Documentation in Support of Category 4e

Waterbody/Watershed Identification

Organization	City of St. Petersburg
Point of Contact	Brejesh Prayman, P.O. Box 2842, St. Petersburg, FL, 33731-2842
Waterbody(s)	1700A, Crescent Lake
No. Waterbody / Pollutant Combinations	1 waterbody segment(s); Verified and/or Impaired for Nutrients on the Tampa Bay, Cycle 3, Verified List

Description of Baseline Conditions

Watershed(s)	Crescent Lake, WBID 1700A
Baseline Data	Run 56, 2017 Impaired for Nutrients; Chlorophyll-a and Total Phosphorus. Assessment Data for Chlorophyll from 2013 to 2017 reported 42, 36, 38, 27, and 16 µg/L, respectively. Assessment Data for TP from 2013 to 2017 reported 70, 90, 70, 90, and 50 µg/L, respectively.
Map	See Figure 2 in Attachment 1

Evidence of Watershed Approach

Area of Effort	Crescent Lake is situated in a highly urbanized neighborhood bounded by 5th Street N and 7th Street N and 22nd Avenue N and 12th Ave N in the City of St. Petersburg. It is located in a public park managed by the City's Parks and Recreation Department and is a 20.3-acre modified natural lake receiving primarily stormwater runoff from the surrounding urban drainage basin.
Key Stakeholders Involved and Their Roles	City of St. Petersburg – Main stakeholder in all maintenance, proactive, and reactive watershed activities. Crescent Lake Neighborhood Association and "Friends of Crescent Lake" – highly active groups that participates in clean-ups and is active in waterbody restoration. Has partnered with funding agencies like Tampa Bay Estuary Programs and Keep Pinellas Beautiful to help management of the lake.
Watershed Plan & Other Supporting Documentation	The area includes the watershed drainage area from WBID 1700 which corresponds to City Basin J surrounding WBID 1700A(s) – Crescent Lake. The objectives outlined by the Crescent Lake Management Plan will address these impairments. These management efforts consist of 8 key plan actions and are named as follows: *Lake Vegetation Management* *Littoral Zone Improvements* *Inlet Structure Improvements* *Outlet Structure Modification* *Destratification Aeration* *Lake Sediment Management* *Upstream Watershed Basin Solutions* Each plan action, incorporates several separate projects to be implemented and are further discussed in the Crescent Lake Management Plan.
Point Sources and Indirect Source Monitoring (Sites)	The entire area is regulated by a Municipal Separate Storm Sewer System (MS4) permit, NPDES MS4 Permit No. FLS000007-005. There are no permitted point source discharges in the basin, and the entire watershed is served by central sanitary sewer facilities. The 2019 MS4 Annual Report is included here as **Attachment 2**.
Nonpoint Sources	The Crescent Lake watershed with has a total area of 395 acres. The major land uses in Crescent Lake watershed include High Density Residential (69%), Commercial and Services (20%), and Institutional (6%). The lake's watershed and sub-basins are shown in Figure 2 in Attachment 1 The largest inflow contributor to the lake is sub-basin 6 with an area of 254.2 acres with a combined impervious area of approximately 70 percent. Stormwater runoff is potentially a major source of pollution to the lake.
Water Quality Criteria	It is expected that Class-III water quality standards for TN, TP and chlorophyll-a will be attained upon successful implementation of projects.

Restoration Work

Existing efforts focused on improved water quality and restoration fall under the same eight action items described in the Crescent Lake Management Plan. (CLMP)

Lake Vegetation Management

1) Efforts include revised maintenance plans from our City maintenance crews that include leaving a larger upland buffer around the lake perimeter to allow natural recruitment of beneficial plant life and habitat.
2) The city has contracted with an aquatic plant removal contractor on an as needed basis to assist in removal of water lettuce.
3) The city has invested in an aquatic harvester specifically for the removal of nuisance vegetation from lake systems.
4) Additionally, partnering with the Friends of Crescent Lake public group and along with city funding to the Keep Pinellas Beautiful Organization provide monthly lake vegetation cleanups. These cleanup activities focus on removing nuisance species and debris from the waterbody removing nutrients with them.

Stormwater Water Quality Improvement
The city invested in a $1.45 million project to improve stormwater quality from sub-basin 7. The project co-funded by the SWFWMD included a nutrient separating baffle box that was installed to help trap and eliminate stormwater runoff pollutants from entering the lake. The baffle box is maintained by the city on a routine schedule.

Upstream Watershed Basin Solutions include an increase in street sweeping from twice a year to four times a year, removing runoff related pollutants from the entire watershed.

Ongoing efforts include the Lake Vegetation Management plans listed above since they are operating on a continual basis. Additionally, we are currently addressing Destratification Aeration with a funded lake aeration project currently in the plan and implementation phase.

The City also is the process of developing a lake management plan for the City's approximately 80 lakes that it manages. The objectives of this plan is to better allocate City resources to management of lakes through a proactive, rather than, reactive, approach. The plan will prioritize lakes based on a set of factors developed by the NE and City staff, taking into account water quality, stormwater flow, recreational use, and other factors. Crescent Lake's efforts are a blueprint for this effort and we expect both efforts will influence the management moving forward – taking what works best from one and incorporating it City-Wide.

Proposed efforts include additional projects that fall under each of the eight action items identified in the CLMP. These will include an increased effort in hand removal, mechanical removal, herbicide application, hydrologic manipulation, and biological control of nuisance vegetation; The enhancement of the existing littoral zone that encourages rooted aquatic plant growth and increased nutrient uptake; Floating treatment wetlands; Floating debris booms and inline stormwater treatment retrofits; Modification to the outfall weir to improve the extent and functionality of the littoral zone; and sediment removal.

Critical Milestones/Monitoring

Anticipated Critical Milestone(s) and Completion Dates:	Lake Aeration –installation occurred January 2021. System is fully operational at present and will continue indefinitely. Littoral Zone Improvements and Weir Modification – Funding planned for FY 2022, design and construction in Summer of 2023.
Monitoring Component	Monthly water quality monitoring will be conducted for one year (12 sampling events) following the installation (January 2021) of the deep aeration system. Each sampling event will include data collection at four sites: Three in the Lake proper and one at the outfall into Coffee Pot Bayou. The parameters that will be included are: • Dissolved Oxygen • Secchi Disk Depth • Specific Conductance • Orthophosphate (PO4-P) • Total Phosphorus (TP) • Ammonia (NH4-N) • Nitrate-Nitrite(NO2-NO3-N) • Total Kjeldahl Nitrogen (TKN) • Total Nitrogen (TN) • Chlorophyll a (corrected) • Biochemical Oxygen Demand • Total Suspended Solids • Turbidity For each Lake water quality station, there shall be one (1) water quality sample from three (3) depths for a total of three (3) samples per station. Samples will be collected in accordance with FDEP Standard Operation Procedure (SOP) FS 2100 Surface Water Sampling and FQ 1000 Field Quality Control Requirements. Monitoring also includes and is concurrent with established monitoring the City implements through its City-Wide water quality monitoring program which collects, Dissolved Oxygen % Saturation, Chlorophyll a, Total Nitrogen, and Total Phosphorus.

Other Key Dates

Estimated Delisting Date	The WBID is in the state's Group 1 Basin in the Coastal Middle Tampa Bay Tributary. The next review and assessment cycle (cycle 5) is expected in 2024; at which time sufficient data will be acquired to fully assess the WBID, and if not impaired, DEP is expected to request the WBID be delisted from the federal 303(d) list (if applicable). The implementation of some of these projects is expected to be rolled out as funding comes available so some may not be complete until after that time. In the meantime, this WBID, should be assigned to Category 4e.

Financial Commitments

Estimated Implementation Cost	The total project cost, for Lake Aeration, Littoral Shelf Improvements, Outfall Structure modification and sampling programs is $850,000. The estimated 20-year operation and maintenance cost is $10,000,000. The estimated cost for proposed projects could cost over $5,000,000 if funding is available in next cycle.
Land Acquisition (if applicable)	**Funding Source:** N/A
Design and Construction (if applicable)	**Funding Source: City Stormwater Fund and Capital Improvements** Approved Budgets for FY21 Include Line Items: Crescent Lake Water Quality Improvements – Total: $175,000 Deep Lake Aeration: Total $200,000 ($88,000 Allocated For Crescent Lake) Total For 4E Implementation FY21………………………………………………………………...$_263,000___

References:

Attachment 1 – Crescent Lake Management Plan
Attachment 2 – City of St. Petersburg MS4 Annual Report Year 1

Attachment 1 – Crescent Lake Management Plan

JACOBS

Memorandum

4350 W. Cypress Street
Suite 600
Tampa, Florida 33607-4178
United States
T +1.813.874.0777
www.jacobs.com

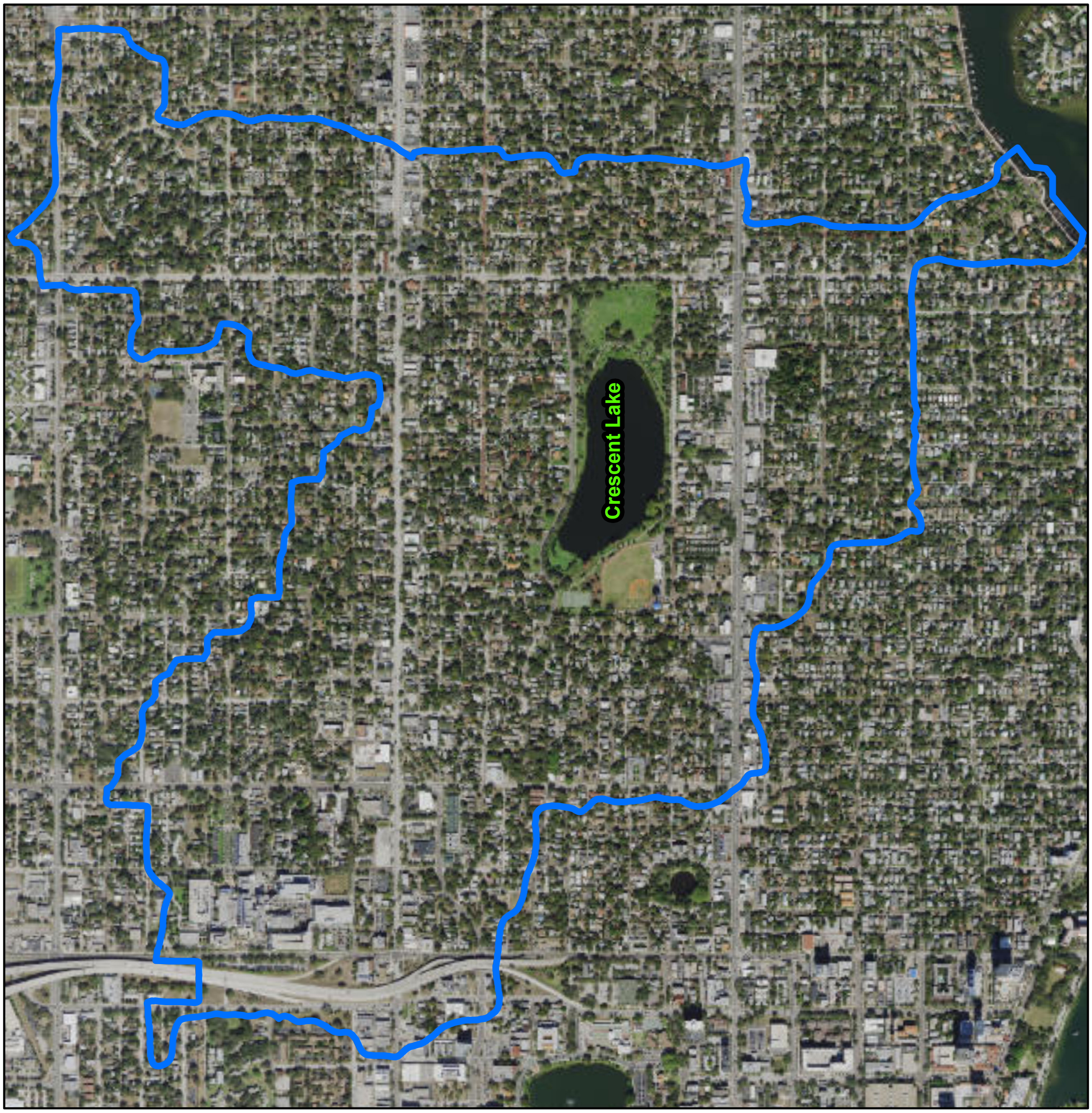
Subject	**Crescent Lake Management Plan**
Attention	City of St. Petersburg
From	Jacobs Engineering Group, Inc.
Date	January 31, 2020
Project No.	697448CH

1. Background

Crescent Lake is a 20.3-acre modified natural lake located within the City of St. Petersburg (City) that receives primarily stormwater runoff from the surrounding urban drainage basin (Figure 1). While the lake is highly valued as the centerpiece to Crescent Lake Park, and sustains a high visitor use, long-term stormwater contributions have resulted in degradation of water quality, blooms of undesirable plant species, and an accumulation of organic sediment within the lake. The City has long been interested in improving water quality conditions in the lake, including vegetation management and the recent installation of a baffle-box type of stormwater quality control system at one of the lake inlets. Because the lake discharges to Coffee Pot Bayou, improvements to the lake environment and water quality have the potential to reduce pollutant loads to Tampa Bay. In coordination with the Florida Department of Environmental Protection (FDEP), the City is developing a Reasonable Assurance Plan to implement a Category 4b control program consistent with the requirements of the Florida Watershed Restoration Act (403.067(4), F.S.).

Given the importance of the lake to the public, the City has requested that Jacobs Engineering Group, Inc. (Jacobs) develop a management plan to improve the water quality of Crescent Lake. This technical memorandum (TM) presents a Crescent Lake Management Plan (CLMP) for the lake and watershed to address water quality concerns and presents a range of alternatives for consideration and refinement by the City. It is anticipated the City will implement selected options for improvement, as resources allow, that will ultimately result in improvement of lake water quality conditions and downstream receiving waters.

A Synoptic Sampling TM was submitted to the City in May 2019 that describes the results for a single season of inlet, outlet, and lake water quality data as well as sediment quality (Jacobs 2019). These data form a basis for the development of the CLMP. In addition, this plan summarizes historic water quality trends, water quality management approaches, sediment management options, as well improvements to the lake littoral vegetation communities with a final goal of improving water quality and overall aesthetics, especially considering the lake's popularity with the City's residents.



Legend

Stormwater Basin J

VICINITY MAP

Notes:
1. Sources: Aerial Imagery, Topographic Map, ESRI 2019.

Feet
0 875 1,750 2,625 3,500

N

Figure 1
Crescent Lake Location
Crescent Lake Management Plan
St. Petersburg, Florida

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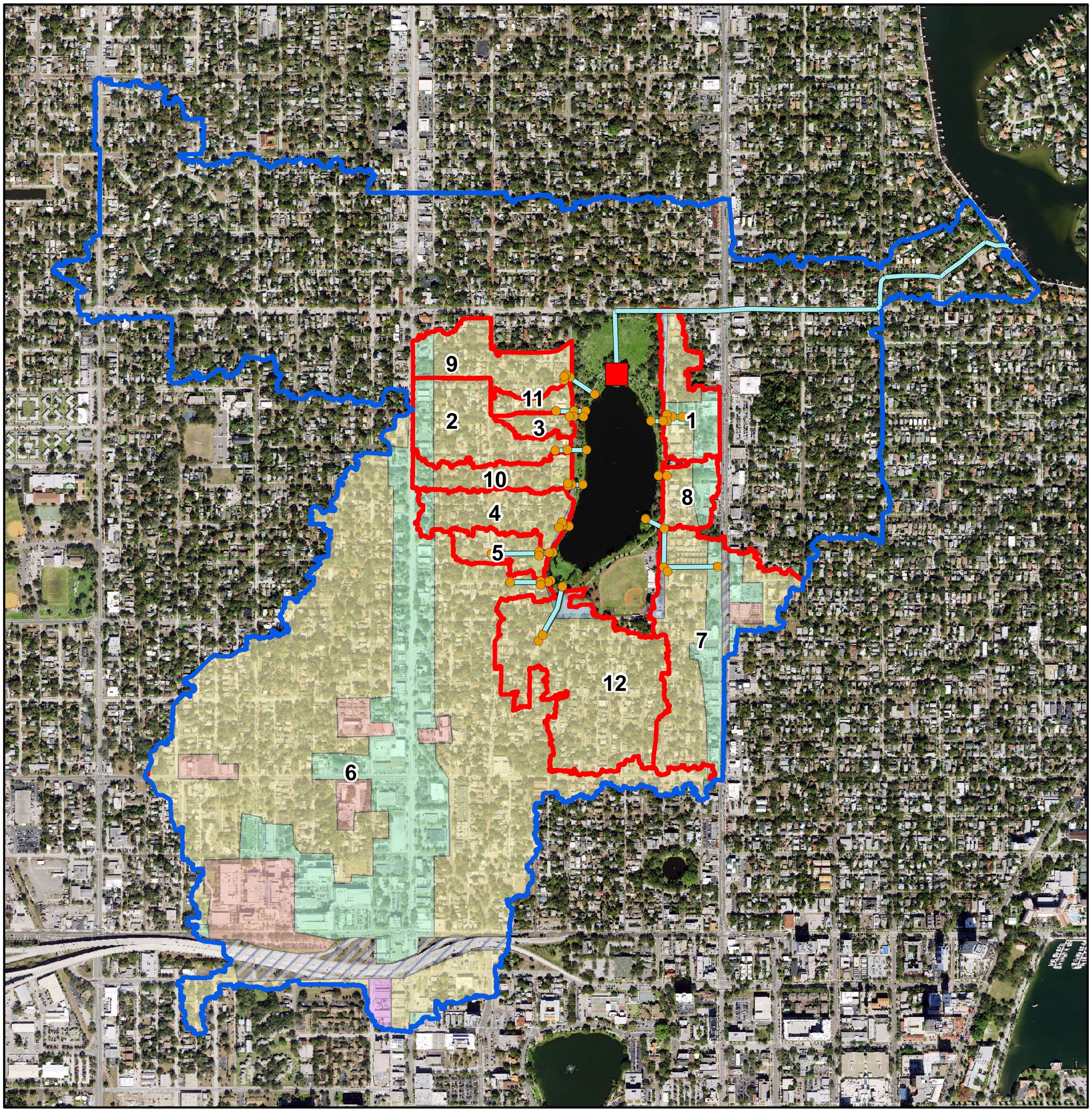
1.1 Watershed Characterization

The Crescent Lake watershed (Basin J) is centrally located in the St. Petersburg watershed with a total area of 394.5 acres. The major land uses in Crescent Lake watershed include High Density Residential (69 percent), Commercial and Services (20 percent), and Institutional (6 percent). The lake discharges to Coffeepot Bayou via an outfall at the north edge of the lake and drains to Middle Tampa Bay (WBID 1558C), which is currently not an impaired water body. The lake's watershed and sub-basins are shown in Figure 2.

The five major sub-basins (listed from largest to smallest) that likely have a greater effect on the lake's water quality are sub-basins 6, 12, 7, 2, and 9. The largest inflow contributor to the lake is sub-basin 6 with an area of 254.2 acres. The major land uses for this sub-basin include High Density Residential, Commercial and Services, and Institutional with a combined impervious area of approximately 70 percent. Considering that the next largest sub-basin covers 35.6 acres, sub-basin 6 is potentially a major source of runoff pollution to the lake and warrants a high priority for runoff reduction and evaluation of green infrastructure solutions to protect the lake's water quality.

Five of the 12 stormwater inflow stations were sampled during the synoptic study in 2019. While nearly all parameters were well below the Class III criteria, inflow from sub-basin 8 showed significantly higher values for almost all parameters when compared to the other inflow locations. A high fraction of this sub-basin's land use consists of Commercial and Services (42.8 percent), which could potentially be a source of the pollutant load. Five sub-basins were ranked from high to low (sub-basins 6, 7, 1, 2, and 8) which also had a large fraction of the Commercial and Services land use category. Further study is required on the contributing sub-basins to the lake to evaluate potential nutrient sources.



Basin No.	Area (acre)	Impervious (%)	Q_10yr	Q_25yr	Q_100yr
1	10.1	64.7	20.7	58.1	77.5
2	14.6	70.0	33.6	94.6	126.1
3	2.6	68.2	6.0	16.9	22.5
4	10.9	67.7	24.7	69.5	92.7
5	5.3	69.4	12.6	35.4	47.2
6	254.2	67.5	577.6	1624.4	2165.9
7	33.2	65.2	73.4	206.4	275.2
8	5.7	67.8	12.2	34.3	45.8
9	12.1	69.6	28.3	79.5	106.0
10	7.4	69.9	17.4	48.9	65.3
11	2.8	69.1	6.6	18.4	24.6
12	35.6	67.6	83.2	234.0	312.0
Total	394.5	---	896.2	2520.5	3360.7
Average	---	68.1	74.7	210.0	280.1

Notes:

1. Sources: Aerial Imagery, Topographic Map, ESRI 2019.

Legend

Stormwater Basin J
Sub-Basins
Outlet
Inlets
Pipes

Land Use
COMMERCIAL AND SERVICES
INDUSTRIAL
INSTITUTIONAL
RECREATIONAL
RESIDENTIAL HIGH DENSITY
TRANSPORTATION

N

0 875 1,750 2,625 3,500 Feet

Figure 2
Watershed and Sub-basins
Crescent Lake Management Plan
St. Petersburg, Florida

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1.2 Lake Stage

The lake receives surface water input from the watershed through 12 culverts distributed around the lake perimeter and discharges to a single outlet at the north end. A fixed concrete weir controls water levels upstream of the discharge to the outlet. It is commonly observed that the lake is always flowing, suggesting that the lake intercepts and conveys groundwater as well as high volumes of stormwater. Lake water levels have only recently become available through the installation of a water level recorder at the stormwater inlet at the southeast corner of the lake. Figure 3 shows lake stage data and rainfall from August 2018 to June 2019. The water level data show that the lake stage is controlled by the outfall weir at elevation 17.5 feet North American Vertical Datum (NAVD) and shows a significant correlation with rainfall events within the watershed. Rainfall data were obtained from the nearest available location at Albert Whitted Airport (NOAA 2019). There is no historical record of water level elevations prior to 2018. However, the project team's direct observations over many years support the assumption that water levels have been operating at this level since construction of the outfall weir.

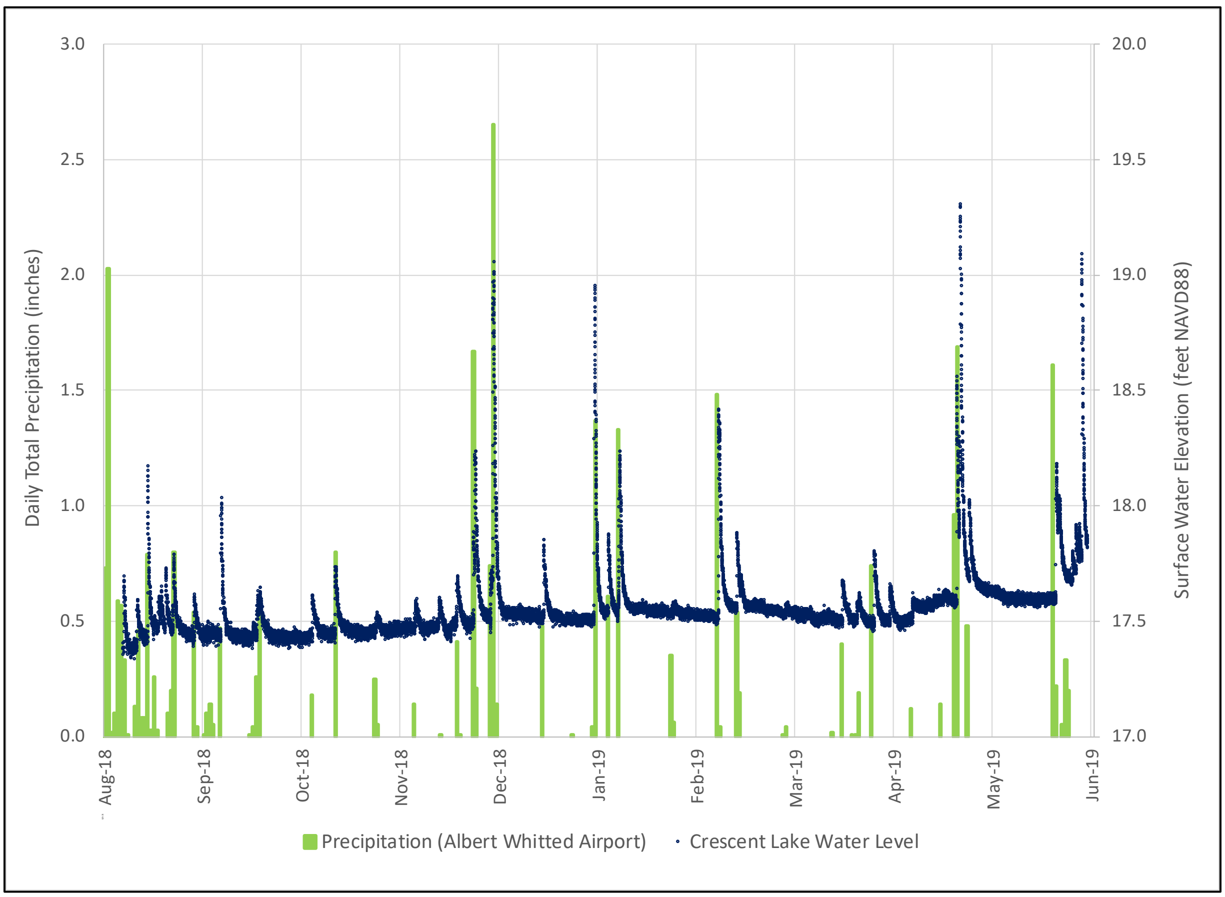


Figure 3. Lake Water Levels for 2018 to 2019
Crescent Lake Management Plan

1.3 Water Quality

Water quality data on Crescent Lake are available from multiple sampling programs over the past 20 years. Since 2007, the Florida Lakewatch program has been providing analyses of water samples collected by volunteers affiliated with the Friends of Crescent Lake (FOCL) organization. Other data collections have been implemented by the Southwest Florida Water Management District and the City's Stormwater Division in recent years. The available data were compiled and are presented to determine trends over time. The goal of the water quality summary is to understand issues with potential stratification, contributing sources of water pollution, and potential algal/vegetation blooms within the lake driven by seasonal changes. The synoptic study (Jacobs 2019) indicated a marked transition in dissolved oxygen (DO) between 18 and 24 feet below water surface, which points to the potential for thermal stratification. This natural process results from warming of surface waters, which lowers density and provides short-term stability between upper and lower water layers. The significant lake depth measured during the study is uncommon for a lake in Florida. The lake was dredged in the early 1920s and the material was used to build up the low-lying swamp along the shoreline.

Based on the January 2019 synoptic summary temperature profile, the deepest station in the center of the lake suggests that a significant change occurs within the 18-foot to 24-foot depth range. Perturbation of the thermocline by cooling of the lake surface during winter would turn over bottom lake waters by distributing nutrients contained in the lake sediment into the water column. This release of nutrients is likely a contributing cause of the seasonal degradation in the water quality of Crescent Lake. This is supported by the synoptic study (Jacobs 2019), which showed high levels of phosphorus, ammonia, and total Kjeldahl nitrogen (TKN) in the sediment samples.

1.3.1 Historical Water Quality Trends

Available water quality data were obtained from the Pinellas Water Atlas (Pinellas County 2019) for the period from 2006 to 2019 to evaluate historical water quality trends in Crescent Lake. These water quality data were collected by the Lakewatch program and include total nitrogen (TN), TKN, total phosphorous (TP), orthophosphate, and algal pigments chlorophyll *a*, *b*, and *c*. Nutrient concentrations were used to estimate the trophic state index (TSI) of Crescent Lake for this period of record. Additionally, total suspended solids (TSS) concentrations, turbidity, and secchi depth measurements were also evaluated to determine lake water clarity.

These nutrient concentrations were plotted against daily average ambient temperature data, obtained from the Albert Whitted Airport climate station (NOAA 2019). Figure 4 shows concentration data for dissolved ammonia (NH_3_N_diss), ammonia (NH_3_N), and nitrogen oxides (NO_x). These data show a pattern between temperature and nutrient concentrations, with peak concentrations observed during the winter months and relatively low concentrations during the summer months. The cause for this pattern is hypothesized to be related to thermal stratification in the lake, with summer high temperatures creating a warmer layer of water on cooler bottom waters, leading to development of anoxic conditions and mobilization of soluble phosphorus and nitrogen from lake sediments. During cooler ambient temperatures in the winter, the upper layers cool and the lake destratifies, leading to a seasonal turnover of the lake and mixing of high nutrient waters from the bottom with lower nutrient waters from the surface.

This hypothesis is supported by several features of the available data. On average, the highest concentration values occur during seasonally low temperatures, particularly when temperatures drop below 50 degrees Fahrenheit (°F). The highest concentration observed was in 2012, where the ammonia concentration was observed to be 1,730 micrograms per liter (µg/L) with average ambient temperature of 45°F. From 2014 to 2019, the highest nutrient concentrations observed were for dissolved ammonia. In 2018 to 2019, concentration measurements were relatively low when the average ambient temperature was maintained above 50°F, suggesting a significant correlation between the two parameters.

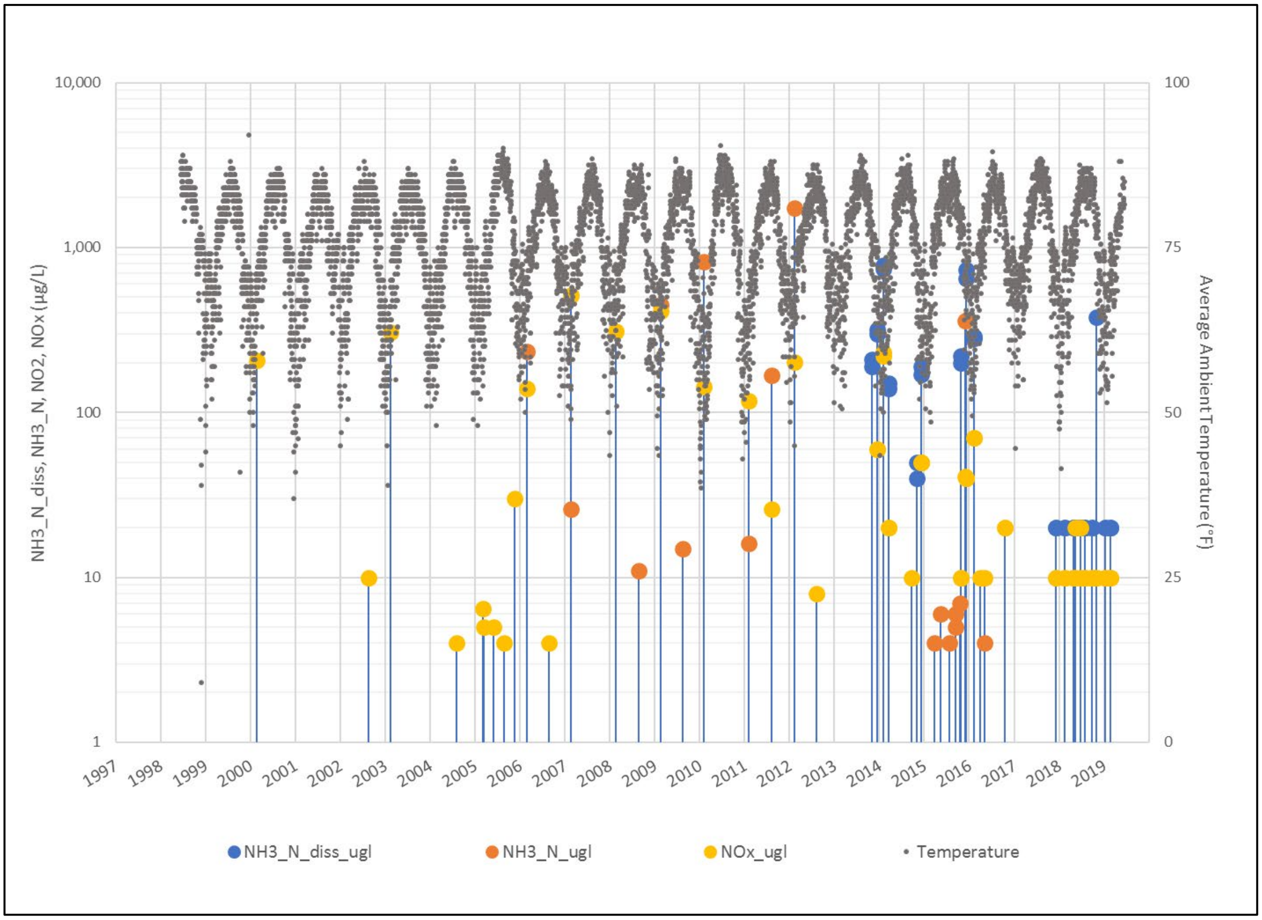


Figure 4. Inorganic Nitrogen Time Series
Crescent Lake Management Plan

From 2010 to 2013, TN concentrations were reported at approximately 5,000 µg/L (Figure 5). This was 2,000 µg/L above the average winter peaks of other years within the period of record. In addition, during early 2010, unusually high concentrations of TP and chlorophyll *a* were also measured in the lake. These results are shown in Figures 6 and 7**,** respectively with a corresponding high TSI value of 96, indicating poor water quality conditions in the lake.

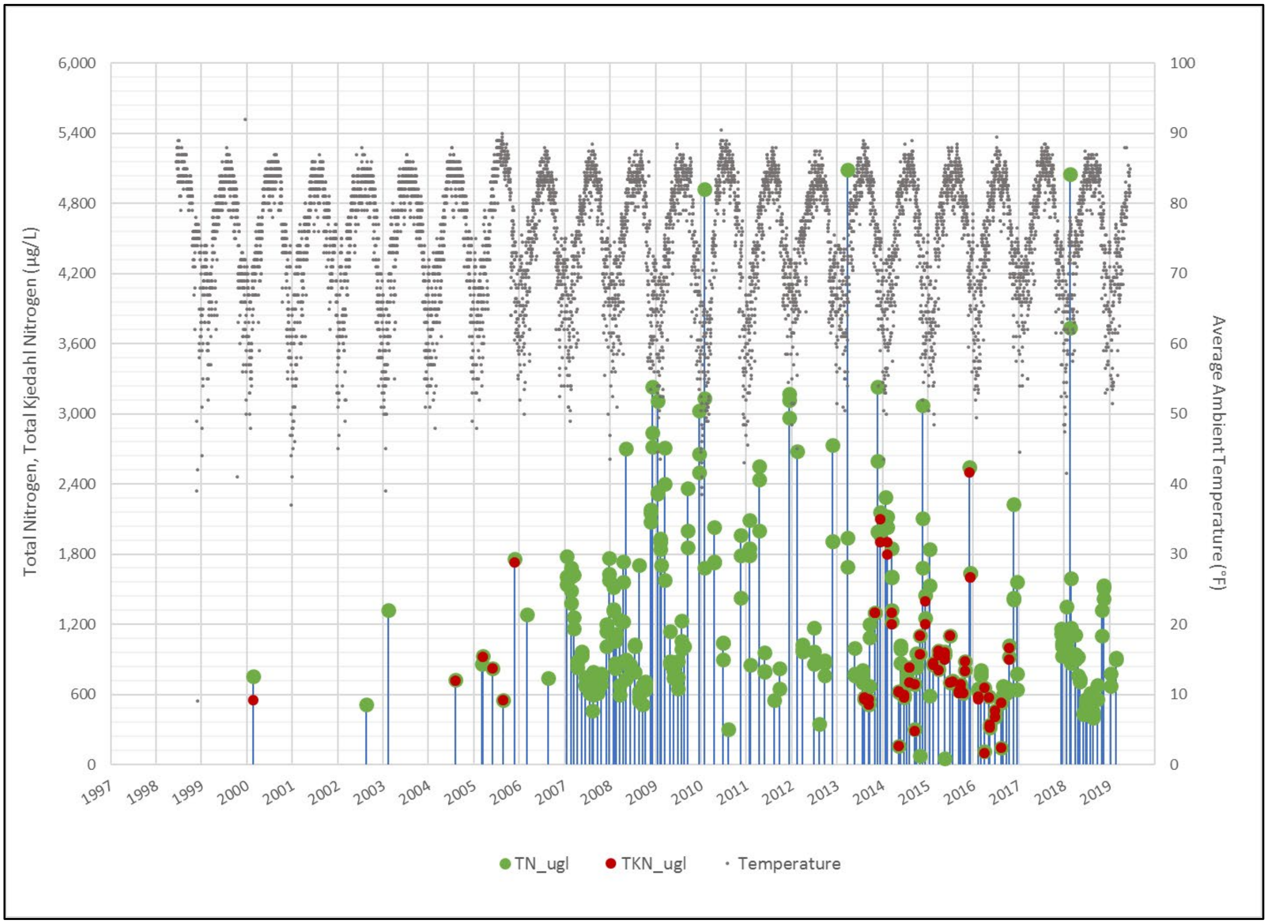


Figure 5. Total Nitrogen Time Series
Crescent Lake Management Plan

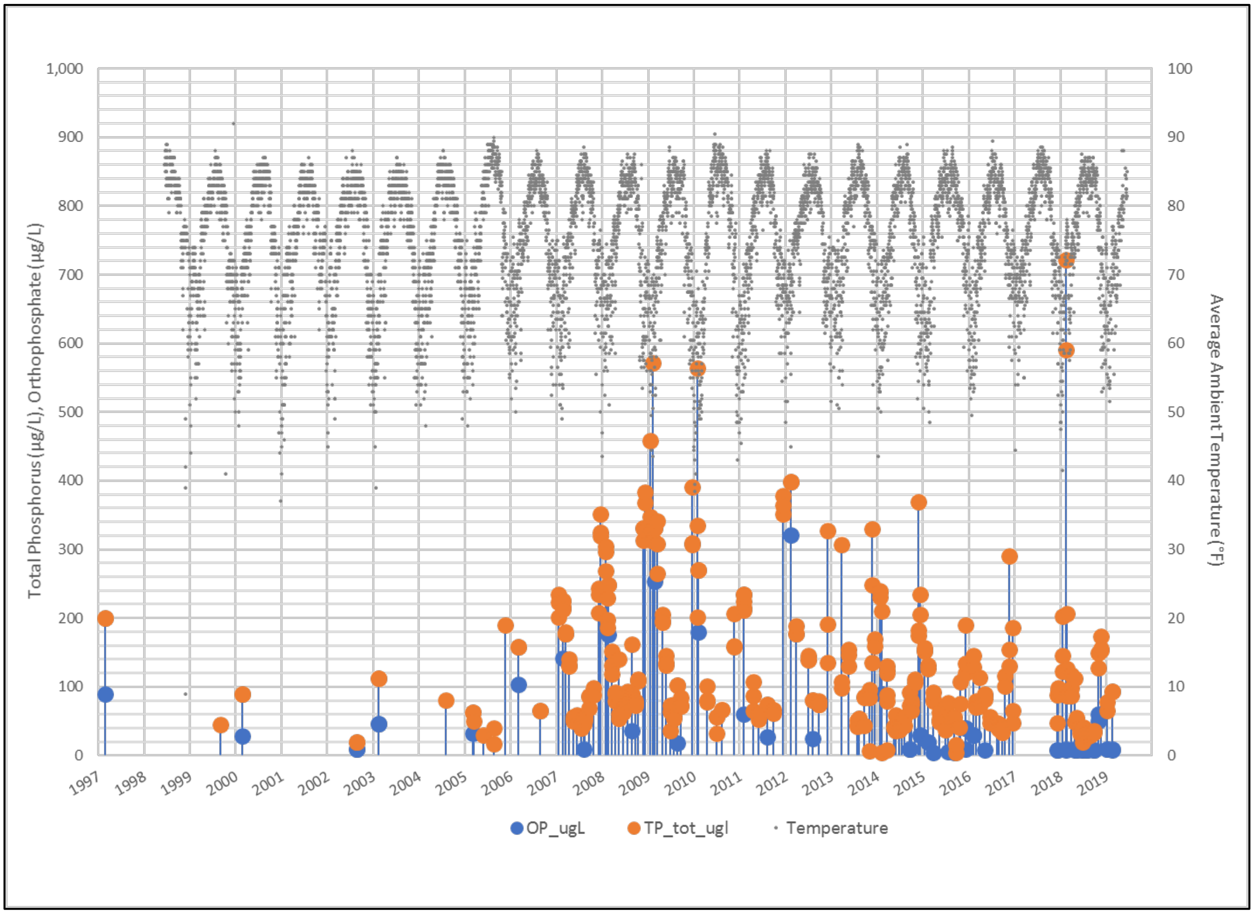


Figure 6. Phosphorous Time Series

Crescent Lake Management Plan

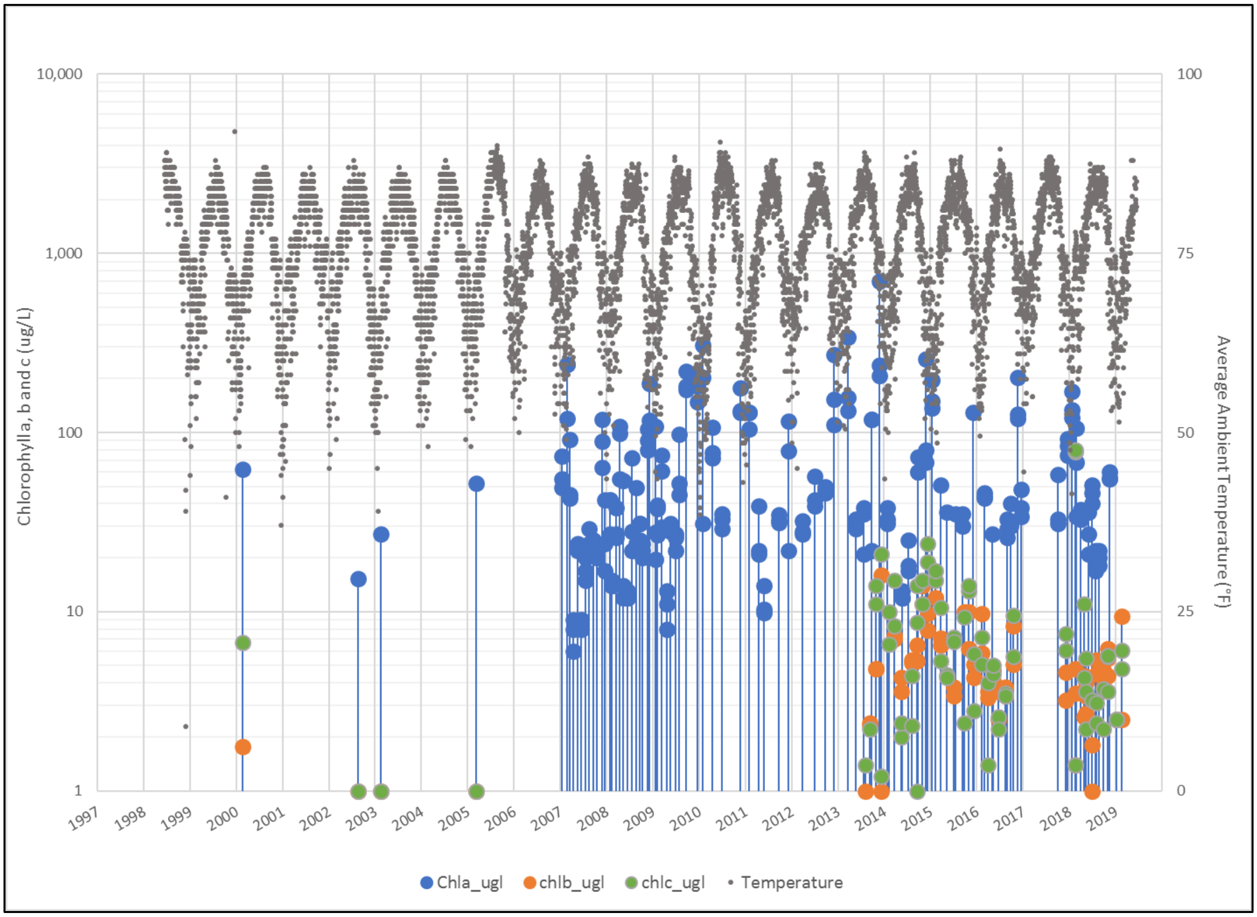


Figure 7. Chlorophyll Time Series
Crescent Lake Management Plan

Figures 8 and 9 show the data for the TSI and parameters related to water transparency, respectively, including TSS and turbidity. The TSI values, TSS concentrations and turbidity values exhibit seasonal and inter-annual variation that correspond to the observed nutrient patterns. Peak TSI values occur during the winter season and show significantly lower values in the summer. The Secchi depth measurements, however, remained relatively constant throughout period of record. The TSI values range from 44 to 97. In this range of values, the water is considered fair or poor quality. These high TSI values are attributable to the seasonally high concentrations of nutrients but also the general presence of algae-rich waters throughout the year.

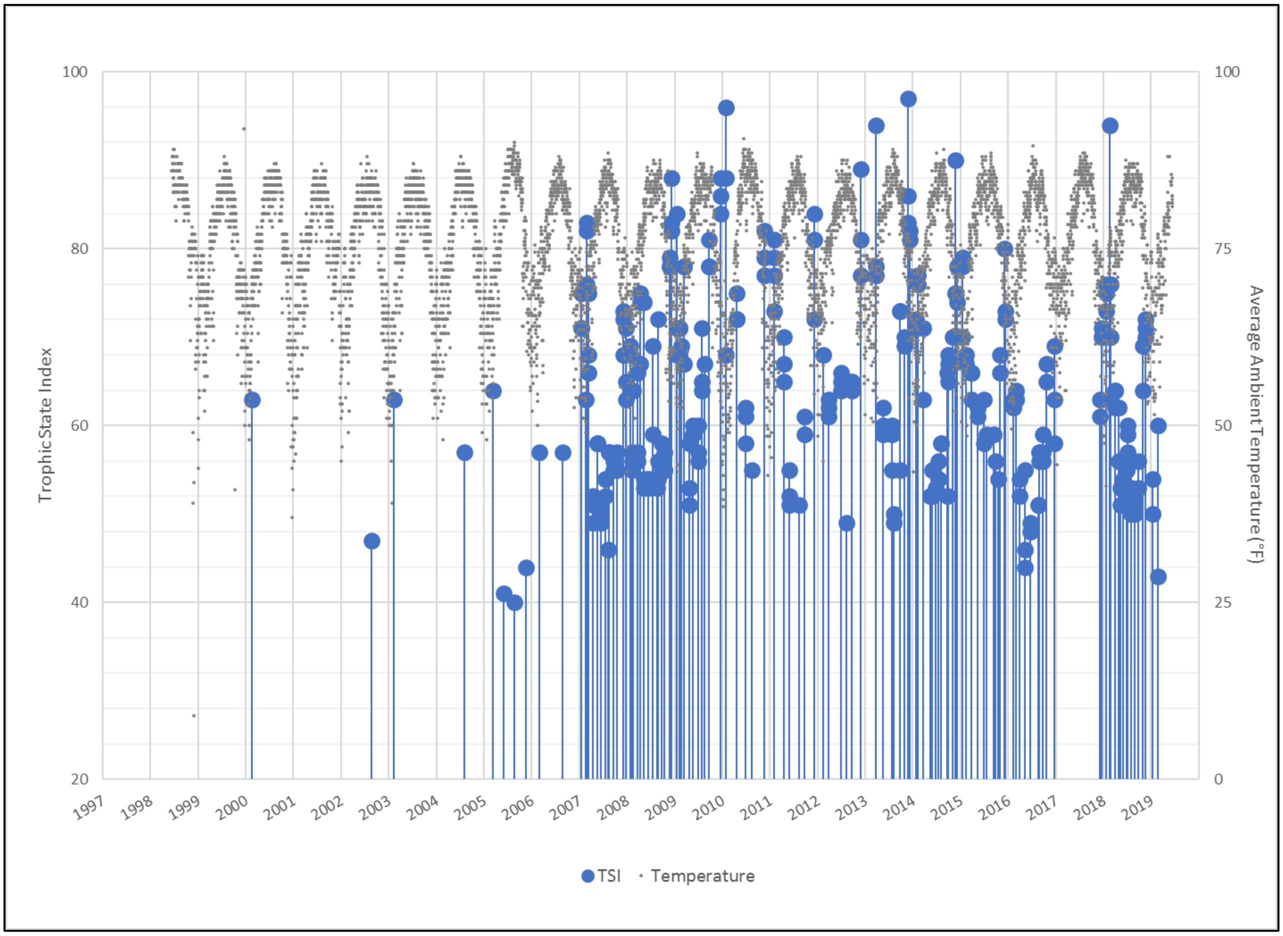


Figure 8. Trophic State Index Time Series

Crescent Lake Management Plan

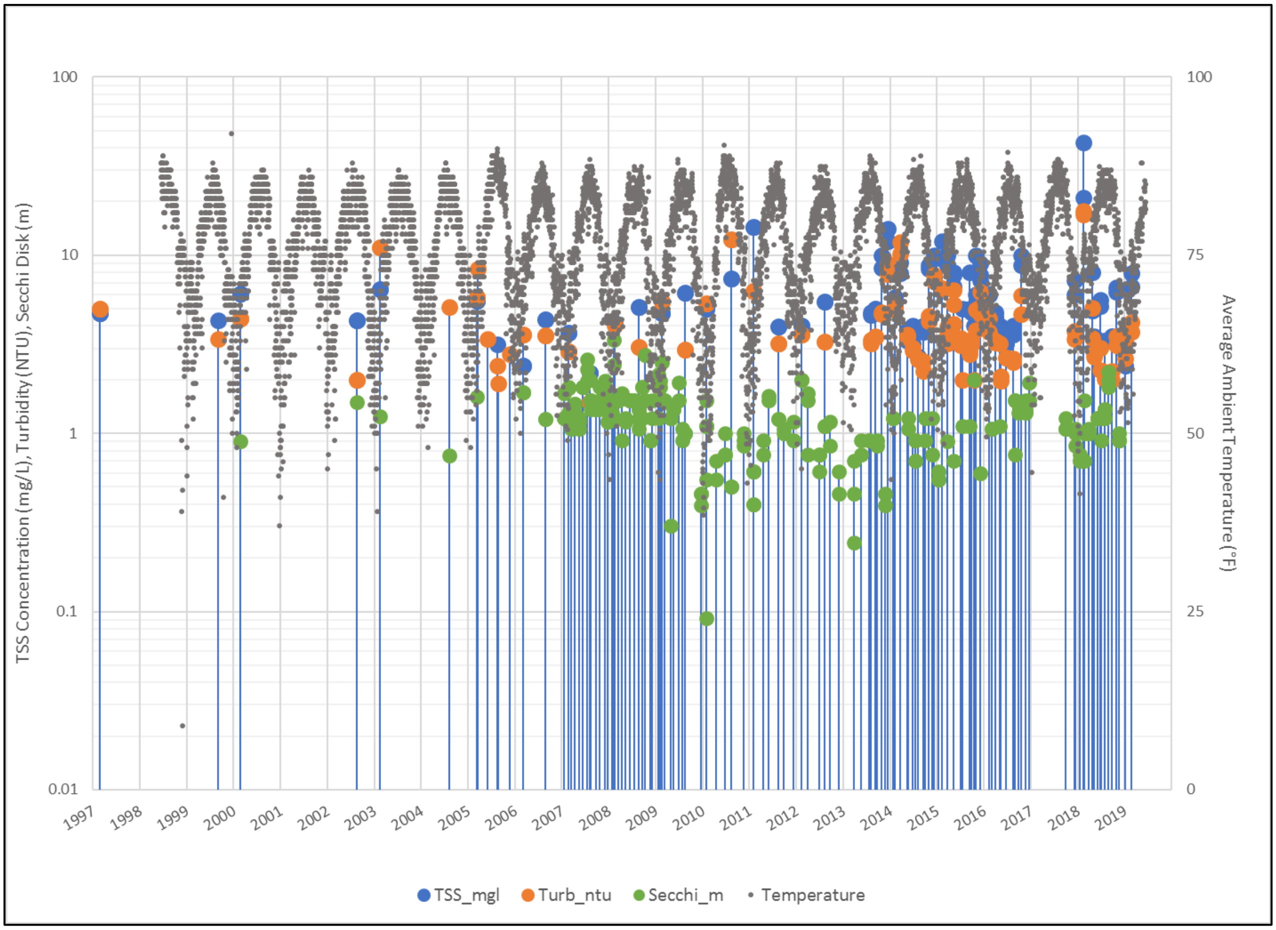


Figure 9. Water Clarity Time Series Plot
Crescent Lake Management Plan

Winter frontal storms are associated with higher wind conditions that could de-stabilize and mix the lake if poorly stratified. High TSS concentrations and turbidity values can be caused by algae growth from excess nutrients, which is hypothesized to be the cause for poor clarity in Crescent Lake. These data reveal relatively poor water quality at Crescent Lake throughout the year, including the winter months. However, data from recent years indicated relatively lower nutrient concentrations during warmer periods.

The results of the synoptic study (Jacobs 2019) support the observed trends in historical lake water quality, with similar concentrations and indications of stratification. However, to fully observe a seasonal pattern, it is recommended that another sampling event be conducted in the summer months, when the lake typically exhibits better water quality and when the conditions for stratification are expected to be present. It is important that profile measurements and samples be collected to fully understand the formation of a potential thermocline to characterize differences between surface and bottom conditions.

1.3.2 Seasonal Variation of Water Quality

Seasonality variation is shown in Figures 10 to 14 based on water quality data obtained from the Pinellas Water Atlas from 2005 through 2019 (Pinellas County 2019). These figures clearly show the temporal variation of four water quality parameters including TP (µg/L), TN (µg/L), Secchi Disk depth (meter), and TSI during the year at three sampling locations (Center, North, and South) within the Lake. As described above, seasonal fluctuations in these parameters show a similar pattern of higher nutrient concentrations in the winter months and lower concentrations in the summer months on an annual basis.

Values for TP, TN, and TSI are low during the summer months (June through October), which typically would be correlated with wet season rainfall and significant runoff contributions to the lake. This indicates either the watershed is not a significant contributor of nutrients or the lake is very efficient in assimilating the stormwater input. Groundwater is also expected to influence conditions in the lake. The highest values for all the studied parameters occur in January, February, November, and December, which is considered the dry season. This again supports the potential effects of lake turnover.

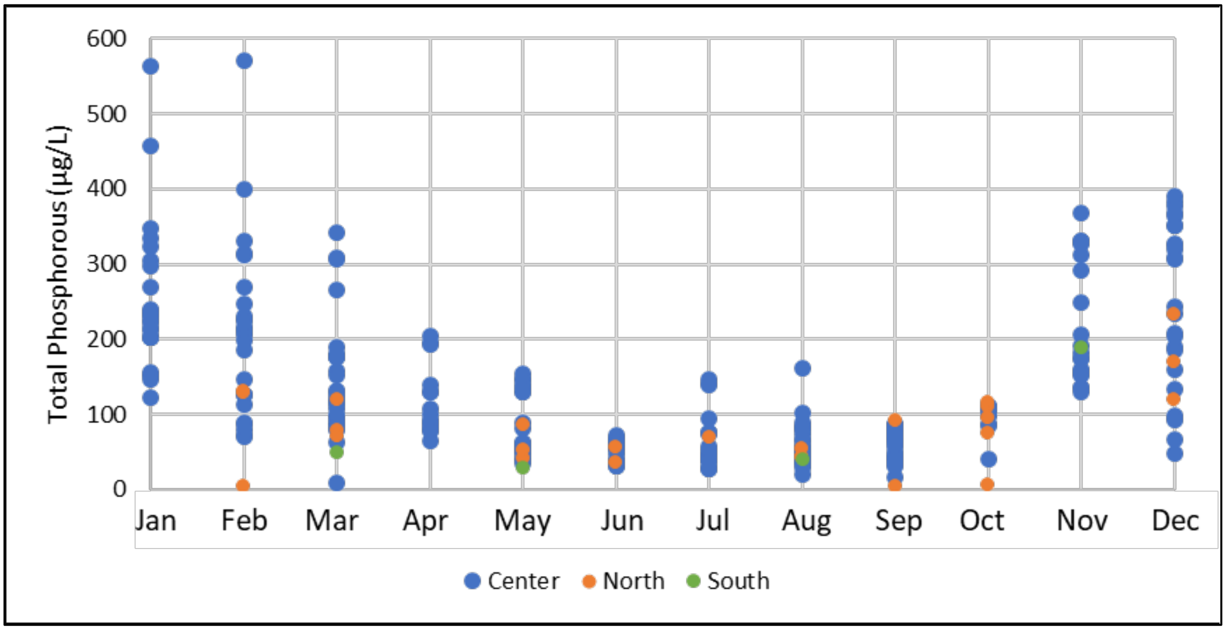


Figure 10. Seasonal TP Concentrations in Crescent Lake
Crescent Lake Management Plan

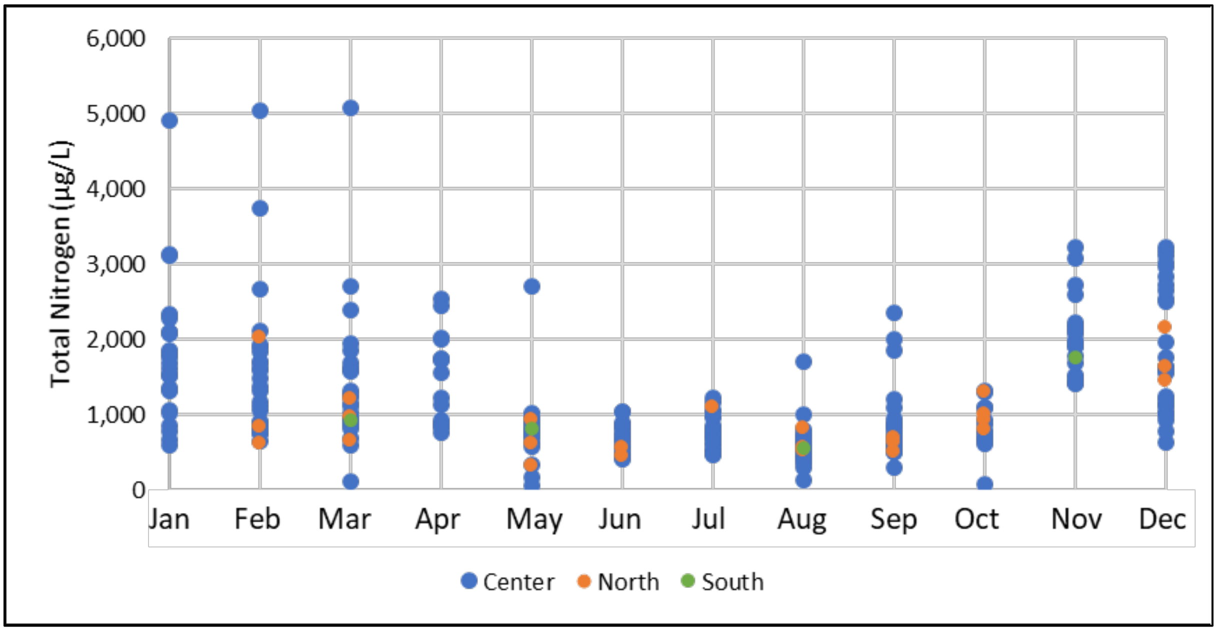


Figure 11. Seasonal TN Concentrations in Crescent Lake
Crescent Lake Management Plan

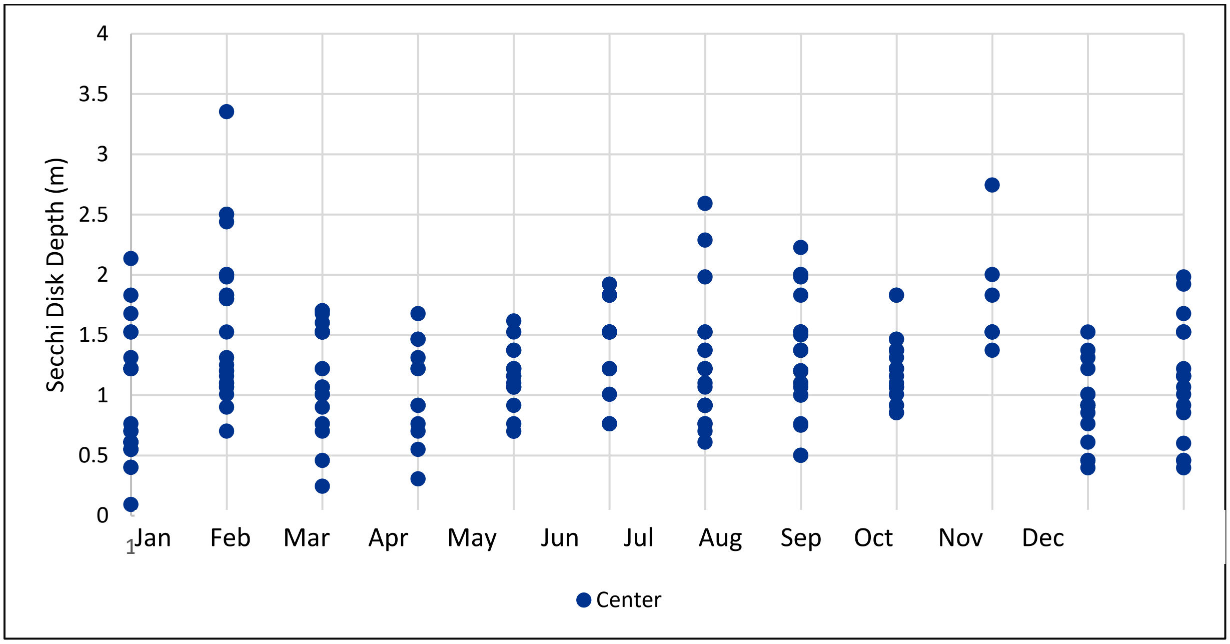


Figure 12. Seasonal Secchi Transparency in Crescent Lake
Crescent Lake Management Plan

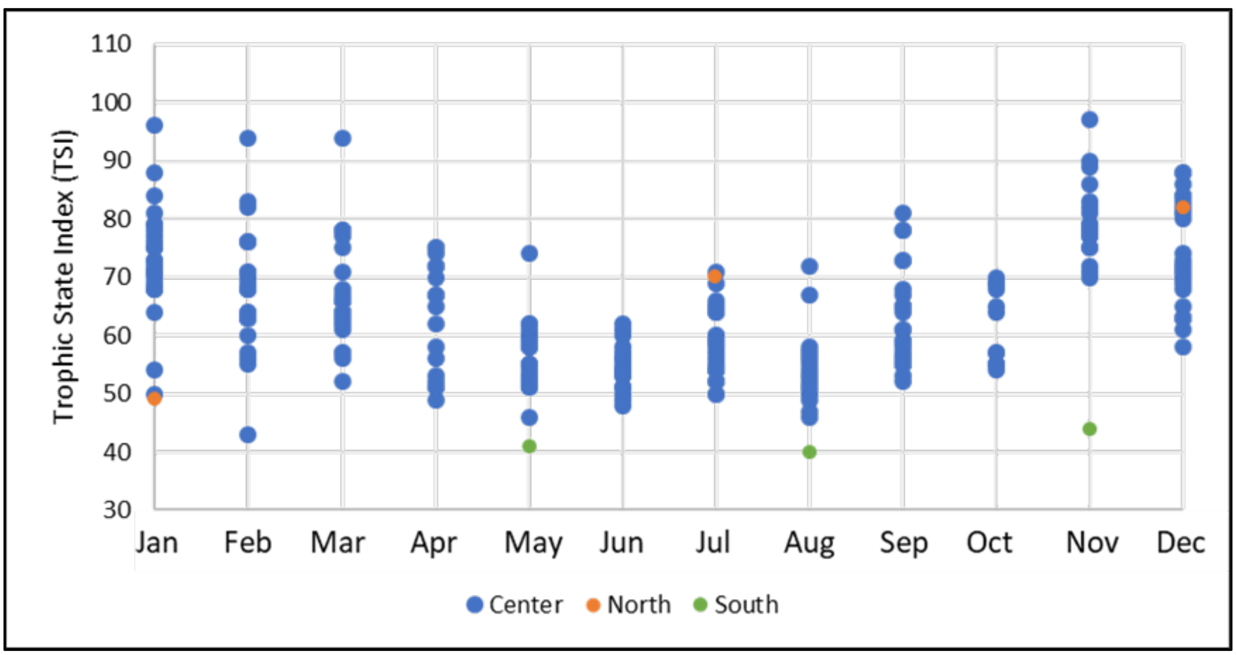


Figure 13. Monthly Trophic State Index in Crescent Lake
Crescent Lake Management Plan

The average TSI for Crescent Lake is 64.0 for the period of record, with significant seasonal variation. During the winter months, the lake TSI value averaged 73.1 while during the summer the TSI value averaged 59.5. Based on the Pinellas County Water Atlas, a “trophic state above 60 but below 70 can be considered highly productive and a reasonable lake for fishing and most water sports” (Pinellas County 2019). During the summer, Crescent Lake is considered fair water quality. The Atlas also describes that lakes with a TSI greater than 70 are hypereutrophic and probably do not meet the lake use criteria. Based on the data presented, Crescent Lake appears to reach a TSI score of 70 or above during at least 10 months of the year, which is considered poor water quality.

1.4 Causes of Water Quality Impairment

The lake is primarily fed by stormwater received from a highly urbanized watershed. The size of the watershed and population density potentially exert significant influence on the water quality entering the lake through 12 inlets from the sub-basins. The storm frequency and intensity have increased with development and have resulted in delivering larger and faster pulses to the lake with less runoff retained in the watershed. These events potentially cause significantly higher pollutant loads to the lake and less residence time within the lake prior to discharge to downstream receiving waters, resulting in potential deterioration of water quality conditions.

In addition, lake depth has a significant effect on water quality conditions by causing stratification in the lake profile. Long-term available data indicate that a seasonal shift in the water chemistry is causing an increase of algal growth with the winter season. The sediment data point toward an accumulation of nutrients in the deepest section from the settlement of organics. Crescent Lake's depth has the potential for the development of a thermocline. Interruption of the thermocline, by cooling the upper strata of water during winter seasons, would potentially cause an inversion of the water column. The temperature inversion would cause colder water on the surface to sink; driving the water formerly contained near the bottom to rise, bringing dissolved nutrients that were previously bound to sediment or trapped in the hypolimnion. This release of nutrients due to the temperature exchange of water is likely a cause of algal growth and blooms of water lettuce. These impaired conditions can be managed through multiple techniques discussed in this TM to improve lake water quality.

1.5 Volunteer Activities

In 2007, the FOCL was created to help restore Crescent Lake. FOCL was created by a neighborhood group of scientists, educators, planners and motivated residents to implement natural methods to enhance water quality and lake biodiversity in a safe manner and to educate the community on these methods. Monthly volunteer opportunities that focus on invasive species removal are organized by FOCL to accomplish the goals created in 2007. Mini-grants received from the Tampa Bay Estuary Program have helped the organization develop a consistent approach to maintaining and managing the lake.

In addition, appreciation for the use of this lake has increased by educational experiences created by FOCL. These experiences helped develop their volunteer base and community partnership as well. In 2016, FOCL partnered with Keep Pinellas Beautiful (KPB), a non-profit organization committed to restoration in Pinellas County. This partnership greatly furthered their outreach initiatives and has increased the pool of volunteers within the past 4 years. Crescent Lake is highly valued by the communities surrounding it, which is made clear by the amount of volunteer work that has been done and is currently being done. The volunteer base more than doubled from 2016 to 2017 (KPB 2019). These volunteer efforts have created many more partnerships and has developed a community dedicated to ecological improvement.

The maintenance of the lake has an incremental benefit to nutrient reduction in the lake. From August 2016 to March 2019, over 1,255 volunteers contributed 4,784 volunteer hours to remove 123,869 pounds (lb) of invasive species. Using these totals and published information on nitrogen and phosphorus content of aquatic and emergent plants (Kadlec and Wallace 2009), the mass of nitrogen and phosphorus removed was estimated (Table 1). Annual runoff and loadings were estimated using best management practices (BMP) Trains Version 3.0 (Wanielista 2020). Based upon these coarse estimations of external loading, the measured removal of water lettuce approximated 2.5 percent and 5.4 percent of the annual nitrogen and phosphorus loads, respectively. These removal values do not account for internal loading from sediments during winter turnover period. However, the relatively small removal of approximately 48 lbs of phosphorus and 143 lbs of nitrogen per year from the lake comes with no cost to the City and provides a positive outlet for members of the community looking to contribute to improved water quality in the lake and the bay.

Table 1. Nutrient Removal by Volunteer Efforts
Crescent Lake Management Plan

Nutrients Removed	Annual Amount Removed (lb/year)	Percent Annual Load (%)	Annual Amount Removed per Person (lb/year * person)
Nitrogen	143	2.5	0.114
Phosphorus	48	5.4	0.038

Basis

- Duration of volunteer activities: March 2016-August 2019
- Total volunteers: 1,255
- Total volunteer hours: 4,784
- Total mass removed: 123,869 lbs
- N = 3% d.w., P = 1% d.w., dry weight = 0.1 w.w., 25 lbs w.w./basket
- Total N Load 5,597 lbs per year (preliminary)
- Total P Load 884 lbs per year (preliminary)

2. Lake Management Plan

Based on the data collected to date on water quality, sediment quality, and volunteer activities, the CLMP has been prepared for the City to develop a sound approach toward reducing nutrients within the lake and improve the overall ecological health of the lake. The CLMP also improves the aesthetics of the shoreline, reduces floating trash, and improves community enjoyment.

2.1 Lake Vegetation Management

Crescent Lake has a distinctly narrow fringe of littoral vegetation consisting of stands of native vegetation but also a significant cover of nuisance exotic vegetation. The dominant floating cover is water lettuce (*Pistia stratiotes*) and is persistent throughout the lake with periodic blooms that have been observed to occupy up to 20 percent of the lake area. Nuisance and exotic vegetation are currently managed by volunteers who perform monthly maintenance on the floating aquatic cover of water lettuce. Littoral zones have been planted with native vegetation such as softstem bulrush (*Schoenoplectus tabernaemontani*), yellow canna (*Canna flaccida*), fire flag (*Thalia geniculata*), pickerelweed (*Pontederia cordata*) and others to encourage further establishment of native lake vegetation. Spatterdock (*Nuphar lutea ssp.advena*) has naturally colonized portions of the deep lakeward fringe of the littoral vegetation zone.

2.2 Existing Exotic and Nuisance Vegetation Cover

Dominant invasive and/or exotic species in the lake include water lettuce and scattered stands of alligatorweed (*Alternanthera philoxeroides*), water primrose (*Ludwigia grandiflora*), paragrass (*Urochloa mutica*), and torpedo grass (*Panicum repens*) which are classified by the Florida Exotic Pest Plant Council's (FLEPPC) 2019 List of Invasive Plant Species (FLEPPC 2015) as Category I. Category I invasive exotics are defined FLEPPC as "invasive exotics that are altering native plant communities by displacing the native species, changing community structures, or ecological functions, or hybridizing with natives." These species displace native vegetation communities and potentially diminish wildlife habitat and aesthetics of the lake. Dense water lettuce cover specifically includes the following concerns:

- Water lettuce mats may lower DO concentrations reducing aquatic life.
- Dense mats can restrict water flow by clogging the outfall, increasing the risk of flooding within the lake and watershed.
- Dense water lettuce populations produce ideal breeding environments for mosquitoes.
- Water lettuce populations crowd out native plants and animals (lowers biodiversity).

Removal of the exotic and nuisance vegetation cover is important for improving the ecological balance within the lake and achieving improved water quality in lake discharges.

2.3 Vegetation Management Techniques

The aesthetic and wildlife habitat value of lakes can be greatly enhanced by establishing and managing desirable native plants (Main 2012). The most effective approach for successful invasive species management is prevention, followed by removal of new or scattered populations, and finally tackling the heavy infestations from the outside edges inward. Ensuring establishment of vigorous and dense native stands of vegetation can also preclude or reduce invasive species establishment. Successful eradication of nuisance exotic species is typically a long-term endeavor requiring perseverance and persistence (Hillmer 2003). Except in the earliest stages of invasion, complete eradication of the infestation typically has a lower chance of succeeding. One approach to managing a widespread infestation in a natural area is to divide the site into management units (littoral zones) requiring different management intensity such as:

- Typical maintenance where the littoral zone is relatively weed-free, or the invasive exotic species is present in low and manageable numbers.
- Intensive rescue effort where the littoral zone has potential, but intensive management is required for a year or more before the native community recovers naturally.
- Complete restoration because the littoral zone is heavily degraded and requires extensive control and replanting with natives, or other complex work.

There are many techniques available for the management and removal of invasive exotic species such as hand removal, mechanical removal, herbicide application, hydrologic manipulation, burning, and biological control (Schmitz 2013). The latter two methods are not practical and not effective considering the target species and the urban setting of the lake. For Crescent Lake, feasible methods include herbicide application, hand and mechanical removal, and hydrologic manipulation of water levels through modification of the outfall structure.

2.3.1 Herbicide Application

More than 60 biological, chemical, mechanical, and physical tools are available to manage aquatic plants in Florida waters. Managing aquatic plants is best accomplished by using an integrated pest management strategy. This strategy basically means using the appropriate management tools singly or in combination that:

- Provide cost-effective control of the target plant
- Conserve or enhance the uses and functions of the water body, including native plant and animal habitat
- Are compatible with current conditions in the water body

Site conditions to consider before herbicide application include:

- Assessing the target plant species
- Seasonal timing of the application
- The presence of desirable species and communities
- Accessibility for the applicator and equipment
- Weather conditions
- Location of surface water
- Depth to groundwater
- The site's sensitivity to trampling when the herbicide is being applied (Windus and Kromer 2001)

The behavior of herbicides in water is dictated by its solubility. Water bodies can be contaminated when directly sprayed upon, or when herbicides drift, volatilize (vaporize), leach in to groundwater, or are carried in surface or subsurface runoff. Amounts of leaching and runoff largely depend on total rainfall the first few days after an application (Ohio State University Extension 1992) and flows can vary significantly in Crescent Lake. To prevent water contamination of downstream receiving waters, careful consideration of the hydrologic residence time of Crescent Lake must be considered to avoiding adverse effects to the downstream aquatic ecosystems. Some herbicides will volatilize rapidly in hot weather and drift even on windless days. Improper spray pressures or techniques can cause droplets or clouds of herbicide to drift and land on non-target vegetation.

Only herbicides that are registered specifically for use in wetlands and aquatic systems by the U.S. Environmental Protection Agency and the Florida Department of Agriculture and Consumer Services can be legally used (Main 2012). Table 2 has suggested herbicides to use on the invasive exotic species found at Crescent Lake, recognizing that new herbicides or products may become available for use.

Table 2. Typical Herbicides Used for Invasive Exotic and Opportunistic Species
Crescent Lake Management Plan

Common Name	Scientific Name	Typical Herbicide[a]
Water lettuce	*Pistia stratiotes*	glyphosate, diquat dibromide, imazapyr, triclopyr
Carolina willow	*Salix caroliniana*	2,4-D, glyphosate, imazapyr, triclopyr
Cattail	*Typha latifolia*	diquat, glyphosate, fluridone

Table 2. Typical Herbicides Used for Invasive Exotic and Opportunistic Species
Crescent Lake Management Plan

Common Name	Scientific Name	Typical Herbicide[a]
Water primrose	*Ludwigia grandiflora*	2,4-D, imazapyr
Para grass	*Urochloa mutica*	glyphosate, imazapyr
Torpedograss	*Panicum repens*	glyphosate, fluridone

Note: The herbicide applicator will use the most appropriate herbicide that meets the conditions in the wetland and targets the appropriate species. Herbicides listed here are only shown as a general example.

[a] Source: Weed Control in Florida Ponds

General guidance to safely use herbicides are as follows:

- Avoid treating on cloudy days when DO levels will naturally be lower.
- If a large portion of the littoral zone is covered with invasive exotic species, treat no more than one-third to one-half of the plants at once, leaving time between applications for oxygen recovery.
- Treat early in the spring before plants get out of control.
- In order to get maximum performance from a herbicide, treat when the water temperature is above 60°F and plants are actively growing.
- Use proper personal protective equipment when applying to avoid exposure.
- Immediately clean any spills when mixing or loading herbicides to ensure there is no exposure to the public.

Many methods of herbicide application are available today but only a select few methods would be applicable for Crescent Lake considering the existing native plant community including:

- Broadcast foliar application to intact plants typically used in large areas
- Spot application using backpack applicator for minor infestations
- Wick application to individual plants
- Hack and squirt on woody vegetation such as Carolina willows
- Stump cut and cut surface painted with herbicide

2.3.2 Water Level Management

Regulating water levels to manage and reduce invasive plant species in aquatic and wetland habitats can be effective but needs to be carefully managed to achieve specific goals. Lowering lake levels can reduce standing biomass, but usually results in repeated invasion by the invasive exotic species when water levels return to their normal operating condition. Lower lake levels would enable improved access to apply herbicides and reduce the risk of uncontrolled drift onto established plant communities. Exposed sediment in the littoral zones would facilitate germination of seed or planted species.

2.3.3 Mechanical and Hand Removal

Mechanical removal involves the use of backhoes or other floating mechanical harvesters to remove exotic and nuisance vegetation. Once the soil along the shore is disturbed, intense management is required with other control methods to prevent regrowth from seeds and root fragments, and recolonization by invasive, non-native plants. Mechanical control could be employed at Crescent Lake to help facilitate the establishment of a desirable, native wetland community. The littoral zones could be cleared and grubbed and replanted with native emergent species known to grow successfully within the lake. This type of activity usually creates significant turbidity and resuspension of sediment so turbidity control at the outfall or within work areas should be considered in the form of floating turbidity curtains or log boarding of the weir to retain any turbid water prior to discharge and avoid violation of water quality standards.

Harvester or shredders could potentially be effective mechanical means to remove nuisance exotic vegetation, but these methods are typically employed in larger water bodies. Risks associated with harvesting include plant and root fragmentation that could potentially spread the exotic species within the system. Ultimately, harvested and mechanically removed vegetation need be physically removed for disposal. A harvester would be required to control large extents of water lettuce blooms on the lake. Given the cumulative experience of volunteer efforts to control water lettuce in Crescent Lake, harvesting will be an ongoing activity with greater removal frequency during the spring.

2.3.4 Biological Control

Biological control typically uses non-native insect species that have been studied and determined to be non-harmful to other indigenous species. Historical studies have determined insects such as the leaf weevil, *Neohydronomous affinis,* or leaf moth, *Spodoptera pectinicornis,* feed on water lettuce and were approved for release. After extensive studies, both species failed to effectively control water lettuce (IFAS 2019). Although the weevil *N. affinis* has been used successfully in other countries, it has had only limited effect in Florida (Dray and Center 1992). Field observations from Crescent Lake indicate that at least the leaf weevil is present at the lake, and that the leaf moth may be, but their populations are apparently not sustained to a level adequate to yield significant control.

2.3.5 Seasonal Activities of Vegetation Control

Plants vary in their response to herbicide application or other methods of control depending on the season. During spring season, when biomass growth is most pronounced, there is an increased susceptibility to herbicides. This makes early season application of herbicides very effective and attempts to regulate uncontrolled growth before a nuisance exotic vegetation outcompetes native vegetation. Fall seasons tend to be much less effective and herbicide applications tend to be less effective.

2.4 Replacement Planting

Planting native species can be an effective way to reduce the likelihood of exotic species reinvasion following removal of these species. Commercially available species can be obtained as seeds, bare root, or potted. Planting of seeds, plant parts, or whole plants should include careful screening for any unwanted pests – plant or animal. Time lag for seeds versus bare root or potted plantings are a concern but may be an acceptable (less expensive) form to supplement the desirable species within the littoral zone. During the establishment phase, active management may be necessary to reduce invasion by exotic species until the plantings are well established.

In areas where there is significant cover of invasive exotic species, it is anticipated that these will be replanted with desirable species after herbicidal control. Current successfully established species within the Crescent Lake littoral zones include scattered presence of fireflag, duck potato (*Sagittaria lancifolia*), golden canna, bulrush and spikerush (*Eleocharis cellulosa*). The species shown in Table 3 are good candidates for lake littoral zone planting and would likely do well throughout the year.

Dense vegetation cover would significantly increase nutrient removal performance of lake vegetation, and would provide an important function to improve water quality prior to discharge to the bay. A dense native cover discourages the establishment of the invasive exotic species and ensures lower maintenance. Demonstrated wetland vegetation success has been documented by the species currently established in the littoral zones. Another species that would be suitable for planting would be maidencane (*Panicum hemitomon*) as it can outcompete torpedograss once established.

Table 3. Candidate Wetland Species for Replacement Plantings
Crescent Lake Management Plan

Common Name	Scientific Name	Ideal Depths
fireflag	*Thalia geniculata*	1 to 2 feet
duck potato	*Sagittaria lancifolia*	1 to 2 feet
saw-grass	*Cladium jamaicense*	1 to 2 feet
golden canna	*Canna flaccida*	<1 foot
bulrush	*Scirpus americanus*	1 to 2 feet
pickerel weed	*Pontederia cordata*	1 to 2 feet
maidencane	*Panicum hemitomon*	<1 foot
arrow-arum	*Peltandra virginica*	<1 foot
spikerush	*Eleocharis cellulosa*	<1 foot

Replacement planting should occur during late winter but preferably no later than early spring. The species to be planted would consist of commercially available species as described in Table 2. The goal is to plant these species and have them gain an advantage over undesirable vegetation and retard further spreading of invasive exotic vegetation.

The replacement plantings should be spaced on maximum 1-foot centers to ensure these have sufficient density to out compete the undesirable vegetation. Planting should only occur when it is safe to replant the area after the manufacturer's specified time period after herbicide application.

2.5 Timing of Maintenance

Herbicide application is recommended during spring when new growth is occurring and anytime during a growth season. Initial treatment would consist of 2 to 3 treatments over a 6-week to 8-week period, then followed by quarterly maintenance. The goal is to start treatment as soon as possible, even if selective repeat treatments are necessary when water levels recede or when spring growth results in the return of invasive exotic vegetation. Once all the nuisance/exotic vegetation is under control and the natives have expanded naturally throughout the spring and early summer, then the system can be evaluated for replanting natives where needed. Late fall or winter season application should be avoided.

2.6 Cost Estimate

The City will have to issue work orders to an aquatic vegetation maintenance contractor to maintain exotic and nuisance vegetation. An immediate action would be preferred to prevent further spreading of undesirable species and minimize the escalation in cost if these actions are delayed.

A Class 5 planning level cost estimate for these vegetation management activities is approximately $1,200 per acre, per event. It is expected that once nuisance and shoreline species have been controlled (which is expected to require less than 3 years), the cost will significantly reduce with minimal additional maintenance required by the City. Volunteer activities are expected to continue at the lake to maintain and assist with vegetation control activities. Mechanical harvester events may be needed to control large blooms of water lettuce. Costs for these events are largely dependent on the extent of water lettuce. The City intends to procure a small-scale mechanical harvester that can be used to remove water lettuce from Crescent Lake, and other City ponds and lakes, as warranted. Given the history of water lettuce blooms in the lake, the application of the harvester may be year-round, and is a good investment towards the management of the lake.

As in any adaptive management planning, this vegetation management plan will need to be updated regularly and the plan adjusted based on past successes and failures. The plan, do, act, check components of any plan will need to be focused to improve management approaches. It is recommended that the City evaluate the effectiveness of this management plan once every 5 years and see whether the goals listed are achieving system success and if maintenance activities are occurring at a sufficient frequency to maintain healthy, functioning littoral system within Crescent Lake.

3. Littoral Zone Improvements

The littoral zone is defined as the interface between the lake's edge and the open water of lakes colonized by rooted aquatic plants. The littoral zone area extends from the shoreline to the greatest depth at which rooted aquatic plants can inhabit. Since most lakes in Florida are relatively shallow and small, the littoral zone contributes greatly to the lake ecosystem and water quality (Florida Lakewatch 2007).

Most of Crescent Lake's littoral zone is nonexistent due to steep slopes from the previous man-made modifications to the lake or lack of wetland vegetation along the gentler slopes of the lake. Thus, the expansion and planting of Crescent Lake's littoral zone could provide several benefits to the water quality and ecological value of Crescent Lake. Floating treatment wetlands (FTW) could also be installed within the 6- to 8-foot depth range of Crescent Lake to expand upon the shoreline littoral zone and provide further water quality improvement. This section reviews the proposed amendments to Crescent Lake's littoral zone and the resulting nutrient reduction and planning-level cost estimates.

3.1.1 Enhanced Littoral Zone

Review of Crescent Lake's shoreline indicates approximately 6.2 acres of the littoral zone could be improved. Enhancement of the littoral zones would be either through reconstruction and planting of existing steep shorelines to create additional littoral zone area or wetland plant installation within existing gently sloped littoral zones void of emergent wetland vegetation. The following sections describe the littoral zone improvement concepts.

3.1.1.1 Reconstruction of Lake Littoral Zone

The gradient of the littoral zone is inversely related to the maximum biomass of littoral zone vegetation due to the difference in sediment stability on gentle versus steep slopes. Steeply sloped shorelines are conducive to erosion and prevent establishment of rooted aquatic plants. Gently sloped shorelines provide the deposition fine sediments required for plant establishment and growth in the littoral zones. Thus, manipulation of the Crescent Lake's littoral zone slope can encourage the establishment and growth of aquatic plants within the lake's littoral zone (Florida Lakewatch 2007).

Since Crescent Lake is a highly modified lake, a significant portion (approximately 50 percent) of its shoreline is steep and not conducive for rooted aquatic plant growth. The steep shorelines of Crescent Lake (greater than 20 degrees slope) could be reconstructed to provide gentler sloped littoral zones favorable for the growth and establishment of aquatic vegetation. As shown in Figure 14, the proposed conditions suggest a portion of the shoreline should be excavated past the current shoreline extent and fill should be placed to provide a littoral zone slope of less than 20 degrees. Once the slope of the shoreline has been modified, native wetland plants such as those provided previously in Table 3 should be planted to promote the establishment of wetland vegetation in the modified littoral zone. To extend the littoral zone further, FTW are suggested to be installed in the deeper portions (6 to 8 feet) of the littoral zone of Crescent Lake (Figure 14). Refer to the following Section 3.1.2 for further details on FTW installation.

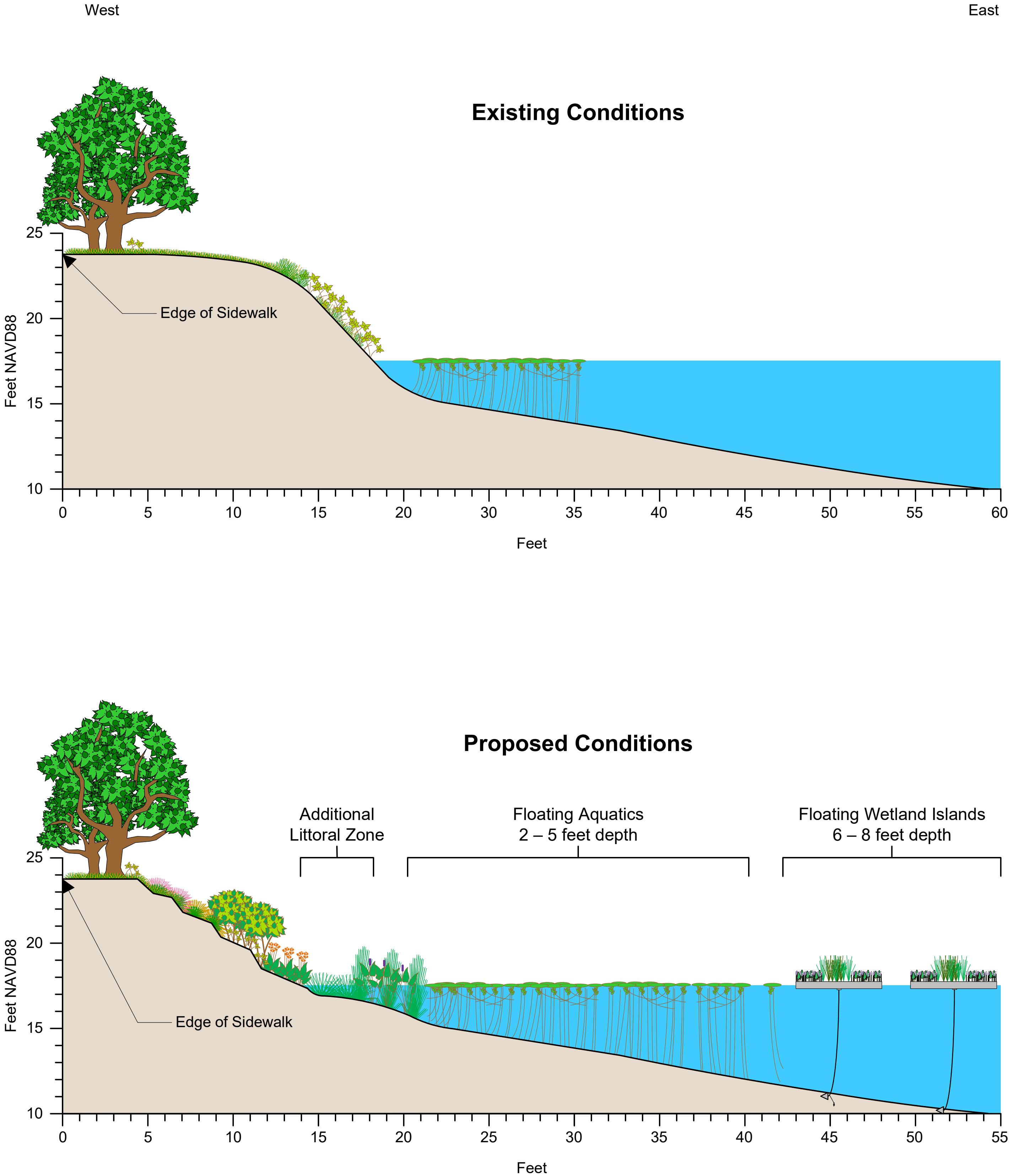
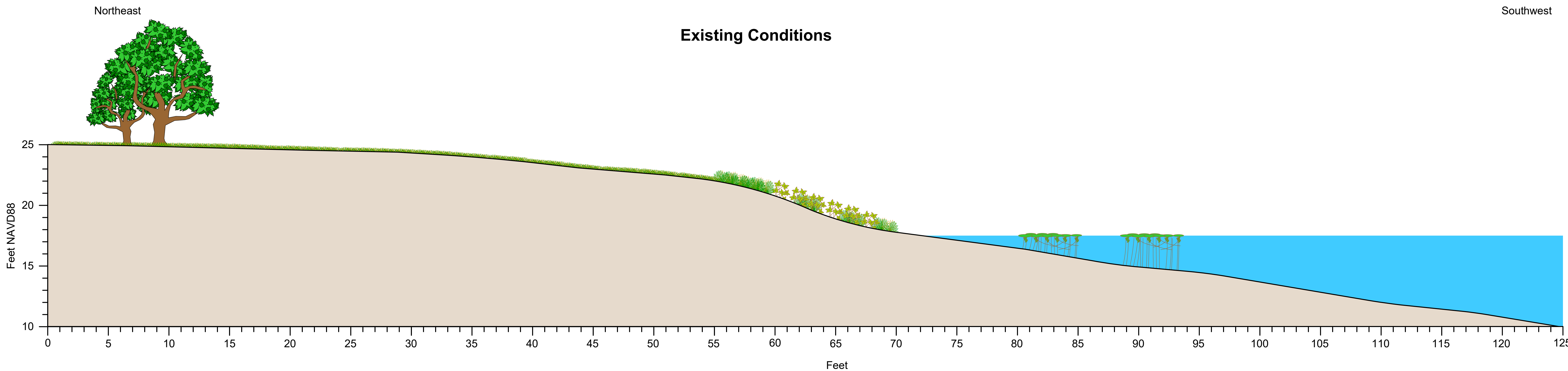


Figure 14
Littoral Zone A – Proposed Improvements
Crescent Lake Management Plan
St. Petersburg, Florida

3.1.1.2 Planting of Lake Littoral Zone

Currently, a portion of Crescent Lake's littoral zone does not contain emergent wetland vegetation, even though the littoral zone's slope has a gentle gradation amenable to the growth and establishment of rooted aquatic plants. This potentially could be due to a lack of emergent wetland plant seed source. For areas in which the gradation of Crescent Lake's shoreline is gentle (less than 20 degrees slope), the littoral zone could be planted with emergent wetland vegetation such as the species mentioned previously in Table 3. Dense vegetation cover would significantly increase wetland treatment performance and serves an important function to improve water quality prior to discharge to the bay. It is imperative that a dense cover is established within the littoral zones. Figure 15 presents a conceptual cross-section comparison of the existing littoral zones and the proposed plantings within the littoral zones at Crescent Lake.



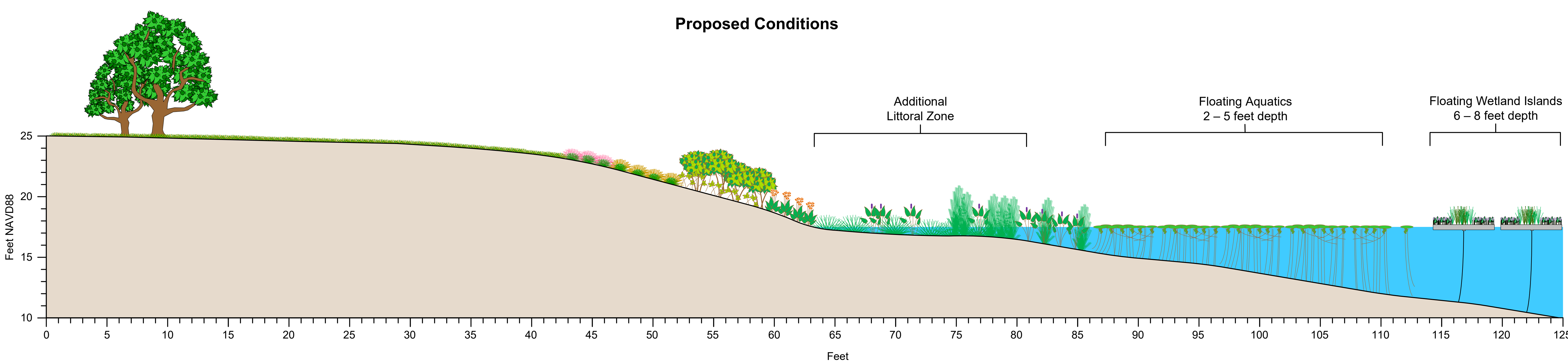


Figure 15
Littoral Zone B – Proposed Improvements
Crescent Lake Management Plan
St. Petersburg, Florida

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3.1.2 Floating Treatment Wetlands

FTW are man-made systems designed to mimic natural floating wetland ecosystems where emergent wetland plants grow on the surface of a floating material within an aquatic ecosystem. FTW are typically constructed with a buoyant mat that is planted with a variety of native emergent macrophytes. This buoyant mat can vary in material but typically is comprised of UV-resistant woven plastic that is injected with polyurethane foam to keep the mat afloat (Stewart et al. 2008). To secure wetland plantings within the mat, the mat surface is pre-drilled by the manufacturer with cup holes on specified spacing intervals. Over time, the plant roots grow beneath the mat within the water column and improve water quality naturally through biofilms that attach to the roots and plant uptake. Figure 16 displays a conceptual drawing of a fully established FTW.

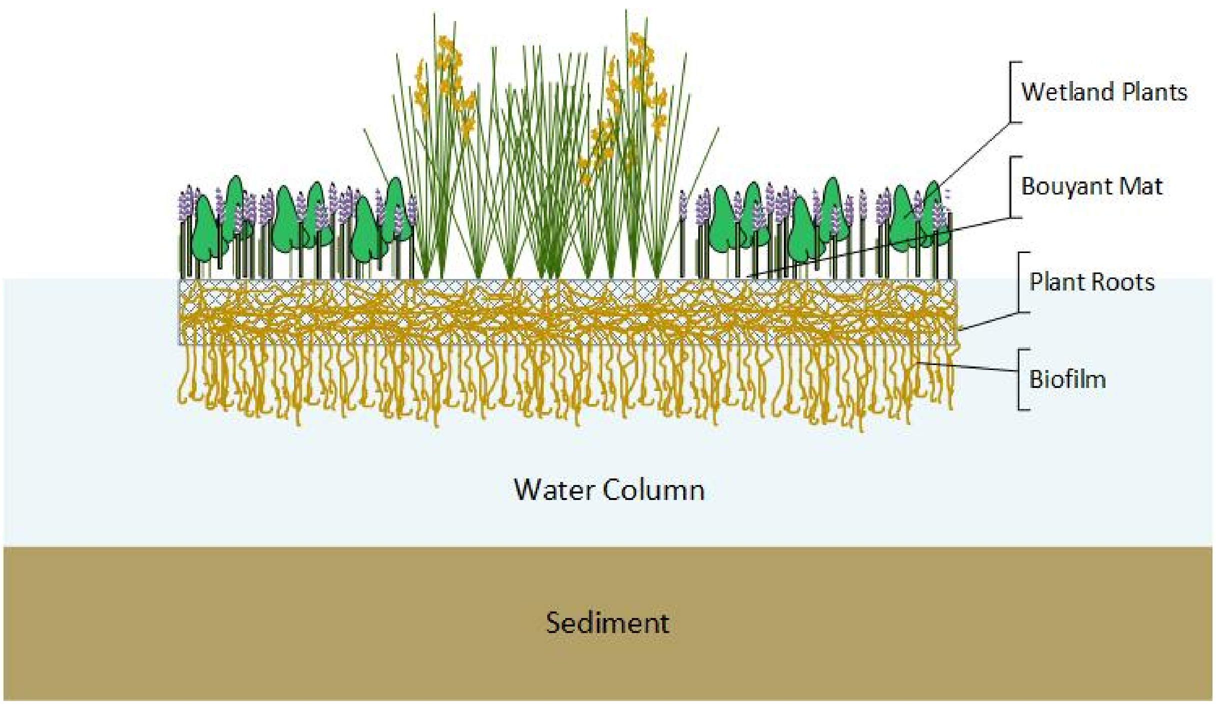


Figure 16. Conceptual Floating Treatment Wetland
Crescent Lake Management Plan

Within the past few years, interest has grown in the use of FTW for passive treatment of waters in ponds or open channels. The FTW provide surface water quality improvement in existing or constructed water bodies where land area constraints may limit the feasibility of other passive treatment methods (e.g., treatment wetlands). In addition, FTW are better able to tolerate significant water level fluctuations as the mat will rise and fall with water levels. For Crescent Lake, the FTW provides a solution to enhance the habitat and improve water quality within the 6- to 8-foot depth range of the lake where the construction of treatment wetlands or other treatment technologies is not feasible and where water levels can fluctuate due to seasonal influences. Due to the flexible nature of FTW installation and operation, FTW are most commonly utilized in stormwater pond or wastewater lagoon treatment applications (Faulwetter et. al. 2011).

FTWs provide water quality improvements via several mechanisms and have been documented to significantly reduce TN, TP, and TSS. The primary removal mechanisms include microbial conversion and uptake, wetland plant uptake, and adsorption to plant roots and substrate materials. As compared to conventional treatment wetland plants, the FTW plant roots are suspended in the water column rather than rooted in soil, resulting in increased contact between the water and the associated microbial biofilms that grow on the roots. While some nutrient removal occurs through plant uptake, it is the root structures of the wetland plants that provide the surface area for microbial communities to colonize and remove most of the nutrients from the water column via biogeochemical processes and conversions (Vazquez-Burney et al. 2015). FTW roots can grow up to 9 feet in length, providing an extensive area for biofilm attachment (Walker et al 2017). Thus, the considerable FTW root surface area exposure to the water column, as compared to conventional treatment wetlands, is advantageous in nutrient reduction.

GIS-analysis of Crescent Lake's bathymetry indicates approximately 1.3 acres of Crescent Lake are within 6 to 8 feet of depth. Thus, it is proposed that 1.3 acres of FTW be installed within the 6- to 8-foot depth range to further improve water quality and enhance Crescent Lake's littoral zone.

3.1.3 Enhanced Littoral Zone and Floating Treatment Wetland Nutrient Reduction

The nutrient removal potential of the enhanced littoral zones (reconstruction and planting of littoral zones) and the installation of the FTW at Crescent Lake was evaluated based on removal rates provided in literature. TN and TP removal rates for the enhanced reconstruction and planting of the littoral zones was calculated based on annual removal rates of 76 g TN/m^2/yr and 1.6 g TP/m^2/yr (Kadlec and Wallace 2009). For the analysis of the FTW, nutrient reduction studies with similar influent nutrient concentrations to Crescent Lake reported FTW areal removal rates ranging from 0.08 g/m^2/d of TN and 0.01 g/m^2/d to of TP (Headley and Tanner 2012). Based on the total area of enhanced littoral zone and FTW suggested for littoral zone improvements, TN and TP reductions were estimated and are provided in Table 4**.** Overall, it is estimated the littoral zone improvements recommended will provide a net reduction of 4,550 lbs TN/year and 140 lbs TP/year.

Table 4. Littoral Zone Improvements Estimated Nutrient Reduction
Crescent Lake Management Plan

Littoral Zone Improvement	Area (acres)	TN Reduction (lb/year)	TP Reduction (lb/year)
Enhanced Littoral Zone	6.2	4,200	90
FTW Installation	1.3	350	50
Total	7.5	4,550	140

3.1.4 Littoral Zone Improvements Conceptual Cost

A planning-level conceptual cost estimate was calculated for the reconstruction and planting of littoral zones and the installation of the floating wetlands at Crescent Lake. For the enhanced littoral zones (reconstruction of shoreline and wetland planting), the 2006 median capital cost of wetland construction was used and escalated using present worth analysis, with a discount rate of 5 percent, to obtain an equivalent 2020 median capital cost (Kadlec and Wallace 2009). A recent Jacobs FTW installation project yielded an area-based capital cost of FTW installation of $75 per square foot of FTW. As shown in Table 5, the total estimated capital cost for littoral zone improvements is estimated to be $5,300,000.

Table 5. Littoral Zone Improvements Estimated Nutrient Reduction
Crescent Lake Littoral Zone Vegetation Management Plan

Littoral Zone Improvement	Area (acres)	Estimated Capital Cost	TP Reduction (lb/year)
Enhanced Littoral Zone	6.2	$1,000,000	90
FTW Installation	1.3	$4,300,000	50
Total	7.5	$5,300,00	140

4. Inlet Structure Improvements

Most debris and nutrients enter Crescent Lake through stormwater inlets. To reduce the trash and nutrient input, it is recommended that the City apply a two-step inlet pollutant removal system approach. The first step applies a floating litter collection system. This system uses flotation devices, or pipe traps, coupled together to contain any floating trash from floating into Crescent Lake. To prevent smaller or submerged litter from entering the lake, the collection systems include an aluminum mesh skirt that attaches to the bottom side of the floating devices and is draped down using weights to ensure the skirt cleans the desired water column. The litter collection system is then manually cleaned as needed. The recommended orientation of the floating litter collection system (Figure 17) allows for proper interception of trash from the inlets while providing an ability to reach the flotation devices to clean out the litter collection system. There are many different manufacturers of litter collection systems including Watergoat, Elastec Trash and Debris Booms, Bandalong Boom Systems, and Orion Floating Debris Booms (pictured below) each with unique adaptations of the litter collection system that can be adapted to the needs of Crescent Lake. Education programs can be started around the litter collection system to increase awareness of the community to the different types of trash and volume of trash that enters the waterways.

Example of Litter Collection System Containing Debris
Source: Orion Containment 2019

The second step of the inlet pollutant removal system is a ring of FWIs. FWI have multiple benefits including reducing sediment and nutrient inputs to Crescent Lake while providing highly diverse habitat for animals, including fish, frogs, turtles, and birds. By using the two-step inlet removal system the larger debris and litter is removed through the litter collection system while significant amounts of nutrients are removed from the stormwater by the FWIs before entering the greater ecosystem of Crescent Lake. Section 3.1.2 discussed the nutrient removal function of FWIs. A recommended configuration of an inlet pollutant removal system is provided in Figure 17. The crescent shape of the litter collection system and the FWI stretching from the bank on either side of the inlets provides significant interception of the incoming stormwater while providing easy access for cleaning and maintenance. The approximate length of the litter collection system is designed to be 50 feet. The approximate length of the surrounding wetland ring is 100 feet with approximately 8 wetlands spanning that distance. The desired size of each FWI determines the number of individual wetlands that will be installed per stormwater inlet. The following cost summary (Table 6) provides estimated costs for the litter collection systems, FWI, and total cost of inlet pollutant removal system.

Table 6. Cost Summary for Crescent Lake Inlet Pollution Removal System
Crescent Lake Management Plan

Description	Cost Opinion Range		
	-30%	Median	+100%
Unit cost for litter collection system ($/linear foot)[a]	$246	$325	$650
Total cost for five inlets[b]	$56,875	$81,250	$162,500
Cost per FWI[c]	$5,250	$7,500	$15,000
Total cost for five inlets[d]	$210,000	$300,000	$600,000
Total cost for inlet pollutant removal system[e]			

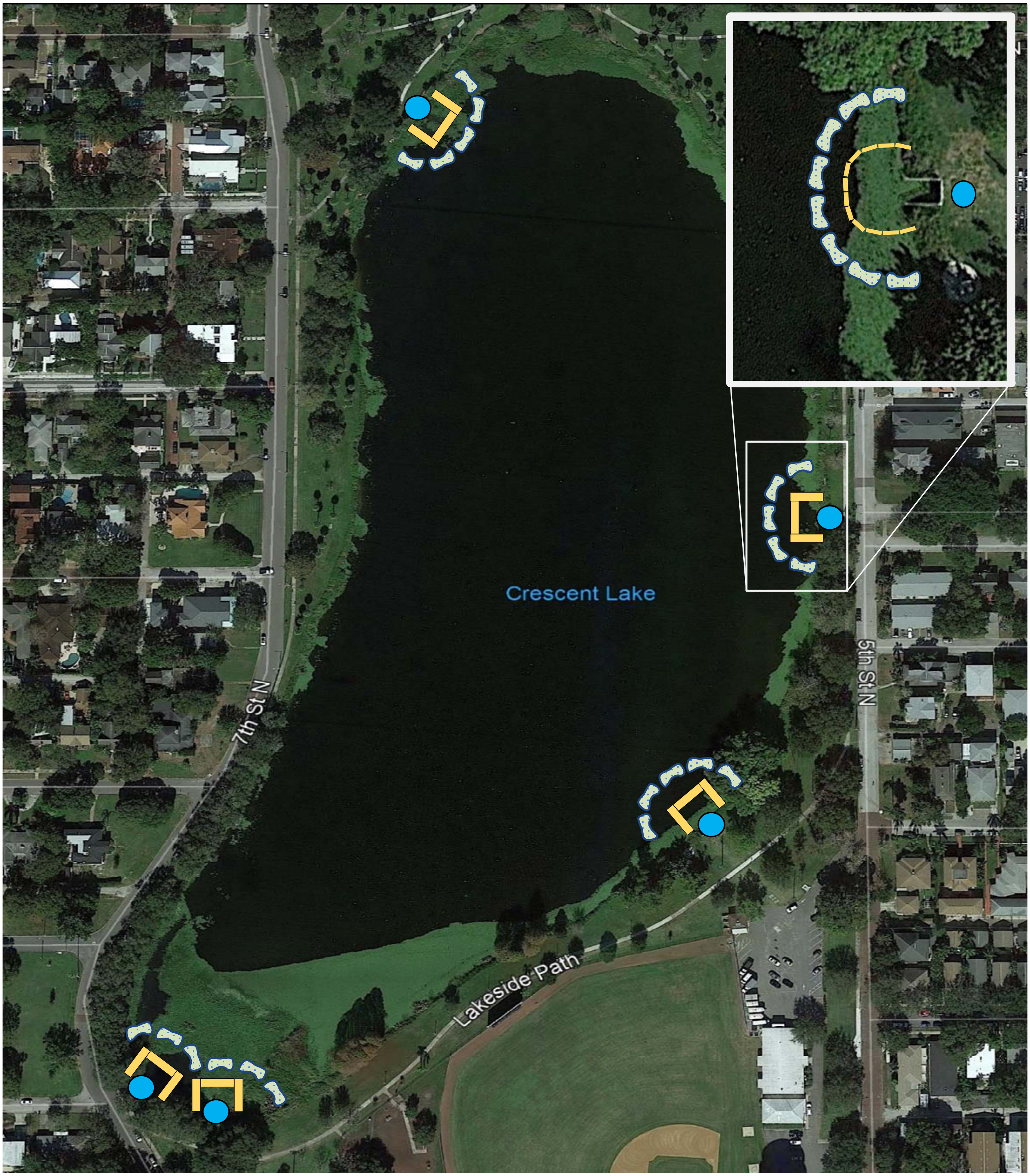
[a] Cost of litter collection system does not include delivery or installation fees. Price quoted from Stormwater Systems.

[b] Total cost for five inlets assumes 50 linear feet of the litter collection system per inlet. This cost does not include delivery or installation fees.

[c] FWI refers to Floating Wetland Island. Cost is for 10-foot x 10-foot islands at a total cost of $75 per square foot including delivery, planting, and installation.

[d] Total cost for five inlets includes eight islands per inlet.

[e] Total cost is for purchase of materials only. Installation and maintenance are determined by City and will affect total cost.



Note: Aerial Image © 2018 Google
Images not to scale

Legend

Floating Wetlands

Litter Boom

Stormwater Inlet

Figure 17
Trash Collection Locations
Crescent Lake Management Plan
St. Petersburg, Florida

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Additional litter collection systems are available for installation if the litter boom floatation devices are not preferred. Additional options include:

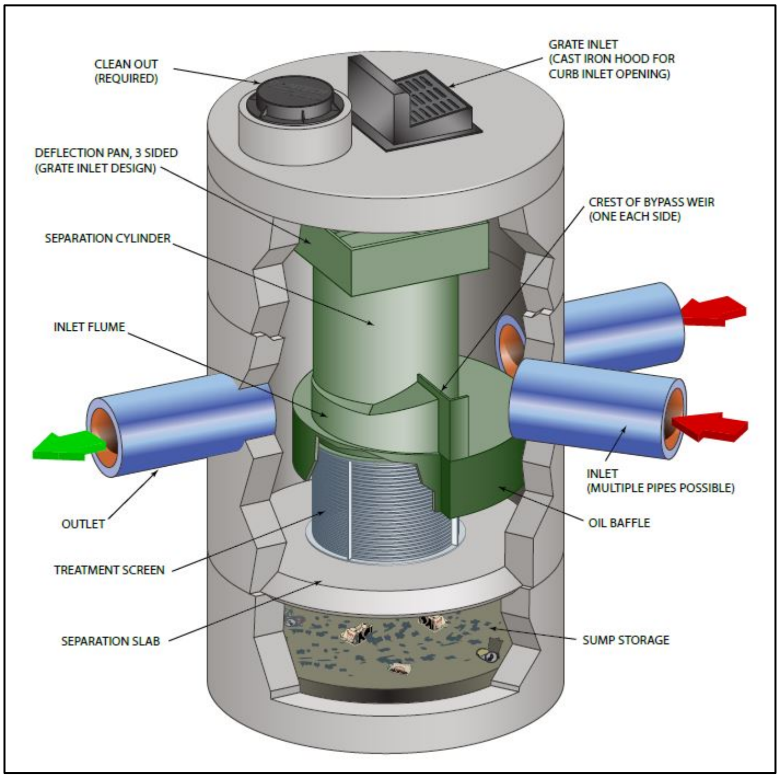
Example of a Stormwater Systems, Inc Trash Trap
Source: Stormwater Systems, Inc. 2019

- Litter Trap – litter trap uses the flow of the stormwater to push the floating debris (trash and organic material) into a collection basket. The basket is then periodically cleaned to remove the debris from the system. A litter trap uses a combination of floating booms and the trap itself to concentrate and capture the floating debris. The litter trap can be cleaned using a crane, boomtruck, backhoe or can be manually cleaned by volunteers or City employees. Costs range from $32,000 to $60,000 not including installation and delivery. An example of a litter trap follows.
- Netting Trash Trap – Netting trash traps are installed into the outlet pipe (or downstream) and capture a wide range of pollutants ranging from large floating trash to organic materials as small as 5 millimeters wide while allowing the stormwater to flow into the lake unimpeded. Depending on the size of the netting installed, the net can be cleaned in a variety of ways. Smaller nets can be removed by City employees or volunteers and cleaned. Larger nets may require a crane, boomtruck, or backhoe based on the weight of trash collected by the netting. The final option is to use a vacuum truck and remove the trash by vacuuming the litter out of the net. Proper installation and sizing are necessary to ensure that no animals get captured by the netting trash trap. Netting trash traps are built to order and generally range from $4,000-$9,000 depending on the model and size, not including delivery and installation. Visual examples of the netting trash trap follow.

Example of Netting Trash Strap Installed in Stormwater Pipe
Source: Stormwater Systems, Inc. 2019

- Continuous Deflective Separation (CDS) Stormwater Treatment – the CDS system is a hydrodynamic separator that uses swirl concentration and continuous deflective separation to separate and trap debris, sediment, and hydrocarbons from stormwater. The CDS system includes indirect, non-blocking screening technology that provides a physical barrier to capture and retain items ranging from floatables to the size of a match head. Along with capturing trash and debris, the CDS removes sediment through settling in the bottom of the device. The filtered stormwater then runs through the treatment screen into the outer shell where it continues through the outlet pipe into Crescent Lake. The system traps and stores debris within the CDS technology that provides out-of-sight concentration of debris.

Maintenance of the CDS system can be achieved using a vacuum truck, with no requirement to enter the unit. The system can be adapted to the size of the stormwater outlet pipe that flows into Crescent Lake. Pricing of the system is based on the pipe size as well as the peak flow. For an 18-inch diameter pipe, the capital cost is estimated at $25,000 to $36,000 per unit. For a 54-inch diameter stormwater pipe, the capital cost is estimated at $118,000 to $126,000 per installation. An example of the technology follows.



Example of the CDS system for trash and debris collection
Source: CONTECH Engineered Solutions 2019

5. Outlet Structure Modification

The current outlet structure maintains the lake at a steady controlled water level with storm events raising lake levels for a short duration. Littoral zone improvements are being considered by grading the lake shorelines to create more shallow zones and planting native plant species established to different water depths across the littoral zone. However, varying water levels can also be integrated into the littoral zone improvement plan to expand the vegetated areas, promote healthy native wetland communities, and help suppress establishment of exotic species. Seasonally varying water levels create diverse wetland communities that leads to an ecological system that requires little vegetation management, maximizes ecological value, and ensures the health of the wetland in the long-term.

A typical analytical approach to understanding water level variations or hydroperiods in a wetland community is to look at the water level percent exceedance curve to understand how often water levels exceed key elevations along the littoral zone. Figure 18 presents the percent exceedance curve of Crescent Lake for the period or record of August 2018 through July 2019.

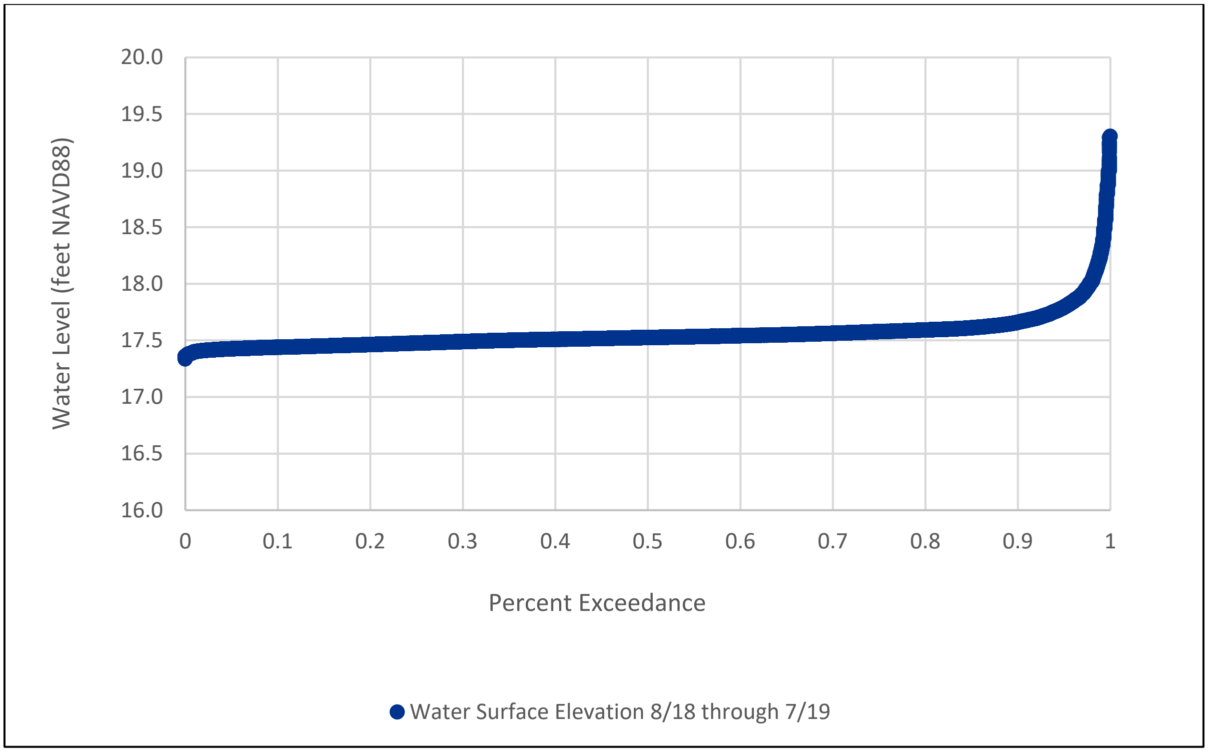


Figure 18. Percent Exceedance Curve of Crescent Lake Water Levels
Crescent Lake Management Plan

The percent exceedance curve reveals that Crescent Lake spends more than 90 percent of the year, or approximately 330 days per year, at an elevation between 17.4 and 17.6 feet NAVD88. The controlling weir at Crescent Lake is set at 17.5, meaning that the weir elevation controls the lake at an almost steady level 90 percent of the time.

One approach to improve the extent and the functionality of the littoral zone is to create a modification to the outlet weir that creates a lake hydroperiod that includes rainfall driven water level fluctuations that mimic natural wetlands in Florida. Figure 19 presents a percent exceedance curve of a reference natural wetland with a P50 level, or 50th percentile, equal to that of Crescent Lake.

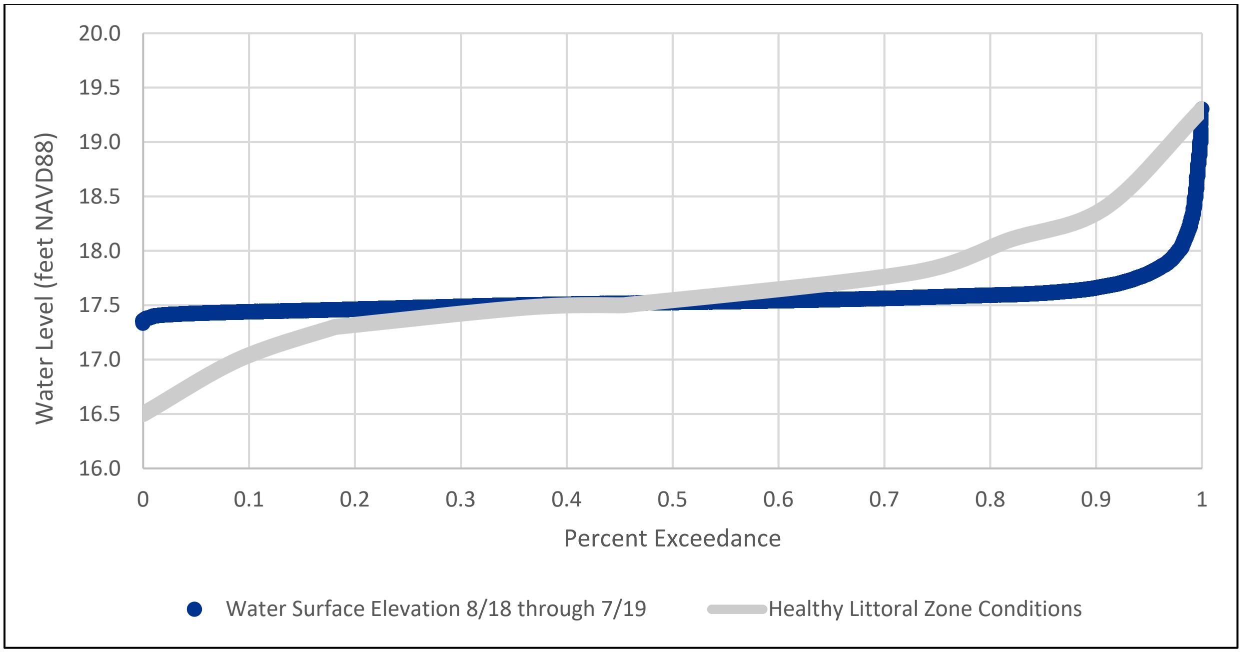


Figure 19. Percent Exceedance Curve for Reference Wetland
Crescent Lake Management Plan

To achieve this type of hydroperiod, the discharge control structure could be changed to allow less flow out during certain storms. This change would help maintain higher water levels for longer timeframes and would help lower control elevations that allow for less flow as water levels recede. This effort would achieve lower water levels and exposure of wider ranges of the littoral zone. One approach to achieving this type of level change is to implement a compound weir, which is typically used in situations where flow rates are expected to vary widely. A compound weir commonly has two or more stages where notches are cut into the center of the crest to different control elevations. For Crescent Lake, a square multistage compound weir (Figure 20) could be designed to achieve the desired water level hydroperiod. The compound weir would lower water levels more than the existing weir during long, dry periods and would increase water levels during wet periods. Also, the water level ranges between dry and wet would widen and vary more on the littoral zone (on an annual basis).

Careful weir design is paramount and implementation requires long-term rainfall records and a detailed daily water balance to ensure flooding would not be aggravated and the lake would not be too low for an extended period of time. The water balance exercise would ensure that the desired water level fluctuation would occur in the desired frequency to support a healthy wetland littoral community.

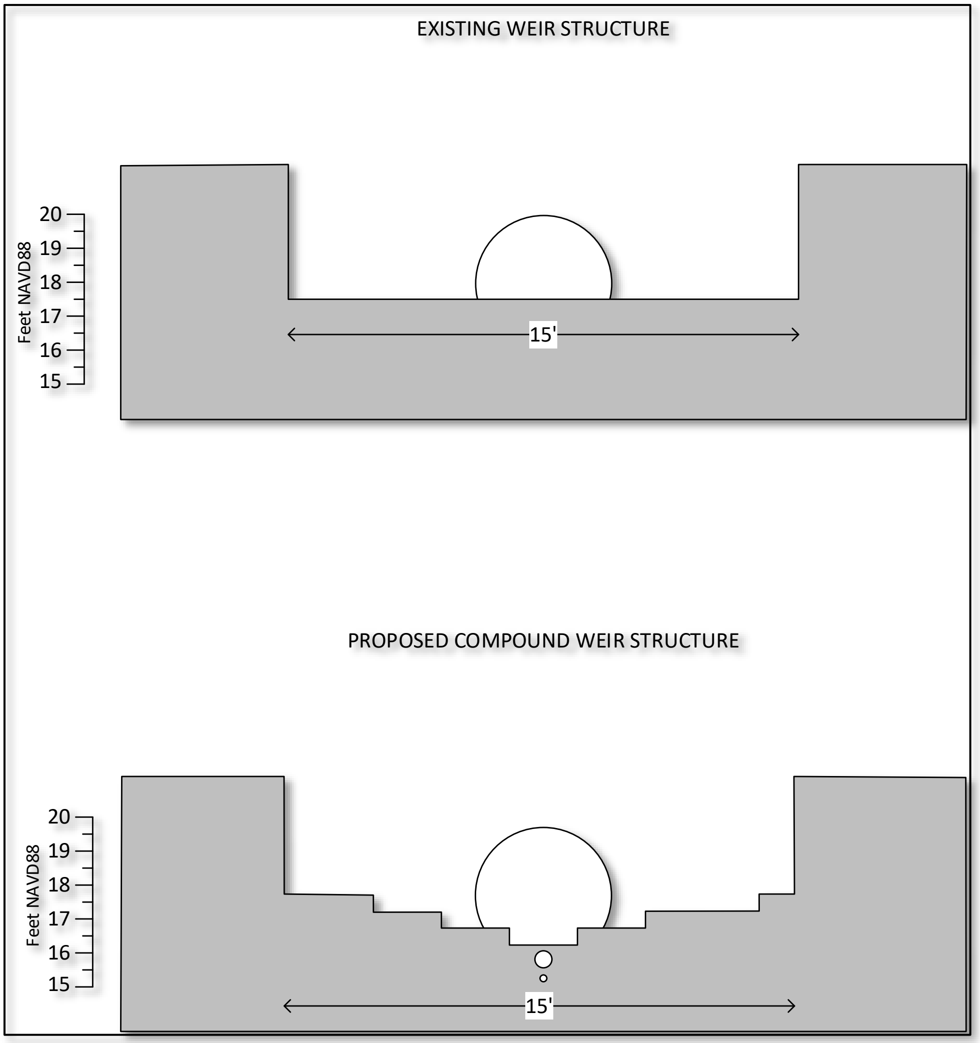


Figure 20. Existing and Conceptual Proposed Compound Weir
Crescent Lake Management Plan

6. Destratification Aeration

Crescent Lake is a unique stormwater-fed lake because of its depth (38 feet), which is deeper than most Florida lakes. According to the synoptic study (Jacobs 2019) findings, Crescent Lake exhibits a thermocline around 18 feet to 20 feet deep, with a total lake depth of 38 feet. During the colder winter months in St. Petersburg, the temperature of the water above the thermocline can drop to, or below, the temperature of the deeper water. This temperature decrease causes the colder upper layer to sink to, or below, the nutrient rich deeper water or offer less resistance to mixing during high wind events. The resulting turnover enriches surface water with nutrients. Turnover can cause a large bloom of algae that feeds on additional nutrients. One option to prevent this cause of algae growth is to prevent the upwelling of nutrients (especially phosphorus) through destratification of the lake water column through aeration.

Destratification aeration can improve the biodiversity and water quality of Crescent Lake. Destratification aeration uses the combination of an air compressor and a diffuser to introduce air into the deeper sections of the lake. Destratification keeps the water temperature the same from the surface to the bottom. The limnological term for this temperature distribution is isothermal. Under isothermal conditions there is no hypolimnion (Figure 21). Light winds mix the lake from the surface to the bottom, instead of just above the thermocline. The nearly continuous turnover that occurs with destratification aeration brings oxygen-rich surface water to the bottom.

There is a fundamental difference between continual turnover and yearly turnover. When there is thermal stratification, the hypolimnion becomes anoxic. With prolonged anoxia, sediments release phosphorus that had been bound to oxidized (ferric) iron but is not bound by reduced (ferrous) iron. When destratification aeration is introduced, there is DO in the deep zones that keeps iron oxidized and bonded with phosphate.

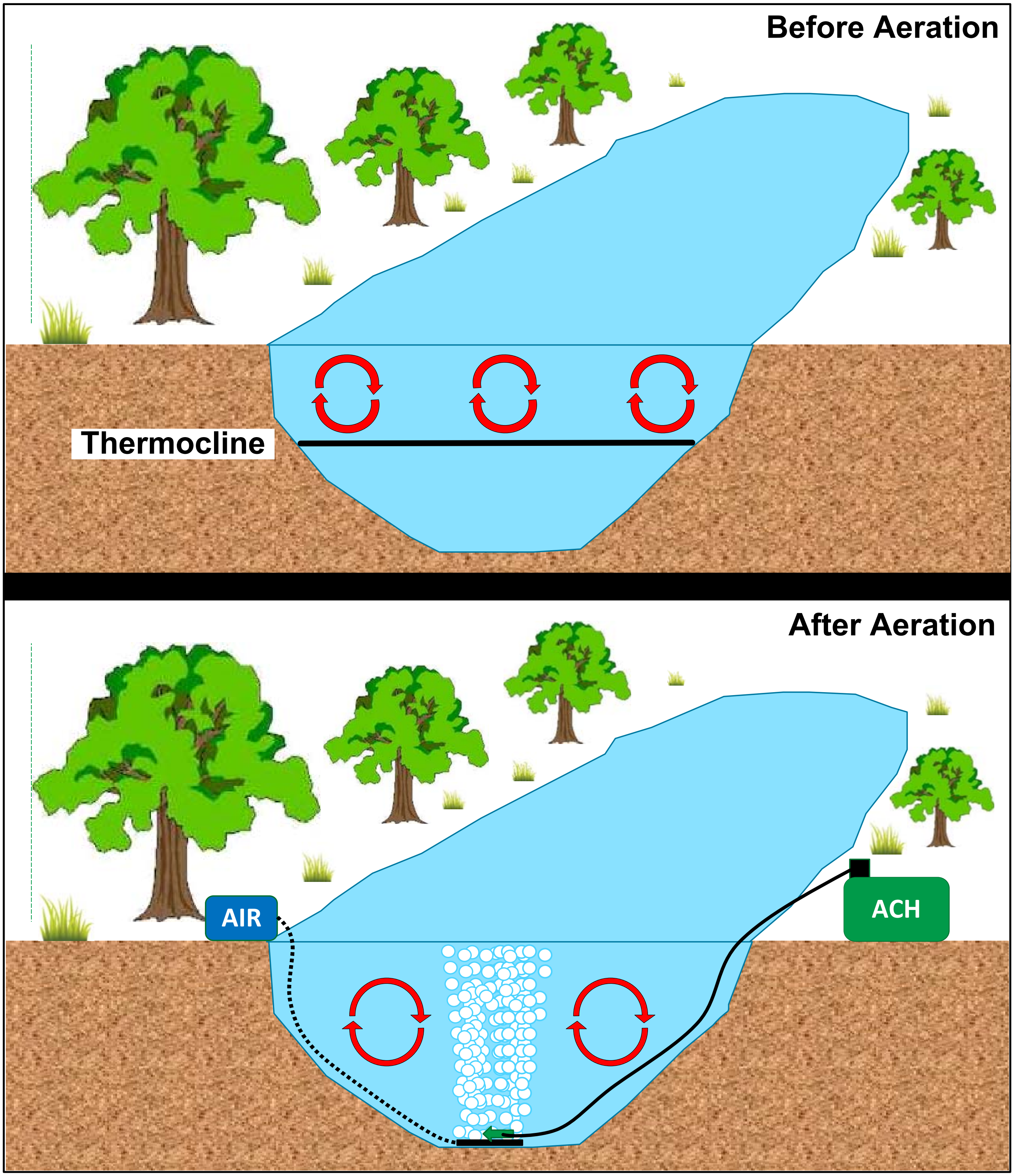
The destratification aeration system includes an air compressor and a diffuser. The system is sized by the total acreage of the lake, with the standard being 1.3 cubic feet per minute (cfm) per acre of the lake. With a lake size of 21.5 acres, the standard suggests a need for 28 cfm. However, if the lake needs a more aggressive aeration treatment, it is suggested to utilize a larger air compressor and dial the compressor down to the needed air flow. The number of diffusers can vary depending on the size of deep zones and the bathymetry of the lake. The bathymetry map shows two pocket deep zones, which suggests at least two diffusers with an additional diffuser suggested for the deep zone present between the deep pockets (Figure 22). The cost estimate for the aeration system is summarized in Table 7.

Keeping the sediment surface aerobic to control nutrient release is an established approach. However, the approach has flaws (Hupfer and Lewandowski 2008). For example, there must be iron in surficial sediments to bind enough phosphate to keep the TP concentrations low. Moreover, the geochemistry is even more complex. Sulfur can scavenge iron to the point where there is not a sufficient amount of iron to bind to a sufficient amount of phosphate. Modeling these processes in any lake is uncertain. A practical response to the uncertainty is to force changes to the lake geochemistry by adding iron or aluminum. Because iron can also be a nutrient for cyanobacteria blooms (Molot et al. 2014), aluminum can be an easier phosphate binding agent with which to work.

If needed, aluminum chlorohydrate (ACH) can be injected into the lake in soluble doses for prolonged periods. Micro-dosing of alum (a type of geochemical augmentation) has been successfully used to keep TP low in stormwater ponds and suppress cyanobacteria blooms (Osgood 2012 and Austin et al. 2017). The U.S. Environmental Protection Agency (EPA) (2018) has published aluminum criteria that allows calculation of ecologically safe dosing practice.

Adding ACH can be achieved by pairing the ACH with the air diffuser stream. This is achieved by installing a storage container on the bank of the lake and a feed line from the storage container to the bottom of the lake where the ACH line attaches to the aeration diffuser. The ACH is distributed throughout the water column as a soluble plume by injection at the air diffuser. Instantaneous mixing prevents localized flocculation of aluminum. The cost for the ACH system is included in the cost estimate summarized in Table 7.

The ACH, with the aeration circulation, bonds with phosphate and organic particles causing it to settle into the lake sediment. The recommended aluminum addition is ACH rather than aluminum sulfate, also known as alum. Adding additional sulfate (through alum introduction) to the lake sediment has the potential to increase sulfate reduction in the sediments. This potential sulfate reduction increases the mercury methylation. To ensure there is no mercury environmental impact, the use of ACH is recommended. In addition, sulfide in sediments can reduce and bind iron, making it unavailable to bind phosphate.



Legend

AIR Air compressor

ACH ACH storage tank

Circulation of water and nutrients

Figure 21
Aeration Destratification Example
Crescent Lake Management Plan
St. Petersburg, Florida

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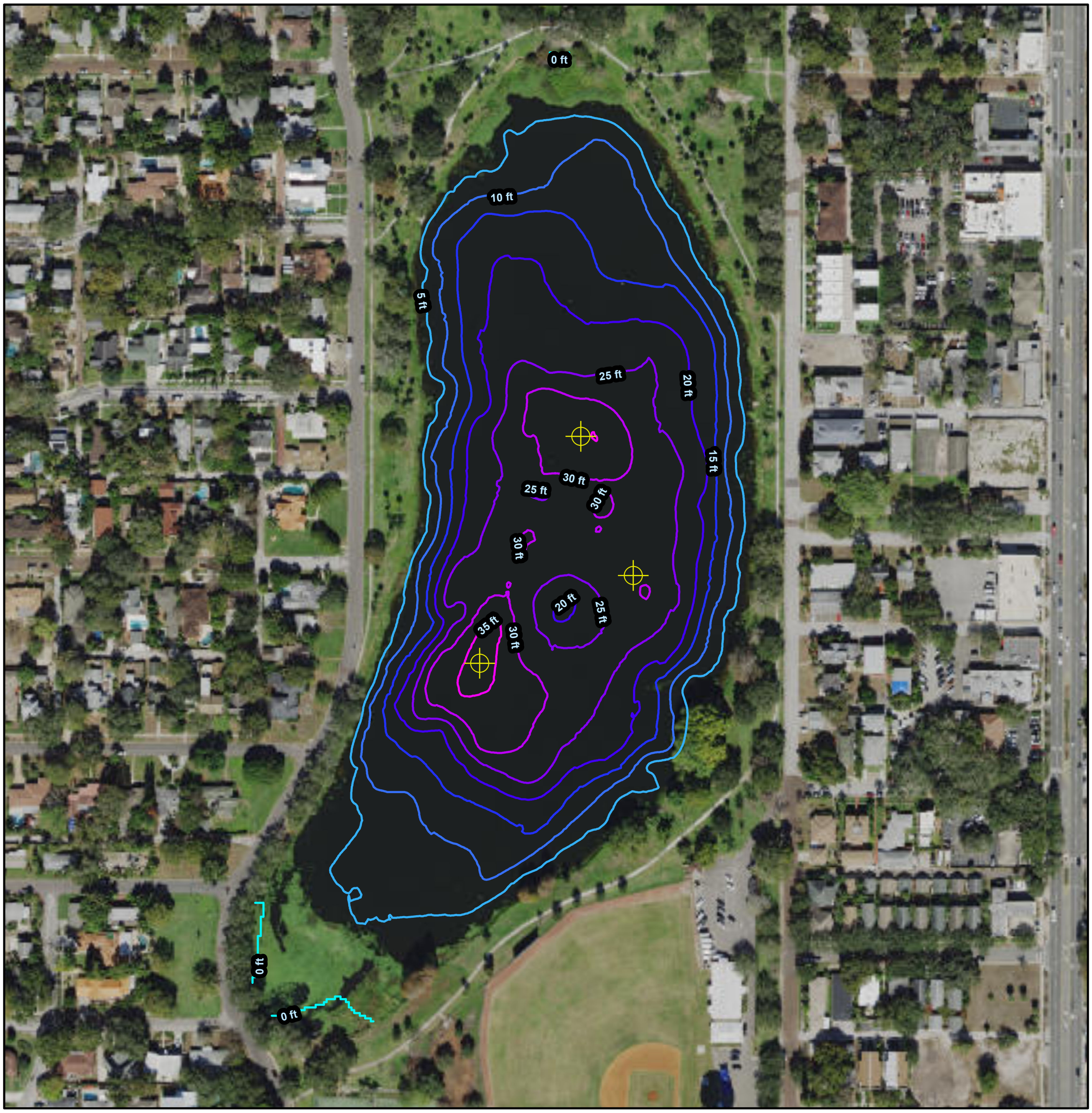
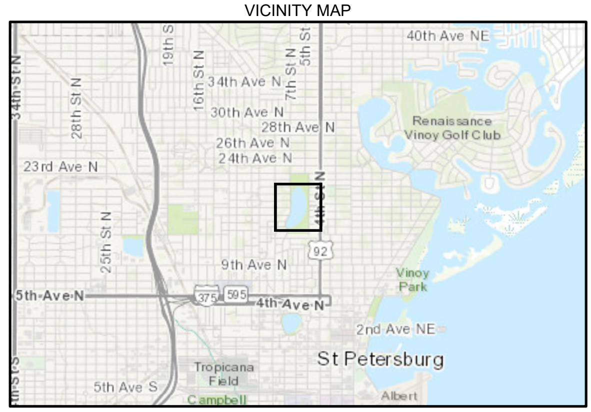


VICINITY MAP



Legend

Proposed Aeration Diffusers

Depth Contours (ft)

- 0
- 5
- 10
- 15
- 20
- 25
- 30
- 35

Notes:
1. Sources: Aerial Imagery, Topographic Map, ESRI 2019.

Feet
0 220 440 660 880

N

Figure 22
Proposed Aeration Diffuser Locations
Crescent Lake Management Plan
St. Petersburg, Florida

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Table 7. Summary of Destratification Aeration and ACH System Costs
Crescent Lake Management Plan

Cost Type	Description	Cost Opinion Range		
		-40%	Median[a]	+100%
Project Costs	ACH, Aeration, and Site Work	\$29,500	\$49,100	\$98,200
Contractor Markups	Overhead, Profit, and Insurance	\$8,600	\$14,300	\$28,600
Non-Construction Costs	Permitting, Engineering, Startup, and Services	\$11,700	\$19,500	\$39,000
Total Cost		**\$49,800**	**\$82,900**	**\$165,800**

Notes:

[a] Median cost includes a 30 percent contingency that covers unknowns.

Estimated costs are based on research from manufacturers and previously built systems installed in lake similar in size to Crescent Lake.

Destratification aeration is a recommended method for control of the nutrients and algae blooms within Crescent Lake. Destratification alleviates spikes of nutrients by almost continuously mixing the water from the surface to the bottom. If additional removal of phosphorus is needed, the addition of ACH can bond with phosphorus to settle into the lake sediments. The ACH system is recommended for Crescent Lake to address phosphorus driven algae blooms.

7. Lake Sediment Management Alternatives

Stormwater inputs into Crescent Lake and organic input from algae blooms, aquatic macrophytes, and plant detritus have resulted in significant accumulation of organic sediment at the bottom of Crescent Lake. Historically, this lake was dredged and the shoreline altered from its original condition. The Crescent Lake Neighborhood Association (2019) reported that the lake was dredged in 1926 by a municipal dredge that had removed 216,000 cubic yards of sand from the lake bottom to fill the low ground around the lake shore, presumably swamp habitat. Additional ditching was performed at the lake that caused the lake water levels to be lowered by 18 inches. The lake original size was reported as 18 acres.

Currently, the lake is 20.3 acres and has a maximum depth of 38 feet. This depth is clearly a result of the historical dredging and is considered atypical for Florida lakes. Potential stratification and organic accumulation are potential sources of phosphorus cycling and contributors to the eutrophic lake condition. To reduce the phosphorus concentrations in the water column during seasonal turnover, sediment would need to be managed within the lake. Two potential approaches include (1) additional dredging to remove accumulated organics at the deepest portions of the lake or (2) application of a sediment cover that would isolate and reduce cycling of phosphorus to the overlying water column.

7.1 Sediment Quality

Based on a recent investigation of lake sediment quality, the deep center of the lake has the largest concentration of fines (silt and clay combined) and consists of a black organic muck layer. The northern portion of the lake near the outfall also has significant fines and some sand but has much less organic content than the deeper center portion of the lake. The shallow southern portion of the lake consists mostly of sand with a smaller fraction of fines. This southern portion of the lake also has a large fraction of plant detritus and is relatively close to the large inflow box culvert (IF-3) contributing stormwater flow to the lake. Table 8 shows sediment quality across the lake in a north-south transect.

Bulk density is lowest at the center of the lake. The highest bulk density was measured at the southern portion of the lake, which is sandier compared to the other lake locations. The lowest bulk density measured in the center of the lake is associated with an unconsolidated organic layer.

Table 8. Sediment Composition for Crescent Lake

Crescent Lake Management Plan

Station	Gravel >4750–2000 µ	Sand 2000–62.5 µ	Silt 62.5–4.00 µ	Clay 4.0–0.9 µ	Textural Description	Bulk Density
North Lake	0	46.8	44.2	9.0	Sandy silt	0.11
Center Lake	0	18.4	68.0	13.6	Sandy silt	0.07
South Lake[a]	1.7	75.7	21.3	1.3	Silty sand	0.34

Notes: Values shown reflect percent of total weight.

[a] Average of native and duplicate sample

µ = micro

High levels of phosphorus, ammonia, and TKN were also observed in the sediment samples. The concentrations of metal constituents in the sediment were found to increase with depth within the lake. This physical and chemistry data presented provides a basic understanding of the upper sediment, but additional data would need to be collected to fully understand the physical characteristics of the sediment layer and underlying substrate through coring and potential borings.

7.2 Lake Bathymetry

The bathymetric survey indicates that Crescent Lake has a maximum depth of 35 feet. Two deep areas are found in the center of the lake and shallow littoral shelves are present at the southern portion of the lake. Most of the eastern and western lake shores are relatively steep and lack a significant littoral shelf.

More than 36 percent of the lake is deeper than 20 feet. Figure 23 presents the bathymetric contour map developed for the lake. The estimated area to be dredged or covered with a sediment cap would be below the 25-foot depth contour and entails approximately 5 acres or more.

7.3 Lake Sediment Dredging

This section presents a lake management approach for dredging and removing the accumulated organic sediment layer and assessing the potential improvements in lake water quality. The significant depth of this lake would require a hydraulic dredge, which has potential implications with management of water and management of odor from anaerobic sediments. The dredging of

Crescent Lake would include hydraulic dredging of sediments from depths between 25 to 35 feet, coarse material separation, and pumping of dredge slurry to geotextile tubes for dewatering. The geotextile dewatering process would be assumed to take place on the southern lake shore next to the ball field or in the parking lot.

The proposed dredging activity would include the following activities:

- Development of a dredge boundary by performing additional sampling and coring of lake sediment to characterize the extent and depth of the accumulated organics.
- Estimating the dredge material volume based on the dredge boundary.
- Development of a detailed sediment dredging plan by preparing a basis of design report (BODR)
- Mobilization of hydraulic dredging equipment.
- Hydraulic dredging to remove the organic accumulation estimated at 5 feet in depth within the current 25-foot depth contour.
- Dewatering/amendment of sediment for future beneficial use onsite or offsite.
- Restoration of the sediment processing area.

The BODR would need to be prepared to describe the sequencing of the primary activities and will be as follows:

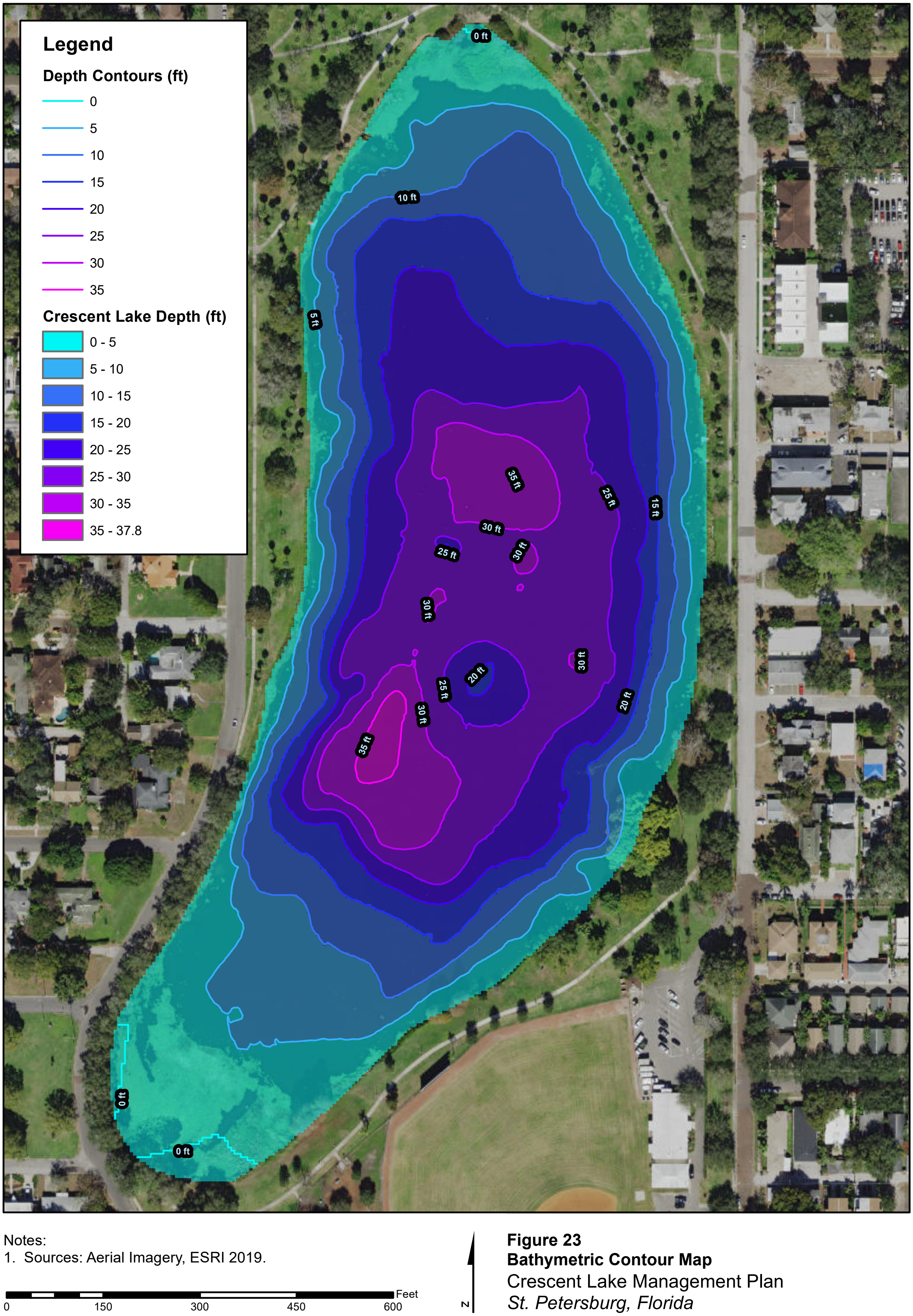
- Preconstruction activities
- Mobilization and site preparation
- Staging area construction
- Surveys
- Dredging and solids management
- Water management
- Transportation and disposal of sediments
- Staging area site restoration
- Demobilization

Additional dredging support, facilities, equipment, and activities would be required but these are considered beyond the conceptual description of the lake dredging.

Based on the sediment chemistry data collected during the synoptic study (Jacobs 2019), elevated concentrations of metals (arsenic) may require additional management of the dredge slurry. The additional management would reduce the volume of sediment required to be placed in a landfill and optimize the beneficial reuse of the dredged material. Dredged slurry material would be processed for sand and fines separation. Slurry fines could also be treated with a polymer before transport to a geotextile tube staging area for dewatering. Separated sand would be stockpiled for beneficial use as structural or non-structural construction fill. In addition, dewatered slurry material (i.e., fines) could be stockpiled for beneficial use as agricultural field nourishment.

It is expected that the dredging contractor would construct the dewatering pad, sumps, and other temporary structures at the dredge material processing area. Slurry management for the dredging would include geotextile tube dewatering and sand stockpiling. The dewatering area typically requires a generous laydown area for the geotextile bags that are isolated by berms for containing and directing filtrate to a collection sump. The area would require regrading to establish gentle slopes of no more than 5 percent in the cross-direction of the geotextile bag. In addition to establishing acceptable grades, site development will include construction of a lined containment berm to collect filtrate for solids, as required. Conventional hydraulic dredging has often considered pumping of dredged sediments to a Confined Disposal Facility (CDF) with no beneficial reuse. With the overall lack of available CDF facilities, increased necessity for environmental dredging, and pressures from state and federal agencies to beneficially reuse dredge spoils, sediment handling systems have become more prevalent and more complicated. Beneficial reuse can come in many forms, including simple use of sediments for fill or cover materials, to separating portions of the sediment and using the resulting factions for different prescribed applications.

Sand separation has become prevalent on environmental dredging projects because most environmental contaminants adhere to the finer fraction of the sediments, and by separating the sand (lesser or even uncontaminated) fraction, that material can be reused, while reducing the quantity requiring disposal. This can benefit the project significantly due to high local disposal [non-hazardous, Resource Conservation Recovery Act (RCRA Subtitle D] costs, i.e., $50 to $65 per ton. Similarly, the cost of hazardous waste disposal (RCRA Subtitle C wastes or other regulated wastes such as TSCA wastes) can range from $150 to $500 per ton depending on the distance to the disposal site. These conditions are not directly applicable to Crescent Lake, as sediments are not thought to require disposal based on physical or chemical (i.e., hazardous) characteristics.



Notes:
1. Sources: Aerial Imagery, ESRI 2019.

Figure 23
Bathymetric Contour Map
Crescent Lake Management Plan
St. Petersburg, Florida

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For Crescent Lake, the dredge material processing and beneficial use would be recommended and would include:

- Separating the sand fraction from the dredge slurry for structural fill
- The remaining fraction (i.e., silts and clays) will be used for non-structural fill purposes (e.g., farm field application).

While the sand separation process would provide a significant volume of material for structure fill purposes, the process may be more expensive than the purchase of local structural fill.

If sand separation is considered cost prohibitive, a polymer additive could be considered for the Crescent Lake dredging activities. This would involve determining a polymer dosage rate based on sand content after separating the fines. This would need to be evaluated in more detail and these costs are not included in the engineer's estimate.

7.3.1 Best Management Practices

A primary objective of dredging is to minimize adverse environmental and public impacts during dredging and dewatering operations. Minimizing the impacts is achieved through proper permitting and planning during the design phases, as well as adherence to environmental controls and monitoring during project execution.

Project information would be communicated to local property owners, Park's department, and general members of the public before and during the maintenance dredge activities to help limit adverse impacts of the project to residents and commercial activities.

Impacts to water quality from the maintenance dredge activities are expected to be minimized by employing BMP. If a water treatment system is required following geotextile bag dewatering, the system would be monitored and tested to meet the discharge requirements for return waters to the lake. Crescent Lake water quality would be monitored and adjustments would be made to the maintenance dredge activities to prevent excursions to water quality standards, if necessary. In addition, odor control would be necessary to avoid impacting the adjacent neighborhood.

7.3.2 Site Restoration

Following the completion of dredging activities, the contractor would remove the water beneficiation plant and dewatering pad and geotextile tubes pads. After removal of materials and equipment, the dewatered sediment and stockpiled sand would be staged at the City's stockpile yard for beneficial use.

7.3.3 Permitting of Proposed Dredging

Typically, the FDEP and United States Army Corp of Engineers (USACE) manage dredging activities and issuance of wetland permits through the Ch. 62-330 (Florida Administrative Code [FAC]) and Section 404 of the Clean Water Act. Crescent Lake dredging activities would potentially be subject to these regulations for the excavation of sediment from Crescent Lake and the discharge of return water into Crescent Lake. Considering the lake is controlled by a weir and is managed as a permitted stormwater facility, the regulatory requirements may be reduced, and/or specific exemptions may be in place to conduct maintenance activities within stormwater facilities. If required, the proposed activities would be addressed through the application for a Ch. 62-330 FAC Environmental Resource Permit and a Section 404 permit.

7.4 Cost Estimate

Assuming that dredging Crescent Lake will be a 100 percent beneficial use and no offsite disposal would be anticipated, Table 9 presents a Class 5 cost estimate for dredging and sand separation.

Table 9. Crescent Lake Class 5 Dredging Cost
Crescent Lake Management Plan

Description	Estimated Cost
Sediment Investigation Extent	$35,000 to 50,000
Dredging BODR/Design	$75,000 to 125,000
Mobilization/Demobilization	$800,000
Hydraulic Dredging	$1,500,000 to $1,750,000
Dewatering	$1,500,000 to $1,750,000
Sand Separation/Hauling	$250,000
Permitting	$50,000
Total Estimated Dredging Cost	$4,210,000 to 4,775,000

7.5 Lake Sediment Cover

This section summarizes the features of a conceptual placement of a sediment cover in Crescent Lake to improve long-term water quality and protect downstream aquatic life by preventing the transport of phosphorus and reduced nitrogen from lake sediments into the water column. The strength of the underlying sediment could be a constraint to placing the sediment cover.

A sediment cover would be designed to create a protective layer that will geochemically stabilize or physically isolate (or both) the sediments in Crescent Lake and limit phosphorus mobilization from the sediments into Crescent Lake water. This should improve Crescent Lake and water discharging downstream and meet appropriate water quality standards.

Three mechanisms potentially exist to control the release of phosphorus from the Crescent Lake sediments. The mechanisms included physical, geochemical, and adsorptive control. The merits of each would be assessed and could include the following:

- Physical Control: Preventing low pH hypolimnion water from contacting sediment by dredging or covering the lake sediment
- Geochemical Control: Chemically preventing phosphorus leaching by placement of a medium over the sediment for reduction and precipitation of phosphorus
- Adsorptive Control: Adsorbing phosphorus as it leaches from the sediment

7.5.1 Laboratory and Bench Testing of Sediment Cover

Many technologies are available for sediment covers. Prior to selecting a sediment cap, laboratory-scale jar tests should be performed on the lake sediment. The tests serve to obtain information to estimate leaching mass flux (e.g., mass of phosphorus per unit surface area per time), evaluate partitioning of phosphorus from Crescent Lake sediment to water under different pH and redox conditions, and estimate the buffering capacity of the materials from the field.

This study would consist of two types of tests, including:

- Batch Replacement Test, in which a layer of sediment was placed in a jar with a layer of overlying water, and the overlying water was periodically replaced with fresh water over selected intervals.
- Static Batch Test, in which the setup would be the same as the Batch Replacement Tests, but without replacing the overlying water.

Results from these tests would assess the feasibility of placing a physical cover on the sediment to limit the contact between the deep portion of lake water and the sediment; thereby, reducing the potential for phosphorus release from the sediment.

In addition to laboratory testing, bench scale testing may prove useful to evaluate the feasibility of placing sediment cover material. These tests could consist of:

- Assessment of the extent of sediment and sand interbed mixing that could occur during full-scale operations.
- Assessment of the consolidation that could occur post-placement of the sand cap.
- Assessment of the similarity and differences between a coarse sand, fine sand, and an engineered subaqueous cap material, such as AquaBlok or AquaGate.

Observations gleaned from such a bench study would provide confidence that either fine sand or a well-graded sand or other cover would meet project goals to be used as cover material. A pilot-scale study would be recommended to determine the feasibility of placement and stability of these materials under actual site conditions, if necessary.

7.5.2 Sediment Cover Placement

The areal extent of the cover placement would entail a minimum of 5 acres and the desired thickness of the sediment cover would be determined based on the results of laboratory and bench scale testing.

To control internal nutrient loading, there are a couple of proven options, but other materials could be investigated. AquaBlok (AquaBlok 2019) is the simplest approach but is generally not employed at large scale. AquaBlok is a low permeable cap used to seal the sediments to eliminate the ongoing cycling and release of nutrients. Metals and other contaminants would be sequestered in the sediments, as well.

AquaGate is another approach using adsorptive/reactive materials that can neutralize the effects of a nutrient imbalance. This is a permeable in-situ amendment layer, where the composite particle materials consist of an aggregate core and powdered treatment materials, such as powdered activated carbon or organoclay. Unlike liquid alum application, this places the alum to the sediment surface where the cycling and release can be addressed at the source. This approach has been used to bind phosphorous at a range of sites.

A sediment cover is typically placed by a dissipater and spreader barge to place the cover materials (i.e., crushed rock and/or limestone sand) in a consistent manner. A slurry is discharged through the spreader bar and allows for optimal distribution.

7.5.3 Post-Placement Performance Monitoring

The main objective of post-placement performance monitoring would be to confirm the sediment cover is performing the basic functions as a protective layer to geochemically stabilize the sediments to prevent phosphorus mobilization in Crescent Lake. The monitoring activities would focus specifically on sediment cover integrity and the potential phosphorus mobilization at the sediment cover-surface water interface.

Performance monitoring for selected parameters, including phosphorus and water chemistry parameters, will be performed over time through the water column to evaluate the effectiveness of the sediment cover. The performance of the sediment cover will be monitored over time based on Crescent Lake water concentrations at the sediment cover-surface water interface.

The post-placement performance monitoring will involve routine periodic chemical monitoring, as well as event-based monitoring triggered by activities that could affect the integrity of the sediment cover.

7.5.4 Permitting of Proposed Capping

As with dredging, the FDEP and USACE manage filling activities and issuance of wetland permits through Ch. 62-330 FAC and Section 404 of the Clean Water Act. A sediment cap placement in Crescent Lake would be potentially be subject to these regulations for the filling of a jurisdictional water body and the discharge of return water into Crescent Lake.

7.5.5 Engineer's Estimate

Based on the project information described in this section, an Association for the Advancement of Cost Engineering (AACE) Class 5 order-of-magnitude cost estimate (+100 to -50 percent) has been prepared. Final project costs will depend on:

- Extent and depth of organic layer within the lake
- Additional testing required
- Recommended type of sediment cover

As a result, the final project costs will likely vary from the cost estimates presented. Because of these factors, project funding must be carefully reviewed before specific financial decisions are made. Table 10 presents a Class 5 cost estimate for a sediment cover placement within Crescent Lake.

Table 10. Crescent Lake Class 5 Sediment Cover Cost Estimate
Crescent Lake Management Plan

Description	Estimated Cost
Mobilization/Demobilization	$800,000
Site Sediment Investigation	$35,000 to 50,000
Laboratory Scale Testing	TBD
Bench Scale Testing	$10,000 to $20,000
Capping BODR/Design	$75,000 to $125,000
Sediment Cover Placement	$3,000,000 to $4,500,000
Post Placement Monitoring	TBD
Permitting	$50,000
Total Estimated Cover Placement	$3,257,000 to $4,835,000

8. Upstream Watershed Basin Solutions

The urban characteristics of the watershed is a significant source of the nutrient and pollutant load to Crescent Lake. Alternative approaches were evaluated to implement green infrastructure solutions to reduce the nutrient and pollutant quantity and improve stormwater quality entering the lake.

Example of Bioretention in an Urban Corridor

8.1 Green Infrastructure

A green infrastructure (GI) project is an increasingly popular solution to stormwater pollution and volume reduction. GI projects attempt to restore a natural water cycle, thereby reducing the impact of development and urbanization on natural systems receiving stormwater inputs. GI projects focus on collecting and treating the stormwater where it lands rather than concentrating flows and pollutants by transporting the runoff to a separate centralized location. The typical goals of GI projects include:

- Reduce the volume of stormwater
- Reduce the flow rate of stormwater
- Remove pollutants in the stormwater

GI improvements are designed to meet one or more of those goals while also providing secondary benefits to the upgraded area. These secondary benefits include groundwater recharge, enhanced biodiversity, aesthetic improvements, traffic calming, reduction of nuisance flooding, energy conservation, and improved air quality. Several types of GI upgrades are described in this section that the City can invest in to improve the water quantity and quality of Crescent Lake and improve the safety and aesthetic appeal of the surrounding community.

8.2 Potential Green Infrastructure for Crescent Lake Watershed

8.2.1 Bioretention

Bioretention facilities are depressions that contain vegetation in an engineered soil mixture above a gravel drainage bed. Bioretention facilities attempt to reintroduce predevelopment hydrologic conditions by providing infiltration, evapotranspiration, or extended detention of stormwater. The unique features of the bioretention systems are that they include soil and vegetation, which increase the treatment of the stormwater by ponding water on the surface prior to filtration and infiltration. The vegetation is typically native vegetation such as meadow grasses, shrubs, and perennials to withstand the periodic drying out and flooding of the bioretention facility. These systems are highly adaptable to most locations with the ability to install them along roadways and other urban sites. Bioretention facilities can be installed in public and private settings with the rain garden being the most common for private household installation. Bioretention facilities can be designed in several variations including the bioretention basin, vegetated swale, and rain garden as described below:

- Bioretention basin – Excavated surface depression with densely planted vegetation in an engineered soil layer on top of a subsurface storage bed. Runoff is collected from surrounding impervious surfaces or roof leader downspouts and is ponded above the engineering soil layer allowing the stormwater to be treated as it slowly infiltrates the engineered soil layer. Bioretention basins are successful in reducing runoff volume and reducing peak flow.

- Vegetated swale – Shallow stormwater channel that can be densely planted with a variety of native vegetation or simply planted with turf grass. They are often used along roads or other linear features and function as a conveyance system to attenuate runoff rates, enhance water quality treatment, and promote infiltration during low flow conditions. They can often be used in combination with infiltration trenches to enhance the overall storage capacity for stormwater.
- Rain garden – Type of bioretention typically used on private residential property with public applications as well. Similar design to bioretention basin but with a smaller footprint and only has the engineered soil layer without the subsurface storage bed.

Example of Bioretention Basin in a City-owned Park

8.2.2 Infiltration Trenches

Infiltration trenches are channels or depressed areas with side slopes filled with vegetation or gravel that intercept runoff from upslope impervious areas. Infiltration trenches are similar in function to bioretention facilities but differ in their placement and appearance. Bioretention facilities are open to the surface while infiltration trenches are typically underneath an impervious surface with a surface inlet to allow the runoff to enter the trench. Infiltration trenches provide storage capacity during rainfall and allow the captured stormwater to infiltrate into the native subgrade soil below. Trenches are typically filled with an appropriate, clean, uniformly graded aggregate that provides adequate void spaces to store and filter stormwater prior to infiltration. Trenches can also include sand based structural soil to provide support under pavements while continuing to allow optimal storage capacity and rooting volume for trees. Alternatively, there are various manufactured storage media units that can be used in space-constrained areas to maximize runoff storage with high void percentages. Infiltration trenches are optimal for reducing runoff volume, attenuating flow, and facilitating direct groundwater recharge. Infiltration trenches applications include:

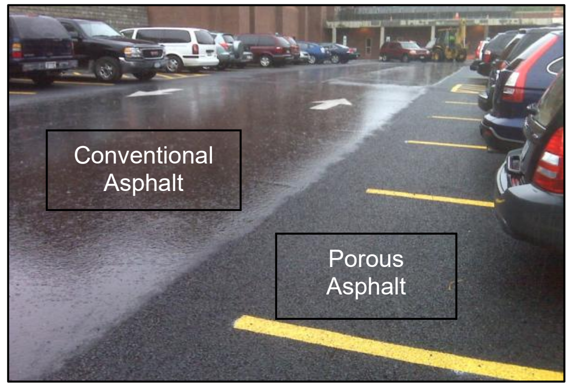
Example of Infiltration Trench Being Constructed along the Edge of a Street

- Tree trench – Combines planting soils with trees and subsurface storage to provide an increase in tree canopy and improve aesthetics. They provide infiltration, storage, and evapotranspiration.

- Trench below pavement – Provides storage underneath impervious pavement including parking lots, alleyways, streets and sidewalks. The stormwater is transported to the trench through a stormwater collection system. This application is pictured above.
- Trench below vegetation – This type of trench is a subsurface storage bed located below vegetation and is complimentary to a vegetated swale as it does not require a surface depression making it safer for nearby pedestrians.

8.2.3 Permeable Pavement

Permeable pavement systems are excavated areas filled with gravel and paved over with a porous concrete-asphalt mix, or various types of permeable pavers. Permeable pavements allow rainfall to immediately pass through the hardscape layer and into the gravel storage layer below. The rainfall is then stored in the gravel storage layer until it infiltrates into the native soil, similarly to an infiltration trench. Permeable pavements are typically utilized in areas where hard, yet permeable, surfaces are desired including parking lots, residential streets, alleys, sidewalks, playgrounds, and basketball courts. There are several different types of permeable pavements including:



Example Showing Porous Asphalt and Conventional Asphalt used in a Parking Lot

- Porous asphalt – Similar to conventional asphalt in appearance, but it is modified to have fewer aggregate fines allowing rainfall to pass through the voids between the larger aggregate.
- Porous concrete – Similar to conventional concrete except for a modification that reduces the amount of fine aggregates in the porous concrete allowing the rainfall to pass through the rougher textured concrete.
- Permeable block pavers – These are pavers that are installed with pea gravel or a similar material installed in the gaps to allow stormwater to infiltrate through the gravel to the native soil below. Permeable block pavers have multiple uses including pavers for delineating parking spaces along the road as well as sidewalks or park areas for pedestrian use.
- Open grid pavers – Similar to permeable block pavers except they are designed with larger open areas filled with gravel, soil, or planted with turf grass that allows infiltration. Open grid pavers are often used for overflow parking areas, driveways or fire truck access lanes where infrequent traffic is expected.

Example of Permeable Block Pavers in Entrance to City-owned Park

Example of Open Grid Pavers in Alleyway

8.2.4 Cost Estimate for Green Infrastructure

The cost of GI projects is generally estimated based on the number of impervious acres that are managed by the GI installment. However, the typical costs reported in Tables 11 and 12, while based on actual constructed GI projects, should be considered equivalent to an AACE Class 5 estimate, with an expected accuracy range of +100 percent to -50 percent. The accuracy range varies because actual costs fluctuate based on local market conditions, material availability, contractor experience level, unknown conflicts and/or limitations to installation, subsurface conditions, and specific design (sizing) considerations, among other factors. The cost estimates provided are for the three main types of GI projects including bioretention, infiltration trenches, and permeable pavement since they are the most likely candidates for implementation in the Crescent Lake watershed.

Table 11. Green Infrastructure Cost Considerations per Impervious Acre Managed
Crescent Lake Management Plan

Green Infrastructure Type	Typical Construction Costs per Impervious Acre Managed ($/AC)[a]	Typical Design Costs as Percentage of Construction Costs[b]	Typical Capital Costs per Impervious Acre Managed ($/AC)
Bioretention / Rain Garden / Vegetated Swales	$180,000	25 to 35%	$230,000 to $240,000
Infiltration Trenches	$140,000	10 to 20%	$150,000 to $170,000
Permeable Pavement	$200,000	15 to 25%	$230,000 to $250,000

[a] Source: City of Lancaster, Pennsylvania built projects

[b] Design cost estimates include various soft costs including fieldwork, engineering, and landscape architecture. Percentages reflect design costs of built projects in various communities in Pennsylvania.

Table 12. Green Infrastructure Types Cost Analysis per GI Area
Crescent Lake Management Plan

Green Infrastructure Type	Typical Construction Costs per GI Area ($/SF)[a]	Typical Design Costs as Percentage of Construction Costs[b]	Typical Capital Costs per GI Area ($/SF)
Bioretention / Rain Garden / Vegetated Swales	$26	25 to 35%	$33 to $35
Infiltration Trenches	$22	10 to 20%	$24 to $26
Permeable Pavement	$24	15 to 25%	$28 to $30

[a] Source: City of Lancaster, PA built projects

[b] Design cost estimates include various “soft costs” including fieldwork, engineering, and landscape architecture. Percentages reflect design costs of built projects in various communities in Pennsylvania.

8.3 Additional Types of Green Infrastructure

8.3.1 Rainwater Harvesting

Rainwater harvesting is the practice of capturing rainwater from roof surfaces and reusing it in place of potable water for landscape irrigation or indoor uses including toilet flushing. Common techniques include rain barrels (residential) and cisterns (commercial/institutional). In addition to reducing runoff volume and peak release rates, rainwater harvesting can also reduce the potable water demand of any household and is a valuable public outreach opportunity for GI.

8.3.2 Stormwater Wetlands

Stormwater wetlands are shallow marsh systems planted with native emergent wetland vegetation. Stormwater wetlands can be designed to maintain a permanent water surface through control structures that also control runoff peak rates, stormwater volume, and improve water quality. Additionally, stormwater wetlands can be designed as subsurface wetlands that treat the stormwater below the soil surface with emergent plants. The subsurface design can lower the contact potential of the wetland with pedestrians and is ideal for stormwater that is highly polluted.

8.3.3 Next Steps to Implement Green Infrastructure

After deciding that GI is one of the solutions to reducing nutrients loads into Crescent Lake, there are some potential next steps to plan, design, and implement GI into the surrounding community. First, a GI master plan should be developed and include the following elements:

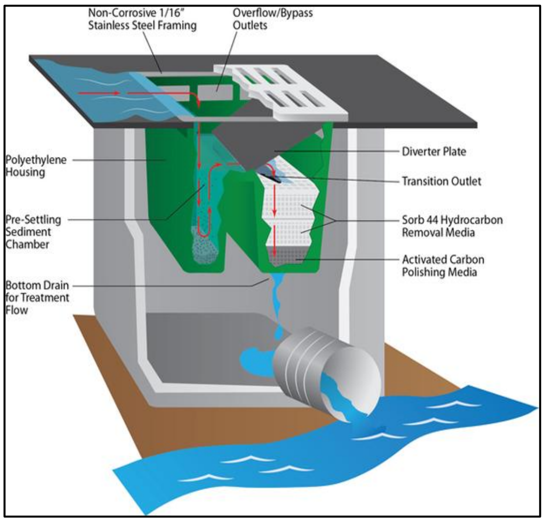
- Establish goals for GI implementation within the Crescent Lake watershed.
- Perform opportunities and constraints analysis to determine feasibility of GI project locations in the community.
- Determine potential amount of impervious area within the overall study area that can be reasonably captured or treated with GI projects.
- Create implementation categories that could be divided into public and private categories, such as parks/schools/streets and residential parcels/commercial parking lots, respectively.
- Develop conceptual GI plans and cost estimates for specific sites
- Identify potential synergies with proposed capital improvements including utility replacements/rehabilitation, road repaving, etc.

8.4 Advanced Drainage Catch Basin Filters

Advanced Drainage Catch Basin Filters (advanced catch basins) are alternative pollution control structures that can be retrofit to most square and round street drains post construction. Catch basins utilize the current stormwater conveyance infrastructure to capture and remove sediment, hydrocarbons, chemicals, phosphorus, and heavy metals. Advanced catch basins apply a two-step process to first remove the sediment from the stormwater using gravitational settling before the water runs into a second chamber that filters capable of focusing treatment on multiple pollutants. The stormwater enters the street conveyance drain as normal dropping into the pre-settling sediment chamber of the drainage filter. Once enough water has entered the drain to fill the sediment chamber, the water flows over the center ridge and then over three filters set in a series. These filters are selected based on the pollutants of concern for each individual drainage filter. The filter media can include:

- Sorb 44 specified to remove oil and other hydrocarbons
- Phos Filter specified for the removal of phosphorus
- Activated Carbon capable of removing multiple different constituents
- Custom filter media designed to remove zinc, lead, copper and other harmful, heavy metals

Advanced catch basins include multiple bypass outlets that ensure that flooding does not occur on the surface during high flow storm events or due to filter clog or sediment build up. The cost per unit makes the advanced catch basins an ideal installation for stormwater that needs water purification without much volume or peak rate control. The cost of materials for the advanced catch basins is summarized in Table 13. There are two sizes of the advanced catch basins fitting 26- to 33-inch drains and 34- to 48-inch drains. Table 13 assumes costs for 20 smaller drain installments and 20 larger drain installments. Further study of the watershed will determine the necessary number of advanced catch basins to be installed to impact Crescent Lake pollutant inputs.



Overview of Advanced Drainage Catch Basin Filter Process
Photo credit: Interstate Products, Inc.

Example of Catch Basin Installation
Source: Interstate Products, Inc.

Table 13. Cost Considerations for Advanced Catch Basin Filters
Crescent Lake Management Plan

Description	Cost Opinion Range		
	-40%	Median (incl. contingency)[a]	+100%
26- to 33-inch Advanced Catch Basin Unit Cost	$936	$1,560	$3,120
34- to 48-inch Advanced Catch Basin Unit Cost	$1,131	$1,885	$3,770
Total Material Cost[b]	$41,340	$68,900	$137,800

Source: UltraTech 2019

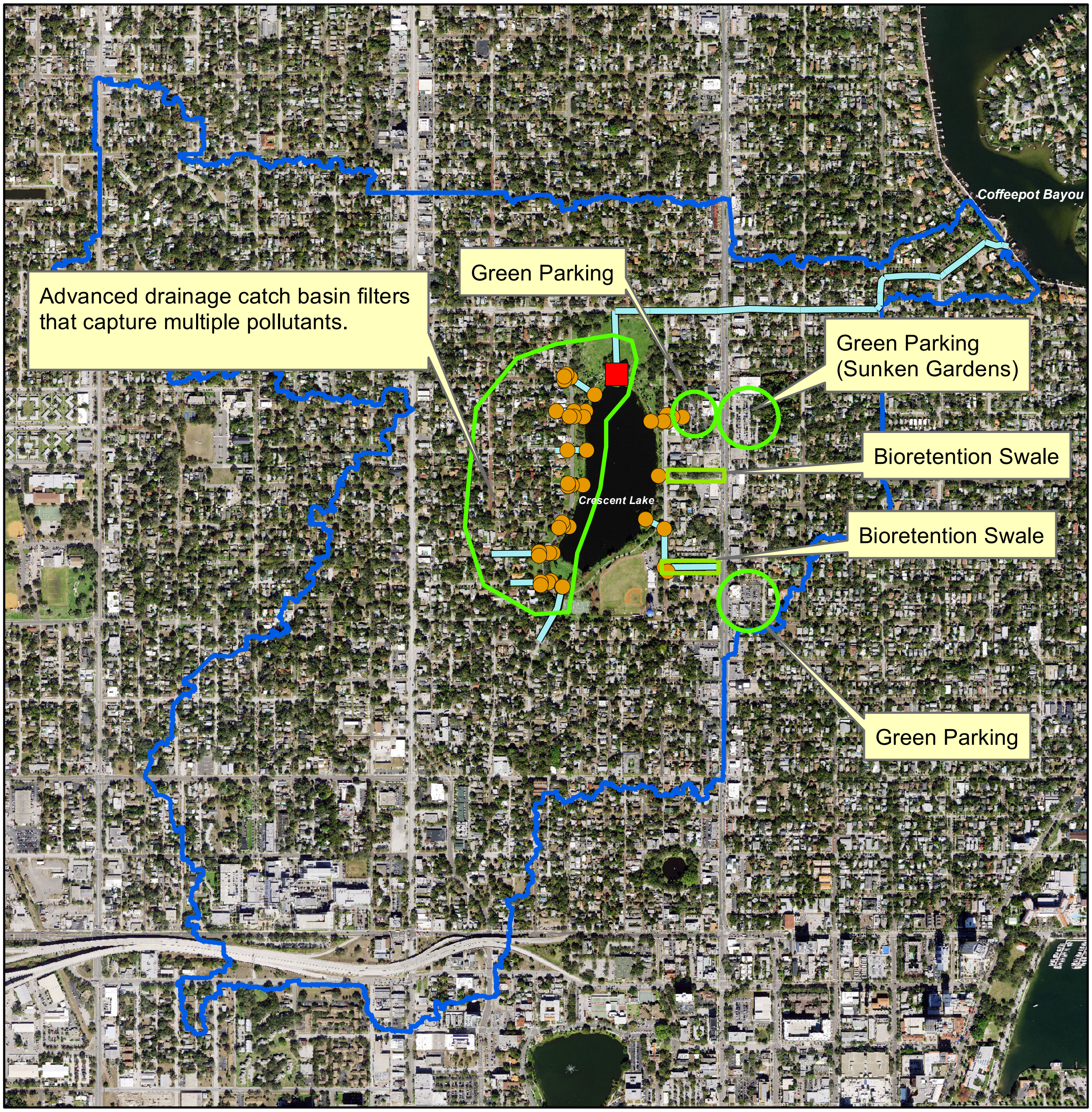
[a] Median cost includes 30 percent contingency added for unknown costs associated.

[b] Total material cost includes twenty 26- to 33-inch advanced catch basins and twenty 34- to 48-inch advanced catch basins for a total of 40 advanced catch basins installed and do not include installation and delivery price.

8.5 Upstream Watershed Basin Solution Recommendations

Jacobs recommends using a combination of green infrastructure solutions and advanced drainage catch basin filters to improve the water quality of the stormwater entering Crescent Lake. Recommendations suggest installing advanced drainage catch basin filters over storm drains on the highly urbanized western side of Crescent Lake. The eastern urban development of Crescent Lake provides some opportunities for green infrastructure with potential aesthetic improvements. According to the synoptic study (Jacobs 2019), Inflow 1 situated at the corner of 5 Street N and 17 Avenue N is contributing the highest pollution concentration stormwater into Crescent Lake. To efficiently reduce the concentration of constituents in the stormwater, it is recommended to implement green infrastructure that effectively filter and reduce the volume of direct stormwater. Green parking lot introduction as well as bioretention techniques, especially vegetated swales, encourage a natural water cycle with the stormwater infiltrating into the native soils before naturally flowing to the lake through the groundwater.

Figure 24 provides a recommendation of green infrastructure and advanced drainage catch basin filters. Depending on the desired treatment, the number of advanced basin filters can be adapted, and additional green infrastructure facilities can be designed and implemented. New construction around the lake can encourage green infrastructure usage to eliminate costs of retrofitting old infrastructure. A watershed solutions feasibility study promotes more precise cost estimates as well as water quality and quantity impact quantification.



Legend

- Stormwater Basin J
- Outlet
- Inlets
- Pipes

Notes:

1. Sources: Aerial Imagery, Topographic Map, ESRI 2019.

N

0 875 1,750 2,625 3,500 Feet

Figure 24
Watershed Basin Solution Recommendations
Crescent Lake Management Plan
St. Petersburg, Florida

JACOBS

9. Summary

This CLMP provides options for the City to decide what technologies could be implemented to improve water quality conditions in Crescent Lake. Any improvements in lake water quality would have a positive effect on downstream receiving waters and provide FDEP with the assurance that water quality criteria will be met. Lake monitoring history shows the modifications over time started with dredging the lake bottom to a complete change in land use within the watershed. The urban character of the watershed has potentially significant influence on lake water quality due to runoff quality and intensity. Further studies would be required to quantify the extent of the pollutant load and sources from the watershed. Internal nutrient cycling has also been shown as a significant contributor to the degraded water quality conditions observed in the lake, demonstrated by decades of monitoring by Lakewatch.

The options in this CLMP range from actions in the watershed to reduce runoff and capture pollutants and trash, restoration of littoral zones, capture of nutrients with FWIs that also create habitat for lake wildlife, management of sediments by either dredging or capping, and improvements to the outfall structure to increase the range of water levels in the lake to improve overall ecology.

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Attachment 2 – City of St. Petersburg MS4 Annual Report

st.petersburg
www.stpete.org

January 29, 2020

Borja Crane-Amores
Program Administrator, NPDES Stormwater Section
Florida Department of Environmental Protection
2600 Blair Stone Road – MS2500
Tallahassee, Florida 32399-2400

Subject: City of St. Petersburg Municipal Separate Storm Sewer System
FLS000007-004 (Cycle 5)
Annual Report Year 1 (July 1, 2018 – June 30, 2019)

Dear Mr. Crane-Amores,

Enclosed is the City of St. Petersburg's MS4 Permit Cycle 5, Year 1 annual report for the period of July 1, 2018 – June 30, 2019.

If you have any questions, please do not hesitate to contact me at carlos.frey@stpete.org or by telephone at 727-892-5380 or Melinda Spall at Melinda.spall@stpete.org or by telephone at 727-551-3566.

Sincerely,

Carlos Frey, P.E.
Design Manager, Stormwater and Environmental

Cc: D. Rawleigh
J. Palenchar
B. Prayman

Annual Report Form
For Individual NPDES Permits For Municipal Separate Storm Sewer Systems
(RULE 62-624.600(2), F.A.C.)

- This Annual Report Form must be completed and submitted to the Department to satisfy the annual reporting requirements established in Rule 62-624.600, F.A.C.
- Submit this fully completed and signed form and any REQUIRED attachments by email to the NPDES Stormwater Program Administrator or to the MS4 coordinator (https://floridadep.gov/water/stormwater/content/npdes-stormwater-permitting-program-contacts). Files larger than 10MB may be placed on the FTP site at: ftp://ftp.dep.state.fl.us/pub/NPDES_Stormwater/. After uploading files, email the MS4 coordinator or NPDES Program Administrator to notify them the report is ready for downloading; or by mail to the address in the box at right.
- Refer to the Form Instructions for guidance on completing each section.
- **Please print or type information in the appropriate areas below.**

Submit the form and attachments to:
Florida Department of Environmental Protection
Mail Station 3585
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

SECTION I. BACKGROUND INFORMATION

A.	Permittee Name: City of St. Petersburg		
B.	Permit Name: City of St. Petersburg MS4		
C.	Permit Number: FLS000007-005		
D.	Annual Report Year: ☒ Year 1 ☐ Year 2 ☐ Year 3 ☐ Year 4 ☐ Year 5 ☐ Other, specify Year:		
E.	Reporting Time Period (month/year): July/ 2018 through June / 2019		
F.	Name of the Responsible Authority: Brejesh Prayman, P.E.		
	Title: Director, Engineering and Capital Improvements		
	Mailing Address: P.O. Box 2842		
	City: St. Petersburg	Zip Code: 33731	County: Pinellas
	Telephone Number: 727-893-7295	Fax Number: 727-892-5476	
	E-mail Address: Brejesh.Prayman@stpete.org		
G.	Name of the Designated Stormwater Management Program Contact (if different from Section I.F above): Carlos Frey		
	Title: Design Manager, Stormwater and Environmental		
	Department: Engineering and Capital Improvements		
	Mailing Address: P.O. Box 2842		
	City: St. Petersburg	Zip Code: 33731	County: Pinellas
	Telephone Number: 727-892-5380	Fax Number: 727-892-5476	
	E-mail Address: carlos.frey@stpete.org		

SECTION II. MS4 MAJOR OUTFALL INVENTORY (Not Applicable In Year 1)

A.	Number of outfalls ADDED to the outfall inventory in the current reporting year (insert “0” if none): 53 (Does this number include non-major outfalls? ☐ Yes ☒ No ☐ Not Applicable) As previously reported, stormwater assets in the city’s GIS database are in the process of verification, updating and mapping. Outfalls have been verified, updated, and mapped accounting for the increase to the inventory.
B.	Number of outfalls REMOVED from the outfall inventory in the current reporting year (insert “0” if none): 0 (Does this number include non-major outfalls? ☐ Yes ☐ No ☒ Not Applicable)

C.	Is the change in the total number of outfalls due to lands annexed or vacated? ☐ Yes ☒ No ☐ Not Applicable

SECTION III.	**PART V.B. ASSESSMENT PROGRAM**
A.	Provide a brief statement as to the status of water quality monitoring plan implementation. Status may include sampling frequency changes, monitoring location changes, or sampling waiver conditions. *<u>DEP Note:</u> If permittee participates in a collaborative monitoring plan, permittee may refer to a joint response as defined by the interlocal agreement.* Name and date of the approved plan: FDEP Number FLS000007 Status: Ongoing The City of St. Petersburg has been implementing the ambient water quality sampling program within the city previously conducted by Pinellas County and the SWFWMD. The City is responsible for sampling, analyses and review of data for the ambient monitoring program. Pinellas County continues to sample other basins within the city's boundary. The goal is to maintain continuity with the previous sampling programs and to expand to waterbodies as dictated by impairment status, TMDLs or other needs to determine the water quality.
B.	Provide a brief discussion of the monitoring and loading results to date which includes a summary of the water quality monitoring data and / or stormwater pollutant loading changes from the reporting year. *<u>DEP Note:</u> Results must be specific to the permittee's SWMP.* Janicki Environmental developed the attached report card and trend analyses for the city, included as Appendix A. All stations examined on the Boca Ciega and Middle Tampa Bay report cards indicated nutrient (total nitrogen and total phosphorus) concentrations have met the established thresholds during all years of examination with the exception of a marginal TN value for 2018 in Lake Maggiore. Most stations met the established thresholds for dissolved oxygen on the report card. However, 1 station in Boca Ciega Bay was scored as having failed to meet established criteria for more than 1 year in the rolling-three year period. Trend tests indicate that dissolved oxygen levels at two stations in Boca Ciega Bay are statistically significantly increasing so in years to come, it is possible the report card status will improve for the station currently scored as "Red". With the exception of one marginal value, stations in Boca Ciega Bay had a chlorophyll *a* grade of "green" for the report card in 2018 (continuing through the partial year 2019). The trend tests indicated that one station (Frenchmans Creek) in Boca Ciega Bay has a statistically increasing trend for chlorophyll *a*, which could impact future report card years. Five of 11 stations in Middle Tampa Bay scored as "red" indicating a failure to meet established thresholds in more than 1 of the current and previous 2 years period. Four of the five failing stations were in lakes, and the 5th was a bayou. Thus, it is anticipated that, for the near-future, the more estuarine/open water sites are expected to maintain a passing status on the report card. This highlights the efforts of the TBEP and its partners (including the City) to implement nutrient reduction programs, resulting in increasing water clarity and vastly improved seagrass coverages.
C.	Attach a monitoring data summary as required by the permit. An analysis of the data discussing changes in water quality and/or stormwater pollutant loading from previous reporting years. *<u>DEP Note:</u> Analysis must be specific to the permittee's SWMP.* Please see Appendix A for the monitoring data summary.

SECTION IV.	**FISCAL ANALYSIS**
A.	Total expenditures for the NPDES stormwater management program for the current reporting year: $18,484,141.11
B.	Total budget for the NPDES stormwater management program for the subsequent reporting year: $24,710,803.52
C.	Did the current reporting year resources decrease from the previous year? Y ☐ / N ☒ If program resources decreased, provide a discussion of the impacts on the implementation of the SWMP. N/A

SECTION V. MATERIALS TO BE SUBMITTED WITH THIS ANNUAL REPORT FORM				
Only the following materials are to be submitted to the Department along with this fully completed and signed Annual Report Form (check the appropriate box to indicate whether the item is attached or is not applicable):				
Attached	N/A	**Required Attachments**	**Permit Citation**	**Attachment Number/Title**
☐	☒	Any additional information required to be submitted in this current annual reporting year in accordance with Part III.A of your permit that is not otherwise included in Section VII below.	Part III.A	
☐	☒	If program resources have decreased from the previous year, a discussion of the impacts on the implementation of the SWMP.	Part II.F	
☐	☒	An explanation of why the minimum inspection frequency in Table II.A.1.a. was not met, if applicable.	Part II.A.1	
☐	☒	A list of the flood control projects that did not include stormwater treatment and an explanation for each of why it did not (if applicable).	Part III.A.4	
☒	☐	A monitoring data summary as directed in Section III.C above and in accordance with Rule 62-624.600(2)(c), F.A.C.	Part V.B.3	
☒	☐	YEAR 1 ONLY: An inventory of all known major outfalls and a map depicting the location of the major outfalls (hard copy or CD-ROM) in accordance with Rule 62-624.600(2)(a), F.A.C.	Part III.A.1	Appendix C
☐	☒	YEAR 2: A summary review of codes and regulations to reduce the stormwater impact from development.	Part III.A.2	
☐	☒	YEAR 2: A copy of the adopted Florida-Friendly Fertilizer ordinance (if applicable).	Part III.A.6	
☐	☒	Year 3 ONLY: The estimates of pollutant loadings and event mean concentrations for each major outfall or each major watershed in accordance with Rule 62-624.600(2)(b), F.A.C.	Part V.A	
☐	☒	YEAR 3: Summary of TMDL Monitoring Results (if applicable).	Part VIII.B.2	
☐	☒	YEAR 3: Bacteria Pollution Control Plan (if applicable).	Part VIII.B.3	
☐	☒	YEAR 4: A follow-up report on plan implementation of changes to codes and regulations to reduce the stormwater impact from development.	Part III.A.2	
☐	☒	YEAR 4: A report on any amendments to the applicable legal authority (if applicable).	Part III.A.7.a	
☐	☒	YEAR 4: Permit re-application information in accordance with Rule 62-624.420(2), F.A.C. • The assessment program (with revisions, if applicable). • If the total annual pollutant loadings have not decreased over the past two permit cycles, revisions to the SWMP, as appropriate.	Part V.B.3 Part V.A.3	
☐	☒	YEAR 4: TMDL Supplemental SWMP (if applicable).	Part VIII.B.3	

DO NOT SUBMIT ANY OTHER MATERIALS
(such as records and logs of activities, monitoring raw data, public outreach materials, etc.)

SECTION VI. CERTIFICATION STATEMENT AND SIGNATURE

The Responsible Authority listed in Section I.F above must sign the following certification statement, as per Rule 62-620.305, F.A.C:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based upon my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name of Responsible Authority (type or print): Brejesh Prayman, P.E., ENV SP

Title: Director, Engineering and Capital Improvements

Signature: Brejesh Prayman. Date: 01/29/2020

SECTION VII.	STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE				
A.	B.	C.	D.	E.	F.
Permit Citation/ SWMP Element	Permit Requirement/Quantifiable SWMP Activity	Number of Activities Performed	Documentation / Record	Entity Performing the Activity	Comments
Part III.A.1	Structural Controls and Stormwater Collection Systems Operation				
	Report the current known inventory. Report the number of inspection and maintenance activities conducted for each applicable type of structure included in Table II.A.1.a, and the percentage of the total inventory of each type of structure inspected and maintained. *Note: Delete structures that are not in your MS4's inventory. The permittee may choose its own unit of measurement (miles, linear feet, acres, etc.) for each structural control to be consistent with the unit of measurement in the documentation.*				

Type of Structure	Number of Structures	Number of Inspections	Percent Inspected	Number of Maintenance Activities	Percent Maintained			
Wet detention systems	10	8	80	3	80	Engineering Insp Records	Engineering	
Underdrain filter systems	7	7	100	7	100	Engineering Insp Records	Engineering	
Dry detention systems	1	1	100	1	100	Engineering Insp Records	Engineering	
Alum Injection systems	7	248	100	101	100	Alum Inspection Records	Water Resources	
Pollution control boxes	8	15	100	15	100	Stormwater Operations Records	Stormwater Operations	
Pump stations	4	143	100	95	100	Stormwater Operations Records	Stormwater Operations	
Major outfalls	294	280	95	81	26	Stormwater operations Records	Stormwater Operations	
Weirs or other control structures	2	200	100	4	100	Stormwater Operations Records	Stormwater Operations	Lake Maggiore gate checked daily
MS4 Pipes / culverts (miles)	638	.85	13	846	100	Stormwater Operations Records, Engineering Records	Stormwater Operations, Engineering	

SECTION VII. STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE									
A.	B.	C.					D.	E.	F.
Permit Citation/ SWMP Element	Permit Requirement/Quantifiable SWMP Activity	Number of Activities Performed					Documentation / Record	Entity Performing the Activity	Comments
	Inlets / catch basins / grates	17870	6452	37	4435	25	Stormwater Operations Records	Stormwater Operations	
	Ditches / conveyance swales (number of conveyances)	344	1321	100	1321	100	Stormwater Operations Records – Mowing Crew	Stormwater Operations	
	If the minimum inspection frequencies set forth in Table II.A.1.a. were not met, provide an explanation of why they were not and a description of the actions that will be taken to ensure that they will be met.	Inspections and maintenance activities will increase over the next reporting period as assets within our GIS database continue to be verified, updated, and accurately mapped.							

SECTION VII. STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE					
A.	**B.**	**C.**	**D.**	**E.**	**F.**
Permit Citation/ SWMP Element	**Permit Requirement/Quantifiable SWMP Activity**	**Number of Activities Performed**	**Documentation / Record**	**Entity Performing the Activity**	**Comments**
Part III.A.1 Summary	Provide an evaluation of the Stormwater Management Program according to Part VI.B.3 of the permit.				
	Strengths: The MS4 is inspected and maintained by the city's Stormwater, Pavement and Traffic Operation Department and is supported by a stormwater utility fee. The city maintains GIS of our infrastructure and records are kept of daily activities, both of which have improved in accuracy over the last reporting period.				
	Limitations: Record keeping of inspections and maintenance activities need improvement.				
	SWMP revisions implemented to address limitations: Improving field collection by providing tablets to field crews will improve data collection and allow for consistency in reporting necessary data.				
Part III.A.2	**Areas of New Development and Significant Redevelopment**				
	Report the number of significant development projects, including new and redevelopment, reviewed and approved by the permittee for post-development stormwater considerations.				
	Number of significant development projects reviewed	14	Application Status Record	Planning and Development Services	
	Number of significant development projects approved	14	Application Status Record	Planning and Development Services	
	Provide in the Year 2 Annual Report the summary report of the review activity. Provide in the Year 4 Annual Report the follow-up report on plan implementation.				
	Year 2 ONLY: Attach the summary report of the review activity	☐	N/A	N/A	N/A
	Year 4 ONLY: Attach the follow-up report on plan implementation	☐	N/A	N/A	N/A
Part III.A.2 Summary	Provide an evaluation of the Stormwater Management Program according to Part VI.B.2 of the permit.				
	Strengths: The city's Construction Services and Permitting Division and Engineering and Capital Improvements Department review new and redevelopment plans for storm water quantity, storm water quality and erosion control.				
	Limitations: Workloads affect the amount of time spent at the active sites for inspections.				
	SWMP revisions implemented to address limitations: Confirm all inspectors are appropriately trained on NPDES program				
Part III.A.3	**Roadways**				
	Report on the litter control program, including the frequency of litter collection, an estimate of the total number of road miles cleaned or amount of area covered by the activities, and an estimate of the quantity of litter collected. *Note: If the permittee does not contract activities, delete CONTRACTOR activities.*				
	PERMITTEE Litter Control: Frequency of litter collection	Daily	Trash Detail Run	Stormwater Operations	*Data doesn't distinguish litter pickup in main city corridor from emptying of trash cans in right-of-way of this area

SECTION VII. STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE					
A.	B.	C.	D.	E.	F.
Permit Citation/ SWMP Element	Permit Requirement/Quantifiable SWMP Activity	Number of Activities Performed	Documentation / Record	Entity Performing the Activity	Comments
	PERMITTEE Litter Control: Estimated amount of area maintained (miles)	28.84	Trash Detail Run	Stormwater Operations	*Data doesn't distinguish litter pickup in main city corridor from emptying of trash cans in right-of-way of this area
	PERMITTEE Litter Control: Estimated amount of litter collected (lbs.)	77,490	Trash Detail Run	Stormwater Operations	*Data doesn't distinguish litter pickup in main corridor from emptying of trash cans in right-of-way of this area
	OPTIONAL: If an Adopt-A-Road or similar volunteer program is implemented, report the total number of road miles cleaned and an estimate of the quantity of litter collected. If you do not participate in an Adopt-A-Road program, report "0".				
	Trash Pick-up Events: Total miles cleaned	7,472	Street sweeping log	Stormwater Operations	
	Trash Pick-up Events: Estimated amount of litter collected (lb.)	247,878	Keep Pinellas Beautiful Monthly Report/Tampa Bay Watch Records/ Neighborhood Partnership Records	KPB, TBW, and Neighborhood Partnership	
	Adopt-A-Road: Total miles cleaned	110	Keep Pinellas Beautiful Monthly Report	KPB	
	Adopt-A-Road: Estimated amount of litter collected (lbs.)	3,200 lbs.	Keep Pinellas Beautiful Monthly Report	KPB	
	Report on the street sweeping program, including the frequency of the sweeping, total miles swept, an estimate of the quantity of sweepings collected, and the total nitrogen and total phosphorus loadings that were removed by the collection of sweepings. If no street sweeping program is implemented, provide the explanation of why not in column F.				
	Frequency of street sweeping	Daily Mon-Fri	Street sweeping SOP	Stormwater Operations	
	Total miles swept	54,572	Street sweeping log	Stormwater Operations	

SECTION VII. STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE

A.	B.	C.	D.	E.	F.
Permit Citation/ SWMP Element	**Permit Requirement/Quantifiable SWMP Activity**	**Number of Activities Performed**	**Documentation / Record**	**Entity Performing the Activity**	**Comments**
	Estimated quantity of sweeping material collected (cy)	62,129	Street sweeping log	Stormwater Operations	
	Total phosphorous loadings removed (pounds)	47,292	FSA MS4 Assessment Tool	Engineering	
	Total nitrogen loadings removed (pounds)	86,891	FSA MS4 Assessment Tool	Engineering	
	Report the equipment yards and maintenances shops that support road maintenance activities, and the number of inspections conducted for each facility.				
	Name of Facility	**Number of Inspections**			
	#1 Fleet Maintenance	12	Inspection Record	Fleet Management	Records kept at Fleet

SECTION VII. STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE					
A.	B.	C.	D.	E.	F.
Permit Citation/ SWMP Element	**Permit Requirement/Quantifiable SWMP Activity**	**Number of Activities Performed**	**Documentation / Record**	**Entity Performing the Activity**	**Comments**
Part III.A.3 Summary	Provide an evaluation of the Stormwater Management Program according to Part VI.B.3 of the permit.				
	Strengths: The city maintains a strong street sweeping and litter removal programs throughout the city.				
	Limitations: The urban environment contributes a certain amount of debris to the MS4.				
	SWMP revisions implemented to address limitations: The City has increased funding to partner organizations to increase litter removal activities, as well as, looking into new innovative trash trapping devices at outfalls.				
Part III.A.4	**Flood Control Projects**				
	Report the total number of flood control projects that were constructed by the permittee during the reporting period and the number of those projects that did NOT include stormwater treatment. Provide a list of the projects where stormwater treatment was not included with an explanation for each of why it was not. Report on any stormwater retrofit planning activities and the associated implementation of retrofitting projects to reduce stormwater pollutant loads from existing drainage systems that do not have treatment BMPs.				
	Flood control projects completed during the reporting period	**1**			
	Flood control projects completed that did not include stormwater treatment	0			
	Stormwater retrofit projects planned/under construction	2			Lake Maggiore gate automation planned; Various minor retrofits (backflow preventers, vaults, weir modifications, inlet increases, etc. are occurring throughout the City
	Stormwater retrofit projects completed	1			Various minor retrofits (backflow preventers, vaults, weir modifications, inlet increases, etc. are occurring throughout the City
	If there were projects that did not include stormwater treatment, provide as an attachment a list of the projects and an explanation for each of why it did not.	☐			
Part III.A.4 Summary	Provide an evaluation of the Stormwater Management Program according to Part VI.B.3 of the permit.				
	Strengths: The city's flood control program is supported by capital improvement funds and the city's storm water utility. The city has a storm water management master plan that is being followed for flood control improvements. Improvement projects include storm water quality.				
	Limitations: Records of minor flood control projects and retrofits are currently not accounted for separately.				
	SWMP revisions implemented to address limitations: Account for all types of flood control aspects separately				

SECTION VII.	STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE				
A.	**B.**	**C.**	**D.**	**E.**	**F.**
Permit Citation/ SWMP Element	**Permit Requirement/Quantifiable SWMP Activity**	**Number of Activities Performed**	**Documentation / Record**	**Entity Performing the Activity**	**Comments**
Part III.A.5	**Municipal Waste Treatment, Storage, and Disposal Facilities Not Covered by an NPDES Stormwater Permit**				
	Report the applicable facilities and the number of the inspections conducted for each facility.				
	Name of Facility	**Number of Inspections**			
	Brush site #1	1	Inspection Report	Engineering	
	Brush site #2	1	Inspection Report	Engineering	
	Brush site #3	1	Inspection Report	Engineering	
	Brush site #4	1	Inspection Report	Engineering	
	Brush site #6	1	Inspection Report	Engineering	
	Sanitation Yard	12	Inspection Report	Sanitation	
Part III.A.5 Summary	Provide an evaluation of the Stormwater Management Program according to Part VI.B.3 of the permit.				
	Strengths: Brush sites are in compliance with permits.				
	Limitations: None				
	SWMP revisions implemented to address limitations: None				
Part III.A.6	**Pesticides, Herbicides, and Fertilizer Application**				
	Report the number of permittee personnel applicators and contracted commercial applicators of pesticides and herbicides who are FDACS certified / licensed.				
	PERSONNEL: FDACS public applicators of pesticides/herbicides	29	Parks and Rec Records	Parks and Rec	
	CONTRACTORS: FDACS commercial applicators of pesticides/ herbicides	1	Engineering Records	Engineering	
	Report the number of permittee personnel who have been trained through the Green Industry BMP Program and the number of contracted commercial applicators of fertilizer who are FDACS certified / licensed.				
	PERSONNEL: Green Industry BMP Program training completed	35	Parks and Rec Records	Parks and Rec	
	CONTRACTORS: FDACS certified / licensed applicators of fertilizer	30	Engineering Records	Engineering	
	Provide a copy of the adopted ordinance with the Year 2 Annual Report. If this provision is not applicable because the permittee is not within the watershed of a nutrient-impaired water body, indicate that in Column F.				
	Year 2 ONLY: Attach copy of adopted Florida-friendly ordinance	☐	N/A	N/A	N/A
	Report on the public education and outreach activities that are performed or sponsored by the permittee within the permittee's jurisdiction to encourage citizens to reduce their use of pesticides, herbicides and fertilizers including the type and number of activities conducted, the type and number of materials distributed, and				

SECTION VII.	STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE				
A.	**B.**	**C.**	**D.**	**E.**	**F.**
Permit Citation/ SWMP Element	**Permit Requirement/Quantifiable SWMP Activity**	**Number of Activities Performed**	**Documentation / Record**	**Entity Performing the Activity**	**Comments**
	the number of website visits (if applicable).				
	Brochures/Flyers/Fact sheets distributed	307,500	Engineering	Marketing	St. Pete Extra (3 editions)
	Neighborhood/ Public Meetings: Number attended	14	Stormwater Ed Records	Stormwater Education	CONA & Neighborhood Meetings
	Newspapers & newsletters: Number of articles/notices published	6	Water Wise E-Splash	Water Resources	
	Newsletters: Number of newsletters distributed	124,000	Water Wise E-Splash; St. Pete Extra	Water Resources	
	Public displays (e.g., kiosks, storyboards, posters, etc.)	16	Stormwater Ed Records: Billboard Photo	Stormwater Education; Marketing	Outreach events and I-275 billboard
	Radio or television Public Service Announcements (PSAs)	1	Stormwater Ed Records	Stormwater Education	
	School presentations: Number conducted	2	Stormwater Ed Records	Stormwater Education	
	School presentations: Number of participants	290	Stormwater Ed Records	Stormwater Education	Great American Teach-In
	Seminars/Workshops: Number conducted	12	Stormwater Ed Records	Stormwater Education	
	Special events: Number conducted	1	Stormwater Ed Records	Stormwater Education	
	Special events: Number of participants	30,000	Stormwater Ed Records	Stormwater Education	Green Thumb Festival
	Number of visitors to stormwater-related pages	70,344	Be Floridian Facebook/ Website – Web Analytics	TBEP	Total website page views and Facebook page engagements
Part III.A.6 Summary	Provide an evaluation of the Stormwater Management Program according to Part VI.B.3 of the permit.				
	Strengths: The city adopted the county's landscape maintenance and fertilizer use ordinance.				
	Limitations: Ability to enforce ordinance is limited due to workload				
	SWMP revisions implemented to address limitations: Improved inter-departmental coordination in addressing issues and improved training will allow for increased enforcement.				
Part III.A.7.a	**Illicit Discharges and Improper Disposal — Inspections, Ordinances, and Enforcement Measures**				
	Report amendments to legal authority in Year 4.				

SECTION VII.	STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE				
A.	B.	C.	D.	E.	F.
Permit Citation/ SWMP Element	**Permit Requirement/Quantifiable SWMP Activity**	**Number of Activities Performed**	**Documentation / Record**	**Entity Performing the Activity**	**Comments**
	Year 4 ONLY: Attach a report on amendments to applicable legal authority	☐	N/A	N/A	N/A
Part III.A.7.c	**Illicit Discharges and Improper Disposal — Investigation of Suspected Illicit Discharges and/or Improper Disposal**				
	Report on the proactive inspection program, including the number of inspections conducted by the permittee, the number of illicit activities found, and the number and type of enforcement actions taken.				
	Proactive inspections for suspected illicit discharges	5268	Illicit Discharge Inspections/Findings Records	Water Resources	
	Illicit discharges found during a proactive inspection	10	Engineering Records	Engineering, Fire, Water Resources	
	NOV/WL/citation/fines issued for illicit discharges found during proactive inspection	2	Engineering Records	Engineering, Water Resources	
	Report on the reactive investigation program as it relates to responding to reports of suspected illicit discharges, including the number of reports received, the number of investigations conducted, the number of illicit activities found, and the number and type of enforcement actions taken.				
	Reports of suspected illicit discharges received	18	Engineering Database	Engineering	
	Reactive investigations of reports of suspected illicit discharges etc.	10	Engineering Database	Engineering	
	Illicit discharges etc. found during reactive investigation	3	Engineering Database	Engineering	
	NOV/WL/citation/fines issued for illicit discharges etc. found during reactive investigation	44	Engineering Database	Engineering	
	Report the type of training activities, and the number of permittee personnel and contractors trained (both in-house and outside training) within the reporting year.				
	Personnel trained	8	Engineering Database	Engineering	
	Contractors trained	0			
Part III.A.7.d	**Illicit Discharges and Improper Disposal — Spill Prevention and Response**				
	Report on the spill prevention and response activities, including the number of spills addressed.				
	Hazardous and non-hazardous material spills responded to	89	Hazardous Materials Responses Report	Fire	
	Report the type of training activities, and the number of permittee personnel and contractors trained (both in-house and outside training) within the reporting year.				
	Personnel trained	321	SWS Records	SWS	

SECTION VII.	STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE				
A.	B.	C.	D.	E.	F.
Permit Citation/ SWMP Element	Permit Requirement/Quantifiable SWMP Activity	Number of Activities Performed	Documentation / Record	Entity Performing the Activity	Comments
	Contractors trained	7	SWS Records	SWS	
Part III.A.7.e	**Illicit Discharges and Improper Disposal — Public Reporting**				
	Report on the public education and outreach activities that are performed or sponsored by the permittee within the permittee's jurisdiction to encourage the public reporting of suspected illicit discharges and improper disposal of materials, including the type and number of activities conducted, the type and number of materials distributed, and the number of website visits (if applicable).				
	Publicized the Complaint Hotline	365	Website	Marketing	Continuous on Website
	Brochures/Flyers/Fact sheets distributed	124,000	Water Wise E-Splash; St. Pete Extra	Water Resources	124,000
	Neighborhood presentations: Number conducted	14	Stormwater Ed Records	Stormwater Education	CONA & Neighborhood Meetings
	Neighborhood presentations: Number of participants	~280	Stormwater Ed Records	Stormwater Education	CONA & Neighborhood Meetings
	Newspapers & newsletters: Number of articles/notices published	6	Water Wise E-Splash	Water Resources	
	Newsletters: Number of newsletters distributed	28,000	Water Wise E-Splash	Water Resources	
	Public displays (e.g., kiosks, storyboards, posters, etc.)	16	Stormwater Ed Records: Billboard Photo	Stormwater Education; Marketing	Outreach events and I-275 billboard
	Radio or television Public Service Announcements (PSAs)	1	Stormwater Ed Records	Stormwater Education	
	School presentations: Number conducted	2	Stormwater Ed Records	Stormwater Education	
	School presentations: Number of participants	290	Stormwater Ed Records	Stormwater Education	Great American Teach-In
	Seminars/Workshops: Number conducted	12	Stormwater Ed Records	Stormwater Education	
	Seminars/Workshops: Number of participants	1	Stormwater Ed Records	Stormwater Education	1
	Special events: Number conducted	1	Stormwater Ed Records	Stormwater Education	
	Special events: Number of participants	30,000	Stormwater Ed Records	Stormwater Education	Green Thumb Festival
	Number of visitors to stormwater-related pages	5,273	Web Analytics	Marketing	
		Tampa Bay Estuary Program **PROGRAM FUNDING: Permittee Provides Funding? Yes**			

SECTION VII.	STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE				
A.	**B.**	**C.**	**D.**	**E.**	**F.**
Permit Citation/ SWMP Element	**Permit Requirement/Quantifiable SWMP Activity**	**Number of Activities Performed**	**Documentation / Record**	**Entity Performing the Activity**	**Comments**
		Amount of Funding = FY2019 $35,946			
	Newspapers & newsletters: Number of articles/notices published	4	Bay Soundings		
	Newspapers: Number of newspapers distributed	193,287	Bay Soundings	TBEP	Online publication- pageviews
	Web Site: Number of hits / visitors to the stormwater-related pages	70,344	Be Floridian Facebook/ Website – Web Analytics	TBEP	Total website page views and Facebook page engagements
Part III.A.7.f	**Illicit Discharges and Improper Disposal — Oils, Toxics, and Household Hazardous Waste Control**				
	Report on the public education and outreach activities that are performed or sponsored by the permittee within the permittee's jurisdiction to encourage the proper use and disposal of oils, toxics, and household hazardous waste, including the type and number of activities conducted, the type and number of materials distributed, the amount of waste collected / recycled / properly disposed, and the number of website visits (if applicable).				
	Brochures/Flyers/Fact sheets distributed	124,000	Water Wise E-Splash; St. Pete Extra	Water Resources	124,000
	Household Hazardous Waste (HHW) Drop-off Events	2	Sanitation Records	Sanitation	
	HHW Drop-off Events: Amount of waste collected/recycled/disposed (tons)	25	Sanitation Records	Sanitation	
	Neighborhood presentations: Number conducted	0			
	Neighborhood presentations: Number of participants	0			
	Newspapers & newsletters: Number of articles/notices published	0			
	Newsletters: Number of newsletters distributed	0			
	Public displays (e.g., kiosks, storyboards, posters, etc.)	0			
	Radio or television Public Service Announcements (PSAs)	0			
	School presentations: Number conducted	0			
	School presentations: Number of participants	0			
	Seminars/Workshops: Number conducted	0			
	Seminars/Workshops: Number of participants	0			
	Special events: Number conducted	1	Stormwater Ed Records	Water Resources	
	Special events: Number of participants	30,006	Engineering Database	Engineering	Green Thumb Festival; HHW Drop Off
	Storm sewer inlets newly marked/replaced	160	Engineering Database	Engineering	
	Number of visitors to stormwater-related pages	33,750	Web Analytics	Marketing	

SECTION VII. STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE

A.	B.	C.	D.	E.	F.
Permit Citation/ SWMP Element	**Permit Requirement/Quantifiable SWMP Activity**	**Number of Activities Performed**	**Documentation / Record**	**Entity Performing the Activity**	**Comments**
Part III.A.7.g	**Illicit Discharges and Improper Disposal — Limitation of Sanitary Sewer Seepage**				
	Report on the type and number of activities undertaken to reduce or eliminate SSOs and inflow/ infiltration, the number of SSOs or inflow / infiltration incidents found, and the number resolved, and the name of the owner of the sanitary sewer system within the permittee's jurisdiction. Report only the SSOs and inflow / infiltration incidents into the MS4.				
	Owner of the sanitary sewer system	City of St. Petersburg			
	Activity to reduce/eliminate SSOs and I&I: (description) **Activity to reduce/eliminate SSOs and I&I: (description)**	See Appendix A			
	SSO incidents discovered	76	SSO Summary	Water Resources	
	SSO incidents resolved	76	SSO Summary	Water Resources	
	Inflow / infiltration incidents discovered	N/A			
	Inflow / infiltration incidents resolved	4,873	Engineering GIS Records	Engineering	SS manholes w/ inflow dish + See Appendix A
Part III.A.7 Summary	For activities required by Part III.A.7: Provide an evaluation of the Stormwater Management Program according to Part VI.B.3 of the permit.				
	Strengths: SSOs and I/I fully addressed in Phase II of Wet Weather Overflow Mitigation Program Report				
	Limitations: None				
	SWMP Revisions implemented to address limitations: None required				
Part III.A.8.a	**Industrial and High-Risk Runoff — Identification of Priorities and Procedures for Inspections**				
	Report on the high-risk facilities inventory, including the type and total number of high-risk facilities. Report on the high-risk facilities inspection program, including the number of inspections conducted and the number and type of enforcement actions taken.				

Type of Facility	Number of Facilities	Number of Inspections	Enforcement Actions			
Operating municipal landfills	**0**	N/A	N/A			
Hazardous waste treatment, storage, disposal and recovery (HWTSDR) facilities	**0**	N/A	N/A			
EPCRA Title III, Section 313 facilities (TRI)	**7**	0	0	TRI Records	Engineering	
Facilities determined as high risk by the permittee	**7**	0	0	TRI Records	Engineering	

Part III.A.8.b	**Industrial and High-Risk Runoff — Monitoring for High Risk Industries**				
	Report the number of high-risk facilities sampled.				

SECTION VII.	STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE				
A.	**B.**	**C.**	**D.**	**E.**	**F.**
Permit Citation/ SWMP Element	**Permit Requirement/Quantifiable SWMP Activity**	**Number of Activities Performed**	**Documentation / Record**	**Entity Performing the Activity**	**Comments**
	High risk facilities sampled	0			
Part III.A.8 Summary	For activities required by Part III.A.8: Provide an evaluation of the Stormwater Management Program according to Part VI.B.3 of the permit.				
	Strengths: Staff are trained to perform inspections. Inspectors in the city's industrial pretreatment program visited their sites routinely and have familiarity with sites.				
	Limitations: None				
	SWMP revisions implemented to address limitations: None required				
Part III.A.9.a	**Construction Site Runoff — Site Planning and Non-Structural and Structural Best Management Practices**				
	Report the number of permittee and private pre-construction site plans reviewed for stormwater, erosion, and sedimentation controls, and the number approved.				
	PERMITTEE SITES: Construction site plans reviewed	0	Engineering Plan Review Records	Engineering	
	PERMITTEE SITES: Construction site plans approved	0	Engineering Plan Review Records	Engineering	
	PRIVATE SITES: Construction site plans reviewed	29	Engineering Plan Review Records	Engineering	
	PRIVATE SITES: Construction site plans approved	14	Engineering Plan Review Records	Engineering	
	Report the number of development permit applicants notified of the ERP and CGP, and the number of applicants who confirmed ERP and CGP coverage.				
	Notified of ERP stormwater permit requirements	1	Engineering Plan Review Records	Engineering	
	Confirmed ERP coverage	14	Engineering Plan Review Records	Engineering	
	Notified of CGP stormwater permit requirements	N/A	Engineering Plan Review Records	Engineering	The City does not maintain these records
	Confirmed CGP coverage	2	NPDES Construction Facilities	DEP	
Part III.A.9.b	**Construction Site Runoff — Inspection and Enforcement**				
	Report on the inspection program for privately-operated and permittee-operated construction sites, including the number of active construction sites during the reporting year, the number of inspections of active construction sites, the percentage of active construction sites inspected, and the number and type of enforcement actions / referrals taken.				
	PERMITTEE SITES: Active construction sites	1	Engineering	Engineering	

SECTION VII.	STORMWATER MANAGEMENT PROGRAM (SWMP) SUMMARY TABLE				
A.	**B.**	**C.**	**D.**	**E.**	**F.**
Permit Citation/ SWMP Element	**Permit Requirement/Quantifiable SWMP Activity**	**Number of Activities Performed**	**Documentation / Record**	**Entity Performing the Activity**	**Comments**
			Construction Records	Construction	
	PERMITTEE SITES: Pre-, During, and Post inspections of active construction sites for E&S and waste control BMPs	104	Engineering Construction Records	Engineering Construction	
	PERMITTEE SITES: Percentage of active construction sites inspected	100	Engineering Construction Records	Engineering Construction	
	PRIVATE SITES: Active construction sites	46	Construction Services and Permitting Navline database	Construction Services and Permitting	
	PRIVATE SITES: Pre-, During, and Post inspections of active construction sites for E&S and waste control BMPs	407	Construction Services and Permitting Navline database	Construction Services and Permitting	
	PRIVATE SITES: Percentage of active construction sites inspected	100	Construction Services and Permitting Navline database	Construction Services and Permitting	
	Enforcement Action	4	Construction Services and Permitting Navline database	Construction Services and Permitting	
Part III.A.9.c	**Construction Site Runoff — Site Operator Training**				

	Report the type of training activities, the number of inspectors, site plan reviewers and site operators trained (both in-house and outside training).					
		DEP Certification	**Annual Training**			
	Permittee construction site inspectors	**13**	0	Engineering Database	Engineering	
	Permittee construction site plan reviewers					
	Permittee construction site operators					

Part III.A.9 Summary	For activities required by Part III.A.9: Provide an evaluation of the Stormwater Management Program according to Part VI.B.3 of the permit.
	Strengths: Inspectors have state certification for sediment and erosion control inspections. Sites are visited monthly for erosion control.
	Limitations: None
	SWMP revisions implemented to address limitations: None required

SECTION VIII. CHANGES TO THE STORMWATER MANAGEMENT PROGRAM (SWMP) ACTIVITIES (Not Applicable In Year 4)		
	Permit Citation/ SWMP Element	**Proposed Changes to the Stormwater Management Program Activities Established as Specific Requirements Under Part III.A of the Permit (Including the Rationale for the Change) — REQUIRES DEP APPROVAL PRIOR TO CHANGE IF PROPOSING TO REPLACE OR DELETE AN ACTIVITY.**
A.	**Part II.A.1 Structural control inspection and maintenance**	Strengths: The MS4 is inspected and maintained by the city's Stormwater, Pavement and Traffic Operation Department and is supported by a stormwater utility fee. The city maintains GIS of our infrastructure and records are kept of daily activities, both of which have improved in accuracy over the last reporting period. Limitations: Record keeping of inspections and maintenance activities need improvement. SWMP revisions implemented to address limitations: Improving field collection by providing tablets to field crews will improve data collection and allow for consistency in reporting necessary data.
	Part II.A.2 Significant redevelopment	Strengths: The city's Construction Services and Permitting Division and Engineering and Capital Improvements Department review new and redevelopment plans for storm water quantity, storm water quality and erosion control. Limitations: Workloads affect the amount of time spent at the active sites for inspections. SWMP revisions implemented to address limitations: Confirm all inspectors are appropriately trained on NPDES program
	Part II.A.3 Roadways	Strengths: The city maintains a strong street sweeping and litter removal programs throughout the city. Limitations: The urban environment contributes a certain amount of debris to the MS4. SWMP revisions implemented to address limitations: The City has increased funding to partner organizations to increase litter removal activities, as well as, looking into new innovative trash trapping devices at outfalls.
	Part II.A.4 Flood control	Strengths: The city's flood control program is supported by capital improvement funds and the city's storm water utility. The city has a storm water management master plan that is being followed for flood control improvements. Improvement projects include storm water quality. Limitations: Records of minor flood control projects and retrofits are currently not accounted for separately. SWMP revisions implemented to address limitations: Account for all types of flood control aspects separately
	Part II.A.5 Waste TSD Facilities	Strengths: Brush sites are in compliance with permits. Limitations: None SWMP revisions implemented to address limitations: None
	Part II.A.6 Pesticide, herbicide, fertilizer application	Strengths: The city adopted the county's landscape maintenance and fertilizer use ordinance. Limitations: Ability to enforce ordinance is limited due to workload SWMP revisions implemented to address limitations: Improved inter-departmental coordination in addressing issues and improved training will allow for increased enforcement.
	Part II.A.7 Illicit Discharge Detection and Elimination	Strengths: SSOs and I/I fully addressed in Phase II of Wet Weather Overflow Mitigation Program Report Limitations: None SWMP Revisions implemented to address limitations: None required
	Part II.A.8 High Risk Industry Runoff	Strengths: Staff are trained to perform inspections. Inspectors in the city's industrial pretreatment program visited their sites routinely and have familiarity with sites. Limitations: None SWMP revisions implemented to address limitations: None required
B.	**Part II.A.9 Construction Site Runoff**	Strengths: Inspectors have state certification for sediment and erosion control inspections. Sites are visited monthly for erosion control. Limitations: None SWMP revisions implemented to address limitations: None required

SECTION IX. TMDL Status Report

A. YEAR 1 Provide a table summarizing the status of the TMDL process. Include a list of prioritized TMDLs and their monitoring and implementation schedule; and include the Identification number of the outfall prioritized for TMDL monitoring.

WBID Number	Segment/ Waterbody/ Basin	Pollutant of Concern	TMDL DEP / EPA	Percent Reduction (WLA)	Priority Rank	Monitoring Summary / BPCP Due Date	Supplemental SWMP Due Date
1668A	Joe's Creek	DO/NUT	☒ / ☐				
1716A	34th Street Basin	Bacteria/Fecal Coliform	☒ / ☐				
1716B	Clam Bayou Drain	Bacteria/Fecal Coliform	☒ / ☐				
1716C	Clam Bayou East Drainage	Bacteria/Fecal Coliform	☒ / ☐				
1716D	Clam Bayou	Bacteria/Fecal Coliform	☒ / ☐				

B. YEAR 3 and annually thereafter, provide a summary of the estimated load reductions that have occurred for the pollutant(s) of concern being discharged from the MS4 to the TMDL water body during the reporting period and cumulatively since the date the Supplemental SWMP was implemented.

Year 3: Submit a Monitoring data summary or BPCP (if applicable).

Year 4: Submit a Supplemental SWMP (if applicable).

Note: Previously prioritized waterbodies with approved TMDL Implementation Plans shall be reported in this section.

WBID Number	Pollutant of Concern	Monitoring Summary / BPCP Submitted	Suppleme ntal SWMP Submitted	Projected load reductions OR Actual load reductions to date
1668A	DO/NUT	See Appendix		
1716A	Bacteria/Fecal Coliform	See Appendix		
1716B	Bacteria/Fecal Coliform	See Appendix		
1716C	Bacteria/Fecal Coliform	See Appendix		
1716D	Bacteria/Fecal Coliform	See Appendix		

C. Provide a brief statement as to the status of TMDL implementation according to Part VIII.B. of the permit (e.g. status of monitoring to validate WLA):

Please see the BPCP summary report in the appendices.

City of St. Petersburg

FLS000007-005

Annual Report

Cycle 5, Year 1

Appendix A

Water Quality Report

January, 2020

City of St. Petersburg 2019 Water Quality Report Card

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City of St. Petersburg
2019 WATER QUALITY REPORT CARD

INTRODUCTION

The City of St. Petersburg is currently meeting the requirements of a Consent Order (OGC No. 16-1280) from the Florida Department of Environmental Protection (DEP). The Consent Order is a result of unpermitted discharges of wastewater and effluent from several of the City's Facilities and Systems into waters of the State and/or into adjacent canals, ditches and ponds that are connected to waters of the State. As part of the Consent Order, the City is required to develop a detailed Water Quality Monitoring Assessment Report and create a Water Quality Report Card.

The following presents the 2019 Water Quality Report Card. The Report Card presents information for two central themes related to water quality – Environmental Health and Human Health. In this updated version of the report submitted earlier this year, the Environmental Health aspects have been updated with data through June 2019. The City has implemented a series of water quality monitoring programs that provide critical insights to the status and trends in water quality as they pertain to these two themes. Each of these monitoring programs are presented, including a description of the program (i.e., the what, where, why and how) and a summary of the data collected by that program.

2019 Water Quality Report Card
ENVIRONMENTAL HEALTH

WHY IS WATER QUALITY IMPORTANT?

To residents of the Tampa Bay area it is obvious that the health of the Tampa Bay ecosystem, specifically its water quality, is important in terms of regional environmental values. What is less commonly considered is the importance of the Bay's healthy ecosystem in terms of the region's economic health and residents' well-being and quality of life.

Economic Value

The Tampa Bay Estuary Program (TBEP) and its partners, including the City of St. Petersburg, established ecosystem goals and developed methods for achieving the goals, as defined in the Comprehensive Conservation and Management Plan (CCMP) originally published in 1996. The goals were related to improving the health of the Tampa Bay ecosystem, with quantifiable targets established for living resources based on bay conditions found in the 1950s, when the bay area population was ~25% of that currently. As noted by the TBEP, the CCMP "...reflected broad-based input from citizens, groups and communities with a common interest in a healthy bay as the cornerstone of a prosperous economy" (see the Program description on the TBEP website, TBEP.org). As a result of management decisions made and implemented by the TBEP partners and other participating entities, the CCMP's primary goal of restoring bay seagrass acreage to 1950-era extents was met and surpassed in the last three years.

The importance of a healthy Tampa Bay as an economic resource has only been recently quantified, however. The Tampa Bay area includes parts or all of six counties with a population of approximately 3 million, and employment of approximately 1.4 million. The TBEP and the Tampa Bay Regional Planning Council (TBRPC) recently completed a study which quantified the Bay's economic value (TBEP and TBRPC, 2014). This valuation identified bay-area business categories as either "Bay Influenced" or "Non-Bay Influenced", with a portion of the "Bay Influenced" category sub-classified as "Healthy Bay Dependent". Those business categories determined to be "Healthy Bay Dependent" include tourism-related ventures as well as real estate and shopping businesses, as examples.

The study found that "Bay-Influenced" businesses accounted for 47% of the total within the Tampa Bay watershed, and that "Healthy Bay Dependent" businesses accounted for 21% of the total. The job totals for "Bay-Influenced" businesses were 660,000, while the subset of these which were "Healthy Bay Dependent" totaled about 300,000.

These findings indicate that the "Healthy Bay Dependent" businesses and associated jobs account for about 1 in every 5 businesses and jobs in the Tampa Bay watershed. The monetary value associated with these jobs was estimated as representing $22 billion (13% of total six-county GDP), and that have the jobs in the Bay watershed, corresponding to $51 billion, are associated with "Bay Influenced" positions.

The study also provided an estimate of the monetary benefits of ecosystem services provided by Bay habitats, including seagrasses. It was estimated that Bay area residents would have to pay additional fees of $20-$100 million/year for stormwater and wastewater treatment without the treatment provided by seagrasses. Additional modeling of the impacts of saving $24 million/year in treatment indicated an estimated economic impact (due to spending on other purchases) of almost 500 jobs and $223 million in personal income within Hillsborough, Pinellas, and Pasco counties. Additional study results quantified the premiums associated with housing, hotels, and food service associated with Bay and non-Bay locations.

Quality of Life

Another recent study quantified the Tampa Bay area's Human Well-being Index (HWBI), related to health, quality of life, clean water and air, and availability of food and recreational opportunities. The HWBI was developed by the USEPA's Office of Research and Development as a means of quantifying the influence of social, economic, and environmental service flows on human well-being (Smith et al., 2012).

The HWBI includes 8 components (domains) of human well-being that can be linked to ecosystem services via their relationship to economic, environmental and societal well-being. The 8 domains (Education, Health, Leisure Time, Living Standards, Cultural Fulfillment, Safety and Security, Social Cohesion, and Connection to Nature), along with 25 indicators and 80 metrics used to calculate the scores for each domain. The HWBI methodology can be applied to any size population. Applied to the Tampa Bay area, the HWBI indicates a slightly higher well-being in the Bay area than in Florida as a whole, but below the national average. Individual domain scores are also provided for each of the five main counties of the Bay area (Hillsborough, Manatee, Pasco, Pinellas, and Polk).

AMBIENT WATER QUALITY MONITORING PROGRAM

The City's Ambient Water Quality Monitoring Program collects data to allow assessment of the quality of the City's surface waters. Data collected assist the City in its environmental stewardship efforts, aiding the City in accomplishing the following:

- determination of overall effectiveness of the City's Stormwater Management Program (SWMP);
- identification and prioritization of portions of the City's stormwater system requiring pollution reduction additional controls;
- evaluation of load reductions due to in-ground projects and other management actions implemented in the City's drainage area;
- identification of local sources where urban stormwater is adversely affecting surface water resources; and
- meeting the requirements of the City's MS4 (Municipal Separate Storm Sewer Systems) permit No. FLS000007. The MS4 permit is the means by which the Florida Department of Environmental Protection and Environmental Protection Agency regulate stormwater discharges to surface waters, and directs the permit holder (the City) to "...reduce the discharge of pollutants...to the Maximum Extent Practicable".

Since 2001, the City's stormwater monitoring requirements were accomplished utilizing data collected by the Southwest Florida Water Management District from Lake Maggiore and Pinellas County data for the inland and coastal sites. Monitoring of the coastal sites and some of the inland sites originally sampled by Pinellas County from 1991 through 2012 within City boundaries were taken over by the City in 2013. In the summer of that year, the City began water quality sampling at a number of sites within its boundaries that had been sampled by the County, and in several additional water bodies (Table 1 and Figure 1). The City’s sampling routine follows that implemented by the County.

The City's monitoring program includes streams and ditches, two lakes, and coastal waters in Tampa Bay adjacent to the City shoreline (Table 1 and Figure 1). Fixed monitoring sites in streams and ditches upstream of tidal influences are sampled for water quality and flow measurements, with four freshwater sampling sites combined in Booker Creek and the Clam Bayou drainage system. Additional water quality samples are collected from marine portions of streams, creeks, and channels (those classified as "Estuary" in Table 1). Fixed monitoring sites include lake monitoring sites in Lake Maggiore and Crescent Lake.

Coastal water sites are also sampled by the City within nearshore regions of Tampa Bay off the City's coastline. The City monitors four sites in each coastal segment in Tampa Bay (E-6 north of the former Pier location and E-7 south of the former Pier location, see Figure 1). The city collects samples from these sites and from all fixed sites approximately every six weeks in the wet season and every seven weeks in the dry season, or a total of eight times per year. The City's accredited water quality laboratory performs all analyses in-house. All monitoring sites are sampled for a full suite of water quality constituents, including the following:

- Physical constituents (salinity, specific conductance, pH, and temperature)
- Nutrients (nitrogen and phosphorus)
- Chlorophyll *a* (phytoplankton biomass)
- Dissolved oxygen and oxygen demanding materials
- Water clarity (Secchi disc)
- Enteric bacteria (fecal coliforms, *Enterococci*, *E. coli*)
- Constituents affecting water clarity (TSS and Turbidity)

Table 1. City water quality sampling stations.				
WBID	**WBID Name**	**Sample Station**	**Water Type**	**Sampling Period**
		BOCA CIEGA BAY		
1716A	34th Street Basin	45-03	Stream	2008-2019
1716B	Clam Bayou Drain	46-03	Stream	2008-2019
1716A	34th Street Basin	578	Stream	2016-2019
1709F	Frenchmans Creek - Basin U	48-03	Estuary	2008-2019
1716C	Clam Bayou (East Drainage)	CB-01	Estuary	2014-2019
1716C	Clam Bayou (East Drainage)	North Canal	Estuary	2016-2019
1716C	Clam Bayou (East Drainage)	South Canal	Estuary	2016-2019
1716C	Clam Bayou (East Drainage)	Central Canal	Estuary	2016-2019
1701	Bear Creek	39-02	Estuary	2008-2019
1716D	Clam Bayou Drain (Tidal)	580	Estuary	2016-2019
1716D	Clam Bayou Drain (Tidal)	CBD-01	Estuary	2016-2019
		MIDDLE TAMPA BAY		
1696	Booker Creek	40-02	Stream	2008-2019
1731A	Lake Maggiore	LM-1	Lake	2013-2019
1731A	Lake Maggiore	LM-2	Lake	2013-2019
1731A	Lake Maggiore	LM-3	Lake	2013-2019
1700A	Crescent Lake	CL-01	Lake	2013-2019
1700A	Crescent Lake	CL-02	Lake	2013-2019
1709D	Little Bayou - Basin Q	51-02	Estuary	2008-2019
1683	Smacks Bayou	32-03	Estuary	2008-2019
1700	Coffeepot Bayou	44-02	Estuary	2008-2019
1558B	Tampa Bay (Middle Segment)	E6-1	Estuary	2003-2019
1558C	Tampa Bay (Middle Segment)	E6-2	Estuary	2003-2019
1558C	Tampa Bay (Middle Segment)	E6-3	Estuary	2003-2019
1558C	Tampa Bay (Middle Segment)	E6-4	Estuary	2003-2019
1558B	Tampa Bay (Middle Segment)	E7-1	Estuary	2003-2019
1558B	Tampa Bay (Middle Segment)	E7-2	Estuary	2003-2019
1558B	Tampa Bay (Middle Segment)	E7-3	Estuary	2003-2019
1558B	Tampa Bay (Middle Segment)	E7-4	Estuary	2003-2019

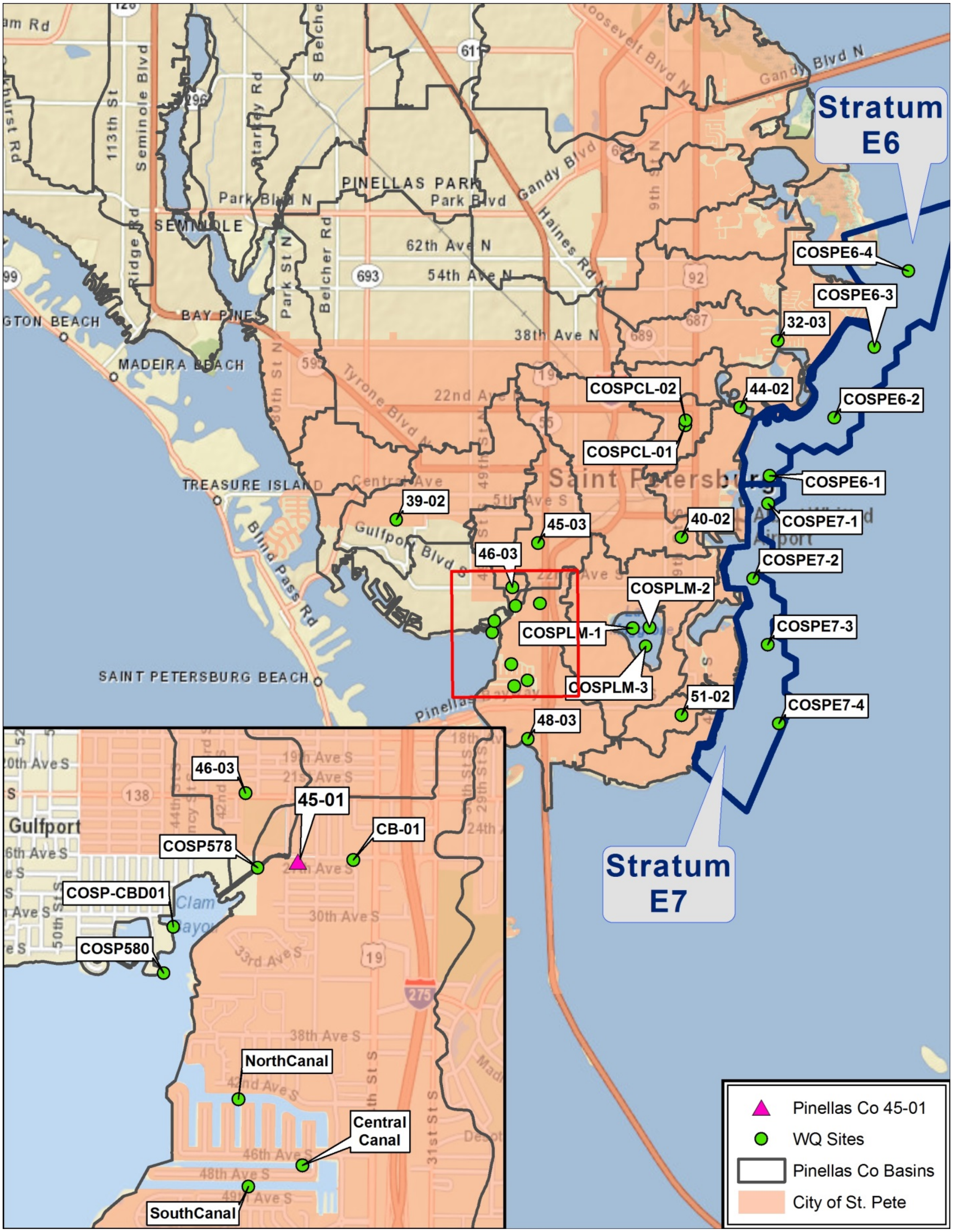

Figure 1. City of St. Petersburg Ambient Water Quality Monitoring Program sampling sites.

REGULATORY STATUS

The FDEP assesses water bodies against a series of regulatory criteria as defined by the Impaired Water Rule (FAC 62-303) on a five-year schedule. If a water body is confirmed to exceed Impaired Water Rule thresholds for a given parameter, the water body is determined to be impaired for that parameter. Currently, there are several waterbodies within the boundaries of the City that are listed as impaired (Figure 2), though not every impaired WBID is regularly monitored by the City as part of its Ambient Monitoring Program. These include impairments for dissolved oxygen (Bear Creek, Little Bayou – Basin Q), chlorophyll *a* (Little Bayou – Basin Q), as well as for nutrients (Crescent Lake) Additionally, multiple WBIDs within the City's boundaries are currently listed as verified impaired, or proposed to be listed with finalization expected imminently (Group 5 WBIDs Cycle 4; those noted with "*" in Figure 2), for various bacteria (Coffeepot Bayou, Little Bayou – Basin Q, Frenchman's Creek, and Clam Bayou (East Drainage)). .

Smacks Bayou and Coffee Pot Bayou were the subjects of State and Federal Total Maximum Daily Load (TMDL) development, with proposed TMDLs calling for reductions in loadings of TN, TP, and BOD to address perceived DO problems. Working closely with FDEP to review the data used in the data evaluation led FDEP staff to agreed that FDEP was justified in no longer pursuing development of nutrient or DO TMDLs for Smacks Bayou or Coffee Pot Bayou. Both water bodies were delisted from the 1998 303(d) list and the State's Verified List (a listing of impaired water bodies).

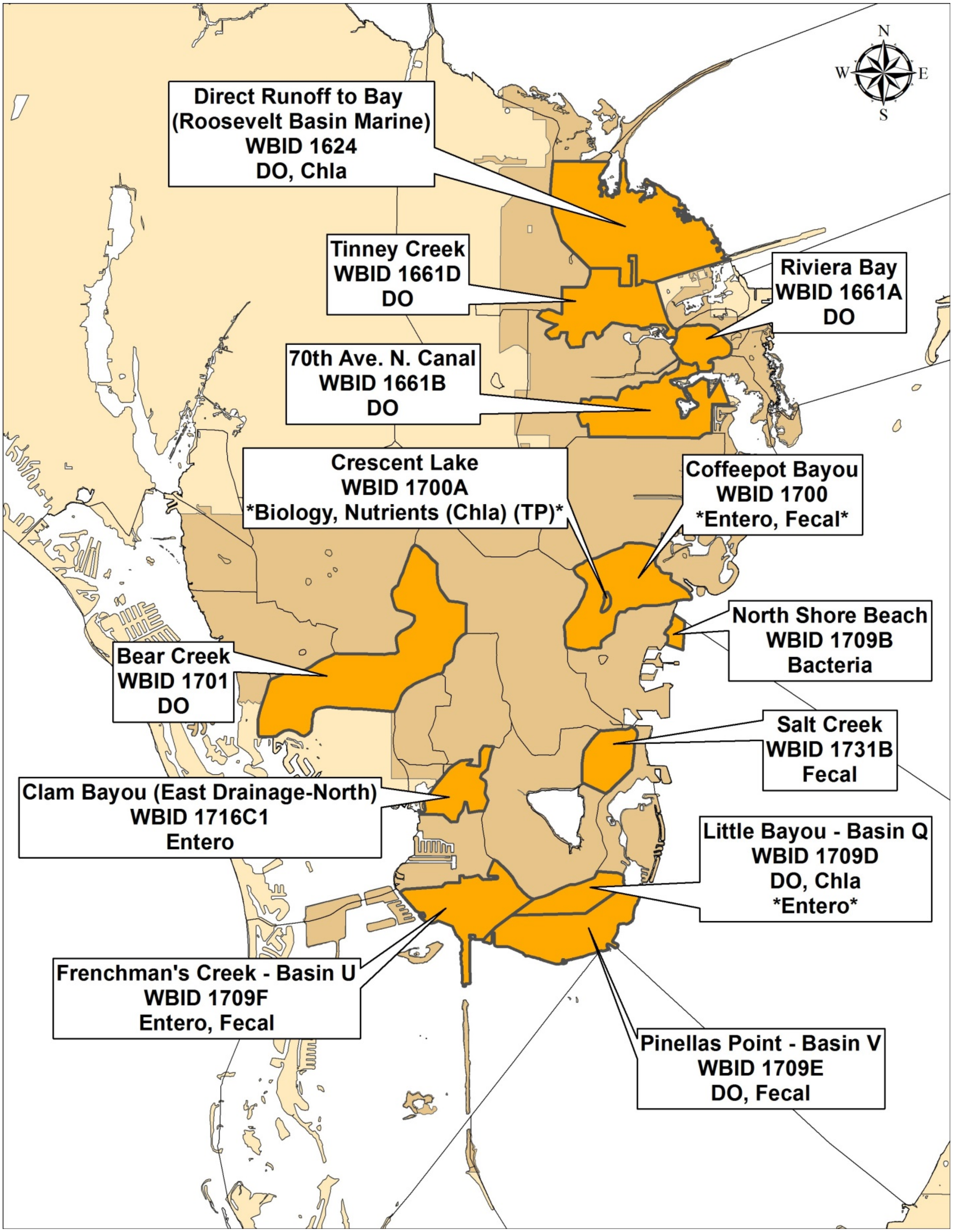

Figure 2. **FDEP Impaired WBIDs within the City of St. Petersburg.**

TAMPA BAY REASONABLE ASSURANCE PLAN

Through the process of developing the Reasonable Assurance Plan (RAP), nitrogen loading allocations for the City were developed. Allocations were developed for both point source and non-point source nitrogen loads. Ongoing or planned/proposed City projects to reduce nitrogen loading to Tampa Bay include expanding and improving its reclaimed water system, street sweeping programs, stormwater system enhancements, Clean Marina Program, central sewer expansion, support for the Florida Yards and Neighborhoods Program, etc. *The City has met its allocated nitrogen loads from both point sources and its MS4 since establishment of allocations as part of the 2009 Reasonable Assurance Update.*

Several of the impaired City water bodies are linked to nutrient pollution, in many cases nitrogen more so than phosphorus. These key nutrients can be added to a water body through both point source (direct discharge) and non-point source (e.g., surface runoff) loadings. A key focus of the TBEP has been to establish nitrogen loading targets for Tampa Bay to encourage seagrass recovery. In 1996, local government (including the City) and agency partners in the TBEP approved a long-term goal to restore 95% of the seagrass coverage observed in 1950 (38,000 acres). Also in 1996, the Tampa Bay Nitrogen Management Consortium (NMC) was formed. The NMC includes local governments (including the City) and agencies participating in the TBEP, as well as industrial, utility and agricultural interests in the Tampa Bay watershed. These entities have pledged to work cooperatively in a voluntary framework to assist with the maintenance of nitrogen loads to support seagrass restoration in Tampa Bay. Combined efforts of the TBEP and its partners (including the City) to reduce nitrogen loading are resulting in more than sufficient water quality for the expansion of seagrasses (Tampa Bay NMC, 2017). Seagrass coverage in Tampa Bay increased between 2012 and 2016 by 7,013 acres. As of 2016, Tampa Bay seagrass acreage exceeds both the TBEP's initial recovery goal, as well as the 1950 benchmark estimate.

CITY AMBIENT WATER QUALITY REPORT CARD

A report card scoring system was developed by Janicki Environmental (2017), using a color-coded scoring system that could be used to evaluate each monitoring station or group of stations (stratum) on an annual basis. As part of the development of the reporting tool, the City was divided into 2 major basins – those sites that drain to either Middle Tampa Bay or Boca Ciega Bay. These major basins correspond to existing delineations of areas used by the City, Pinellas County or by other local intergovernmental agencies including the Tampa Bay Estuary Program to report on watershed management actions and the FDEP to evaluate water quality with respect to established standards. The major basins are depicted in Figure 3. Four water quality parameters are evaluated for the water quality report card:

- Dissolved Oxygen % Saturation (DO %sat),
- Chlorophyll *a* (µg/L) (Chla),
- Total Nitrogen (mg/L) (TN), and
- Total Phosphorus (mg/L) (TP).

A short description of each of these parameters and the justification for their inclusion in the City's monitoring and reporting is described below. Where possible, the thresholds chosen to evaluate City water quality data for the reporting tool are consistent with numeric criteria and standards promulgated by FDEP to evaluate compliance with these standards.

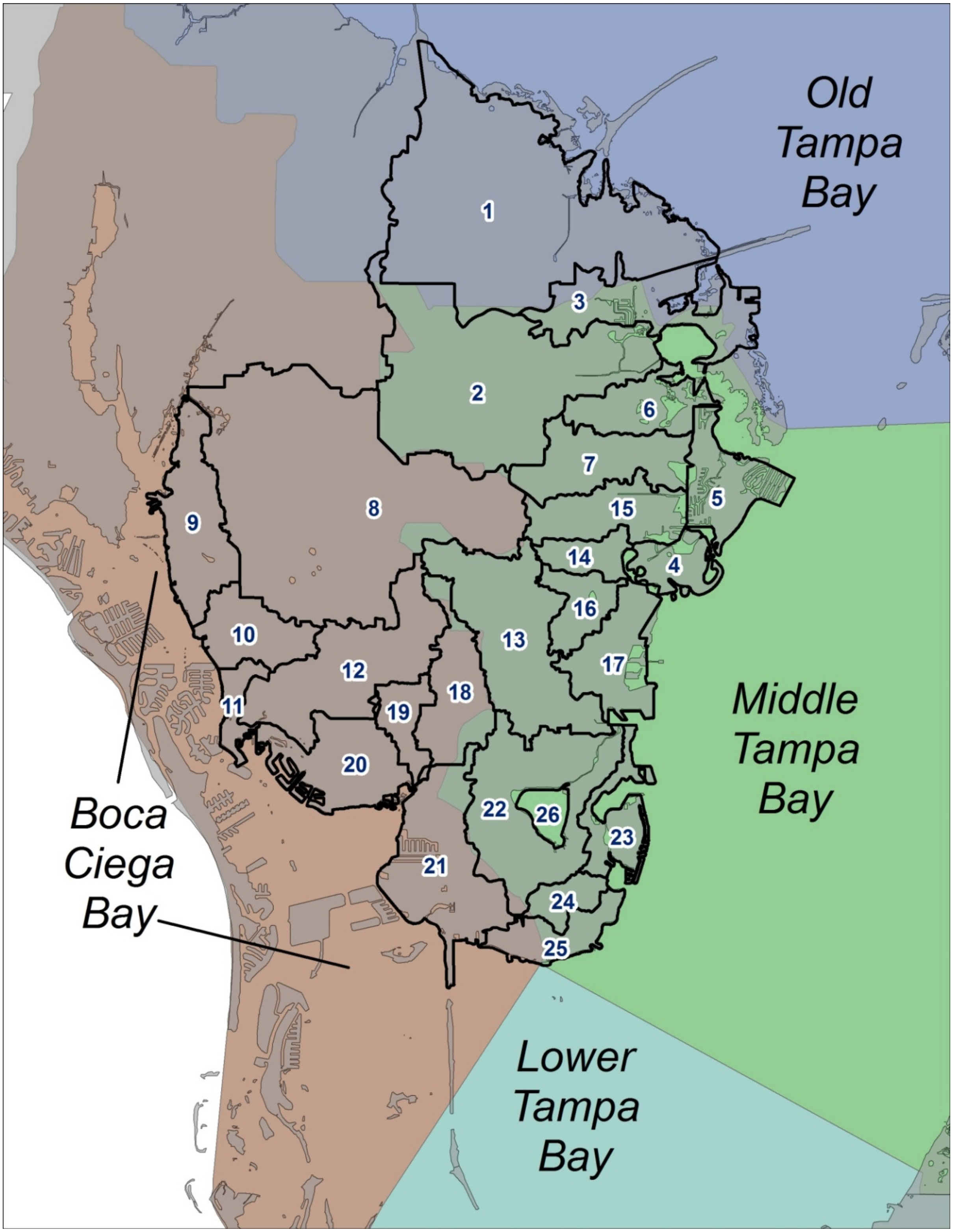

Figure 3. **Bay segments and the basins that drain to them. Basin labels coincide with those reported in Table 1.**

Dissolved Oxygen Saturation

Dissolved oxygen is a measure of the amount of oxygen available in the water to living creatures. The amount available depends upon the amount of algae and decomposing organic matter and determines habitats for fish and bottom-dwelling organisms. Additionally, oxygen levels are influenced by water temperature, with colder water able to “hold” more oxygen than warmer water and salinity.

To establish thresholds for the reporting tool, established Florida Administrative Code rules (FAC 62-303.530 and 62-303.533) were used for City streams, lakes and estuaries. The thresholds differ depending upon the water body type and its designated use according to Florida rules. For predominantly freshwaters that are designated as potable water supply, fish consumption, recreation, or the propagation and maintenance of a healthy well-balanced population of fish and wildlife, no more than 10% of the daily average percent dissolved oxygen saturation values shall be below 38%. For predominantly marine waters, no more than 10% of the daily average percent dissolved oxygen saturation values shall be below 42%.

Chlorophyll a

Chlorophyll *a* is the pigment that makes plants and algae green. This pigment is what allows plants and algae to use energy from sunlight to produce organic carbon. Chlorophyll *a* concentrations provide a measure of the amount of algae in the water. Algae occur at the base of the food chain and provide a food source for the organisms higher in the aquatic food changes. Additionally, algae add oxygen to the water as a by-product of photosynthesis. However, too much chlorophyll *a* is indicative of an algal bloom which decreases available light and lowers dissolved oxygen values (via decomposition of dead algae).

For the report card tool, the threshold values for chlorophyll *a* concentrations varied. In general, for freshwaters including lakes and streams an annual geometric mean concentration of 20 (µg/L) was used. The estuary strata in Middle Tampa Bay were evaluated against an arithmetic annual mean of 8.5 (µg/L) (Janicki Environmental, 2011a). There are samples collected by the City in tidal streams for which Chlorophyll *a* concentration criteria have not currently been established by FDEP. In these cases an annual geometric mean of 11 (µg/L) was used to evaluate threshold exceedances.

Total Nitrogen and Total Phosphorus

Total nitrogen and total phosphorus are essential nutrients for plants and animals, but in excessive amounts can cause algal blooms which decrease available light and dissolved oxygen levels. As a result, excess nutrients can cause changes in shifts in algal and plant species communities, diebacks of seagrass, reduced populations of fish and shellfish, and losses of acceptable aquatic habitats. Sources of nitrogen include wastewater treatment plants, runoff from fertilized lawns and croplands, and failing septic systems. The Tampa Bay region has extensive phosphate deposits and both fresh and estuarine waters of the region can be enriched with phosphate. Compared to other estuaries, the levels of nitrogen relative to phosphorus in Tampa Bay are relatively low, and algae are therefore suggested to be limited by nitrogen (the addition of nitrogen can fuel algal growth). While naturally occurring in Florida soils, increased levels of phosphorus can also cause algal blooms in excessive amounts. In addition to naturally occurring concentrations, phosphorus may enter a water body via wastewater discharges, or drainage from the surrounding watershed.

The FDEP and the Environmental Protection Agency (EPA) have recently developed water quality standards for nutrients. These are typically expressed as annual geometric mean concentrations. However, for the estuarine waters of Boca Ciega Bay and Middle Tampa Bay, geometric mean concentrations reported as management level thresholds for total nitrogen and total phosphorus in technical support documents used in the development of the criteria (Janicki Environmental 2011a, b) were used for the report card tool. Therefore, for freshwater the nutrient criteria used for the report card was:

- TP = a geometric annual mean of 0.12 (mg/L)
- TN = a geometric annual mean of 1.54 (mg/L).

For the open bay estuarine segments, the nutrient thresholds used for the report card are reported as annual geometric means:

- TP = 0.29 (mg/L)
- TN = 0.87 (mg/L)

There are samples collected by the City in tidal streams for which numeric nutrient criteria have not currently been established by FDEP. In these cases, for the report card tool, are assumed to be in compliance.

The thresholds described above for each monitored water quality parameter were used to establish a color-coded scoring system that could be used to evaluate each monitored station or stratum on an annual basis. The scoring system is defined below:

- If the annual data for a particular station or stratum were in compliance with (i.e. did not exceed) the established threshold then that station/stratum was assigned a color code of Green.
- If the annual data for a particular station or stratum were in exceedance of the established threshold then that station/stratum was assigned a color code of Yellow.

- If more than one in a rolling three-year period (the evaluation year and the two previous years), annual data for a particular station or stratum were in exceedance of the established threshold then that station/stratum was assigned a color code of Red.

Report card evaluations for the most recent complete year of water quality sampling (2018) are shown in Figure 4 for Boca Ciega Bay and Middle Tampa Bay stations/strata. Report cards for 2019 (data collected through June 2019) are also shown in Figure 4. Report cards for each individual station or stratum, showing annual results for 2003 through June of 2019, are shown in Figure 5 through Figure 26. Note that 2019 represents an incomplete year of sampling and that sampling data will be available in the future for the remainder of 2019.

All stations/strata (Figure 4) for Boca Ciega Bay were in compliance (scored as "Green") for total nitrogen and total phosphorus in 2018, and initially scored as green for the first half of 2019. Report card results for all years between 2003-2019 (partial year) for total nitrogen and total phosphorus were also listed as "Green" for all stations, with the exception of one marginal value ("Yellow") in 2011, indicating compliance with established thresholds. For Middle Tampa Bay, total phosphorus values were in compliance ("Green") at all stations in 2018, and initially scored as green for the first half of 2019. However, for total nitrogen, values in Lake Maggiore were marginal ("Yellow"); the partial sampling completed through June of 2019 indicated the values were once again in compliance ("Green"). Remaining stations in Middle Tampa Bay were all in compliance for both total nitrogen and total phosphorus in 2018, and initially scored as green for the first half of 2019, and all stations were in compliance for these parameters for all years between 2003 and 2019 (through June).

Report card results for dissolved oxygen were largely "Green" indicating compliance with established thresholds in 2018, with the exception of 1 station in Boca Ciega Bay (Clam Bayou CB-01) which was scored as "Red" (the score of "Red" continued for the first half of 2019) and 1 station in Middle Tampa Bay (Little Bayou 51-02) which was scored as "Yellow" (data collected the first half of 2019 indicated a score of "Green"). These two stations have been scored in the "Red" in years prior to 2019 (Figure 11 and Figure 19). A "Red" score indicates more than one exceedance in the three-year period including the year of evaluation and the two years prior to the year of evaluation.

In terms of chlorophyll *a*, the report card indicates that all stations in Boca Ciega Bay, with the exception of a marginal value ("Yellow") in Central Canal during 2018 (initial mid-year scoring for 2019 indicates a return to "Green") were in compliance with the evaluated thresholds. However, 5 of the 11 stations in Middle Tampa Bay were graded as "Red" during 2018 (Figure 4), indicating there has been more than one exceedance in the three-year period 2016-2018. These 5 stations were Little Bayou, 1 Crescent Lake station, and 3 Lake Maggiore stations; the majority of the failing stations in 2018 were lake stations. The Lake Maggiore (Figure 24 through Figure 26) and Crescent Lake (Figure 21) stations did not have data available prior to 2013. However, each annual report card for these stations has displayed a score other than green (initial year yellow with one year of failing to meet the threshold, remainder red indicating continued failing to meet the threshold). Data for Little Bayou (Figure 19) extend back to 2008, but only one year during this period (2012) has been scored with a passing "Green" in that period. Initial scoring (partial year) for 2019 indicates that a Middle Tampa Bay station in Little Bayou and 2 stations in Lake Maggiore were still "Red" while 1 station each in Crescent and Maggiore Lakes indicated a return to "Green".

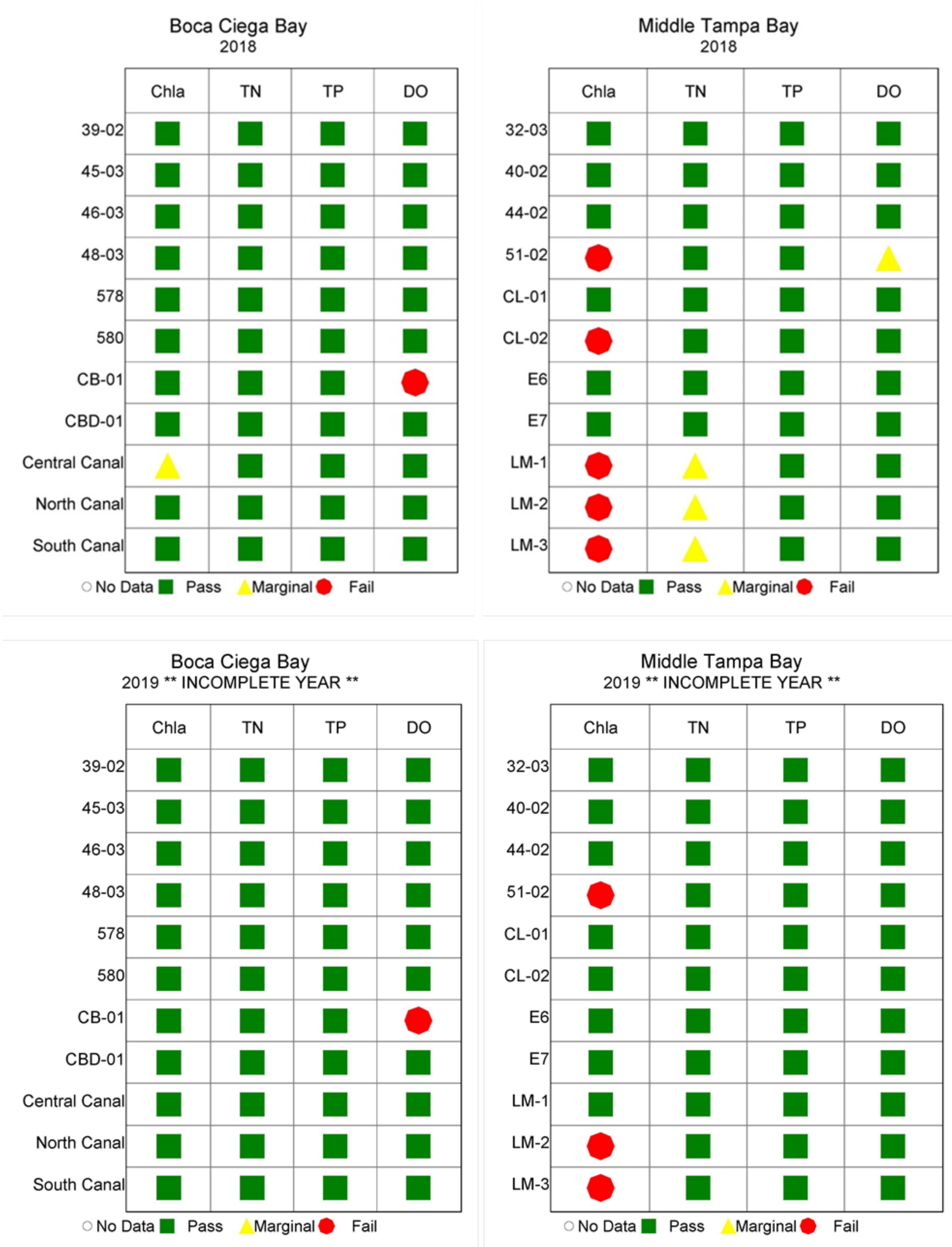

Figure 4. **Report Card outcomes for 2018 (top) and the first half of 2019 (bottom) in Boca Ciega Bay and Middle Tampa Bay.**

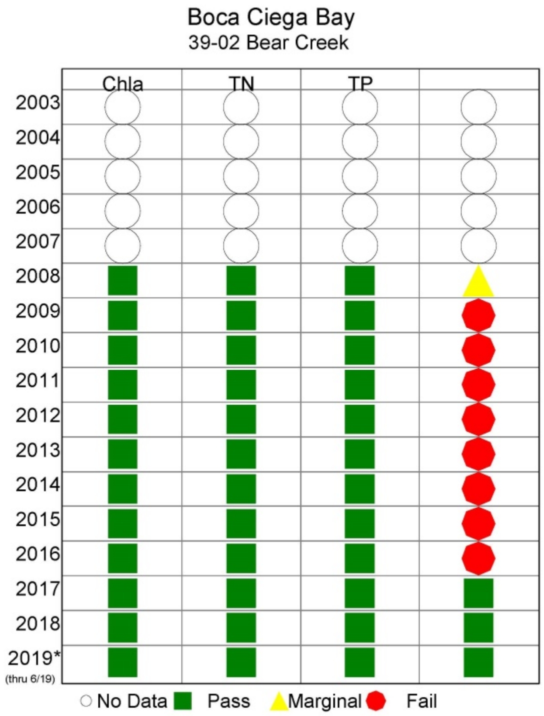

Figure 5. Station 39-02 Report Card.

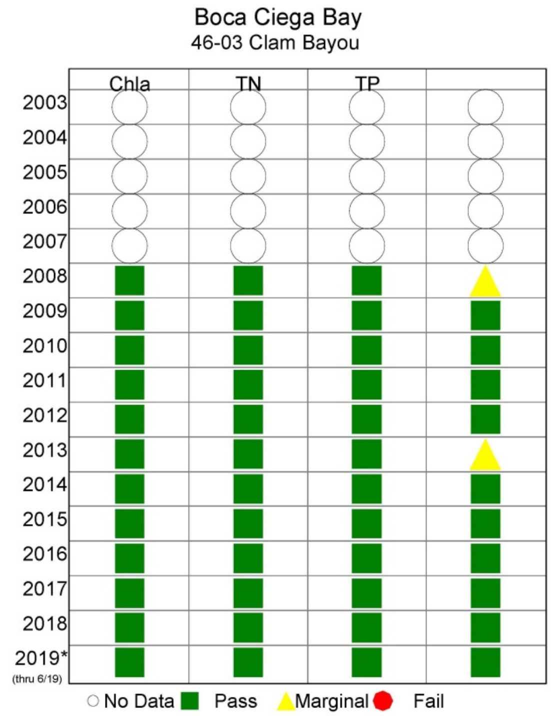

Figure 7. Station 46-03 Report Card.

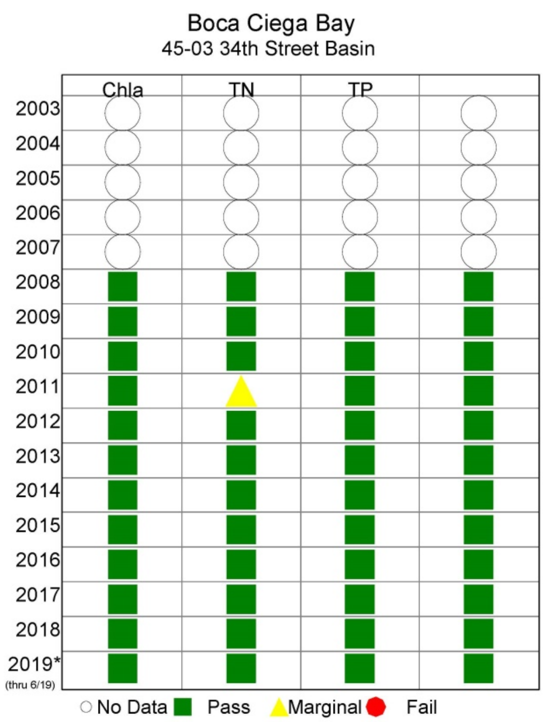

Figure 6. Station 45-03 Report Card.

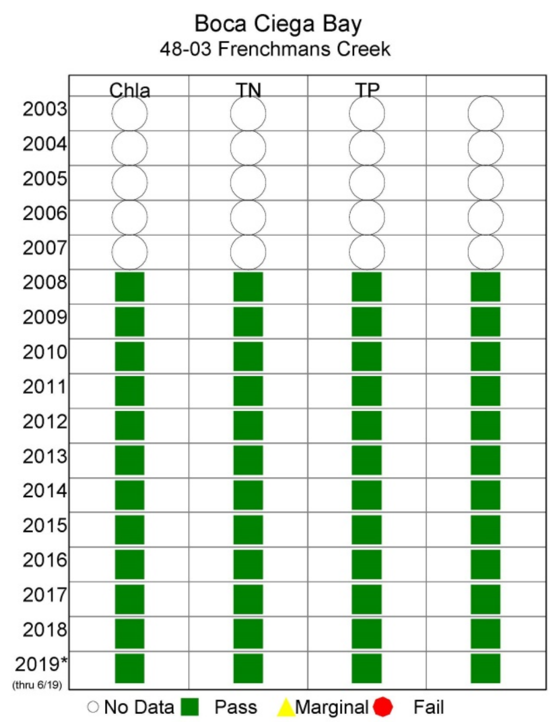

Figure 8. Station 48-03 Report Card.

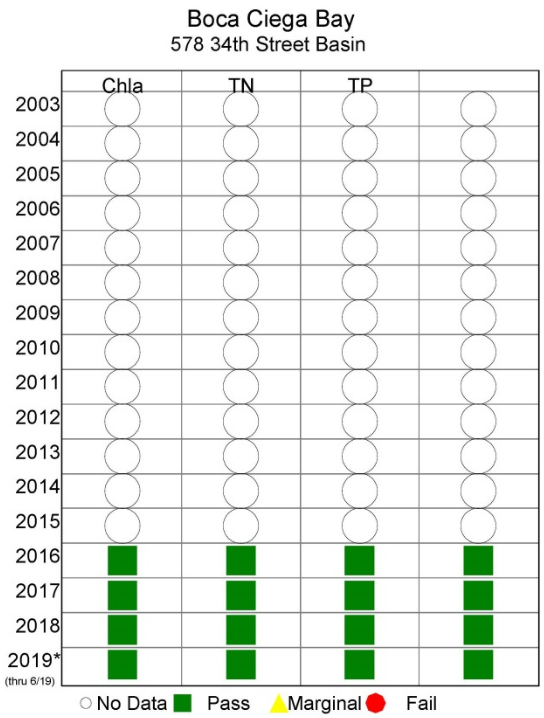

Figure 9. **Station 578 Report Card.**

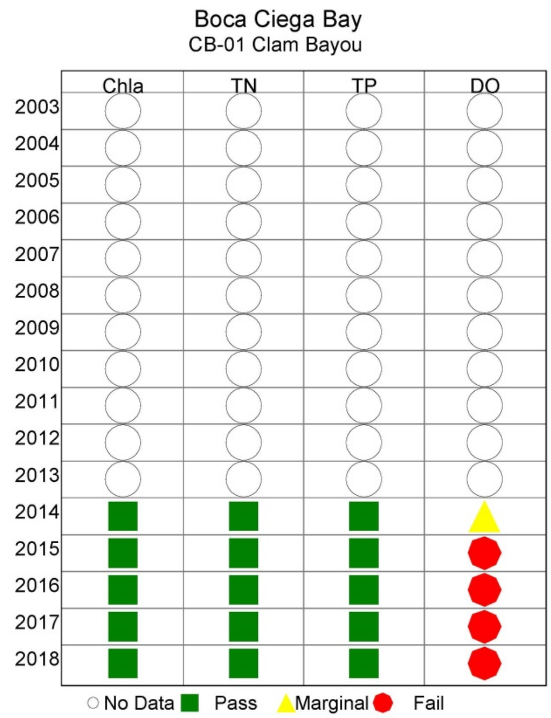

Figure 11. **Station CB-01 Report Card.**

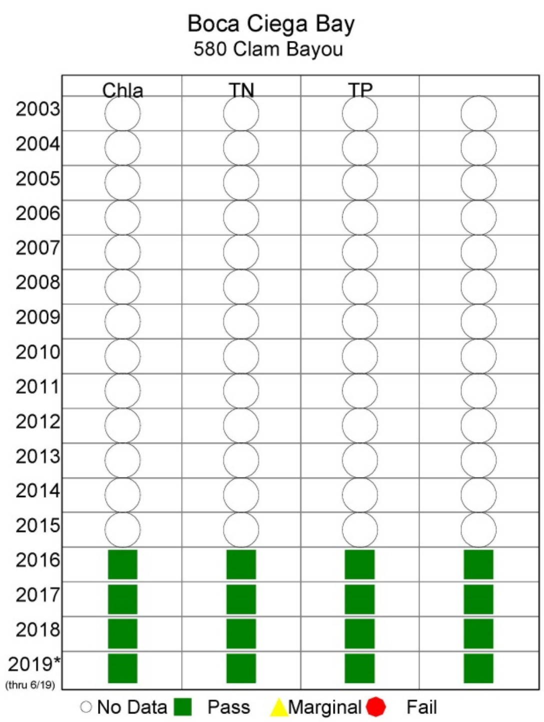

Figure 10. **Station 580 Report Card.**

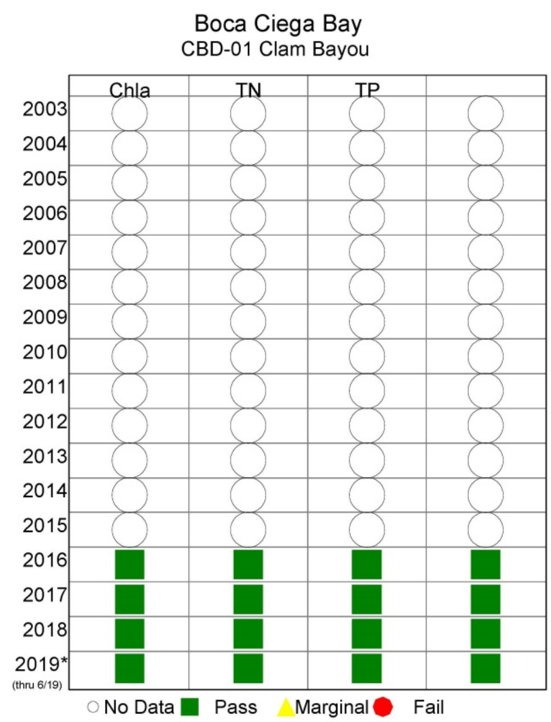

Figure 12. **Station CBD-01 Report Card.**

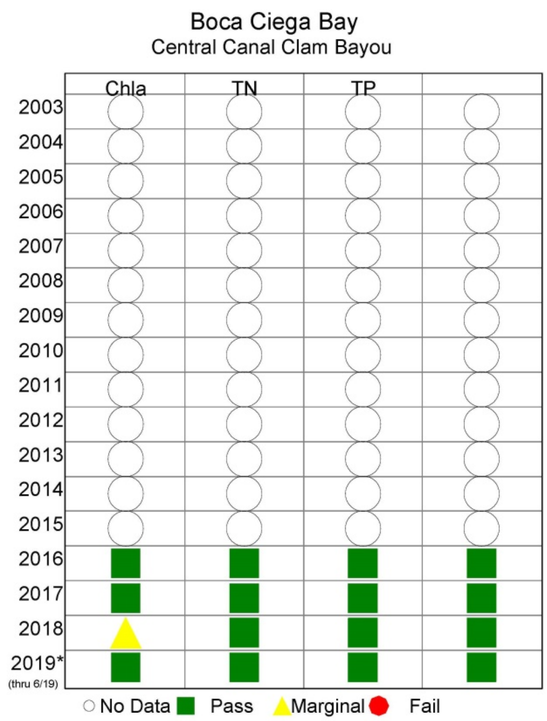

Figure 13. Central Canal Report Card.

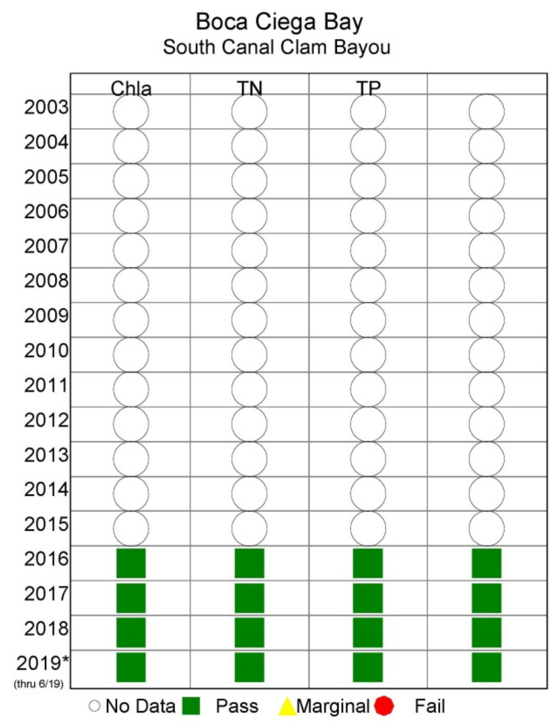

Figure 15. South Canal Report Card.

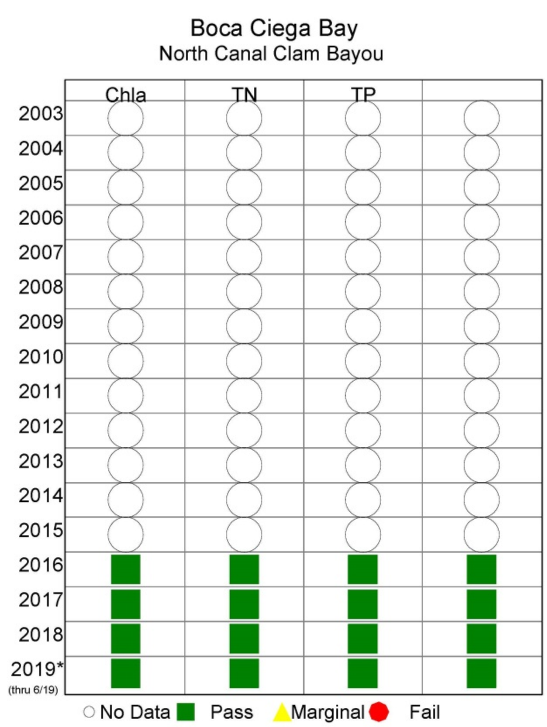

Figure 14. North Canal Report Card.

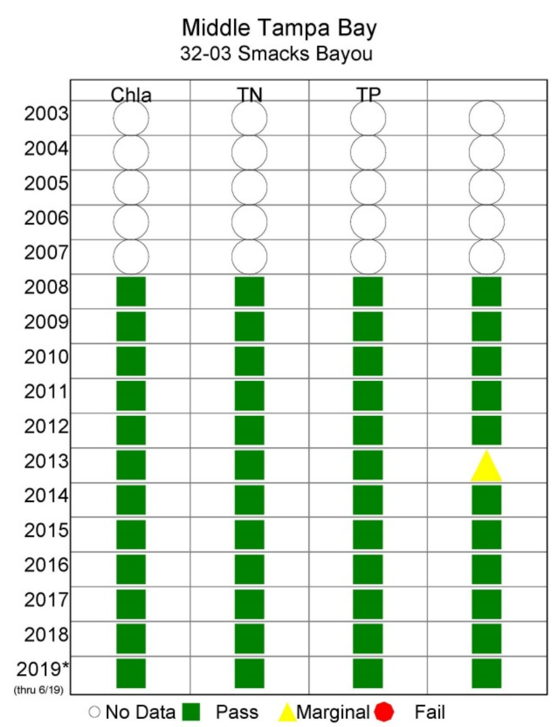

Figure 16. Station 32-03 Report Card.

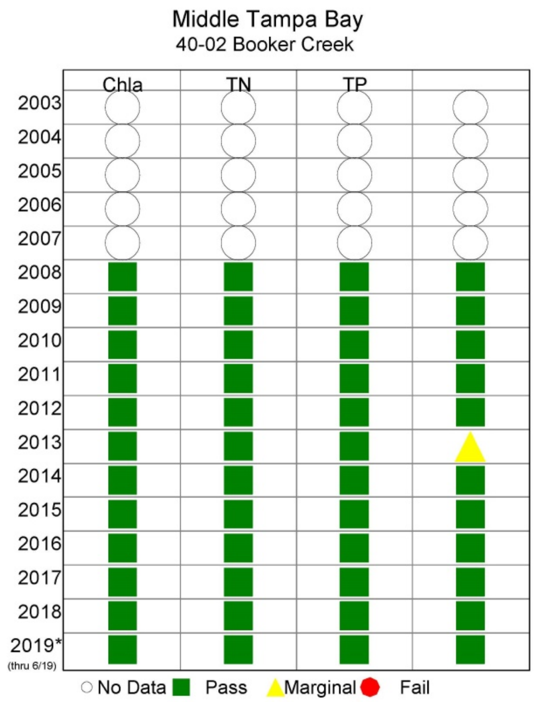

Figure 17. Station 40-02 Report Card

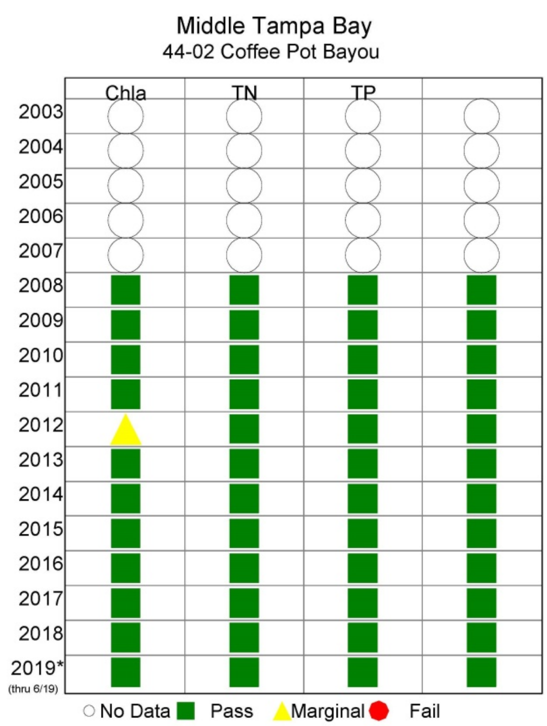

Figure 18. Station 44-02 Report Card

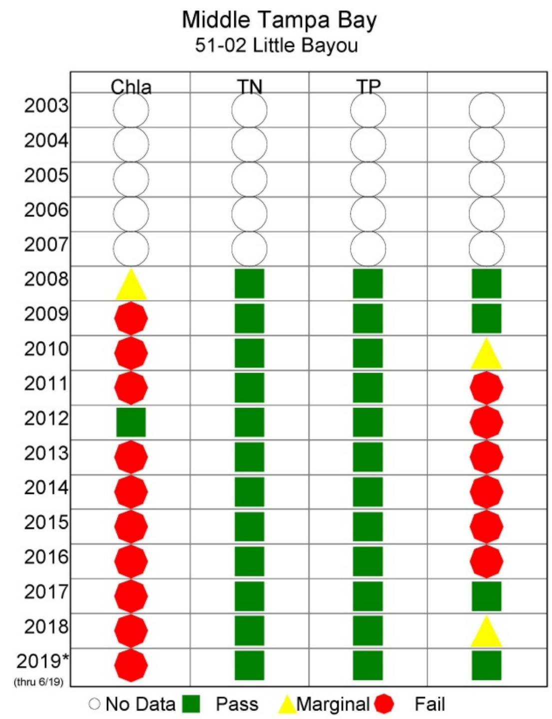

Figure 19. Station 51-02 Report Card

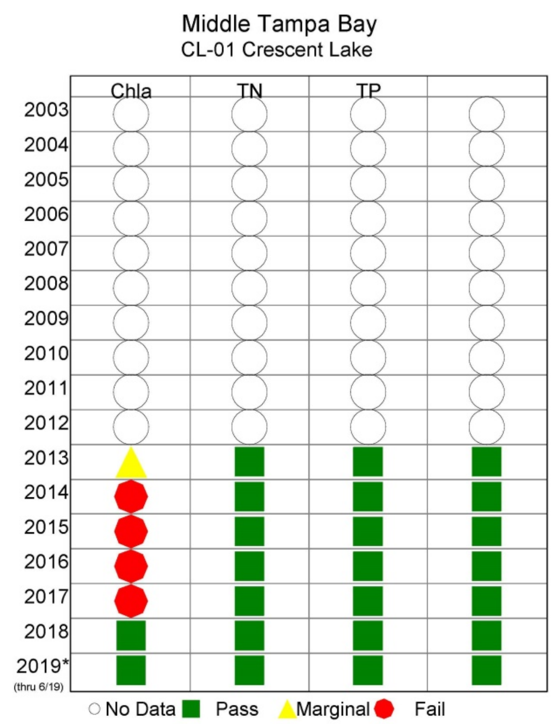

Figure 20. Station CL-01 Report Card

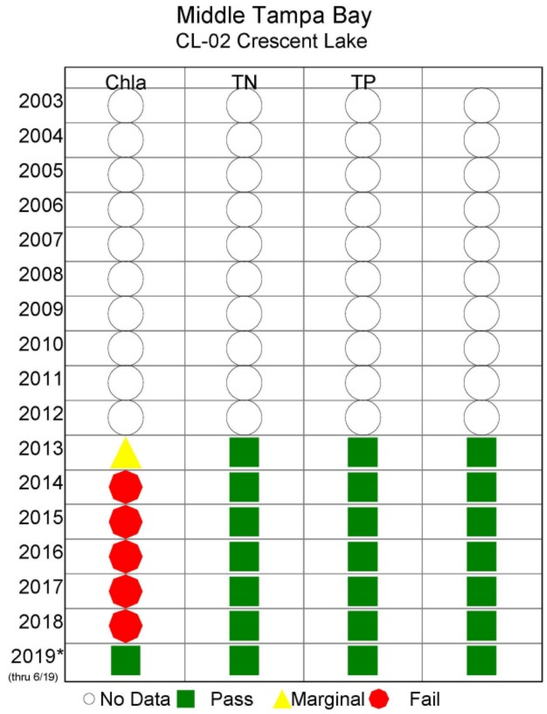

Figure 21. Station CL-02 Report Card.

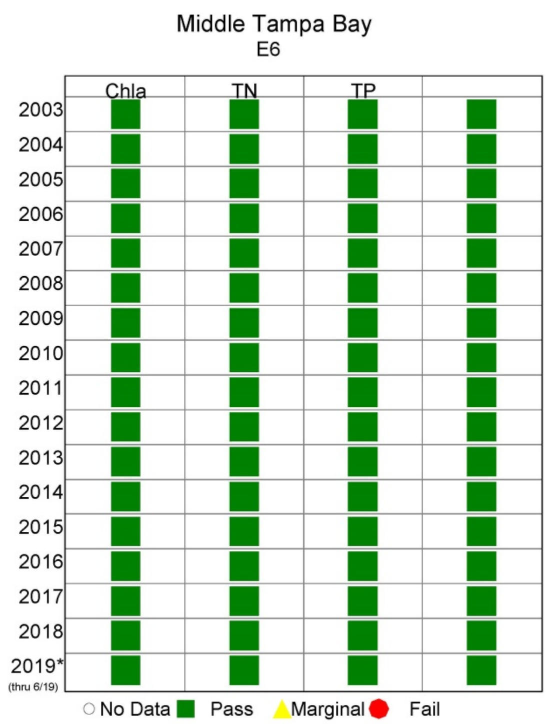

Figure 22. E6 Stations Report Card.

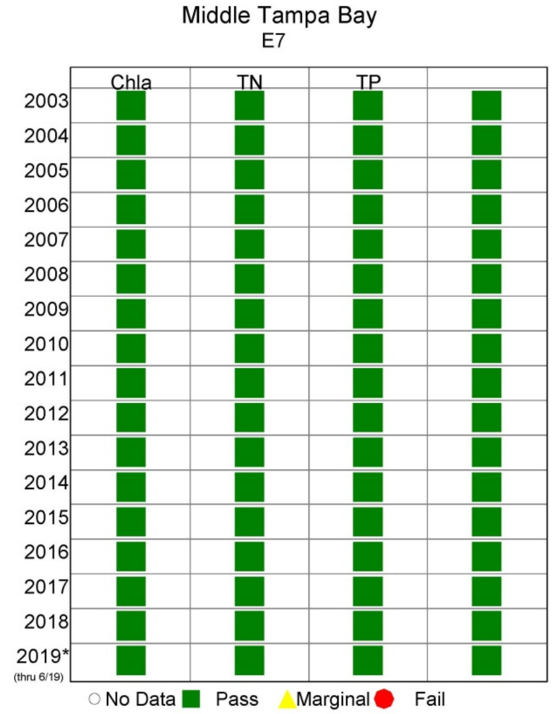

Figure 23. E7 Stations Report Card.

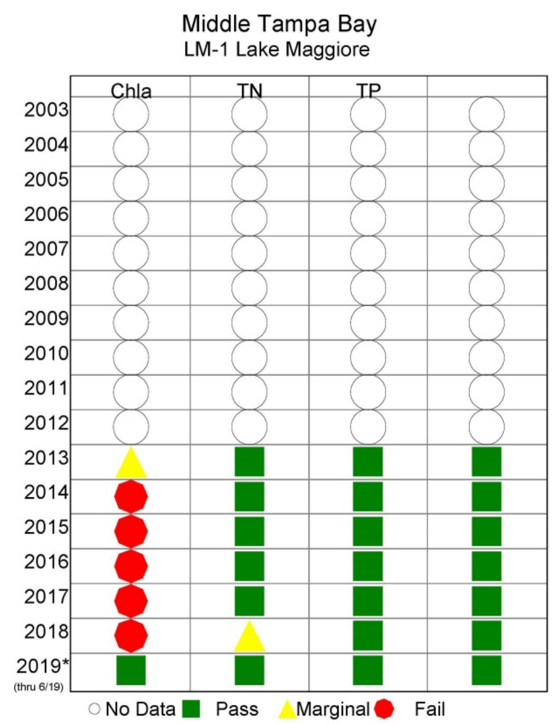

Figure 24. Station LM-1 Report Card.

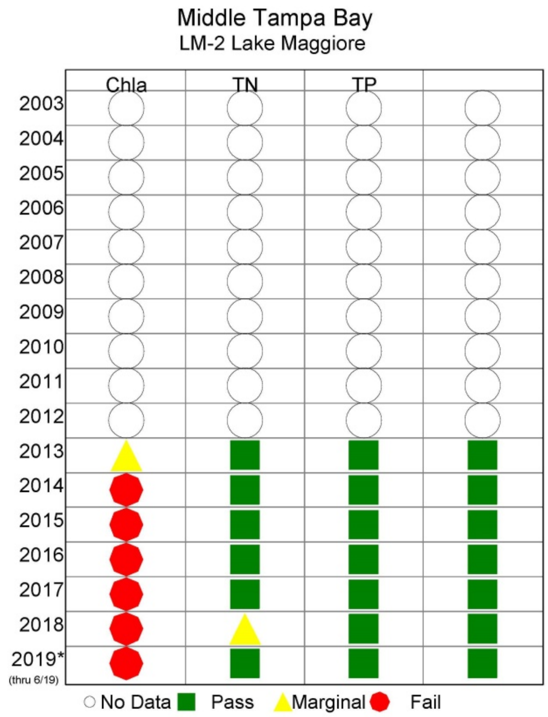

Figure 25. Station LM-2 Report Card.

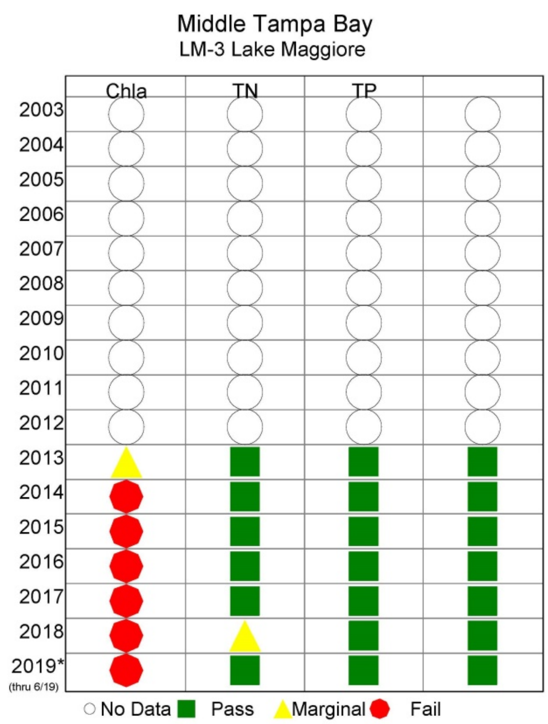

Figure 26. Station LM-3 Report Card.

TRENDS IN WATER QUALITY

Trend analysis of a time-series of data is the practice of collecting information and attempting to spot a pattern over time. In terms of the City’s water quality monitoring program, the use of trend tests allows managers to identify degradation in water quality conditions preferably prior to an actual exceedance of a regulatory standard, or before significant harm occurs to aquatic habitats. Thus, the results of analyses of trends in water quality provide the City with an “early warning system” and should best be used with the results of the report card analyses of compliance with water quality standards and criteria. A significant increasing trend in a pollutant need not imply non-compliance, rather the City should respond to such a result before such trends lead to an eventual non-compliance.

For the sake of a simple interpretation of the results of the trend tests, several points should be considered. First, the water quality parameters include parameters such as nitrogen and phosphorus and those parameters that are indicative of the status of the water bodies “health” including chlorophyll *a* and dissolved oxygen. Secondly, the direction of any significant trends is important to note. For most parameters investigated, increasing trends can be considered to be negative or undesirable. These particularly include the nutrients and chlorophyll *a*. In contrast, increasing dissolved oxygen is a positive result as low dissolved oxygen conditions are undesirable as the support of most aquatic fauna require adequate dissolved oxygen conditions.

Results of trend tests performed for each monitored station (see Figure 1and Table 1) for data collected through June 2019 are shown in Figure 27 to Figure 30. Summary information for each parameter analyzed is also provided below each Figure. For the purposes of this report, “small trends” are defined as statistically significant trends with a rate of change less than 10% of the median value per year, and “large trends” are defined as statistically significant trends with a rate of change greater than or equal to 10% of the median value per year. Thus, “small trends” represent water quality conditions that are changing (either increasing or decreasing) at a lesser rate of change than for “large trends.” The terms “large” and “small” do not imply either ecological significance or the lack of ecological significance.

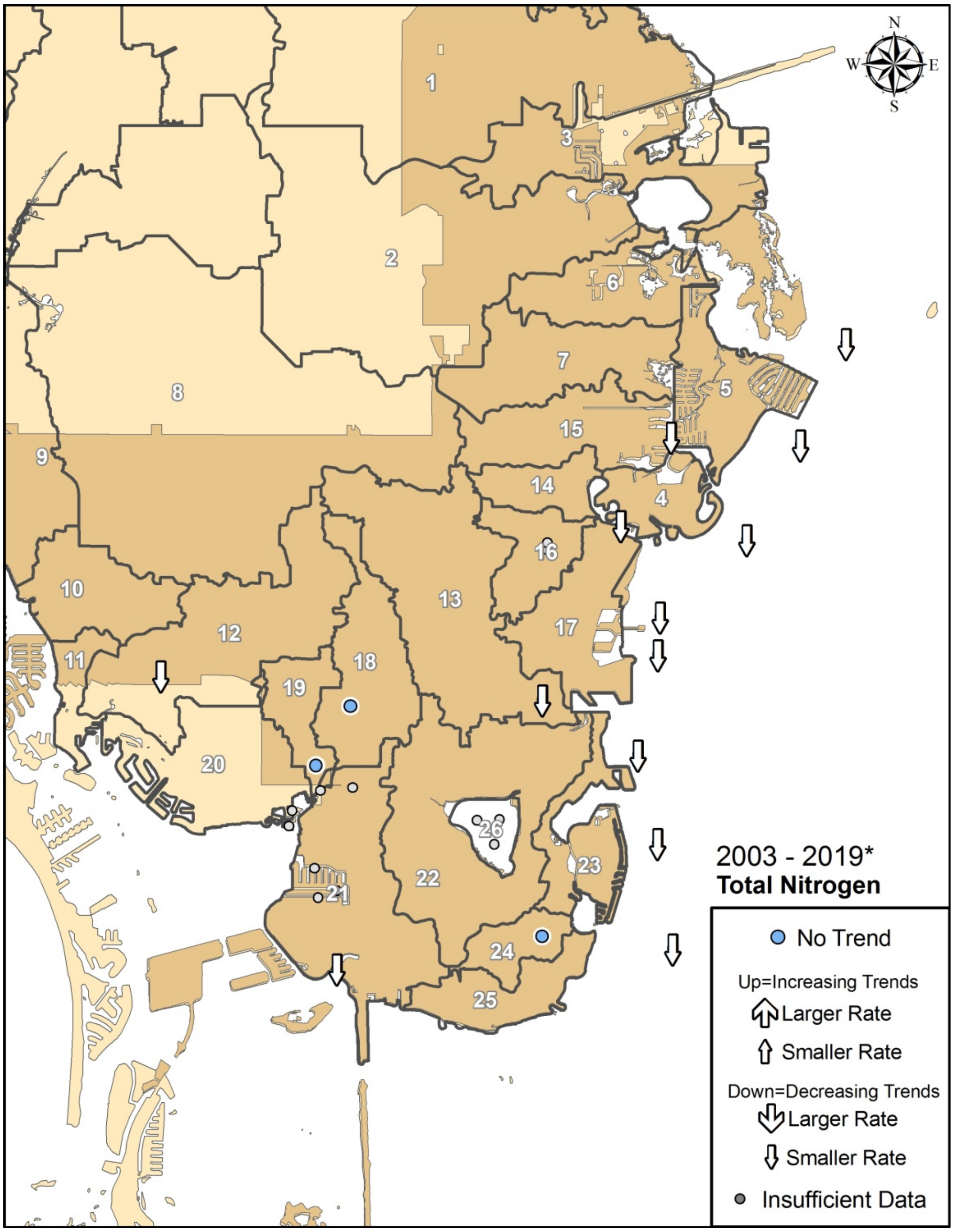

Figure 27. **Trend test results for Total Nitrogen. *2019 sampling ongoing.**

- Nearly all stations in Middle Tampa Bay were characterized by significant decreasing trends in total nitrogen.
- The only station in Middle Tampa Bay that did not have a significant decrease was Little Bayou, where no apparent trend was evident.
- For Boca Ciega Bay, two sites had no apparent trend (34th Street Station 45-03 and Clam Bayou Drain) while two others (Bear Creek and Frenchmans had decreasing trends for total nitrogen.

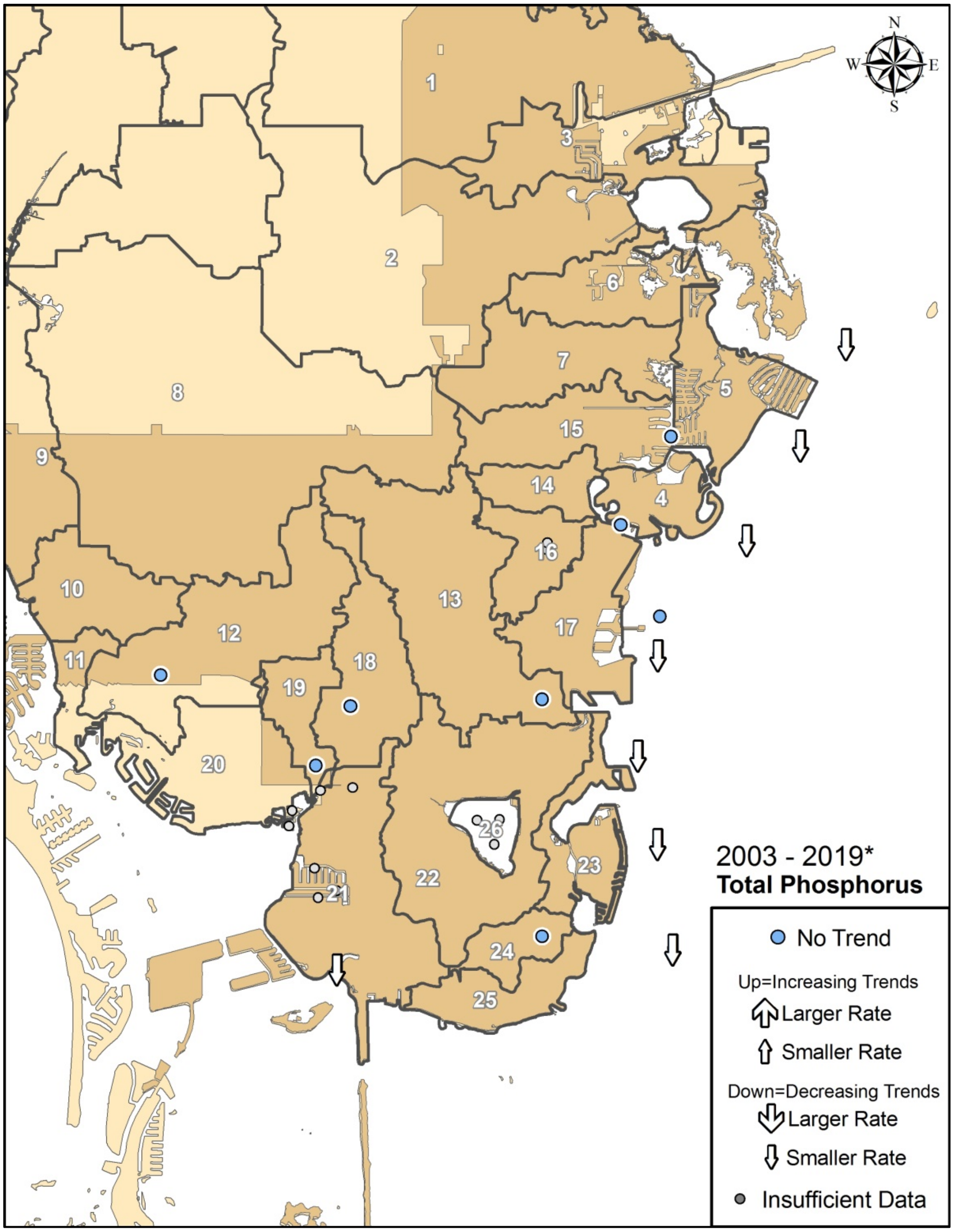

Figure 28. **Trend test results for Total Phosphorus. *2019 sampling ongoing.**

- One of the 4 stations (Frenchmans Creek) in Boca Ciega Bay exhibited a significant decreasing trend in total phosphorus; the remaining 3 stations exhibited no trend.
- 4 of the 12 stations in Middle Tampa Bay also exhibited no significant trends in total phosphorus
- The remaining 8 stations in Middle Tampa Bay displayed decreasing trends in total phosphorus; those stations that displayed decreasing trends in total phosphorus tended to be found in estuarine waters

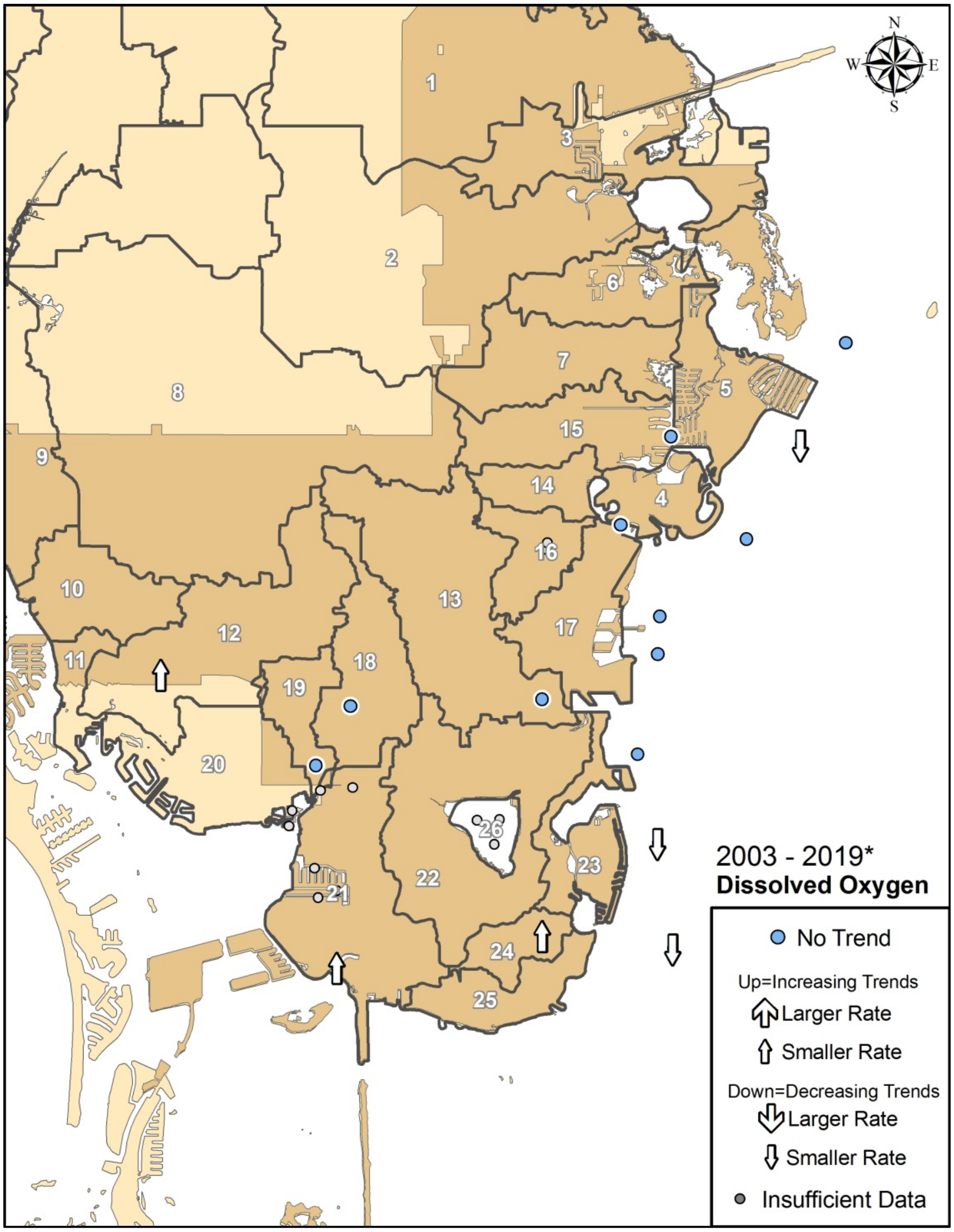

Figure 29. Trend test results for Dissolved Oxygen. *2019 sampling ongoing.

- A significant, increasing trend in dissolved oxygen was observed for Bear Creek and Frenchmans Creek, in the Boca Ciega Bay Basin.
- Neither of the two remaining stations in the Boca Ciega Bay Basin displayed any significant trend in dissolved oxygen
- One station (Little Bayou) in Middle Tampa Bay exhibited a significant increasing trend in dissolved oxygen while two stations in the E7 segment and one station in the E6 segment exhibited decreasing trends. The remaining stations had no significant trends for dissolved oxygen.

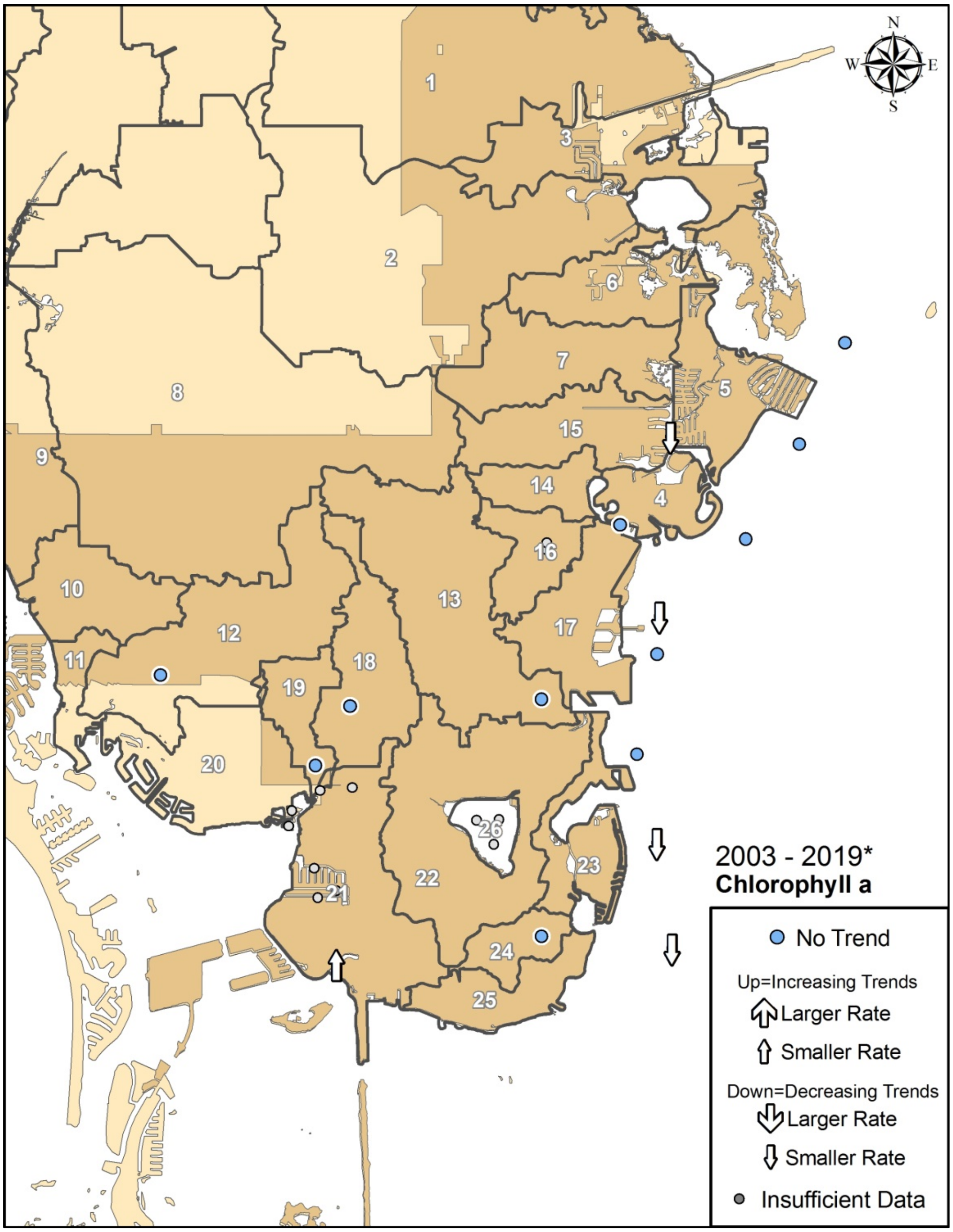

Figure 30. Trend test results for chlorophyll *a*. *2019 sampling ongoing.

- One station (Frenchmans Creek) in Boca Ciega Bay displayed an increasing significant trend in chlorophyll *a*
- The remaining stations in Boca Ciega Bay exhibited no significant trends
- Four estuarine stations in Middle Tampa Bay (Smacks Bayou, Middle Tampa Bay E6-1, E7-3 and E7-4) displayed significant declining trends in chlorophyll *a*
- The remaining stations in Middle Tampa Bay exhibited no significant trends

CONCLUSIONS

The following summarizes the status of the City's monitoring stations in regards to environmental health as represented by nutrients, dissolved oxygen and chlorophyll *a*. Recommendations are provided based on our evaluation of the data collected by the environmental health ambient monitoring program.

- With the exception of a marginal TN value for 2018 in Lake Maggiore, all stations examined on the Boca Ciega and Middle Tampa Bay report cards indicated nutrient (total nitrogen and total phosphorus) concentrations have met the established thresholds during all years of examination. The partial sampling completed through June of 2019 indicated the values for this station were once again in compliance ("Green"). Trend tests indicate that this status for nutrients may be expected to continue in the near-term, as the only observable significant trends for nutrients were declines in concentrations; only increases in concentrations might be expected to trigger a change on the report card.
- Most stations met the established thresholds for dissolved oxygen on the report card. However, 1 station in Boca Ciega Bay was scored as having failed to meet established criteria for more than 1 year in the rolling-three year period. Trend tests indicate that dissolved oxygen levels at two stations in Boca Ciega Bay are statistically significantly increasing so in years to come, it is possible the report card status will improve for the station currently scored as "Red". Three stations in the Bay segments E6 and E7 exhibited decreasing dissolved oxygen trends with the addition of more recent 2019 data (through June). Trend tests for all other stations indicated no statistically significant change over time in dissolved oxygen. Thus, dissolved oxygen levels do not appear to have significantly decreased over time for the majority of sample locations.
- With the exception of one marginal value, stations in Boca Ciega Bay had a chlorophyll *a* grade of "green" for the report card in 2018 (continuing through the partial year 2019). The trend tests indicated that one station (Frenchmans Creek) in Boca Ciega Bay has a statistically increasing trend for chlorophyll *a*, which could impact future report card years. Five of 11 stations in Middle Tampa Bay scored as "red" indicating a failure to meet established thresholds in more than 1 of the current and previous 2 years period. Four of the five failing stations were in lakes, and the 5th was a bayou. Initial scoring (partial year) for 2019 indicates that a Middle Tampa Bay station in Little Bayou and 2 stations in Lake Maggiore were still "Red" while 1 station each in Crescent and Maggiore Lakes indicated a return to "Green". The only significant trends in chlorophyll *a* in Middle Tampa Bay were decreasing trends at four sites. Thus, it is anticipated that, for the near-future, the more estuarine/open water sites are expected to maintain a passing status on the report card. This highlights the efforts of the TBEP and its partners (including the City) to implement nutrient reduction programs, resulting in increasing water clarity and vastly improved seagrass coverages.

- It is recommended that the City continue the Ambient Water Quality Monitoring Program as currently designed and implemented.

2019 Water Quality Report Card
HUMAN HEALTH

The monitoring most relevant to human health issues is what is known as enteric bacteria monitoring. Enteric bacteria are those that normally inhabit the intestinal tract of humans and animals and can be indicative of stormwater runoff, sewage flows, pets and wildlife. The City of St Petersburg collects three forms of bacteria samples: fecal coliforms, *Escherichia coli (E. coli)* in fresh waters and *Enterococci* in marine waters. Until February 2016, fecal coliforms were the primary indicator bacteria but the fact that fecal coliforms reside in all warm blooded animals made it difficult to distinguish between human (pet waste, farms, sewage) or natural (nesting areas, bat colonies) sources. While no longer the accepted standard, many organizations continue to monitor fecal coliforms since they have long historical records.

The US EPA issued guidance regarding the use of *E. coli* and *Enterococci* for fresh and saline waters, respectively. The Florida Department of Health and the Florida Department of Environmental Protection both adopted the new USEPA guidance as criteria and began assessing surface waters with the new standards (Table 2).

The Florida Department of Health takes the assessment a step further when looking at bathing areas such as beaches through the Healthy Beaches Program whose protocols are followed by the City. Beaches are sampled for Enterococci; waters that don't meet the standard are considered moderate. When samples exceed 70 colony forming units (cfu)/100 mL, they are considered poor and an advisory will be posted when a confirming value is collected the following day. The City does not wait for a confirming value but posts an advisory when the results exceed 70 cfu/100 mL. The results from the City's monitoring can be found on the Recreational Water Quality Map app on the City's website at http://www.stpete.org/water/waterquality.php.

Table 2. FDEP bacteriological criteria for various class waters from 62-302.530 F.A.C.		
(6)(a) Bacteriological Quality (Fecal Coliform Bacteria) (Class II Waters)	Number per 100 ml (Most Probable Number (MPN) or Membrane Filter (MF))	MPN or MF counts shall not exceed a median value of 14 with not more than 10% of the samples exceeding 43 (for MPN) or 31 (for MF), nor exceed 800 on any one day. To determine the percentage of samples exceeding the criteria when there are both MPN and MF samples for a waterbody, the percent shall be calculated as $100*(n_{mpn}+n_{mf})/N$, where n_{mpn} is the number of MPN samples greater than 43, n_{mf} is the number of MF samples greater than 31, and N is the total number of MPN and MF samples.
(6)(b) Bacteriological Quality (*Escherichia coli* Bacteria) (Class I and Class I-Treated Waters)	Number per 100 ml (Most Probable Number (MPN) or Membrane Filter (MF))	MPN or MF counts shall not exceed a monthly geometric mean of 126 nor exceed the Ten Percent Threshold Value (TPTV) of 410 in 10% or more of the samples during any 30-day period. Monthly geometric means shall be based on a minimum of 5 samples taken over a 30-day period.
(6)(b) Bacteriological Quality (*Escherichia coli* Bacteria) (Class III Predominantly Fresh Waters)	Number per 100 ml (Most Probable Number (MPN) or Membrane Filter (MF))	MPN or MF counts shall not exceed a monthly geometric mean of 126 nor exceed the Ten Percent Threshold Value (TPTV) of 410 in 10% or more of the samples during any 30-day period. Monthly geometric means shall be based on a minimum of 10 samples taken over a 30-day period.
(16)(c) Bacteriological Quality (*Enterococci* Bacteria) (Class III Predominantly Marine Waters)	Number per 100 ml (Most Probable Number (MPN) or Membrane Filter (MF))	MPN or MF counts shall not exceed a monthly geometric mean of 35 nor exceed the Ten Percent Threshold Value (TPTV) of 130 in 10% or more of the samples during any 30-day period. Monthly geometric means shall be based on a minimum of 10 samples taken over a 30-day period.

The City of St. Petersburg has implemented a series of monitoring programs whose primary focus is on water quality as it relates to human health. These are described in the subsections below.

BEACHES MONITORING PROGRAM

The City has several beach areas with relatively heavy recreational use, including primary contact activities such as swimming. Monitoring bacterial concentrations in these waters provides for identification of potential threats to human health, with the City able to provide public warnings at the beaches when unsafe bacterial levels exist based on the monitoring data. The objective of the Beach Monitoring Program is to monitor water quality where the public engages in activities classified as primary contact such as swimming. The City of St. Petersburg has been monitoring beach water quality for bacterial contamination since at least the mid-1970s, when monitoring included North Shore Beach, Spa Beach, and Maximo Beach. These sites were selected to include the most utilized beaches within the City limits and along with Lassing Park and Treasure Island Beach (Figure 31), are currently monitored by the City. Data collected since 2010 are included in the City's electronic database, and are available for evaluation. Monitoring at the Spa Beach site ceased after mid-August 2017 when construction on the new Pier began, and the City picked up the Treasure Island Beach site at that time, with City monitoring there beginning in September 2017. Spa Beach sampling is scheduled to return once Pier construction is complete and access to the sampling site is again available.

The Beaches Monitoring Program sampling and laboratory analytical methodologies follow those of the Florida Healthy Beaches Program. Samples are collected on a weekly basis every Wednesday. As part of the initial implementation of the Beaches Monitoring Program fecal coliform concentrations were measured. Measurement of *Enterococci* concentrations was implemented in 2010. The State standard for enteric bacteria changed from fecal coliforms to *Enterococci* in marine waters in 2016.

The City has established a classification system for *Enterococci* concentrations as follows:

- Good conditions - 0-35 cfu/100 mL
- Moderate conditions - 36-70 cfu/100 mL
- Poor conditions >70 cfu/100 mL.

The City issues a beach advisory when the concentrations of *Enterococci* exceed 70 cfu/100 mL. The City continues sampling on a daily basis until the *Enterococci* concentration drops to 70 cfu/100 mL or less.

Tables 3 through 6 present the frequency of exceedances of *Enterococci* concentrations of 70 cfu/100 mL and fecal coliform concentrations of 800 cfu/100 mL in each of the beaches in the Beaches Monitoring Program for the period 2010 through 2018. Figure 32 through Figure 35 present the number of samples that were classified as Good, Moderate or Poor at the same beaches and years.

The preponderance of samples was classified as Good in each of the beaches. There is no apparent temporal trend in the frequency of occurrence of Poor samples, with the exception of North Shore Beach where the number of poor samples has increased since 2014. Additionally, larger numbers of Poor samples were found in 2015 and 2016 at multiple sites, two years in which rainfall was extremely high.

Figure 31. Beach Monitoring Program sampling sites.

Table 3. Enteric bacterial monitoring results from Maximo Beach.

	Enterococci (Exceedance > 70 (cfu/100ml))		Fecal Coliform (Exceedance > 800 (cfu/100ml))	
Year	**Number of Samples**	**Number of Exceedances**	**Number of Samples**	**Number of Exceedances**
2010	42	3	41	1
2011	48	6	47	1
2012	52	1	52	0
2013	53	2	53	0
2014	55	5	54	2
2015	62	9	59	4
2016	58	7	41	1
2017	56	4	0	0
2018	57	6	0	0
All	483	43	347	9

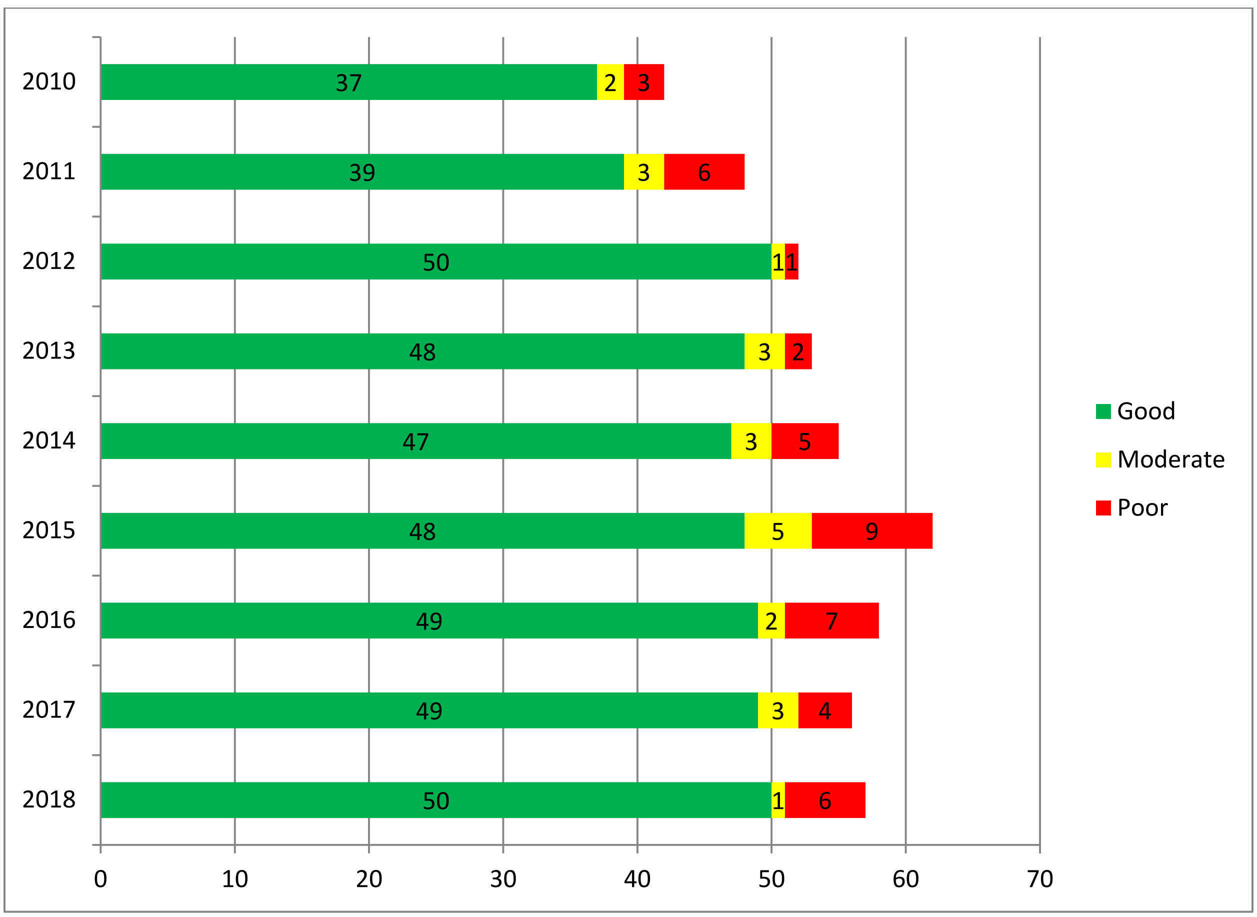

Figure 32. **Number of Good, Moderate, and Poor conditions in relation to *Enterococci* concentrations in Maximo Beach.**

Table 4. Enteric bacterial monitoring results from North Shore Beach.				
	Enterococci (Exceedance > 70 (cfu/100ml))		Fecal Coliform (Exceedance > 800 (cfu/100ml))	
Year	**Number of Samples**	**Number of Exceedances**	**Number of Samples**	**Number of Exceedances**
2010	46	7	46	2
2011	50	15	50	7
2012	55	8	61	7
2013	56	9	58	3
2014	57	7	59	3
2015	61	11	62	2
2016	65	15	44	2
2017	69	17	0	0
2018	71	22	0	0
All	530	111	380	26

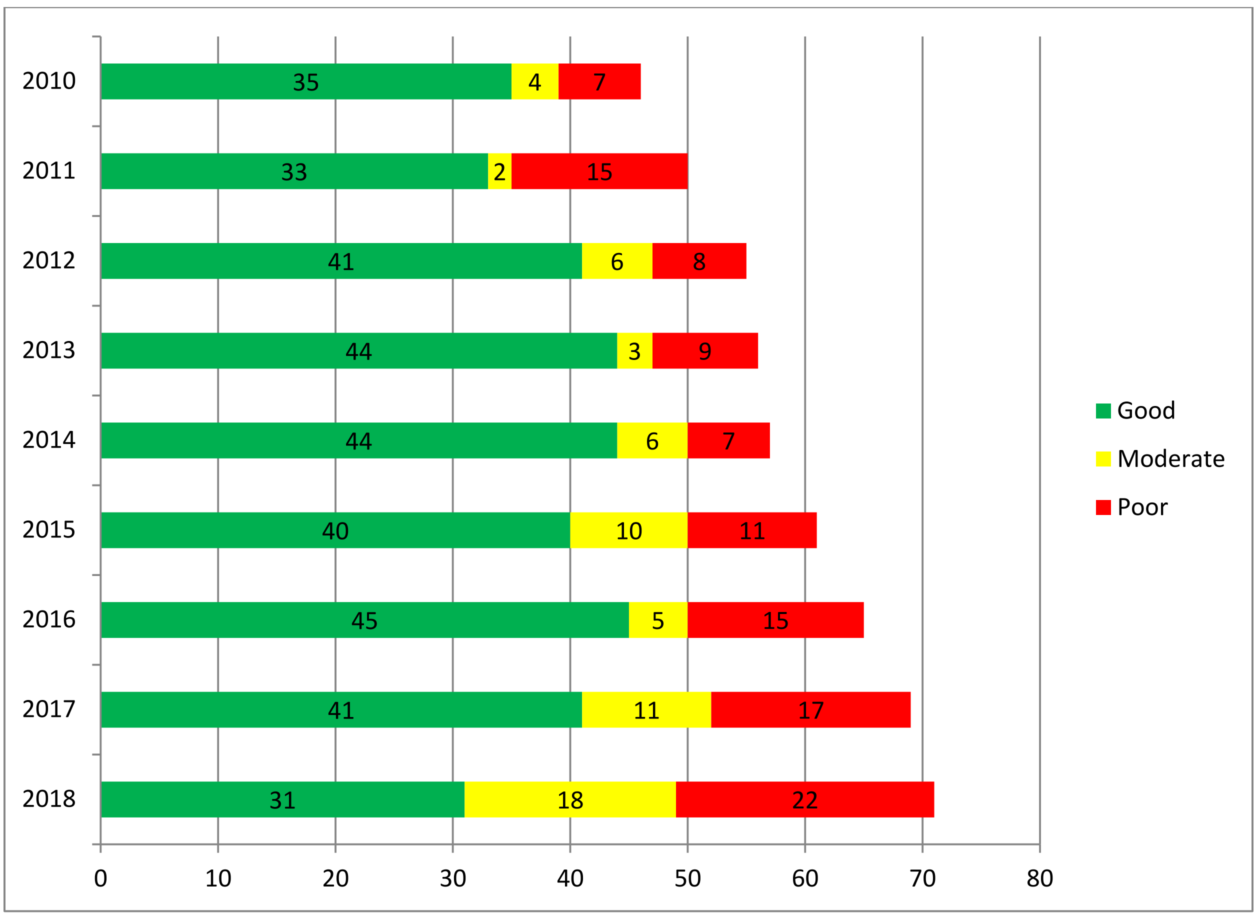

Figure 33. **Number of Good, Moderate, and Poor conditions in relation to *Enterococci* concentrations in North Shore Beach.**

Table 5. Enteric bacterial monitoring results from Treasure Island Beach.				
	Enterococci (Exceedance > 70 (cfu/100ml))		Fecal Coliform (Exceedance > 800 (cfu/100ml))	
Year	**Number of Samples**	**Number of Exceedances**	**Number of Samples**	**Number of Exceedances**
2010	53	4	53	0
2011	45	2	26	0
2012	25	1	0	0
2013	27	1	0	0
2014	27	2	0	0
2015	31	6	0	0
2016	27	1	0	0
2017	39	5	0	0
2018	55	3	0	0
All	329	25	79	0

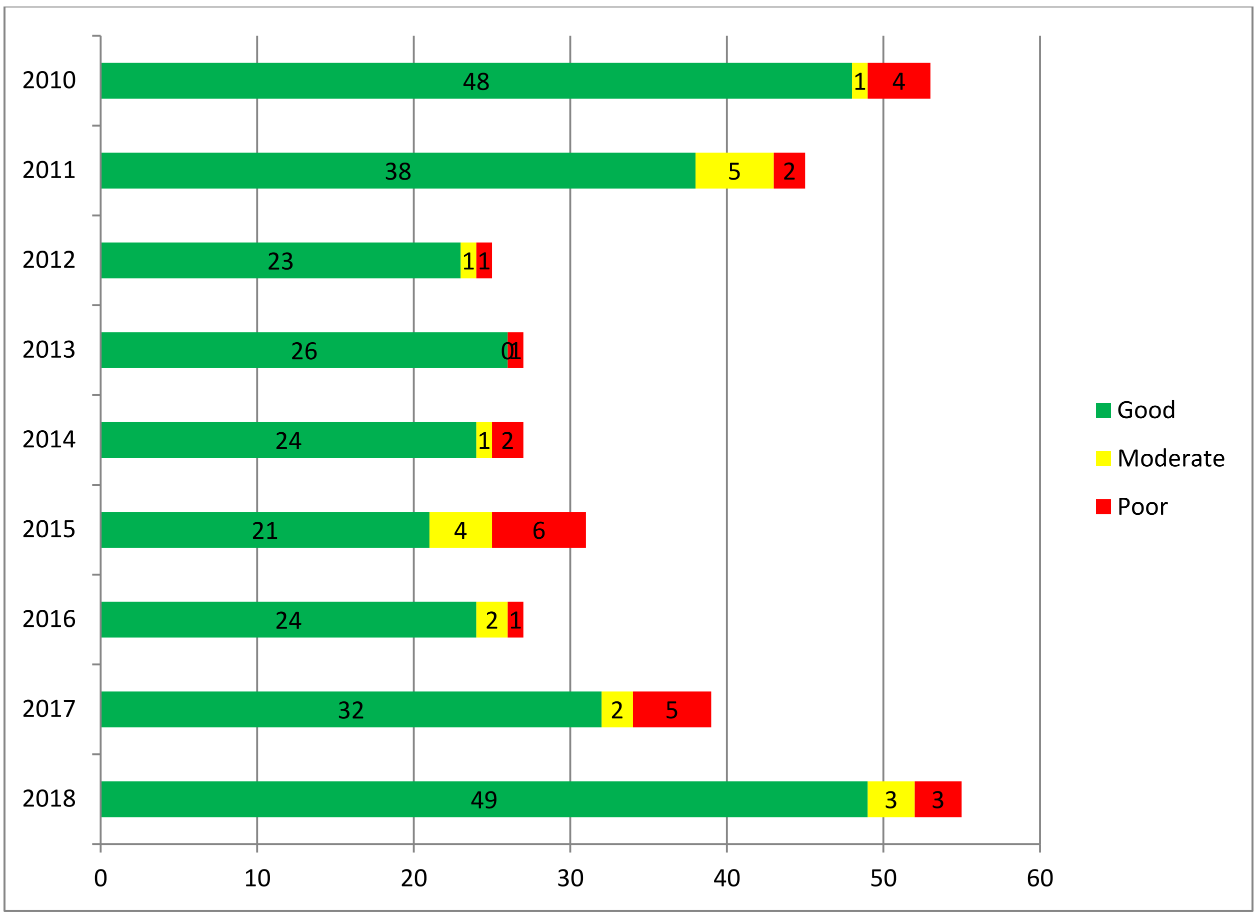

Figure 34. **Number of Good, Moderate, and Poor conditions in relation to *Enterococci* concentrations in Treasure Island Beach.**

Table 6. Enteric bacterial monitoring results from Spa Beach and Lassing Park.				
	Enterococci (Exceedance > 70 (cfu/100ml))		Fecal Coliform (Exceedance > 800 (cfu/100ml))	
	Number of Samples	Number of Exceedances	Number of Samples	Number of Exceedances
Spa Beach				
2016	14	0	1	0
2017	38	5	0	0
All	52	5	1	0
Lassing Park				
2016	1	0	0	0
2017	33	6	0	0
2018	59	8	0	0
All	93	14	0	0

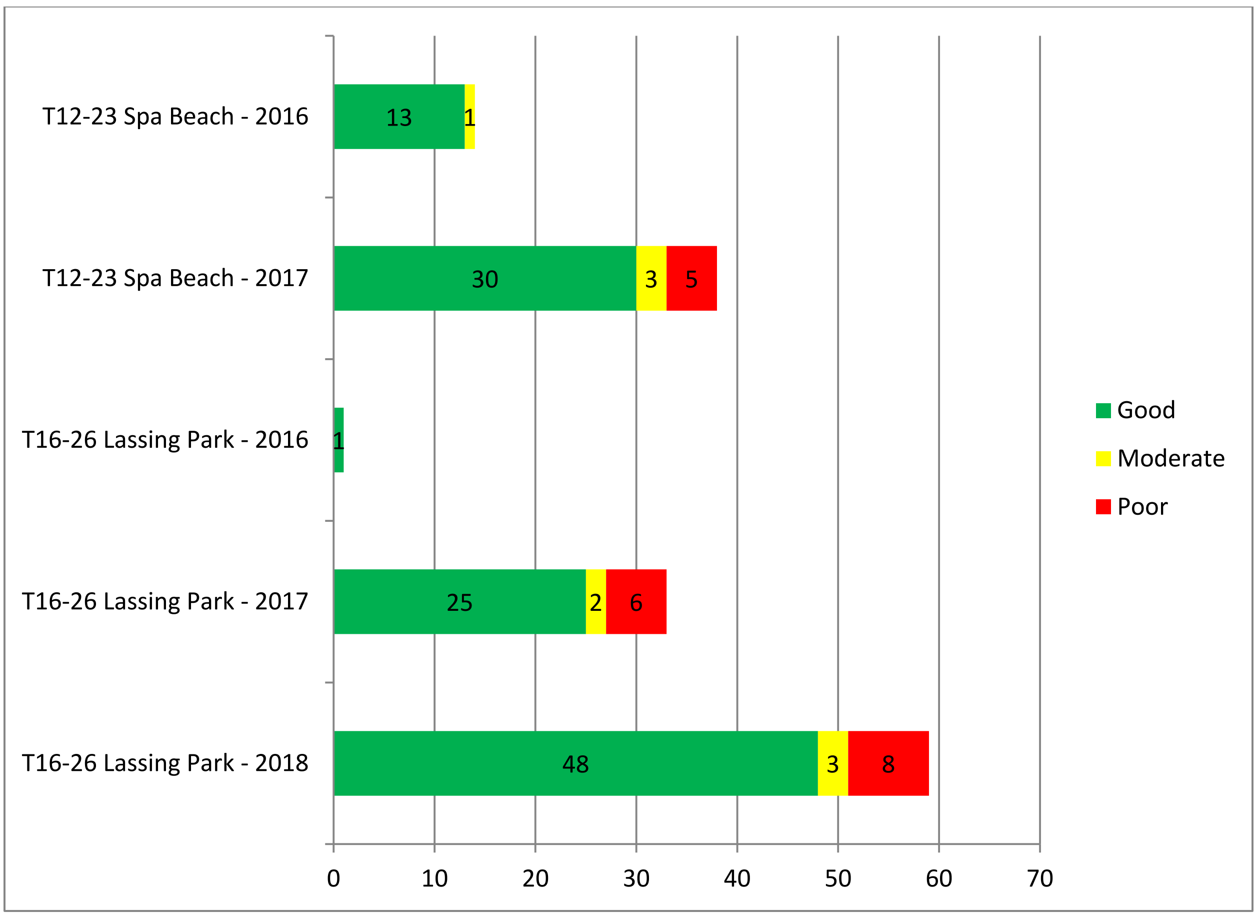

Figure 35. Number of Good, Moderate, and Poor conditions in relation to *Enterococci* concentrations in Spa Beach and Lassing Park.

RECREATIONAL AREA MONITORING PROGRAM

Many city parks are adjacent to or contain water bodies used for recreation other than swimming. These parks support secondary (non-submersive) contact with water during recreational activities, such as fishing, kayaking, boating, and paddle boarding. The objective of the Recreational Area Monitoring Program is to increase public awareness about the water quality conditions as they relate to human health within the City's recreational areas.

Monitoring of enteric bacteria in the recreational areas shown in Figure 36 was initiated in April 2017 stemming from public concerns following unplanned wastewater releases of 2015 and 2016. Prior to this time, several recreation sites were sampled as part of the City's Sanitary Sewer Overflows Monitoring Program and therefore data prior to April 2017 exist for selected sites.

Samples are collected monthly and *Enterococci* concentrations estimated. The results are compared to the City’s classification system described above.

Table 7 presents the 2017 and 2018 sampling results from the Recreational Area Monitoring Program. The greatest numbers of *Enterococci* exceedances were found in Fossil Park Lake and Salt Creek, where all samples taken except for one indicated exceedances. Given these results, it would be prudent to investigate the sources of *Enterococci* in these two systems.

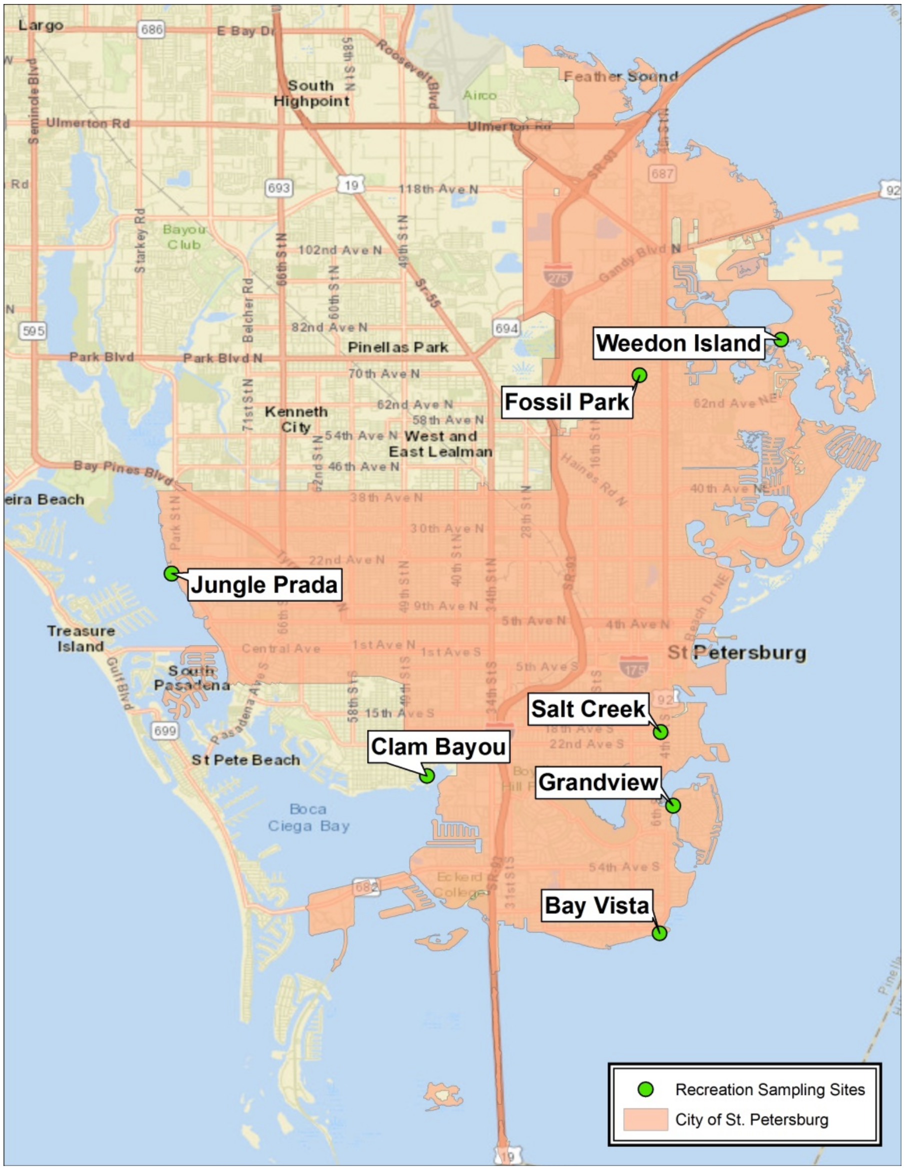

Figure 36. **Recreational Area Monitoring Program sampling sites.**

Table 7. Occurrence of Enterococci counts in excess of 35 (cfu/100 mL) depicted as "Red". "Green" indicates non-exceedances and blank cells depict no samples. Data collected by the Recreational Area Monitoring Program.

Sample Date	Bay Vista Park	Fossil Park Lake	Grandview Park	Jungle Prada Recreational Park	Salt Creek	Weedon Island	Clam Bayou Kayak Launch
19APR17	NO	YES	NO		YES	NO	
10MAY17	NO	YES	NO	NO	YES	NO	
07JUN17	YES	YES	YES	YES	YES	YES	
05JUL17	NO	YES	NO	NO	YES	NO	
10JUL17	YES						
23AUG17	NO	YES	NO	NO	YES	NO	
26SEP17	YES	YES	NO	YES	YES	NO	
27SEP17	NO						
25OCT17	YES	YES	NO	YES	YES	NO	
08NOV17	NO	YES	YES	NO	YES	YES	
11DEC17	NO	YES	NO	NO	YES	NO	
10JAN18	NO	YES	YES	NO	YES	YES	
11JAN18			NO				
14FEB18	NO	YES	YES	NO	YES	NO	
14MAR18	NO	YES	NO	NO	YES	NO	
15MAR18							YES
16MAR18							YES
25APR18	NO	YES	NO	NO	YES	NO	NO
03MAY18							
04MAY18							
07MAY18							
23MAY18	NO	YES	NO	NO	YES	NO	YES
24MAY18							YES
13JUN18	NO	YES	NO	NO	YES	NO	NO
25JUL18	NO	YES	YES	YES	YES	NO	YES
26JUL18			YES	YES			NO
22AUG18	YES	YES	NO	NO	YES	NO	NO
23AUG18	NO						
12SEP18	NO	YES	YES	NO	YES	NO	YES
13SEP18							YES
10OCT18	YES	YES	YES	YES	YES	YES	YES
12OCT18	NO		YES	YES			YES
06NOV18	NO			NO			

SANITARY SEWER OVERFLOWS MONITORING PROGRAM

Many urban areas with aging drainage and sanitary sewer infrastructure experience occasional Sanitary Sewer Overflow (SSO) events, commonly due to heavy rainfall and resultant runoff, conveyance pipe breakage, and flooding. The City has been responding to reports of SSOs since at least the mid-1970s, and has been collecting bacterial data associated with these overflows (based on paper copies of reports within City archives).

The objective of the Sanitary Sewer Overflow Monitoring Program is to quantify and minimize the impacts to the environment and the public from SSO events. Monitoring provides information that assists the City in determining appropriate courses of action for mitigation or remediation (if needed). Monitoring sites are selected based on reported SSO events, with samples collected in response to the event. Each SSO location is sampled, if possible, at the immediate point of impact of the SSO on the receiving water body (stream, canal, lake/pond). If possible, samples are also collected upstream and downstream of the impact point. SSO monitoring sites visited since 2010 are shown in Figure 37. Data are available in the City's electronic database back through 2010.

Monitoring at a given sampling site continues daily until the enteric bacterial counts drop below background levels as defined by the Background Monitoring Program (described below) associated with that site, or until a level is reached deemed acceptable based on professional judgment.

The locations of all SSO sampling sites are provided in Figure 37. For this report card, an event is defined as one reported SSO at one location. In total, the City SSO database contains data for sampling during 105 events. Of all the SSOs, seven general locations were associated with locations where SSOs were sampled during multiple events. The fecal coliform concentrations observed at these locations are provided in Table 8 and described below.

- 54th Ave. N. Discharge - There were three events during which samples were collected at this location, with samples at the point of discharge, upstream of the discharge, and downstream of the discharge. Nearly 100% of the samples collected were in exceedance of State standards for fecal coliforms (Table 8).
- Albert Whitted Emergency Overflow – The discharges due to these overflows entered Tampa Bay in the near vicinity of the plant. Sampling was implemented at multiple locations associated with the City's beaches in the vicinity of these discharges. Few of the samples showed fecal coliform concentrations in exceedance of State standards (Table 8).
- Clam Bayou Discharge - Sampling at multiple sites associated with discharges to Clam Bayou occurred during multiple events. The fecal coliform results from these sites show that at about half the sites, a very high proportion (80%-90%) of the samples had fecal

coliform concentrations in excess of the State standard. For most of the remaining sites, fecal coliform exceedances were found in approximately 40%-70% of the samples. At only one site were the fecal coliform exceedances found in less than 5% of samples (Table 8).

- Lake Maggiore SSO – Samples were taken from Lake Maggiore during two events at three different locations. The site designated as the stormwater drain to the lake likely reflects the most direct influence expected from the SSO and all samples collected at this site had fecal coliform concentrations exceedance of the State standard. Given that this was likely associated with a relatively high rainfall event, and thus it is likely that the lake was discharging into Salt Creek north of the SSO inflow, it is reasonable that the site north of the inflow also had all samples in exceedance. The site south of the inflow, however, only had one of four samples in exceedance of the State standard for fecal coliform. This appears to be reasonable given the likely flow path of the SSO discharge through Lake Maggiore.

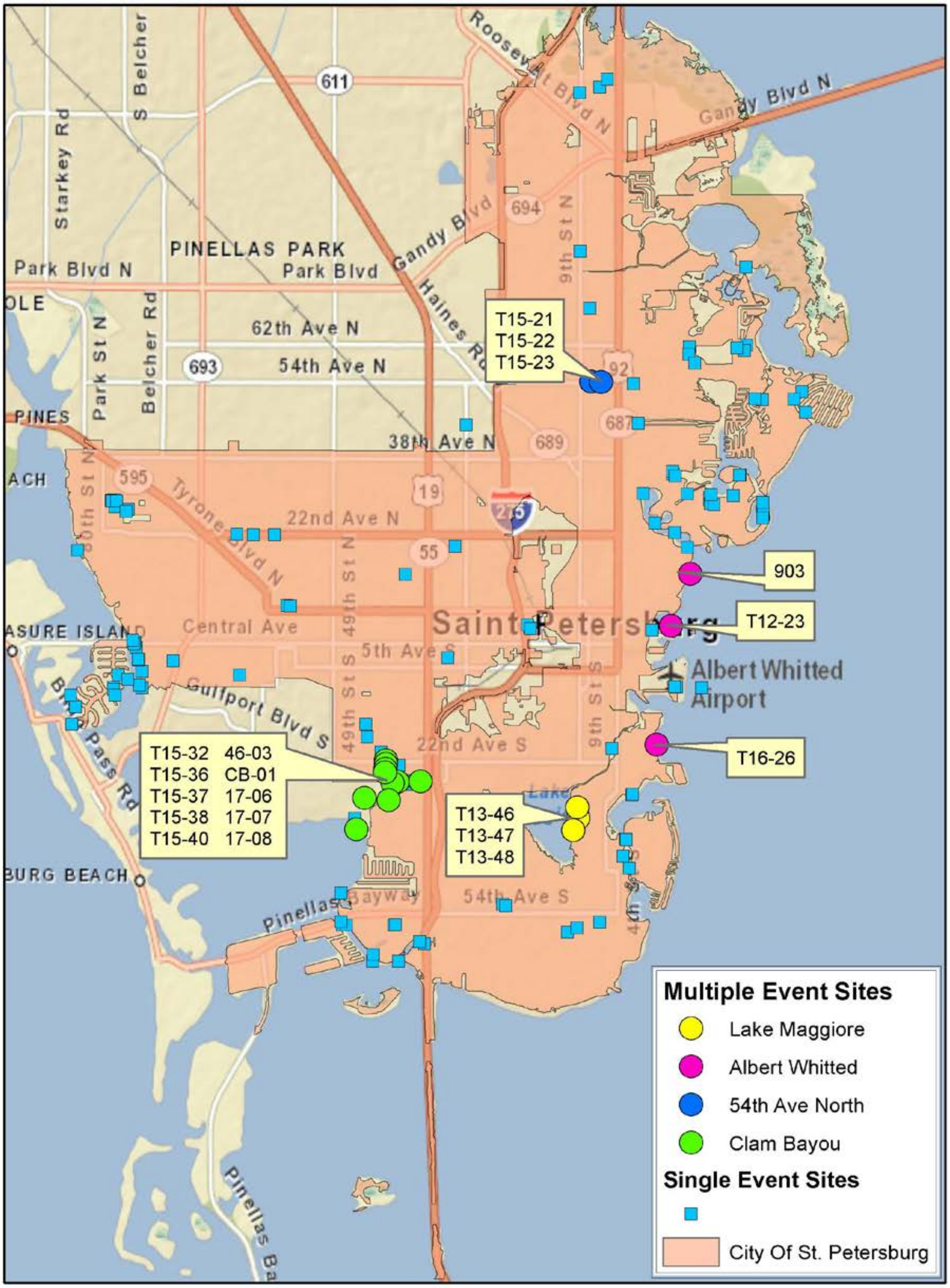

Figure 37. **Sanitary Sewer Overflow (SSO) Monitoring Program sampling sites.**

Table 8. Sampling associated with SSOs occurring at same locations over multiple events.			
Site Name	**Fecal Coliform>800 cfu/100 mL**	**Number of samples**	**Number of events**
54TH AVE. N. DISCHARGE			
T15-21 (Point of Discharge)	28	28	3
T15-22	23	27	3
T15-23	25	27	3
ALBERT WHITTED EMERGENCY OVERFLOW			
Northshore Beach (903)	0	5	2
T12-23 Spa Beach	1	5	2
T16-26 Lassing Park	2	15	3
CLAM BAYOU – DISCHARGE			
T15-32	3	77	1
T15-36 (Point of Discharge)	70	97	2
T15-37	58	97	2
T15-38	39	96	2
T15-40	20	77	1
46-03	7	8	1
CB-01	9	10	1
T17-06 Upstream	4	5	2
T17-07 Point of Impact	5	5	2
T17-08 Downstream	4	5	2
SANITARY SEWER OVERFLOW - LAKE MAGGIORE			
T13-46 Stormwater Drain Entry to L. Maggiore	4	4	2
T13-47 South of L. Maggiore Entry	1	4	2
T13-48 North of L. Maggiore Entry	4	4	2

BACKGROUND CONDITION MONITORING PROGRAM

City staff identified that in order to meaningfully interpret the data collected by its Sanitary Sewer Overflows Monitoring Program that additional data collected in the same areas but in the absence of an overflow event could provide the appropriate baseline or background data. The objective, therefore, of the Background Monitoring Program is to provide location-specific "normal" bacterial levels in the absence of conditions influenced by an SSO.

Monitoring began in February 2017 at these sites for background conditions. Sampling frequency is approximately every six weeks to two months, often coinciding with Ambient Monitoring sample collection. Concentrations of *Enterococci*, *E. coli,* and total fecal coliforms were estimated in each sample. It is important to note that the State's bacterial standard has recently been redefined by *Enterococci* and *E. coli* concentrations. Fecal coliform data continue to be monitored given the longer data record for this parameter.

Background monitoring sites were selected to coincide with locations where known SSO events occurred in the past and were, therefore, more likely to occur in the future (Figure 38). The selected sites include both marine and freshwater locations. For each site, background enteric bacterial concentrations are defined by the geometric mean of background concentrations observed in the absence of an SSO event.

Table 9 presents the calculated geometric mean of the enteric bacteria concentrations, i.e., the background concentrations, for each of the background monitoring sites. The highest geometric mean fecal coliform concentrations were found in the following sampling sites:

- T16-25 1st St. N. + 45th Ave
- T15-23 54th Ave N. + 1st St.
- T16-49 Joe's Creek 38th Ave N + 66th St.
- T16-51 Booker Creek 11th Ave S

The geometric mean *E. coli* concentrations were generally similar across the majority of the sampling sites ranging from 20 - 418 mpn/100mL. However two sites had order of magnitude higher geometric means for *E. coli*: T16-25 1st St. N. + 45th Ave (3080 mpn/100mL) and T15-23 54th Ave N. + 1st St. (1105 mpn/100mL). Similar to the fecal coliform results, the *Enterococci* geometric means were highest at the T16-25 1st St. N. + 45th Ave and T15-23 54th Ave N. + 1st St. These results suggest that investigation into the potential sources of bacterial contamination at these two sites should be conducted.

Figure 38. **Background Monitoring Program sampling sites.**

Table 9. Geometric mean concentrations of *Enterococci*, *E. coli*, and total fecal coliform from the Background Monitoring Program.

Sampling Site	Number of Samples	Fecal Coliform (cfu/100ml)	*E. coli* (mpn/100ml)	*Enterococci* (cfu/100ml)
T15-23 54th Ave N. + 1st St.	19	1887	1105	713
T16-19 2201 61st St. N. Canal	20	974	217	290
T16-25 1st St. N. + 45th Ave	19	3038	3080	771
T16-43 WFP Outfall	19	592	172	160
T16-45 Sunset Dr. N. & Central	19	42	20	47
T16-46 Sunset Dr. S. & 3rd Ave	19	48	173	33
T16-49 Joe’s Creek 38th Ave N + 66th St.	19	1329	302	390
T16-50 Joe’s Creek 45th Ave N + 28th St.	20	628	282	226
T16-51 Booker Creek 11th Ave S	19	1291	418	191

CONCLUSIONS

The following summarizes the status of the City's monitoring in regards to human health as represented by enteric bacteria. Recommendations are provided based on our evaluation of the four human health monitoring programs.

- With the exception of the Beaches Monitoring Program, the remaining three human health programs (recreational, SSO and background conditions) were all instituted relatively recently. While the results from these three monitoring programs provide an overview of existing conditions, the limited period of record does not allow evaluation of temporal trends, i.e., whether human health conditions are improving or declining. It is recommended that the City continue implementation of all four programs which will allow analysis of long-term changes in human health conditions.
- The Sanitary Sewer Overflows monitoring program identified specific areas where elevated bacterial concentrations have been observed most frequently. These locations include the 54th Ave. N. and 1st St. location, Clam Bayou, and Lake Maggiore. It is recommended that the City implement investigations into the potential sources of bacterial contamination. It is also recommended that the City institute a sampling protocol similar to that used in the Background Conditions Program in these areas, where multiple SSO events have been observed. The 54th Ave. N. and 1st St. location is already part of the Background Condition Monitoring Program but the other locations are not, so it is recommended that Clam Bayou and Lake Maggiore be added to the Background Program, with sampling under this program allowing establishment of "normal" conditions and development of a long-term database for these locations.
- For sites monitored as part of the Sanitary Sewer Overflows Monitoring Program, it is recommended that the focus be on obtaining samples from downstream receiving waterbodies where impacts are likely to be most important.
- With respect to the Recreational Areas Monitoring Program, the greatest numbers of *Enterococci* exceedances were found in Fossil Park Lake and Salt Creek, where all samples taken except for one indicated exceedances. Given these results, it would be prudent to investigate the sources of *Enterococci* in these two systems.

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City of St. Petersburg
FLS000007-005
Annual Report
Cycle 5, Year 1

Appendix B
BPCP Annual Summary for
WBIDS 1668A and 1716A-1716D
And
WMP BMP Annual Summary for
WBID 1668A DO/Nut

January, 2020

Summary Report of Activities for

BPCPs in Clam Bayou WBIDs 1716A, 1716B, 1716C and 1716D and Joe's Creek WBID 1668A

And

WMP BMPs for Joe's Creek WBID 1668A DO/Nut

BPCP Annual Summaries for WBIDs 1716A-1716D and WBID 1668A

The city currently has five (5) TMDLs for Fecal Coliform, all of which currently have approved Bacteriological Pollution Control Plans (BPCP): Clam Bayou WBIDs 1716A, 1716B, 1716C and 1716D and Joe's Creek WBID 1668A. It is important to note that WBIDs shapes are based on stormwater basins whereas sanitary sewers continue from WBID to WBID towards the treatment plants. Activities outside of the boundaries of the WBIDs are important since they can directly affect the sanitary sewer within the WBID. The following provides a discussion of activities citywide with specific information for each WBID. WBID 1716C has been divided by FDEP into 1716C1 and 1716C2 due to the different characteristics of the watersheds. Due to discharges of untreated or partially treated wastewater during recent heavy rain events, the city has agreed to a consent order with the Florida Department of Environmental Protection to address releases and the operation of the sanitary sewer system citywide. These WBIDs are within the citywide area of sanitary sewer improvement. Improvements to the sanitary sewer system includes significant upgrades to the Water Reclamation Facilities. The improvements are designed to increase the capacity of the plants by increasing the headwork filtration to allow larger flows and additional recharge wells for disposal of the treated effluent. Inflow and infiltration of stormwater and groundwater into the sewer system is the significant factor during heavy rainfall events that have caused unplanned discharges or manhole overflows. The city with its consultants, CH2M, has been studying the entire sanitary system through a Wet Weather Overflow Mitigation Study.

Inspection and maintenance of the sanitary sewer system is an integral part of the city's program to reduce I/I. The Appendix contains maps specific to the individual WBIDS that show sanitary sewer and storm sewer improvements within the WBIDs. Also, included in the Appendix are tables that summaries the activities taken to improve the sanitary sewer citywide for the period covered by this annual report. In addition to the activities shown on the table, the city has installed over 4800 sanitary sewer manhole "dishes" citywide since 2008 that help to prevent inflow from stormwater flooding.

Additional WBID Investigations for Bacteria

Other WBIDs in the city have been identified as impaired for bacteria including Salt Creek (WBID 1731B), Frenchman's Creek (WBID 1709F) and Little Bayou Basin Q (WBID 1709D). None of WBIDs currently have an approved BPCP but the city has taken on studies to help determine the sources of bacteria. In WBIDs 1731B and 1709F, the city is working with the University of South Florida's Department of Integrative Biology and Dr. Valerie Harper to perform source tracking. Following are summaries of those activities. For WBID 1709D, the city has approved funding to conduct a study and has engaged a consultant. Updates for WBID 1709D will be provided in subsequent annual reports.

City of St. Petersburg Salt Creek Bacterial Investigation Pilot Project (WBID 1731B)

The Salt Creek Study Area is part of Basin C located in the southeast part of St. Petersburg with a watershed covering around 3,400 acres. Salt Creek is a tidally influenced creek with limited capacity that has been altered through decades of development. Land use within the basin consist mainly of medium density residential, with arterial corridors wrapped with commercial interest, except at the mouth of the creek where light industrial activity covers the landscape. A bacterial investigation was needed due to persistent fecal indicators from previous water quality sampling and monitoring efforts within Salt Creek.

This project began in 2016 with gathering CCTV data followed up with smoke testing within the basin. Then the City partnered with University of South Florida (USF) to investigate sources of bacteriological indicators, conducting speciation of fecal indicators. Results of study identified significant bird sources, but also humans contributing to the persistent fecal indicators at some sites. In 2019, the City of St. Petersburg worked with Environmental Canine Services, using scent-trained dogs to sniff out human waste, helping to determine the direction of the sources and differentiate between human and animal waste. The study included 115 sites and 7 field blanks scented by the canines. 27 fecal samples were analyzed, 13 of which were above the healthy beaches' standards and 6 tested positive for quantifiable human indicators.

Based on results of canine and water quality source tracking, priority areas were identified. In these priority areas, targeted physical stormwater infrastructure investigations were conducted, with the first impaired infrastructure being corrected in May 2019 and continuing into the current annual cycle.

Frenchman's Creek (WBID 1709F)

Based on current impaired status of Frenchman's Creek and the recreational use of the waterbody, the city has engaged the USF Department of Integrative Biology to perform source tracking. Land uses within the WBID include institutional, residential, parks, marinas, interstate highways and local roads. The after preliminary screening, the study is underway and updates will be provided in subsequent annual reports.

WMP BMPs Joe's Creek DO/Nut (WBID 1668A)

A Best Management Plan Practices (BMP) Alternative Analysis Report dated December 2016 was developed by Pinellas County's consultant in conjunction with the city of St. Petersburg and SWFWMD. The plan suggested some structural improvements to improve water quality and listed various non-structural recommendations which include the following:

1. Increase resource allocation for inspection and repair of sanitary utility lines and fittings

2. Perform wastewater facility capacity studies in areas where frequent sanitary sewer overflows or plant releases are occurring
3. Continue public awareness campaigns to encourage xeriscaping, responsible pet waste management, and low fertilization landscapes.
4. Encourage parcel-based stormwater harvesting such as private raingardens, pervious pavers and rain barrels. Consider demonstration projects on municipal parcels.
5. Continue street sweeping programs at the current frequencies. Continue to add roads to the sweeping programs as staffing and equipment allow.
6. Low impact development (LID) incentives for new and redeveloped commercial/industrial sites encouraging practices such as functional landscaping, green buffers for runoff infiltration, green-roofing, minimizing directly connected impervious areas, and incentives for organic mulching over fertilizers

All of these recommendations have been incorporated in the city's practices and summarized as follows:

1. As described in the BPCP summary above, the city has significantly allocated resources to correct and improve the sanitary sewer system including plant capacity improvements, increased inspections and increased resources for sanitary sewer repairs, replacement and lining.
2. The city wide study was conducted as described above which has helped the city focus on problematic areas.
3. Public awareness campaigns have continued with the annual Florida Style Landscape Workshop conducted every year and other workshops and attendance at events. The city has is again conducting rain barrel/rain garden workshops for the Cycle 5, Year 2 permitting period.
4. The city has instituted a residential rebate program for citizens who attend a rain barrel/rain garden workshop. The attendees will receive a free rain barrel and can apply for rebates in their stormwater utility fee for installing the rain barrel or a rain garden.
5. The city has significantly increased the street sweeping program in the city by the addition of new staff and equipment.
6. LID practices are encouraged by the city. Code revisions and design templates are being investigated to further promote LID.

Activities that have been reported for the BPCP summaries above, also, assist in improving water quality for DO and nutrients. The city has increased its street sweeping frequency and now covers the entire city ten (10) times per year. WBID 1668A is a fairly substantial watershed in the city with over 340 lane miles of streets (146 centerline miles). Based on the citywide nutrient removal numbers reported in the annual report, this equates to over 3800 cy of material removed from the WBID and 5400 pounds of TN and 2900 pounds of TP removed during the reporting period in WBID 1668A.

The city is currently in the second year of a multi-year update of our Stormwater Management Master Plan which addresses flooding concerns, sea level rise and water quality improvements. The update includes all 26 watersheds in the city and is co-funded by the Southwest Florida Water Management District. Additional water quality and flood improvement activities suggested by the

December 2016 BMP report for WBID 1668A are being refined in the city's Stormwater Management Master Plan Update.

Please see Appendix A of this report for WBID maps displaying reporting period locations for CIPP lining of the sanitary sewer and storm sewer, as well as, sanitary sewer smoke testing conducted. Please see Appendix B of this report for the WWM Annual Report that details citywide maintenance activities for sanitary sewer.

City of St. Petersburg

FLS000007-004

Annual Report

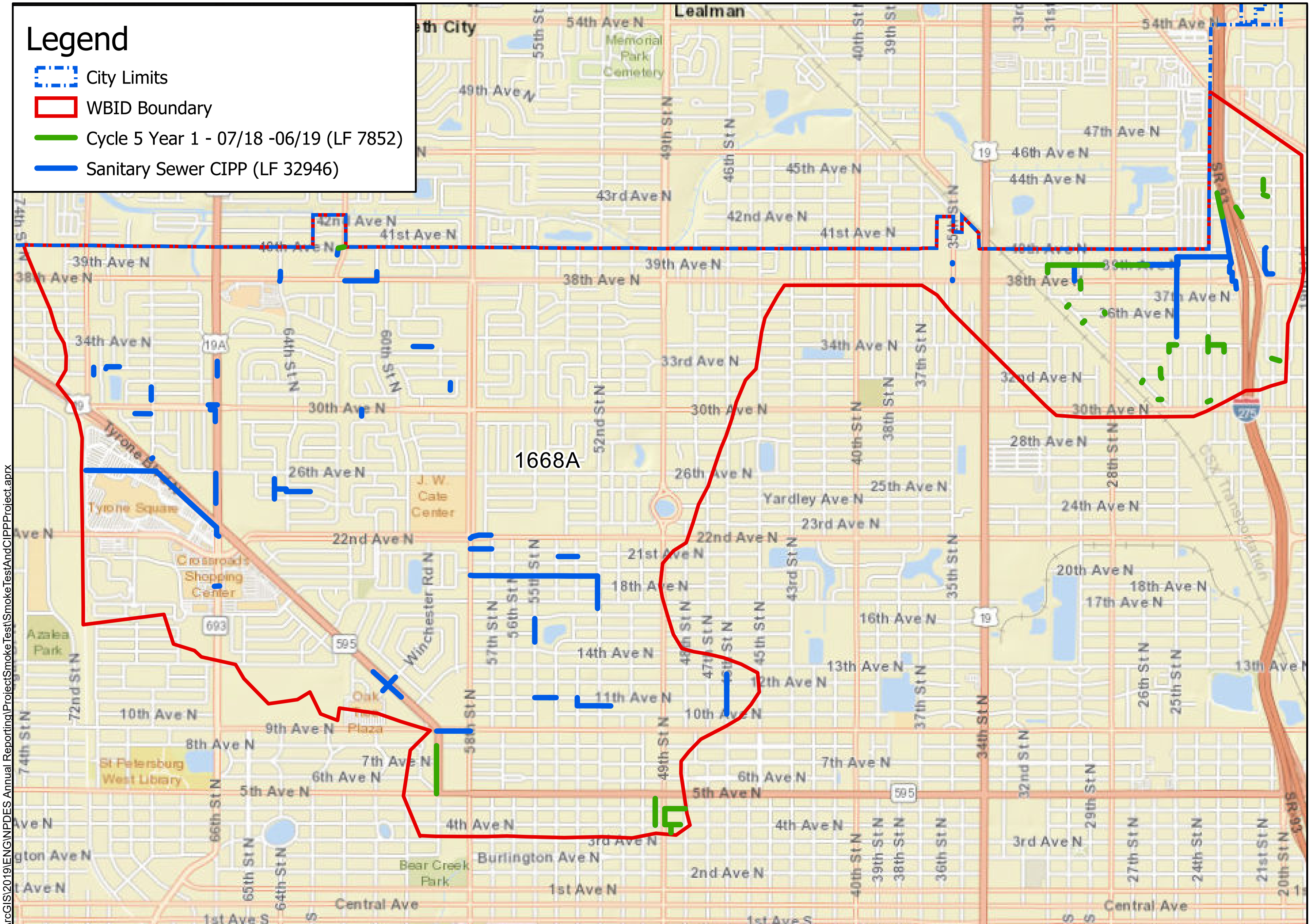
Cycle 5, Year 1

Appendix A

WBID Maps

January, 2020

WBID 1668A Stormwater CIPP



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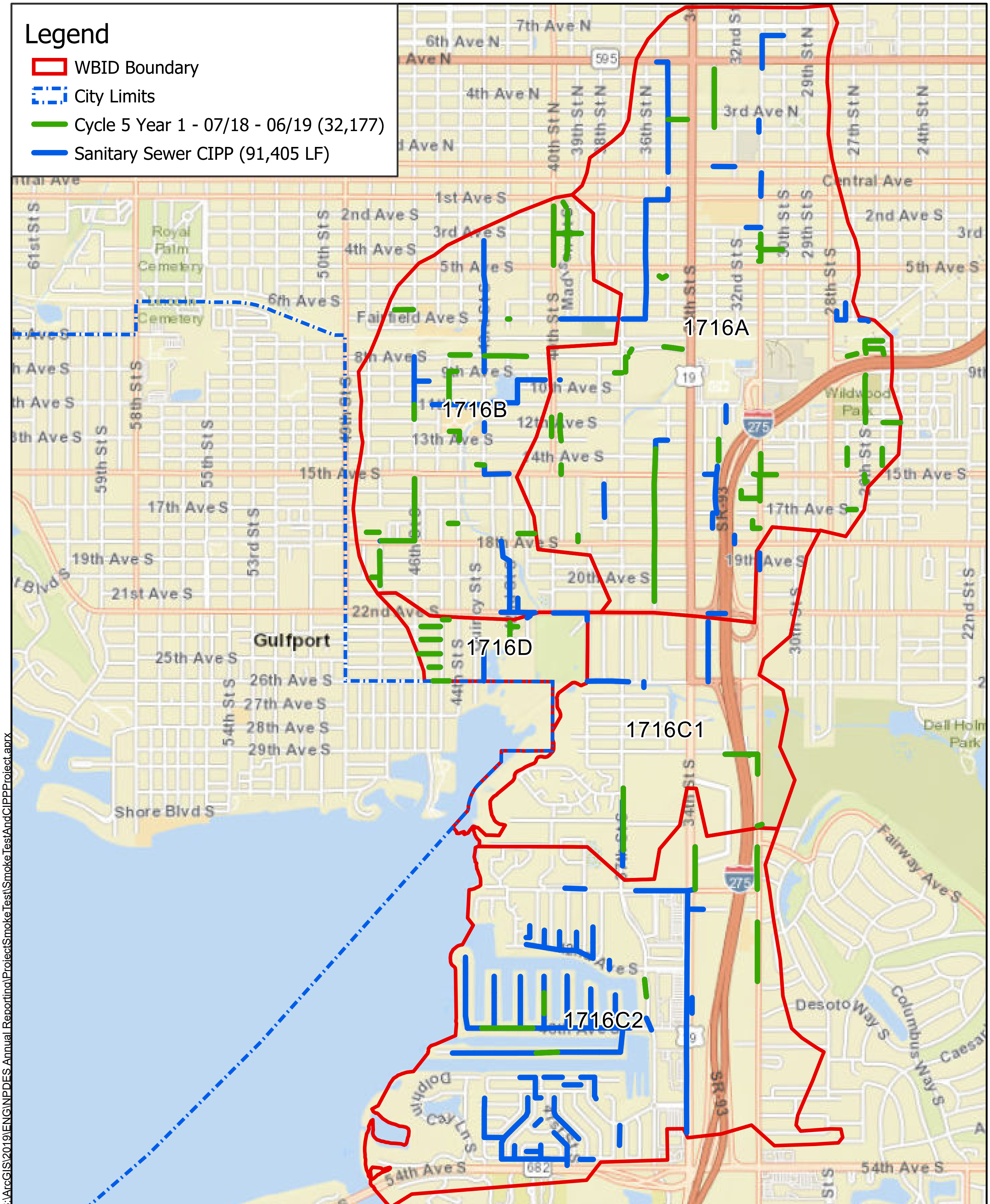
Date: 12/5/2019

ENGINEERING & CAPITAL IMPROVEMENTS DEPARTMENT
CITY OF ST PETERSBURG

Map Number: ENG-000

st.petersburg
www.stpete.org



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WBID 1716A - 1716D Sanitary Sewer CIPP

ENGINEERING AND CAPITAL IMPROVEMENTS DEPARTMENT
CITY OF ST PETERSBURG

Date: 12/6/2019
Map Number: ENG-0000a

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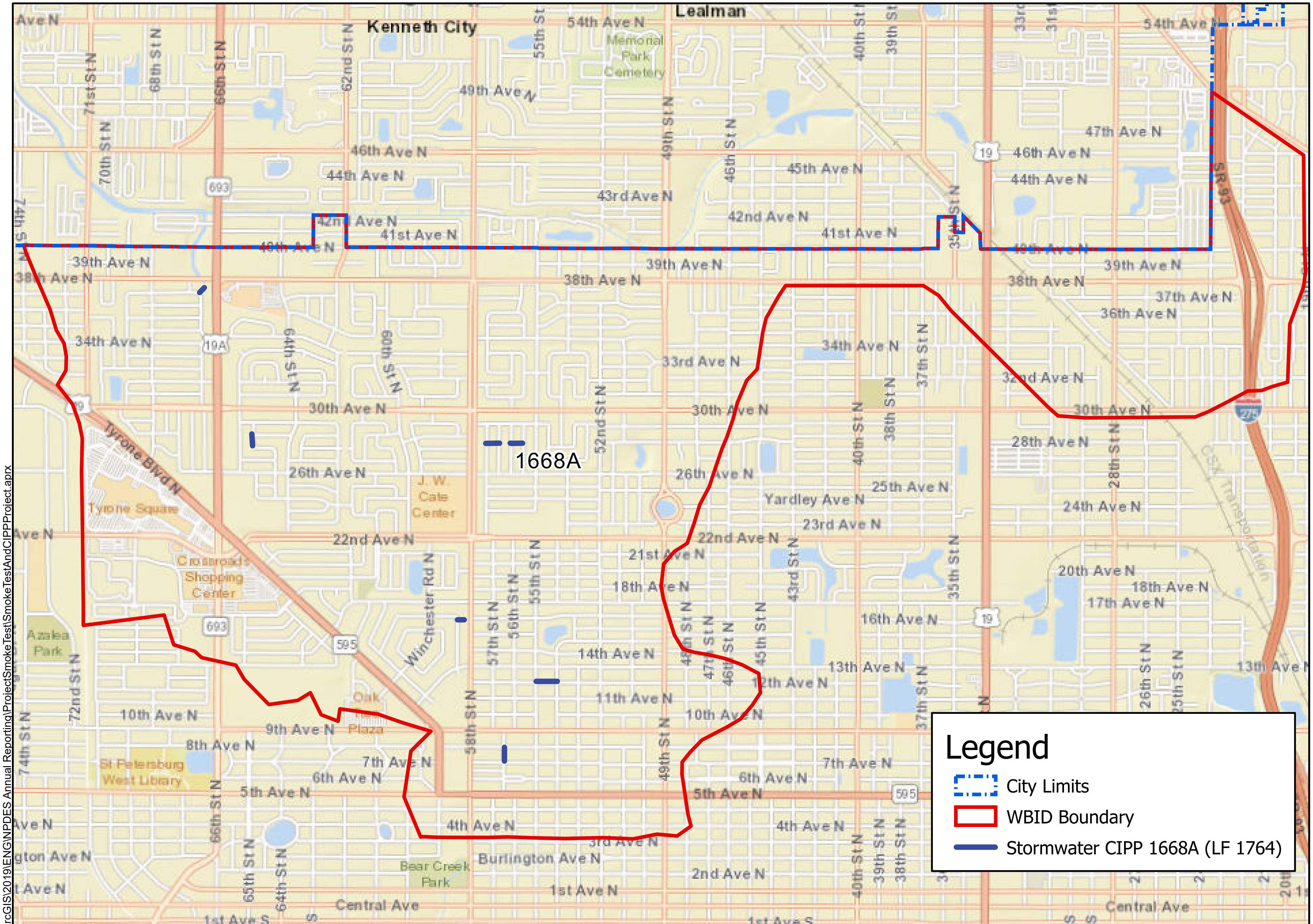
www.stpete.org



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WBID 1668A Stormwater CIPP

ENGINEERING & CAPITAL IMPROVEMENTS DEPARTMENT
CITY OF ST PETERSBURG

Date: 12/6/2019

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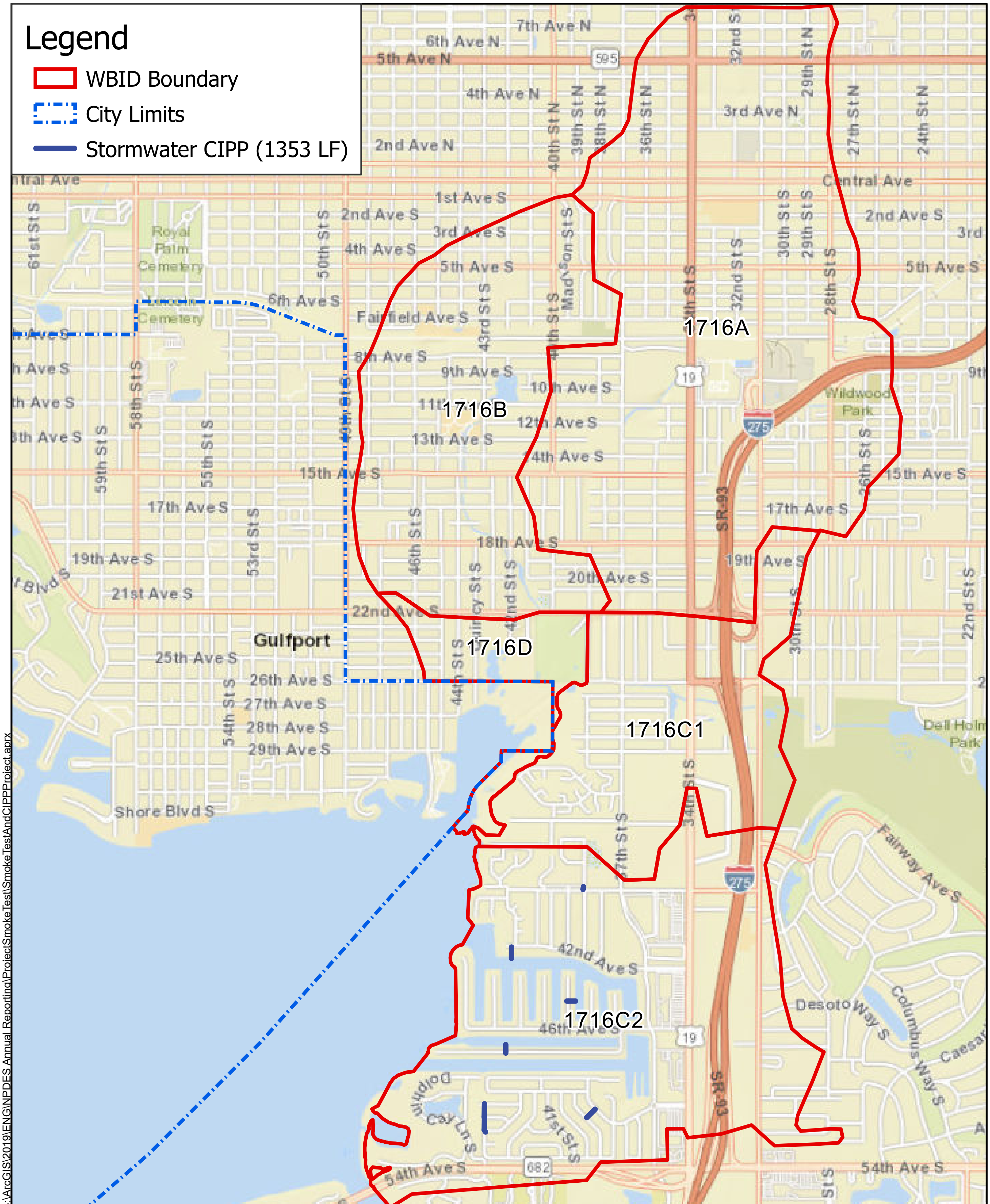

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WBID 1716A - 1716D Stormwater CIPP

ENGINEERING AND CAPITAL IMPROVEMENTS DEPARTMENT
CITY OF ST PETERSBURG

Date: 12/6/2019
Map Number: ENG-0000a

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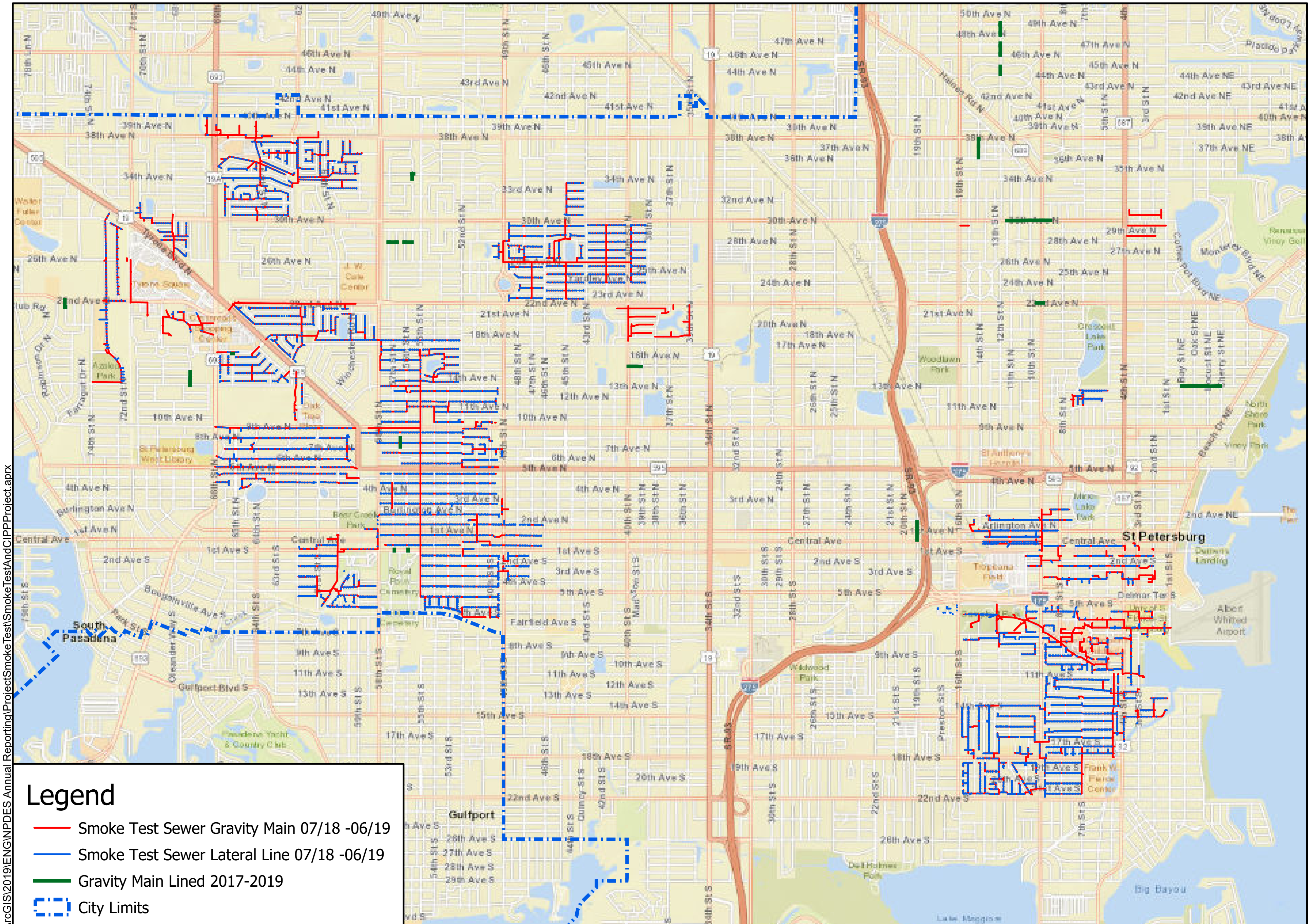

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Smoke Test - Stormwater Sewers 2018/2019

ENGINEERING & CAPITAL IMPROVEMENTS DEPARTMENT
CITY OF ST PETERSBURG

Date: 12/23/2019

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FLS000007-004

Annual Report

Cycle 5, Year 1

Appendix B

WWM Annual Summary Report

January, 2020

WWM ANNUAL REPORT

FISCAL YEAR 2018

Row	Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total Amt
1	GRAV MAIN REPAIRS COUNT	8	12	13	20	18	7	11	12	16	14	15	13	159
2	GRAV MAIN REPLACE COUNT		3	1	2	2			1	2		1	1	13
3	CLEANOUT INSTALL COUNT	8	4	8	16	9	1				1			47
4	LATERAL REPAIRS COUNT	34	25	40	24	22	51	36	12	32	35	37	19	367
5	LATERAL REPLACED COUNT	8	10	10	2	7	9	6	8	6	12	9	4	91
6	MANHOLE REPAIRS COUNT	3	14	9	8	4	6	18	2	2	9	2	4	81
7	CCTV INSPECTION LF	17,666.7	23,487.38	22,582.35	18,034.07	15,197.28	1,925.56	3,060.55	2,235.35	18,838.81	11,233.98	11,613.03	17,297.48	163,172.54
8	QTV INSPECTION LF	18,913.4	15,779.72	107,387.12	71,547.92	110,716.94	78,930.2	34,313.69	22,194.46	10,269.28	28,483.35	63,064.27	68,923.5	630,523.85
9	VACTOR CLEANED LF	15,363.22	24,405.45	21,588.26	45,704.86	42,674.53	31,578.48	48,787.42	30,647.11	38,406.72	45,056.42	25,050.61	44,006.46	413,269.54
10	ROOT CONTROL LF						1,471.43			400	562			2,433.21
11	FORCEMAIN LF	1,470		840			2,565				640			5,515
12	SMOKE TEST GRAVPIPE LF				19,563.86	102,187.07	118,759.24	137,343.69	157,840.01	163,278.38	149,964.84		3,590.93	852,528.02
13	SMOKE TEST LATERAL COUNT				423	2,619	3,438	3,872	3,995	3,678	3,056			21,081
15	SERVICE REQUESTS CREATED	96	72	75	118	110	126	126	120	115	113	110	111	1,292
20	MANHOLE INSPECTIONS	303	426	17	13	27							50	836

WWM ANNUAL REPORT

FISCAL YEAR 2019

Row	Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total Amt
1	GRAV MAIN REPAIRS COUNT	17	19	13	19	24	16	7	16	14	17	14	18	194
2	GRAV MAIN REPLACE COUNT		1				1		1				1	4
4	LATERAL REPAIRS COUNT	28	34	18	29	28	24	41	41	21	44	24	44	376
5	LATERAL REPLACED COUNT	4	2	5	5	4	2	8	6	3	2	6	7	54
6	MANHOLE REPAIRS COUNT	3	4	6	11	2	1		2	8	7	6	2	52
7	CCTV INSPECTION LF	35,572.99	49,978.43	76,286.52	60,158.33	7,117.93	735	2,549.56	18,066.19	56,924.78	38,705.97	3,847.19	15,144.2	365,087.09
8	QTV INSPECTION LF	13												13
9	VACTOR CLEANED LF	49,198.04	60,161.41	102,754.97	69,356.2	18,224.43	23,440.54	24,434.07	31,995.89	23,845.44	76,186.59	36,679.95	75,204.9	591,482.43
10	ROOT CONTROL LF									4,879.26				4,879.26
12	SMOKE TEST GRAVPIPE LF	296	315	4,705.56		33,463.86		19,631.57		118,814.47	274		501	178,001.68
13	SMOKE TEST LATERAL COUNT	1	1		1	884		7		2,769			20	3,683
15	SERVICE REQUESTS CREATED	111	89	109	144	134	135	132	135	128	176	213	122	1,628
20	MANHOLE INSPECTIONS	150	13											163

City of St. Petersburg

FLS000007-004

Annual Report

Cycle 5, Year 1

Appendix C

Major Outfall Inventory

and Map

January, 2020

Major Outfall Inventory

DISCHID	INTERSECTION
E-2-6	BAYSHORE DR NE & 2ND AVE NE
D-9-1	BEACH DR SE & 16TH AVE SE
E-9-5	16TH AVE S & 1ST ST S
D-32-3	61ST AVE NE & FOCH ST NE
D-32-1	58TH AVE NE & FOCH ST NE
D-32-2	FOCH ST NE & 60TH AVE NE
S-8-1	PARK ST N & BOGIE AVE N
L-11-1	22ND AVE S & 41ST ST S
F-36-3	NORTHWEST BLVD N & ATWOOD AVE N
A-26-2	MARYLAND AVE NE & LANSING ST NE
R-2-1	CENTRAL AVE & TREASURE ISLAND CSWY
C-20-1	BIRCH ST NE & 38TH AVE NE
D-30-1	VENICE WAY NE & QUINTANA PL NE
H-4-5	18TH ST N & BURLINGTON AVE N
D-20-1	36TH AVE NE & POPLAR ST NE
E-9-3	17TH AVE S & 4TH ST S
F-17-2	30TH AVE S & 4TH ST S
F-15-2	PALLANZA DR S & 28TH AVE S
F-15-1	WEST HARBOR DR S & 9TH ST S
K-25-2	50TH AVE S & 37TH ST S
D-10-2	16TH AVE NE & NORTH SHORE DR NE
E-1-4	1ST AVE SE & BAYSHORE DR SE
E-2-4	BAYSHORE DR NE & 2ND AVE NE
G-39-1	FRIENDLY WAY S & PLEASANT WAY S
A-22-1	CONNECTICUT AVE NE & BAYSHORE BLVD NE
G-48-1	14TH ST N & 89TH AVE N
F-10-4	15TH AVE N & 5TH ST N
F-29-2	5TH WAY S & HILLSIDE DR S
K-33-1	PINELLAS POINT DR S & 34TH ST S
K-33-2	PINELLAS POINT DR S & 34TH ST S
E-4-2	4TH AVE NE & BEACH DR NE
L-27-1	DOLPHIN CAY LN S & 54TH AVE S
D-4-1	5TH AVE NE & BAYSHORE DR NE
K-25-1	46TH AVE S & 37TH ST S
L-25-1	49TH AVE S & 44TH ST S
O-18-1	34TH AVE N & 62ND ST N
D-24-1	45TH AVE NE & LOCUST ST NE
O-20-2	59TH LN N & 35TH AVE N
E-24-8	45TH AVE NE & LOCUST ST NE
J-35-2	CANTON ST S & 68TH AVE S
R-1-1	3RD AVE S & SUNSET DR S
B-32-2	BAYOU GRANDE BLVD NE & PENNSYLVANIA AVE NE
N-35-1	62ND AVE S & 54TH ST S
M-35-1	62ND AVE S & 52ND ST S
E-29-1	55TH AVE S & 4TH ST S
F-19-2	37TH AVE S & 6TH ST S
F-17-1	34TH AVE S & 6TH ST S
E-2-5	2ND AVE NE & BAYSHORE DR NE
F-40-4	77TH AVE N & DR ML KING ST N
F-40-1	77TH AVE N & DR ML KING JR ST N
F-40-2	77TH AVE N & DR ML KING ST N
O-2-2	BURLINGTON AVE N & 59TH ST N
D-8-1	11TH AVE NE & NORTH SHORE DR NE
P-3-1	6TH AVE S & 63RD ST S

Major Outfall Inventory

DISCHID	INTERSECTION
R-8-2	9TH AVE N & ROBINSON DR N
P-5-1	BROOKWOOD DR S & BAMBOO DR S
O-3-1	5TH AVE S & 60TH ST S
A-24-1	VENETIAN BLVD NE & BAYSHORE BLVD NE
R-8-1	FARRAGUT DR N & ROBINSON DR N
E-18-2	OAK ST NE & COFFEE POT DR NE
E-18-1	31ST AVE N & 1ST ST N
C-48-1	WEEDON DR NE & SAN MARTIN BLVD NE
F-11-1	22ND AVE S & E HARBOR DR S
D-8-2	13TH AVE NE & NORTH SHORE DR NE
E-22-1	40TH AVE N & 4TH ST N
E-24-2	45TH AVE N & 1ST ST N
E-24-3	45TH AVE N & IST ST N
A-26-1	BUTTERFLY PL NE & MASSACHUSETTS AVE NE
E-24-4	45TH AVE N & 1ST ST N
E-24-5	45TH AVE N & 1ST ST N
E-24-6	45TH AVE N & 1ST ST N
E-24-7	45TH AVE N & 1ST ST N
E-36-2	70TH AVE N & 4TH ST N
E-36-3	70TH AVE N & 1ST ST N
E-38-1	74TH AVE NE & LOCUST ST N
T-16-1	27TH AVE N & PELHAM RD N
F-30-1	54TH AVE N & KELLY DR N
E-28-5	54TH AVE N & 4TH ST N
F-40-3	77TH AVE N & DR ML KING ST N
E-40-2	78TH AVE N & 4TH ST N
E-40-3	78TH AVE N & 4TH ST N
E-40-4	78TH AVE N & 4TH ST N
E-40-5	78TH AVE N & 4TH ST N
E-40-1	78TH AVE N & 4TH ST N
F-30-2	54TH AVE N & KELLY DR N
E-28-4	54TH AVE N & 4TH ST N
E-28-3	54TH AVE N & 4TH ST N
E-28-6	54TH AVE N & 4TH ST N
E-28-2	54TH AVE N & 4TH ST N
E-2-3	CENTRAL AVE & BAYSHORE DR NE
F-28-1	53RD TERR N & 7TH ST N
B-34-1	62ND AVE NE & BAYOU GRANDE BLVD NE
L-13-1	QUINCY ST S & 26TH AVE S
SD-169	6TH AVE N & 41ST ST N
SD-183	(EAST) 34TH AVE N & 58TH ST N
F-36-4	ATWOOD AVE N & LIVINGSTON AVE N
F-36-5	ATWOOD AVE N & STEWART AVE N
F-10-5	15TH AVE N & 5TH ST N
F-23-1	9TH ST S & 45TH AVE S
G-15-1	28TH AVE S & 27TH AVE S
E-7-1	4TH ST S & 13TH AVE S
E-9-2	3RD ST S & 17TH AVE S
K-13-2	38TH ST S & 22ND AVE S
E-9-4	3RD ST S & 15TH AVE S
E-14-2	25TH AVE NE & COFFEE POT BLVD NE
D-6-1	BAYSHORE DR NE & 7TH AVE NE
E-21-1	POMPANO DR SE & 43RD AVE SE
E-23-1	SUNRISE DR S & 45TH AVE S

Major Outfall Inventory

DISCHID	INTERSECTION
I-37-1	70TH AVE S & PINELLAS POINT DR S
J-35-1	28TH ST S & 67TH AVE S
E-42-1	81ST AVE N & RIVERSIDE DR N
E-2-1	1ST AVE SE & BAYSHORE DR SE
E-2-2	BAYSHORE DR & CENTRAL AVE
E-16-2	30TH AVE NE & COFFEE POT BLVD NE
E-5-1	8TH AVE S & 3RD ST S
A-28-3	MONTANA AVE NE & GRAND CANAL BLVD NE
A-28-2	MONTANA AVE NE & LANSING ST NE
F-35-2	8TH ST S & PINELLAS POINT DR S
F-37-1	10TH ST S & FRIENDLY WAY S
L-19-2	43RD ST S & 39TH AVE S
M-22-1	40TH AVE N & 50TH ST N
E-14-3	26TH AVE NE & COFFEE POT BLVD NE
S-16-2	29TH AVE N & 80TH ST N
E-33-1	4TH ST S & 64TH AVE S
O-3-2	FAIRFIELD AVE S & 60TH ST S
G-1-1	1ST AVE S & 13TH ST S
G-1-2	1ST AVE S & 13TH ST S
G-3-1	5TH AVE S & 10TH ST S
G-3-2	5TH AVE S & 10TH ST S
F-5-1	9TH AVE S & 7TH ST S
F-7-1	11TH AVE S & 5TH ST S
F-7-2	11TH AVE S & 5TH ST S
F-7-3	11TH AVE S & 5TH ST S
F-7-4	11TH AVE S & 5TH ST S
L-9-1	44TH ST S & 15TH AVE S
K-5-3	8TH AVE S & 34TH ST S
E-44-1	RIVERSIDE DR N & TOBAY RD N
F-35-1	COLONY POINT RD S & COLONY DR S
F-28-2	54TH AVE N & PALM CT N
F-9-1	17TH AVE S & 4TH ST S
F-19-1	37TH AVE S & 6TH ST S
E-3-1	DANE WHELDON WAY & BAYSHORE DR SE
E-9-1	17TH AVE S & 4TH ST S
L-29-1	CRESCENT PL & ACADEMY WAY
F-7-5	4TH ST S & 13TH AVE S
E-46-1	4TH ST N & 87TH AVE N
F-29-1	7TH ST ST & HILLSIDE DR S
D-10-1	15TH AVE NE & NORTH SHORE DR NE
R-10-5	PAR AVE N & FARAGUT DR N
R-5-2	VILLAGRANDE AVE S & SUNSET DR S
R-5-1	VILLAGRANDE AVE S & SUNSET DR S
E-29-2	55TH AVE S & 4TH ST S
K-15-2	26TH AVE S & 37TH ST S
K-15-3	26TH AVE S & 37TH ST S
R-6-1	PARK ST N & COUNTRY CLUB RD N
M-17-2	46TH ST S & 29TH AVE S
A-28-1	HUNTINGTON ST NE & BAYOU GRANDE BLVD NE
F-50-2	94TH AVE N & 7TH ST N
M-29-1	CRESCENT PL & ACADEMY WAY
M-29-2	CRESCENT PL & ACADEMY WAY
K-31-2	PINELLAS POINT DR S & 34TH ST S
K-31-1	31ST ST S & 59TH AVE S

Major Outfall Inventory

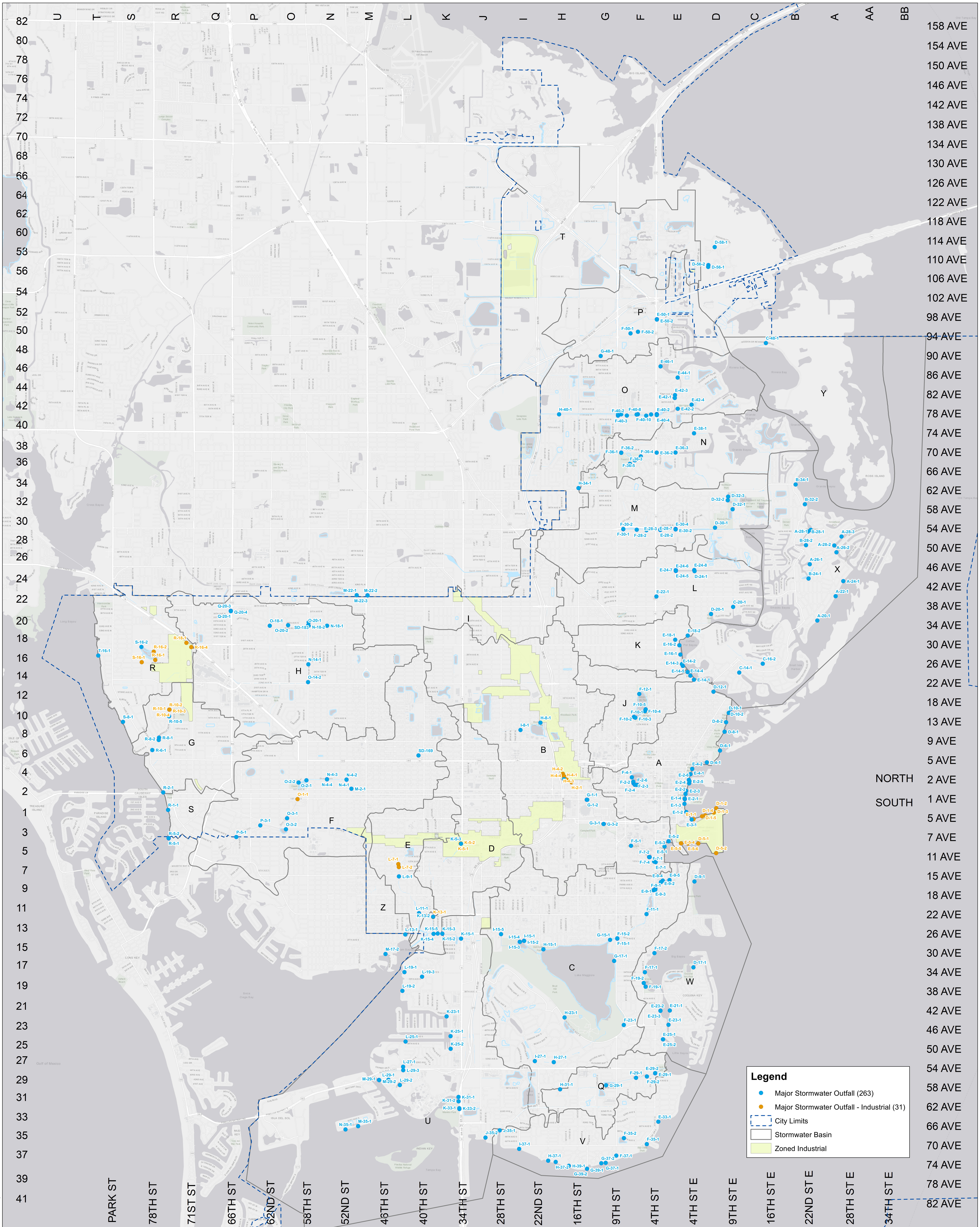
DISCHID	INTERSECTION
F-4-1	BURLINGTON AVE N & MIRROR LAKE DR N
F-2-2	2ND AVE N & MIRROR LAKE DR N
F-2-3	ARLINGTON AVE N & MIRROR LAKE DR N
F-2-4	ARLINGTON AVE N & MIRROR LAKE DR N
F-2-5	6TH ST N & MIRROR LAKE DR N
F-2-6	6TH ST N & MIRROR LAKE DR N
O-2-1	BURLINGTON AVE N & 58TH ST N
N-4-3	BURLINGTONN AVE N & 55TH ST N
N-4-4	BURLINGTON AVE N & 55TH ST N
N-4-1	BURLINGTON AVE N & 52ND ST N
E-42-4	ORIENT WAY NE & 80TH AVE NE
E-23-3	42ND AVE S & SUNRISE DR S
E-4-1	3RD AVE NE & BEACH DR NE
N-4-2	BURLINGTON AVE N & 52ND ST N
F-40-5	77TH AVE N & DR ML KING ST N
F-40-8	77TH AVE N & 7TH ST N
E-42-2	78TH AVE N & 1ST ST N
F-36-1	70TH AVE N & DR MLK JR ST N
F-36-2	70TH AVE N & DR MLK JR ST N
L-29-2	FRANKLIN CT S & COLLEGE AVE S
E-23-2	42ND AVE S & SUNRISE DR S
I-8-1	11TH AVE N & 25TH ST N
D-56-2	BRIGHTON BAY BLVD NE & VERANDEA
H-40-1	77TH AVE N & 18TH WAY N
F-12-1	20TH AVE N & CRESCENT LAKE DR N
K-23-1	42ND AVE S & 37TH ST S
E-25-1	SUNRISE DR S & CYPRESS WAY S
E-1-3	2ND AVE SE & BAYSHORE DR SE
F-50-1	8TH ST N & 94TH AVE N
E-1-2	1ST ST S & 1ST ST SE
L-19-1	34tTH AVE S & 40TH ST S
G-17-1	32ND AVE S & 9TH ST S
B-28-2	SHORE ACRES BLVD NE & VENETIAN BLVD NE
B-28-1	BAYOU GRANDE BLVD NE & DOVER ST NE
I-15-1	LAMPARILLA WAY S & MURILLA WAY S
I-15-2	LAMPARILLA WAY S & MURILLA WAY S
H-34-1	63RD AVE N & 16TH ST N
E-28-7	54TH AVE N & 1ST ST N
E-5-2	8TH AVE S & 3RD ST S
E-5-3	8TH AVE S & 3RD ST S
F-40-10	77TH AVE N & 4TH ST N
E-30-4	54TH AVE N & 1ST ST N
E-30-3	54TH AVE N & 1ST ST N
E-30-2	54TH AVE N & 1ST ST N
E-30-1	54TH AVE N & 1ST ST N
H-23-1	COUNTRY CLUB WAY S & ALCAZAR WAY S
G-37-1	WILLIAMS DR S & FRIENDLY WAY S
G-39-2	FRIENDLY WAY S & PLEASANT WAY S
F-40-7	77THAVE N & 7TH ST N
D-58-1	BRIGHTON BAY BLVD NE & ADDISON DR NE
N-18-1	34TH AVE N & 55TH ST N
N-14-1	26TH AVE N & 58TH ST N
N-18-2	34TH AVE N & 58TH ST N
O-20-1	34TH AVE N & 58TH ST N

Major Outfall Inventory

DISCHID	INTERSECTION
H-27-1	19TH WAY S & LAKEWOOD CLUB DR S
O-14-2	22ND AVE N & 58TH ST N
Q-20-1	38TH AVE N & 66TH ST N
Q-20-2	38TH AVE N & 66TH ST N
Q-20-3	38TH AVE N & 66TH ST N
Q-20-4	38TH AVE N & 66TH ST N
K-15-1	26TH AVE S & 34TH ST N
I-27-1	ANASTASIA WAY S & COLUMBUS WAY S
F-10-1	14TH AVE N & 7TH ST N
F-10-2	14TH AVE N & 7TH ST N
F-10-3	14TH AVE NE & 7TH ST N
M-22-2	40TH AVE N & 49TH ST N
M-22-3	40TH AVE N & 49TH ST N
F-2-1	2ND AVE N & MIRROR LAKE DR N
E-50-1	4TH ST N & KOGER BLVD N
F-40-9	77TH AVE N & 5TH ST N
F-40-6	77TH AVE N & 8TH ST N
K-15-4	38TH ST S & 26TH AVE S
K-15-5	KINGSTON ST S & 26TH AVE S
H-37-1	BLOSSOM WAY S & 21ST ST S
H-37-2	BLOSSOM WAY S & SERPENTINE CIR S
H-39-1	DEMENS DR S & ARMISTEAD PL S
E-14-4	COFFEE POT BLVD NE & 23RD AVE NE
E-50-2	4TH ST N & KOGER BLVD N
D-56-1	BRIGHTON BAY BLVD NE & VERANDAS
C-16-2	APPIAN WAY NE & RAMON WAY NE
M-2-1	1ST AVE N & 51ST ST N
I-15-5	26TH AVE S & 28TH ST S
I-15-4	LAMPARILLA WAY S & 25TH ST S
E-14-5	COFFEE POT BLVD NE & 23RD AVE NE
C-14-1	BRIGHTWATERS BLVD NE & MARON ST NE
H-8-1	13TH AVE N & 22ND ST N
H-31-1	20TH ST S & 58TH AVE S
G-37-2	FRIENDLY WAY S & MUROK WAY S
E-42-3	81ST AVE N & RIVERSIDE DR N
E-14-1	COFFEE POT BLVD NE & LOCUST ST NE
D-12-1	20TH AVE NE & COFFEE POT BLVD NE
D-17-1	SUNFISH DR SE & MANATEE DR SE
G-29-1	11TH ST S & 58TH AVE S
L-19-3	35TH AVE S & 40TH ST S
H-15-1	UNION ST S & LAKESIDE DR S
A-20-1	ARKANSAS AVE NE & BAYSHORE BLVD NE
L-29-3	PINELLAS BAYWAY & COLLEGE LANDINGS BLVD S
E-16-1	COFFEE POT BLVD NE & 28TH AVE NE
E-25-2	SUNRISE DR S & CYPRESS WAY S
B-24-1	HARRISBURG ST NE & DELAWARE AVE NE
I-15-3	LAMPARILLA WAY S & 25TH ST S

Major Outfall Inventory - Industrial

DISCHID	INTERSECTION
D-1-4	DAN WHELDON WAY & BAYSHORE DR SE
E-1-1	DAN WHELDON WAY & BAYSHORE DR SE
E-5-6	8TH AVE SE & 1ST ST S
E-5-5	8TH AVE SE & 1ST ST S
O-1-1	1ST AVE S & 60TH ST S
E-5-4	8TH AVE SE & 1ST ST S
R-10-1	15TH AVE N & FARAGUT DR N
R-10-2	15TH AVE N & FARAGUT DR N
R-10-4	15TH AVE N & FARAGUT DR N
L-7-1	13TH AVE S & 44TH ST S
K-13-1	38TH ST S & 22ND AVE S
D-1-3	ALBERT WHITTED AIRPORT
D-1-2	ALBERT WHITTED AIRPORT
K-5-1	8TH AVE S & 34TH ST S
K-5-2	8TH AVE S & 34TH ST S
H-2-1	BURLINGTON AVE N & 17TH ST N
H-4-2	BURLINGTON AVE N & 18 ST N
H-4-4	BURLINGTON AVE N & 18TH ST N
D-5-1	1ST ST SE & 1ST ST S
H-4-1	BURLINGTON AVE N & 18TH ST N
R-16-1	75TH ST N & 26TH AVE N
S-16-1	79TH ST N & 26TH AVE N
R-10-3	15TH AVE N & FARAGUT DR N
L-7-2	13TH AVE S & 44TH ST S
D-5-2	13TH AVE SE & BEACH DR SE
R-18-1	PINELLAS TRAIL & TYRONE BLVD N
R-16-2	26TH AVE N & 75TH ST N
H-4-3	BURLINGTON AVE N & 18TH ST N
D-1-5	DAN WHELDON WAY & BAYSHORE DR SE
R-16-3	75TH ST N & 26TH AVE N
R-16-4	TYRONE BLVD N & 71ST ST N



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MAJOR STORMWATER OUTFALLS

ENGINEERING AND CAPITAL IMPROVEMENTS DEPARTMENT
CITY OF ST PETERSBURG

Date: 12/19/2019
Map Number: ENG-0016e

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