUM 1)

LAKE BONNET POLLUTANT SOURCE REDUCTION FEASIBILITY STUDY

LAKELAND, POLK COUNTY, FLORIDA

PROJECT NUMBER: 600537X5 CITY: TAMPA Z:\PROJECTS-C3D\600537 Lake Bonnet\Drawings\2018\Oct_2018\600537X5_Lake Bonnet_Dredging Area.dwg LAYOUT: FIGURE E-4 SAVED: 11/30/2018 2:16 PM PLOTSTYLETABLE: CIVIL-MASTER.CTB PLOTTED: 11/30/2018 3:18 PM DRAWN BY: VIVES, MARTIN



LEGEND

APPROXIMATE LIMITS OF ELEV 135' OR LESS

N W E S

0 200 400 Feet

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SCALE:	AS SHOWN
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PROJECT NO.	600537X5

CITY OF LAKELAND

FIGURE E-5
DREDGING TEMPLATE
LAKE BONNET POLLUTANT SOURCE REDUCTION FEASIBILITY STUDY
LAKELAND, POLK COUNTY, FLORIDA

PROJECT NUMBER: 300537X5 CITY: TAMPA
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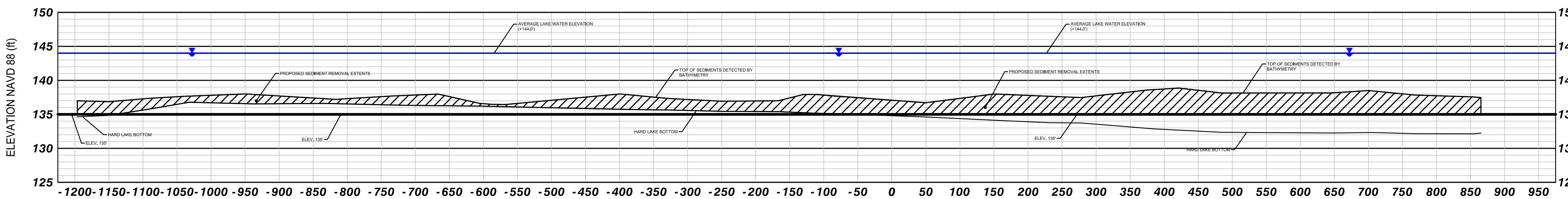

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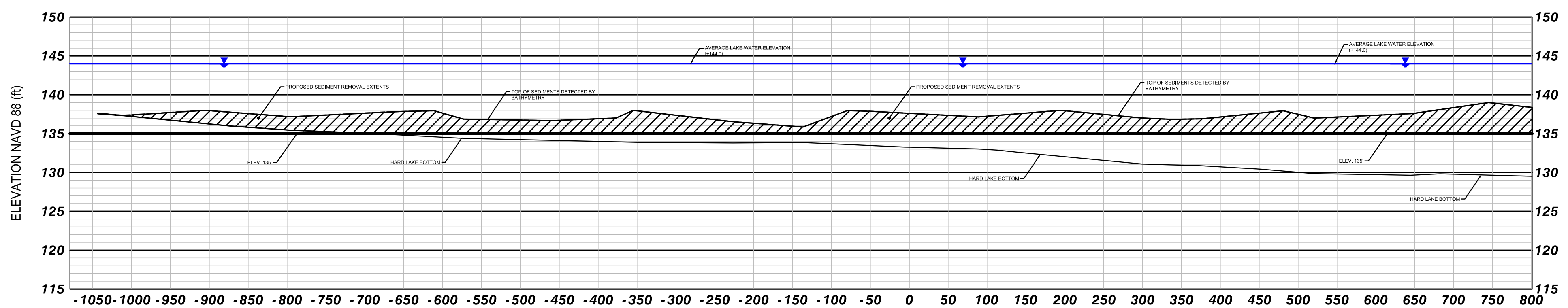

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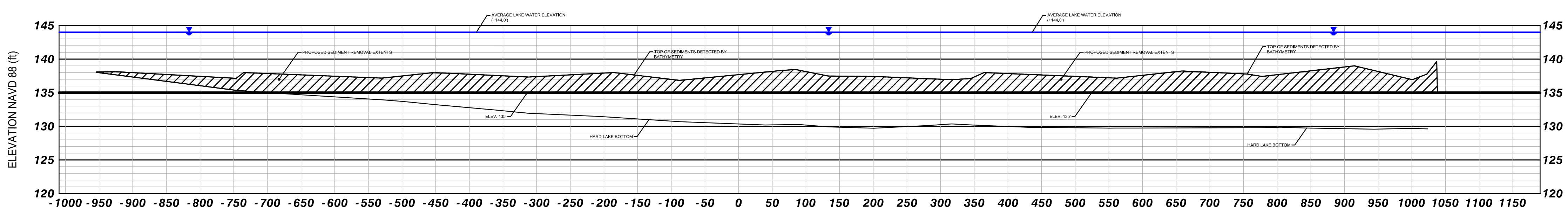

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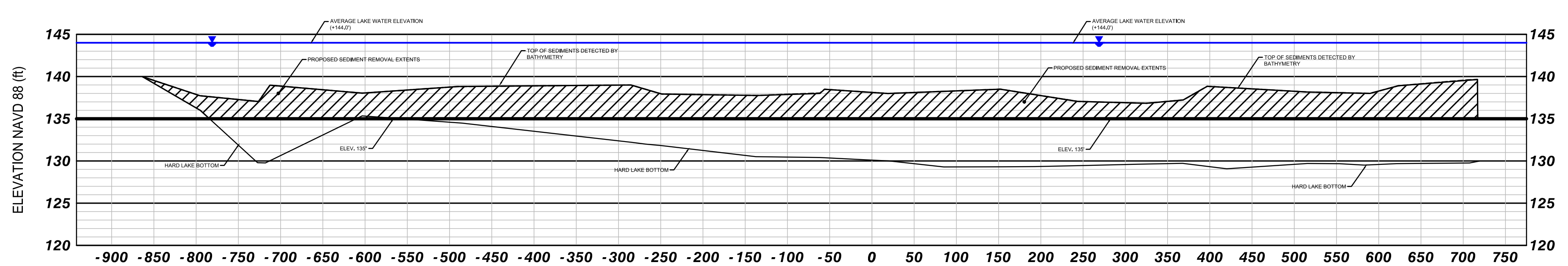

TRANSECT 4

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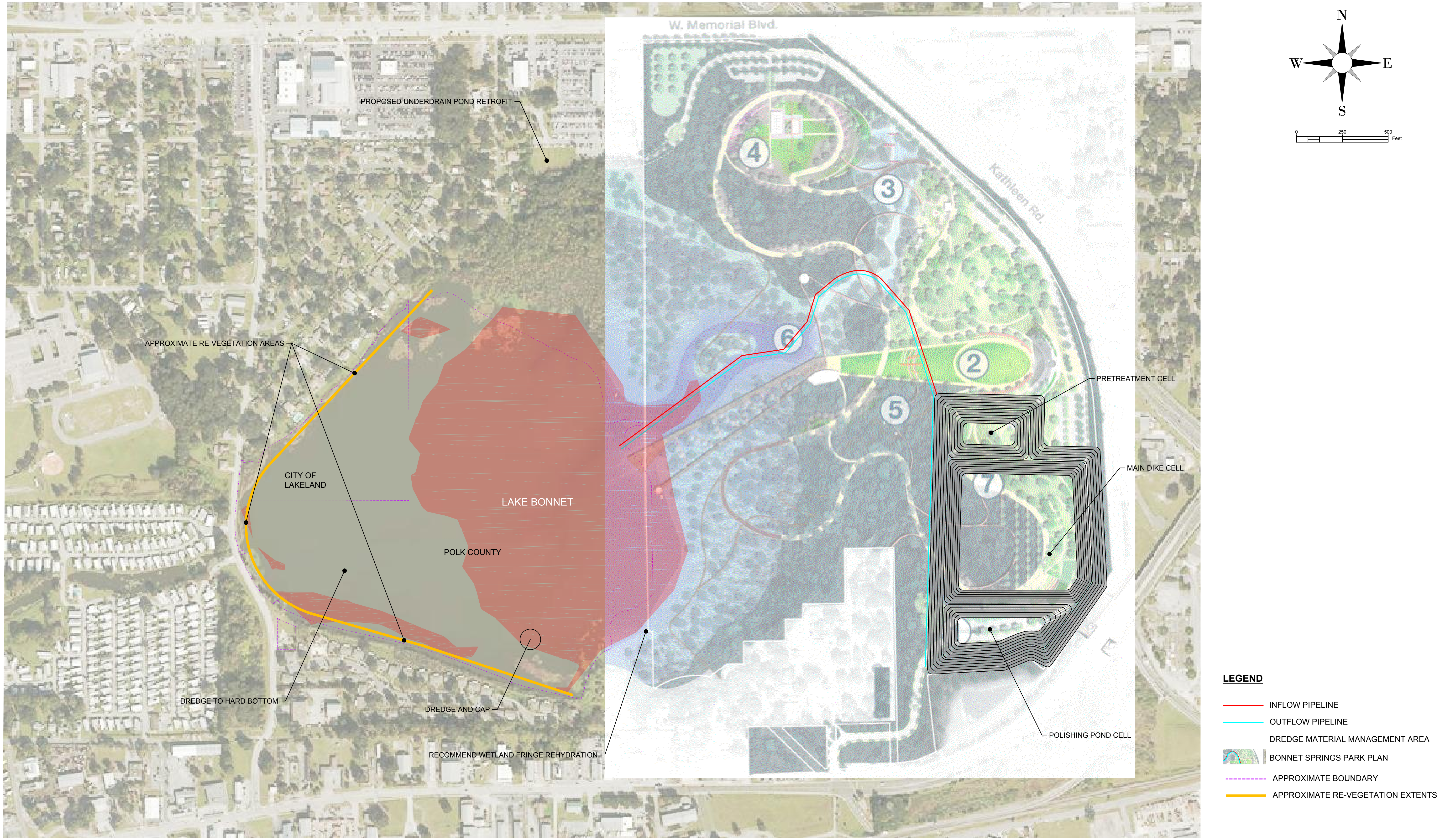
APPROVED BY:	J. WAGNER		

CITY OF LAKELAND

FIGURE E-6
DREDGING CROSS SECTIONS
LAKE BONNET POLLUTANT SOURCE REDUCTION FEASIBILITY STUDY
LAKELAND, POLK COUNTY, FLORIDA

PROJECT NUMBER: 300537X5 CITY: TAMPA
Z:\PROJECTS-C3D\600537 Lake Bonnet\Drawings\2018\Oct_2018\600537X5_Lake Bonnet Surfaces.dwg LAYOUT: FIGURE E-6 SAVED: 11/30/2018 3:16 PM PLOTSTYLETABLE: CIVIL-MASTER.CTB PLOTTED: 11/30/2018 3:18 PM DRAWN BY: VIVES, MARTIN



DATE	REVISIONS

wood.
Environment & Infrastructure Solutions, Inc.
1101 Channelside Drive, Suite 200, Tampa, FL 33602
Phone: 1.813.289.0750 Fax: 1.813.289.5474
www.woodplc.com CA-5392

DESIGNED BY:	J. WAGNER	SCALE:	AS SHOWN
DRAWN BY:	M. VIVES	DATE:	11/30/2018
CHECKED BY:	C. MEHLE	PROJECT NO.	600537X5
APPROVED BY:	J. WAGNER		

CITY OF LAKELAND

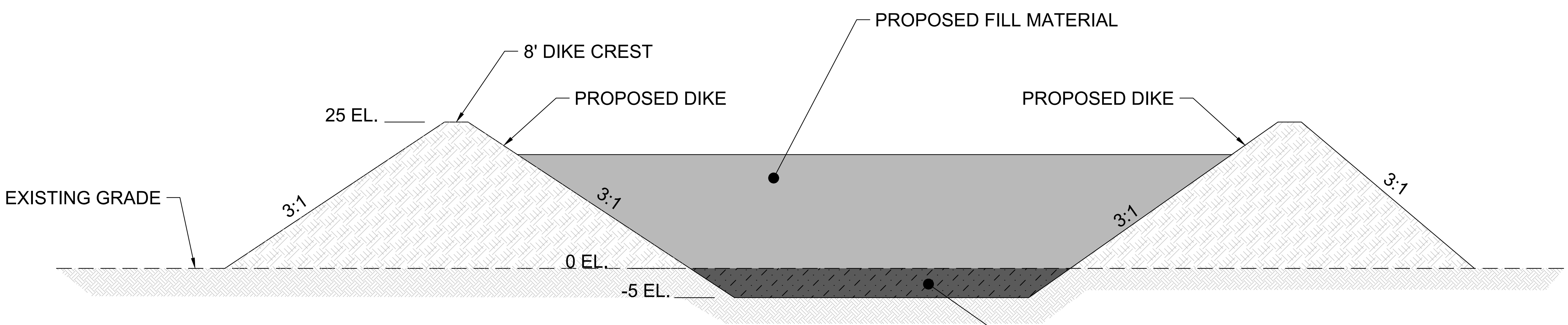
FIGURE E-7

PROPOSED RESTORATION PLAN

LAKE BONNET POLLUTANT SOURCE REDUCTION FEASIBILITY STUDY

LAKELAND, POLK COUNTY, FLORIDA

PROJECT NUMBER: 300537X5 CITY: TAMPA
Z:\PROJECTS-C3D\600537 Lake Bonnet\Drawings\2018\Oct_2018\600537x5_DDMA_Lake Bonnet_Vegetation Plan.dwg LAYOUT: FIGURE E-7 SAVED: 11/30/2018 4:13 PM PLOTSTYLETABLE: CIVIL-MASTER.CTB PLOTTED: 11/30/2018 4:14 PM DRAWN BY: VIVES, MARTIN



SEDIMENT STORAGE AREA

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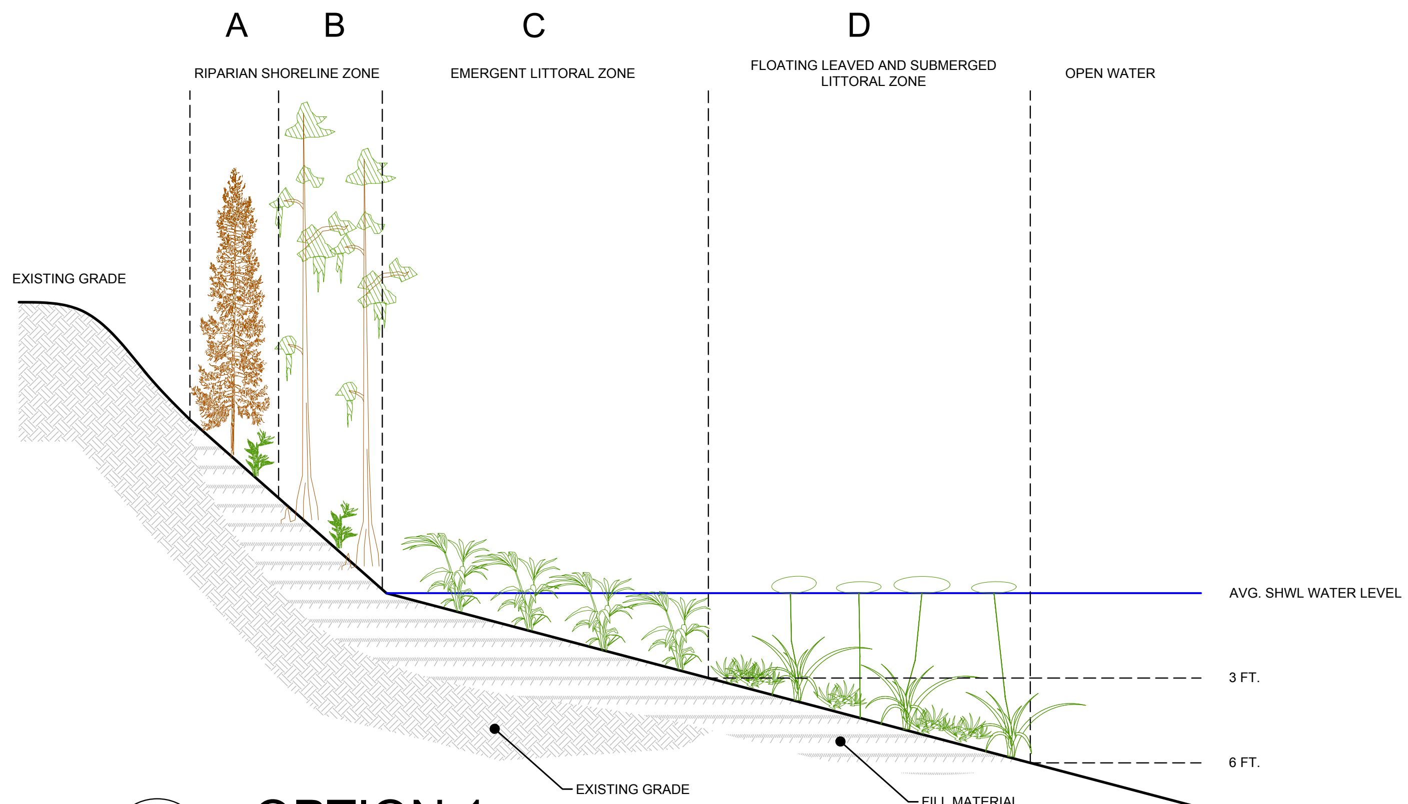
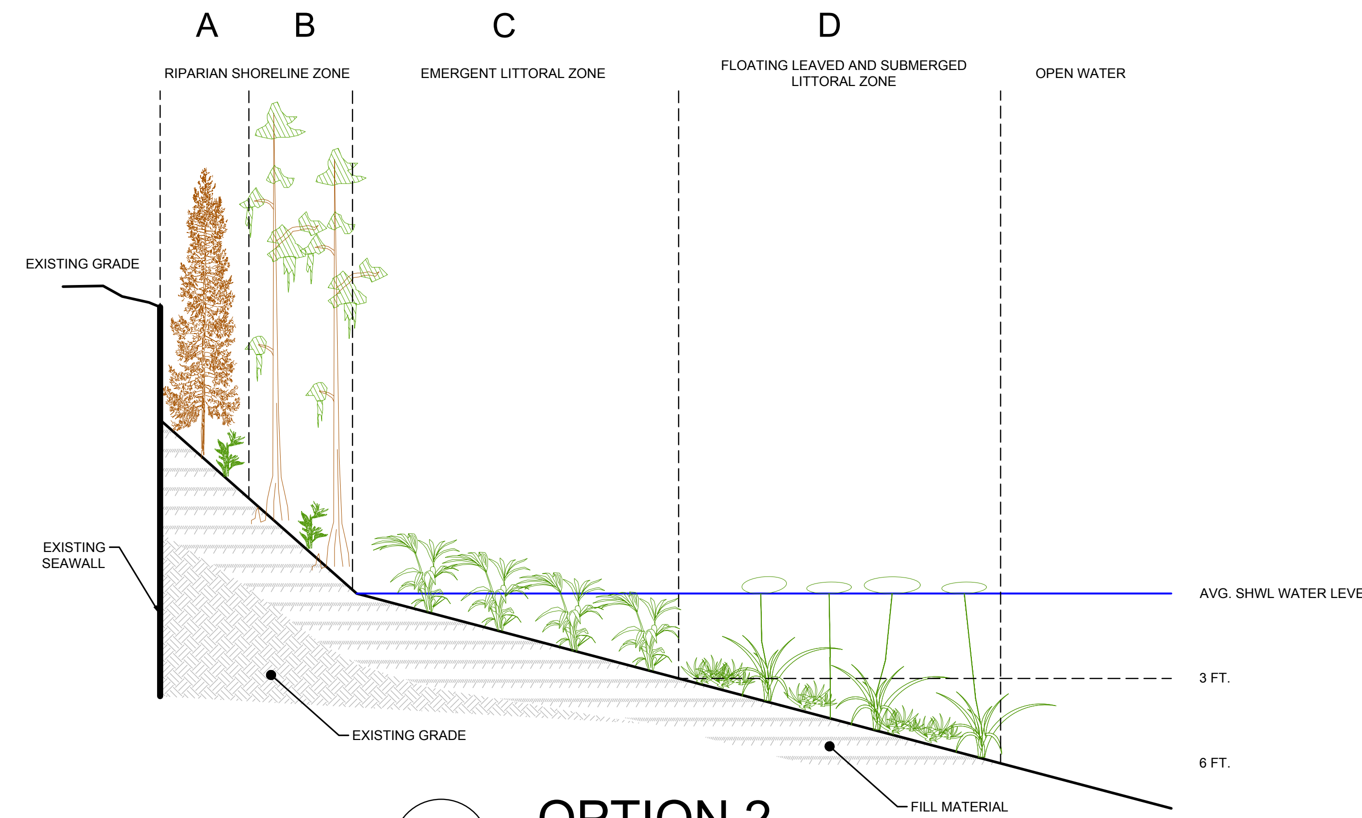
DRAWN BY:	M. VIVES	DATE:	11/30/2018
CHECKED BY:	C. MEHLE	PROJECT NO.	600537X5
APPROVED BY:	J. WAGNER		

CITY OF LAKELAND
FIGURE E-8
SEDIMENT STORAGE AREA
LAKE BONNET POLLUTANT SOURCE REDUCTION FEASIBILITY STUDY
LAKELAND, POLK COUNTY, FLORIDA

PROJECT NUMBER: 300537X5 CITY: TAMPA
Z:\PROJECTS-C3D\600537 Lake Bonnet\Drawings\2018\Oct_2018\600537x5_DDMA_Lake Bonnet Storage Area.dwg LAYOUT: FIGURE E-8 SAVED: 11/30/2018 2:27 PM PLOTSTYLETABLE: CIVIL-MASTER.CTB PLOTTED: 11/30/2018 3:18 PM DRAWN BY: VIVES, MARTIN



1 OPTION 1
NOT TO SCALE



2 OPTION 2
NOT TO SCALE

CONCEPTUAL SHORELINE AND LITTORAL PLANTING PLAN							
PLANTING ZONE		STRATUM	CHARACTERISTIC NATIVE SPECIES		CONTAINER SIZE	SPACING (FT)	No. PER ACRE
NAME	CODE		COMMON NAME	SCIENTIFIC NAME			
RIPARIAN SHORELINE	A	TREE	LAUREL OAK	QUERCUS LAURIFOLIA	7 GALLON	15	194
		SHRUB	DAHOON HOLLY	ILEX CASSINE	3 GALLON	15	194
		GROUND	SAND CORDGRASS	SPARTINA BAKERI	1 GALLON	3	4840
CYPRESS	B	TREE	BALD CYPRESS	TAXODIUM DISTICHUM	3 GALLON	10	436
EMERGENT LITTORAL	C	EMERGENT	MAIDENCANE* DUCK POTATO* ARROWHEAD*	PANICUM HEMITOMON* PONTEDERIA CORDATA* SAGITTARIA LANCIFOLIA*	BARE ROOT	3	4840**
FLOATING-LEAVED AND SUBMERGED LITTORAL	D	SUBMERGENT	EEL-GRASS	VALLISNERIA AMERICANA	3' X 15' MAT	9	323
		FLOATING-LEAVED	WATER LILY	NYMPHAEA ODORATA	BARE ROOT	3	4840

NOTES:
* ALL BAREROOT 3' CENTERS
** TOTAL FOR ALL 3 SPECIES (NOT INDIVIDUALLY)
1. SUGGESTED PLANT SPECIES ARE FOR PLANTING PURPOSES. SUBSTITUTE WITH APPROPIATE NATIVE SPECIES BASED ON COMMERCIAL AVAILABILITY.

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DESIGNED BY:	K. SHELTON
DRAWN BY:	M. VIVES
CHECKED BY:	C. MEHLE
APPROVED BY:	J. WAGNER

SCALE:	AS SHOWN
DATE:	
PROJECT NO.	600537X5

CITY OF LAKELAND
FIGURE E-9
SHORELINE & LITTORAL RESTORATION CONCEPTUAL PLAN
LAKE BONNET POLLUTANT SOURCE REDUCTION FEASIBILITY STUDY
LAKELAND, POLK COUNTY, FLORIDA

PROJECT NUMBER: 300537X5 CITY: TAMPA
Z:\PROJECTS-C3D\600537 Lake Bonnet\Drawings\2018\Oct_2018\600537x5_DDMA_Lake Bonnet_Restoration Plan.dwg LAYOUT: FIGURE E-9 SAVED: 11/30/2018 2:29 PM PLOTSTYLETABLE: CIVIL-MASTER.CTB PLOTTED: 11/30/2018 3:18 PM DRAWN BY: VIVES, MARTIN

APPENDIX F

Opinion of Probable Costs

Preliminary Order of Magnitude Engineering and Construction Cost Estimate

Client: The City of Lakeland — **Prepared by: RJW**
Project: Lake Bonnet Pollutant Source Reduction — **Date: December 11, 2018**
Project No.: 600537X5 — **Revision 0.0**
Preliminary Order of Magnitude Engineering & Construction Cost Estimate[1] — **Reviewed by: MAT**

Item	Description	Plan Qty.	Unit	Unit Price	Total
1.00	**ENGINEERING ITEMS:**				
1.01	Data Collection & Conceptual Design[2]	1	LS	$334,000	$334,000
1.02	Permitting & Final Engineering Design[3]	1	LS	$208,000	$208,000
1.03	Final Order of Magnitude Construction Cost[4]	1	LS	$5,000	$5,000
1.04	Construction Plans & Specifications	1	LS	$128,000	$128,000
1.05	Bidding Assistance & Construction Administration	1	LS	$189,000	$189,000
	Subtotal (Engineering Items):				**$864,000**
2.00	**GENERAL ITEMS:**				
2.01	Mobilization/Demobilization	1	LS	$350,000	$350,000
2.02	Construction Surveys (pre- & post-dredging & pre- & post-DMMA construction)[6]	4	LS	$18,500	$74,000
2.03	Construction & Ecological Surveys (pre- & post-construction of the Steel Sheet Pile Walls)[7]	2	LS	$25,500	$51,000
2.04	Construction Surveys (pre- & post-condition evaluation of the Bonnet Springs Park area)[8]	2	LS	$18,500	$37,000
2.05	Erosion Controls & Soil Tracking Prevention Devices	1	LS	$16,500	$16,500
2.06	Maintenance of Traffic	1	LS	$45,000	$45,000
	Subtotal (General Items):				**$573,500**
3.00	**DREDGING, TEMPORARY HANDLING, & DISPOSAL:**				
3.01	Clearing, Grubbing, & Preparing DMMA[9]	33.5	AC	$3,250	$108,875
3.02	Steel Sheet Pile Wall Instillation[10]	1	LS	$940,000	$940,000
3.03	DMMA Excavation[11]	440,000	CY	$2.25	$990,000
3.04	DMMA Dike Construction[12]	400,000	CY	$4.25	$1,700,000
3.05	Pipeline Instillation & Final DMMA Preparation13	1	LS	$32,500	$32,500
3.06	Mechanical separation of debris, gravel, & sand[14]	425,000	CY	$1.75	$743,750
3.07	Material Removal (Dredging) of Lake Bonnet	425,000	CY	$12.00	$5,100,000
3.08	Transportation/Disposal of Debris	1	LS	$17,500	$17,500
3.09	In Lake Sand Cap (Reused Dredged Material)[15]	53,000	CY	$22.50	$1,192,500
3.10	In Lake Sand Cap (Trucked Sediments)[16]	67,000	CY	$37.50	$2,512,500
3.11	Capping & Vegetating the DMMA17	17.5	AC	$15,000	$262,500
3.12	Rehabilitation of all Construction Areas[18]	1	LS	$85,000	$85,000
	Subtotal (Dredging Items):				**$13,685,125**
4.00	**NATURAL RESOURCE ENHANCEMENTS:**				
4.01	In Lake Sand Placement (Littoral Shelf)[19]	10,250	CY	$37.50	$384,375
4.02	Shoreline Restoration (Littoral Shelf Plantings)	4,300	LF	$77.00	$331,100
	Subtotal (Natural Resource Enhancement Items):				**$715,475**
5.00	**STORMWATER & GROUNDWATER IMPROVEMENTS:**				
5.01	Stormwater: Dry Retention Best Management Practices with Biosorption Activated Media	1	LS	$1,662,500	$1,662,500
5.02	Groundwater: Best Management Practices with Biosorption Activated Media	1	LS	$549,000	$549,000
	Subtotal (Stormwater & Groundwater Improvement Items):				**$2,211,500**

Preliminary Order of Magnitude Engineering and Construction Cost Estimate

Construction Project Total (with contingency[20])	**$20,620,000**
Engineering & Construction Project Cost (with contingency[20])	**$21,510,000**
Approximate Dredging Volume (cubic yard):	**425,000**
Average Dredging Cost per cubic yard:	**$41.30**

Notes:

1 The preliminary Order of Magnitude Engineering & Construction Cost Estimate ("estimate") is consistent with the recommendations made to the City of Lakeland by the consultant as outlined in the project feasibility study.

2 The consultant will collect any final data & create conceptual plans & narratives suitable for permitting. Data collection & the conceptual plans will cover all elements of the proposed project.

3 Before bid document submission the consultant will update the draft construction drawings & specifications based on all permitting conditions. This may significantly alter the final engineering design.

4 The consultant will provide a short letter memorandum & worksheets summarizing the consultant's order of magnitude construction cost estimate, which will be used for final budgeting purposes.

5 The consultant's Construction Administration / Project Closeout effort assumes a contiguous 1.5 to 2.5-year construction period, which may prove to be unattainable due to unforeseen or unanticipated site conditions.

6 A hydrographic construction survey will establish (pre- & post-construction) horizontal & vertical limits & establish/verify existing elevations for payment applications. A similar survey (pre-and post-construction) will establish that the placement areas have been constructed as required.

7 A hydrographic & ecological conditions survey will establish pre- & post-construction conditions along the line of the proposed steel sheet pile wall

8 A hydrographic & ecological condition survey will establish pre- & post-construction conditions within the Bonnet Springs Park portion of the project area.

9 The selected contractor will mechanically clear, grub, & remove vegetation & any debris from the proposed dredged material management areas (DMMA). The selected contractor will dispose of the material in an approved location. In no case should material be placed in such a way as to impede entrance to the site or Bonnet Springs Park.

10 To prevent the collapse of the forested wetlands during dredging, the consultant recommends the installation of a sheet pile wall along the forested wetland edge with Lake Bonnet & creating a gradual slope from the forested wetland edge to the final dredging depth. This gradual slope would be reinforced with coarser sediments or other stabilization methods, including plantings, in addition to the proposed sand layer for the capped sediments.

11 The selected contractor will excavate roughly 440,000 cubic yards of material from below the proposed footprint of the new sediment storage area for the initial phase of construction. Given a conservative waste rate of 10% (40,000 cubic yards), approximately 400,000 cubic yards of sandy material is assumed to be available from below the proposed footprint of the DMMA itself.

12 This preliminary estimate assumes that the selected contractor would erect the new DMMA dike from sediments located under the proposed footprint of the DMMA. if the sediments in this area are not sufficient then new material will have to be brought in at a much higher cost.

13 The selected contractor will construct the pipelines & install a series of mechanical dewatering equipment to separate debris, gravel, sand, from the incoming slurry. During dredging the remaining effluent, composed of the targeted sediments & the slurry stream will then be directed to the main central dike area designed to contain the muck sediments.

14 The selected contractor will dispose of any structural grade material in an approved area. In no case should material be placed in outside of permitted placement areas, with the exception of any collected debris.

15 Sand from the dredged sediments, estimated at approximately 10 to 15% of the materials to be dredged, can be separated & returned to the lake to provide roughly 53,000 cy of the 120,000 cy necessary for the sand cap.

16 As needed, the selected contractor will truck additional clean sandy sediments to the lake & used to cap the remaining fine-grained nutrient-rich organic sediments. It is currently estimated that an additional 67,000 cy of sand will be required.

17 For cost estimation purposes, the consultant has assumed that the selected contractor will dewater, decant, & condense the sediments left in the main central dike area of the DMMA before capping this cell with at least two feet of clean sand.

18 This estimate assumes that the selected contractor will not be required to monitor environmental resources during any construction activities.

19 The shorelines along the western half of the lake have been altered & now only support patchy desirable shoreline & littoral vegetation, & no submerged aquatic vegetation (SAV). Restoration of a more natural shoreline will provide water quality & water clarity improvement. The selected contractor will truck additional clean sandy sediments to the lake to create a littoral shelf for the planting of shoreline vegetation.

20 A 20 percent construction contingency & 3 percent contingency for construction supervision & permit closeout costs has been added.

Wood

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