L-8 FEB AND STA OPERATIONAL GUIDANCE STUDY

1.1 OVERALL STUDY PLAN SUMMARY

The primary objective of the L-8 Flow Equalization Basin (FEB) is to improve the operations of Stormwater Treatment Area 1 East (STA-1E) and Stormwater Treatment Area 1 West (STA-1W) by attenuating peak flows and temporarily storing stormwater runoff (SFWMD 2015b). The purpose of this L-8 FEB and STA Operational Guidance Study is to collect the necessary water quality, stage, flow, and groundwater data from within the FEB to improve predictive understanding of the relationships between these factors. Findings from this study should contribute to the development of operational guidance for the L-8 FEB that will assist STA-1E and STA-1W in achieving compliance with the effluent limits on total phosphorus (TP) in discharges to the Everglades.

The project team has completed an initial study phase and will conduct a second and potentially a third phase. Phase I included water quality sampling in the interior compartments of the FEB and in groundwater wells within the immediate project boundary. In Phase II, monitoring of surface waters within the FEB will be continued, with a focus on collecting samples during inflow and outflow pumping events at both high and low water levels in the FEB. In addition, sediment samples from within the FEB, L-8 Canal and soils from the banks of the FEB will be sampled and characterized to determine whether they are likely to contribute to water column TP export. Subsequent phases may include a continuation of the water quality sampling effort with some refinements, and/or an evaluation of potential biological sources of TP such as phytoplankton, mussels, and fish.

Upon completion of the second phase, a STOP/GO decision point will occur to determine whether to proceed to the next phase of the study.

1.2 BASIS FOR THE PROJECT

Key Science Plan Question Study Addressed

- Key question 1: How can the FEBs/reservoirs be designed and operated to moderate inflow phosphorus (P) concentrations and optimize P loading rates (PLR) and hydraulic loading rates (HLR) in the STAs, possibly in combination with water treatment technologies or inflow canal management?

1.3 BACKGROUND/LITERATURE REVIEW

The L-8 FEB, a critical component of the Restoration Strategies Regional Water Quality Plan (SFWMD 2012), is a 950-acre former rock mine capable of storing approximately 45,000 acre-feet (15 billion gallons) of water. It is located approximately 20 miles west of West Palm Beach, immediately west of the L-8 Canal and approximately 1 mile north of Southern Boulevard/State Road 80. Prior to incorporation into the South Florida Water Management District's Restoration Strategies Regional Water Quality Plan (SFWMD 2012), the L-8 FEB was part of the Comprehensive Everglades Restoration Program (CERP) and was referred to as the L-8 Reservoir. The facility consists of six interconnected cells in series, an inflow structure (G-538) and an outflow pump station (G-539), which deliver water to and from the L-8 canal (Figure 1). Details of additional structures and facility components are provided elsewhere (SFWMD 2015b).

The primary purpose of the L-8 FEB is to attenuate peak stormwater flows and temporarily store stormwater runoff to improve inflow delivery rates to Stormwater Treatment Area 1 East (STA-1E) and Stormwater Treatment Area 1 West (STA-1W), thereby providing enhanced operational flexibility and improved P treatment performance to assist in achieving state water quality standards in the Everglades Protection Area. The L-8 FEB also may be used to maintain minimum water levels and reduce the frequency of dry out conditions within STA-1E and STA-1W, which will sustain P treatment performance. The L-8 FEB began operations in June 2017. Following the Operational Cycle Testing Evaluation phase, the L-8 FEB began routine operations in December 2017.

As the L-8 FEB was not designed as a P removal facility, marked reductions in FEB water column P concentrations were not expected. While TP concentrations near the L-8 FEB outflow structure were lower than at the inflow sampling location in WY2017 (Xue 2018), outflow TP concentrations in WY2018 were higher than inflow TP concentrations (Xue 2019). Outflow TP concentrations observed during the first half of WY2019 were lower than inflow TP concentrations, as in WY2017. The water quality data collected in WY2018 suggests that the L-8 FEB could have been a source of TP during this period. Elevated TP concentrations near the outflow structure occurred from May to June 2017 and April 2018, when little flow entered the FEB and water levels were low. A concomitant increase in specific conductance levels was observed during those periods, which possibly indicates the influence of groundwater seepage (Xue 2019). Low stage conditions periodically are created to increase water storage capacity of the reservoir, but under these conditions there is increased potential for groundwater seepage into the reservoir from the surrounding surficial aquifer. While the interactions between the shallow groundwater within this surficial aquifer and the L-8 FEB operations are not well understood, there is a possibility that groundwaters are contributing substantial P loads to the FEB's surface water under certain operational conditions.

Several hypotheses have been proposed that suggest potential sources of water column P in the L-8 FEB (Table 1). These sources (discussed further below) include groundwater interactions, levee sediment erosion (sensu Daroub et al. 2005), benthic sediment resuspension (sensu James 2017, Shantz et al., 2004), and biotic P release (Griffiths 2006, Hoyer et al., 2009, DeBoer et al. 2016). While each of these sources has the potential to interact with P in the water column (see following sections), the primary goal addressed by Phase I of this study was to determine the spatial (vertical and horizontal) water column P concentrations over time within the L-8 FEB and whether groundwater is a potential source of P to the surface waters within the FEB. Phase II will focus on benthic sediment and levee bank soil composition as well as the operational conditions under which resuspension may occur.

Table 1. Hypotheses and study plan components to investigate potential sources of water column P in the L-8 FEB.

Phase	Hypotheses	Study Plan Components
I	1: High TP groundwater (relic seawater) flows into the FEB during low stages.	Water Quality Sampling and Analysis
II	2: Runoff induces erosion of levee sediments inside the FEB which contributes to an increase in allochthonous P loading.	Sediment and Soil Characterization within the L-8 FEB and L-8 Canal
	3: At lower FEB stages, benthic sediments are more easily resuspended, resulting in high TP concentrations in the water column.	Event-Based Surface Water Sampling
III	4: Rapid reductions in stage disrupt selected biological components inside the FEB, resulting in increases in internal P loading.	Impacts of Biota

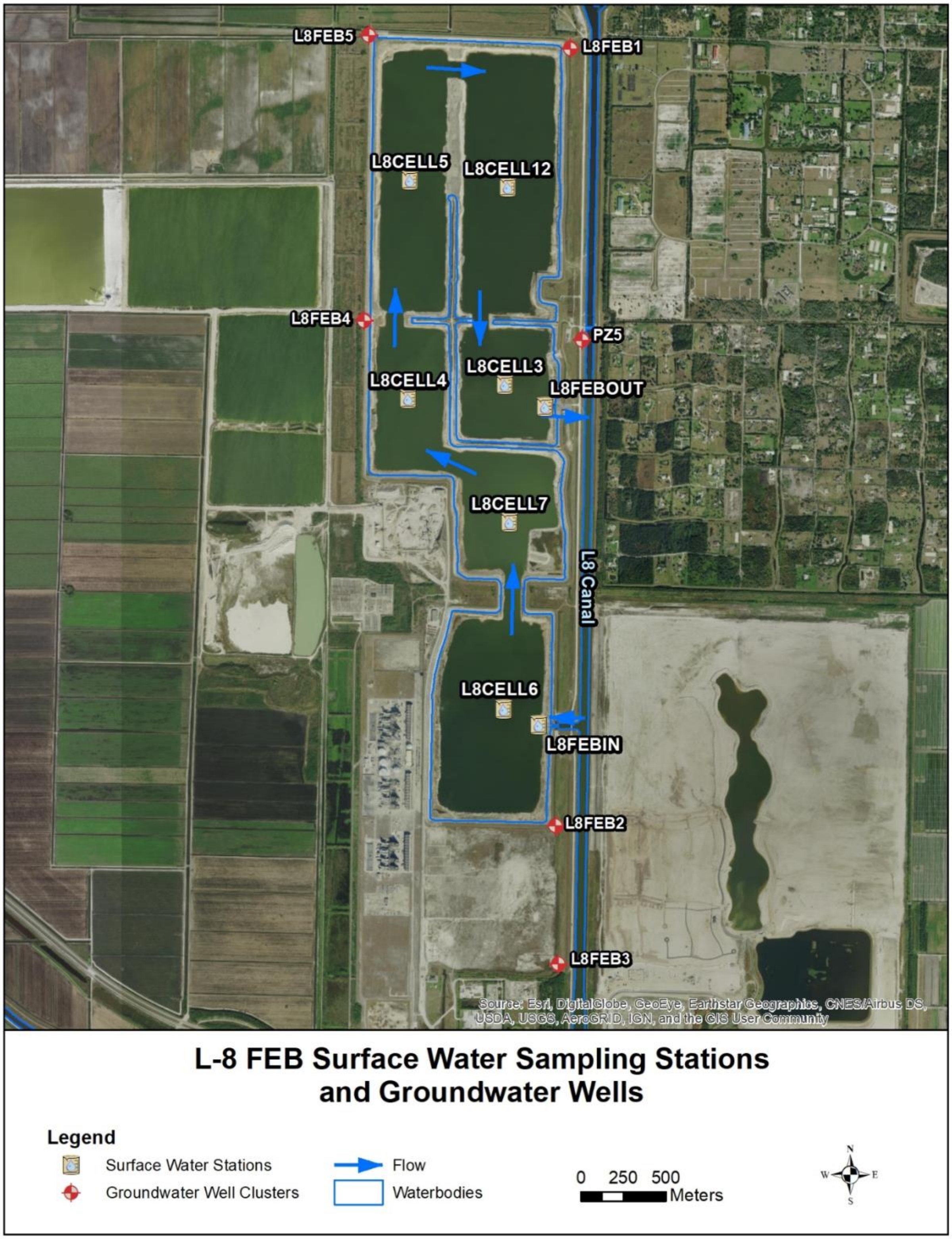

Figure 1. L-8 FEB surface water monitoring stations and groundwater wells.

1.3.1 Groundwater Interactions

Little is known about the potential for P exchange between the rock matrix into which the FEB was excavated, and the surface waters temporarily stored within this facility. Groundwater seepage into the FEB is known to occur at a rate that is relative to the head difference between the FEB stage and the L-8 Canal. A previous study estimated a seepage rate of 0.038 in/day/foot of head difference between the reservoir and the L-8 canal (MacVicar, Federico and Lamb, Inc. 2009). At the time of the seepage test, this rate was approximately 1.5 cfs per foot of head (Archer Western/Jacobs 2013). The operational range of water levels within the L-8 FEB create head differentials of 0 to 50 ft, which makes the potential range of seepage from 0 to 75 cfs. In an effort to reduce the seepage into the FEB, a low-permeability seepage barrier was installed around Cell 6 (BCI Engineers & Scientists, Inc. 2005). Even though it is clear that groundwater seepage into the FEB can occur, there unfortunately are no historical groundwater TP measurements available from the monitoring wells installed around the FEB to indicate whether such seepage is a likely source of high-P water to the reservoir (SFWMD 2015a).

The surficial aquifers of central and western Palm Beach County have been found to contain high salinity waters (Reese and Wacker 2009). Several hypotheses to the origins of these waters have been proposed. Either upwelling of brackish water from the Floridan aquifer, connate water, or relic seawater have been theorized to explain this high salinity water. Connate water is porewater that has been trapped within sedimentary rocks when they were deposited whereas relic seawater is seawater that was trapped in an aquifer during periods of elevated sea levels. Previous investigations support the hypothesis that the high salinities in the surficial aquifer in north central Palm Beach County result from the influence of relic seawater (Reese and Wacker 2009). Analysis and comparison of major anions and cations has been used successfully to classify water types and differentiate surface waters from groundwater and relic seawater with elevated chloride concentrations (Harvey et al., 2002). Similar approaches to characterizing shallow and deep groundwater interactions with surface waters in nearby STA-1W and WCA-1 were conducted by Harvey and McCormick (2009). Another recent study of shallow groundwater interaction with overlying and adjacent STA wetlands (STA-3/4 PSTA project) used chemical composition analysis and graphical representations (e.g., Piper diagrams) to characterize seepage (Zamorano 2017). That study found more evidence of lateral seepage potential than vertical groundwater flux. The water depths and changes in stage within the L-8 FEB are substantially greater than those in the STA-3/4 PSTA project, STA-1W or WCA-1. Hence, gradients in hydraulic potential will be higher for the L-8 FEB under most regional and operational conditions than were encountered in these previous studies. Importantly, however, these previous studies demonstrated that the differences in chemical composition between groundwater and surface water can be used to detect groundwater seepage into surface waters.

Prior studies have suggested that relic seawater contributed to elevated conductivity in farm canals of the Everglades Agricultural Area (EAA) and shallow groundwater in the region (Chen et al., 2006; Harvey et al., 2002). While these studies have documented influence of relic seawater in some canals, the location and extent of relic seawater in the region is undefined (SFWMD 1989). Previous studies have not reported the P content of the relic seawaters, and therefore it is unknown whether these are important sources to the surface waters of the L-8 FEB. A thorough chemical characterization of both the L-8 FEB water column and the groundwater in the adjacent surficial aquifer, the focus of Phase I of this project, has provided additional insights (DBE 2019e).

1.3.2 Erosional and Resuspension Processes

Most of the upper portions of the L-8 FEB levees are armored with concrete revetments (SFWMD 2015b). However, at lower water levels, large areas of the unarmored levees and banks may be exposed to erosive forces. The rate of erosion is dependent on physical characteristics such as slope, composition and degree of exposure. Because eroded material is transported and deposited based on particle size and density, fine clay-sized particles and eroded low-density organic material may remain suspended in the water column, while larger aggregates will settle quickly. The degree of mixing in the FEB, coupled with operations (inflow/outflow), may result in the release of highly turbid water with elevated P concentrations (Turner 1981). Because little is known about the P content of the levee and bank materials within the FEB, and erosion of the unarmored portions of the bank is evident (photo), the potential P contribution to the FEB surface water via erosion warrants further investigation.

Drawdowns of the FEB not only expose greater areas of the banks to erosion, the shallow water levels could also subject the bottom sediments to increased resuspension by waves or currents. The sediment surface of the L-8 FEB was reportedly covered by fine rock material that remained from mining and aggregate processing operations (SFWMD 2015b). The current composition, extent and distribution of these sediments is unknown. In addition, organic sediments from the accumulation of decaying and settled algae are a potential source of TP to the water column. The resuspension of benthic sediments can contribute to P and total suspended solids (TSS) export from reservoirs after drawdown (Shantz 2004; Ploskey 1983). The suspension of sediments in reservoirs can release P into the water column and fuel algal growth, or alternatively, act as a P sink (e.g., Hansen et al., 1997).

1.3.3 Impacts of Biota

Due to fluctuating water levels, the L-8 FEB lacks a stable and substantial littoral zone. The dominant vegetation in the L-8 FEB is likely phytoplankton, although floating macrophytes may also occur in the system. Fish, invertebrates, and other faunal species within the FEB also represent biological sinks of P. Fish biomass within lakes and reservoirs typically increases under higher nutrient conditions (Griffiths 2006), and the L-8 FEB is relatively nutrient rich. It is also hydraulically connected to canals and marsh environments that support large fish populations (SFWMD 2010). Anecdotally, the fish community in the L-8 FEB is healthy. During routine monitoring for toxicants in fish, FWC found that between 2006 and 2010, the FEB supported a population of bluegill, sunfish and largemouth bass (FWC 2007, 2008, 2009, 2010, 2011).

Research on the effects of large-scale drawdowns of reservoirs and lakes has shown significant changes to ecological processes and aquatic communities within and downstream of the waterbody (Wantzen et al. 2008, Wright and Szluha 1981, Ploskey 1983). Drawdowns of reservoirs have the potential to cause fish kills as a result of lower dissolved oxygen (DO) levels (Benejam et al. 2007). Large-scale fish mortality has resulted in the increase of P in the waters downstream (Cak et al. 2008). The desiccation of mussels and other benthic invertebrates may also occur in the zone of water level fluctuation (Wright and Szluha 1981) and may be another P source to the surface water. If P concentrations are found to increase within the L-8 FEB and the data indicate that groundwater, levee erosion and sediment resuspension are likely not the primary source, the effects of operations on biota could be considered in the future.

1.4 STUDY HYPOTHESES AND EXPERIMENTAL DESIGN

Phase I of this study consisted of initial baseline data collection to characterize the chemical composition of the water column and groundwaters associated with the L-8 FEB project (DBE 2019a). The study's data and analyses were used to provide insight into the relationships between L-8 FEB water quality and stage, flows, and groundwater interaction, to address Hypothesis 1 (DBE 2019e). The study results may also be used in the development of operational guidance for the L-8 FEB in a manner that assists STA-1E and STA-1W in achieving compliance with the effluent limits for TP in discharges to the Everglades.

Phase II of the study will include additional analyses and interpretation of the data collected in Phase I, plus evaluation of levee and benthic sediments and processes that may cause erosion or resuspension of these sediments. The Phase II data and associated analyses will address Hypotheses 2 and 3. A potential Phase III collection effort may address biological sources of P to the water column of the FEB to address Hypothesis 4.

1.4.1 Study Plan Description

This study plan describes a sample collection effort at the L-8 FEB, including chemical analysis and data evaluation, that is separate from any permit-required routine collection of stage, flow, and water quality data, and which is being performed to develop insights into how operations affect the sources of P in the FEB.

This multi-year study began in October 2018 and is anticipated to continue through September 2021. This study is comprised of an initial phase (completed) and one or two subsequent phases with STOP/GO points between each phase. Phase I included monthly water quality sampling in the interior compartments of the FEB and quarterly sampling in the surrounding groundwater wells (i.e., within the immediate project boundary) during an 8-month period (DBE 2019a, b, c and d). Phase II (described here) will include a more exhaustive analysis and interpretation of the Phase I data (DBE 2019e), continued and refined water quality sampling in the FEB, along with an evaluation of potential internal sources of TP from runoff, soils and sediments. A subsequent phase may include an evaluation of biological sources of P, such as phytoplankton, mussels, and fish, if warranted.

1.4.2 Study Plan Components

Phase I – Water Quality Sampling and Analysis

Water quality data was collected at 6 locations monthly for 8 months at the approximate center of each cell (L8CELL12 to LCELL7, Figure 1) and locations near the inflow and outflow of the FEB (L8FEBIN and L8FEBOUT, Figure 1). A vertical profile of specific conductance, pH, temperature, and DO was taken at 1.0 m intervals. Three water samples were collected: surface (0.5 m), mid-depth (1/2 total depth m), and bottom (within 0.5 m of the FEB floor). Water samples were analyzed for Total Nitrogen (TN), Total Phosphorus (TP), Total Dissolved Phosphorus (TDP), Orthophosphate (OPO4), Nitrate-Nitrite (NOX), Ammonia (NH_4), Dissolved Calcium (Ca), Chlorides (Cl), Sulfates (SO_4), Dissolved Magnesium (Mg), Dissolved Sodium (Na), Dissolved Potassium (K), Alkalinity (ALKA), Dissolved Organic Carbon (DOC), and TSS. In addition, surface water samples were collected for these parameters at, or adjacent to, the inflow and outflow structures (L8FEBIN and L8FEBOUT). Samples were only collected from L8FEBIN and L8FEBOUT locations when there was no flow from the nearby structure to ensure the safety of the field sampling personnel. In the event of flow through the G538 structure the L8FEBIN sample was collected from the bridge immediately upstream of G538.

Groundwater well clusters (L8FEB1 to L8FEB5 and PZ5) were sampled on a quarterly basis for the same suite of parameters, except for TSS. The groundwater wells are equipped with data recording instrumentation. These instruments were removed by SFWMD's Water Quality Monitoring Bureau staff prior to sampling and replaced in the wells after sample collection.

For each sampling event, the samples were submitted to SFWMD's laboratory for analysis. On a quarterly basis (i.e., three in Phase I) sample results were reported and analyzed for consistency. Exploratory data analysis reports were developed quarterly, in which spatial and temporal trends in nutrients, ions, and other collected parameters were presented in a graphical fashion. Piper (trilinear) diagrams were also included in each report (DBE 2019b, c and d). These quarterly reports focused exclusively on presentation of results, rather than on interpretation and discussion of the findings.

After all Phase I water quality sampling and data analyses were complete, the study team met to review and discuss the results. It was decided that the water quality data are aiding in the understanding of the influence of operations on TP concentrations in discharges. The team discussed whether to continue the water quality sampling in the FEB and in the groundwater wells into the next phase, as well as whether to conduct other study components as noted in the subsequent phase section below. The team recommendation was to continue to the next phase. The final STOP/GO decision to proceed with Phase II will be made by the Restoration Strategies Steering Group.

Phase II – Data Analysis, Water Quality, Sediment and Soil Characterization

Detailed Interpretation and Discussion of Phase I Data

Phase I of this study was a data collection effort to evaluate the L-8 FEB water quality (nutrients, ions, temperature, DO, and conductivity) and groundwater quality to provide insight into the relationship of the L-8 FEB water quality with stage, flows, and potential groundwater interaction. The surface water and groundwater data collected from January to August 2019 was analyzed to assess whether groundwater seepage is a significant source of P contributing to the TP export previously observed and to address the hypothesis: "whether high TP groundwater (relic seawater) flows into the FEB during low stages". The results of this data analysis were provided in summary report.

Only one well (L8FEB3L) showed evidence of relic seawater (based on ionic composition), and the TP concentrations of that groundwater were relatively low, at 26, 50, and 26 µg/L TP in January, April, and July 2019, respectively. The remaining wells in the surficial aquifer surrounding the L-8 FEB also had low groundwater P concentrations (mean of 28 µg/L). These data do not support the hypothesis that the surficial groundwaters or relic seawater are high in TP. Furthermore, when compared to the surface water TP concentrations (mean of 111 µg/L), the low groundwater TP concentrations suggest that any groundwater contribution would dilute the surface waters and lower the TP concentration of water within the L-8 FEB.

These data, do however, show evidence of groundwater seepage into the reservoir, which could potentially contribute between 6-15% of the P load to the L-8 FEB. This is not a substantial source when compared to the P loading from surface water, and therefore it is very unlikely that groundwater-associated P could explain the high (>200 µg/L) TP concentrations previously observed in the L-8 FEB outflow samples. However, under low stage conditions, like those observed in July 2019, groundwater seepage does appear to affect the ionic composition of surface waters within the reservoir by increasing the sodium and chloride concentrations.

Particulates are the dominant form of P in the reservoir during periods of high P concentrations. The large inflow event in January 2019 contributed a substantial load of dissolved and particulate P to the L-8 FEB and resulted in elevated P concentrations throughout the water column, which were dominated by PP. Planktonic algae can quickly utilize the dissolved bioavailable P fraction, and the quiescent conditions that allowed the water column to become stratified in February could promote settling of algae and PP to the hypolimnion. These P-enriched waters may have been transported toward the discharge pumps that were operational prior to the sampling event in February, and potentially accounted for the increasing bottom water TP trend toward the FEB outfall. Extended pumping prior to the July 22, 2019 sampling event lowered the water levels by 12.4 ft and created a shallow water column approximately 9 ft (2.8 m) deep. Elevated P levels observed in July were again almost entirely particulate. Based on available data it is unclear whether pumping or wind and wave action contributed to the resuspension of particulates or if an algal bloom is the source of elevated PP in these samples. Determining the source and composition of the PP observed at times in the L-8 FEB will be the focus of Phase II investigations.

Continuation of Phase I Water Quality Sampling and Analyses

Two additional surface water sampling events, one in October and one in December, will be performed to complete the annual 2019 water sampling efforts. The parameters will be the same (i.e., nutrients, ions, temperature, DO, and conductivity) as those collected during previous months in 2019. Chemical analyses will be performed by the SFWMD's laboratory. A data report will be provided, similar to the data reports provided in FY 2019.

Sediment and Soil Characterization within the L-8 FEB and L-8 Canal

To determine if erodible soils are a potential source of P to the L-8 FEB, specific areas along the banks of the reservoir will be evaluated. Little is known about the P content of the levee and bank materials within the L-8 FEB. Sediment and soil samples will be collected from levee banks, below the concrete revetments in the L-8 FEB, at 3 locations where erosion potential appears high (Figure 2).

L8 FEB sediment samples will also be collected to help determine their source, and to characterize whether they are likely to contribute to water column TP export. Sediment material will be collected with an Ekman dredge from the center of each of the 6 reservoir cells (Figure 2). In addition, L-8 canal sediments will be collected from three locations upstream of the inflow structure, and from one additional location within the reservoir, just downstream of the inflow spillway (the internal "spoil mound") (Figure 2). These sediments, along with soils from the levees, will be sampled and analyzed for total P, water extractable P, bulk density and ash free dry weight (AFDW). The analysis of these data will focus on addressing Hypothesis 2. All chemical analyses will be performed by the DB Environmental (DBE) laboratory.

To address Hypothesis 3, sediment and soil samples collected from within the FEB cells and L-8 Canal will be evaluated for P release during suspension events through laboratory experimentation and analysis. An aliquot of each sediment sample will be used to evaluate the relative contribution to persistent turbidity after settling, through controlled resuspension in the laboratory. Following suspension in laboratory vessels, TP, TDP and turbidity of the supernatant will be measured after 0.5 hr, 1 hr and 24 hours of settling. Results will be provided in a laboratory analytical report. These results will provide insight into the potential source of sediments in the L-8 FEB, as well as provide an indication of the potential for various bottom sediments to contribute to elevated suspended particulate P and dissolved P concentrations in the reservoir water column and outflow, relative to sediments from the source canal (L-8 canal) and levee banks.

Event-Based Surface Water Sampling

To supplement the sediment and soil characterization efforts in defining the potential source of PP to the water column within the L8 FEB, this effort will define the conditions and driving forces that cause the internal resuspension of sediments. A targeted sampling effort of the water column will be undertaken. Flow volume and velocity are likely factors contributing to the resuspension of sediments. Four surface water sample collections will occur during different inflow and outflow conditions to examine this relationship. This will involve sample collection of FEB waters, spatially and with depth, during four events, bracketing differing flow/stage conditions. For example, likely conditions to be targeted include high inflow spillway flow rates, both during low and high stages, and during an outflow pumping event, during both low and high stages. It is understood that the manipulation of water levels for this study are unlikely to occur and that sampling will be opportunistic based on routine FEB operations.

Samples for all 4 events will be collected from the L-8 canal upstream of the inflow and near the outflow structure (surface only), near the center of each cell (at three depths: surface 0.5 m, mid-depth, and 0.5 m above the bottom), and in the channels exiting Cell 6 (inflow cell) and entering Cell 3 (outflow cell) (Figure 3). These channels are likely to exhibit relatively high velocity conditions when the FEB is filling or discharging, particularly under low stage conditions. Samples will be submitted to SFWMD's laboratory for chemical analyses of TP, TDP, SRP, turbidity, TSS, volatile suspended solids (VSS), and chlorophyll a. These analytical parameters will allow for quantifying the inter-relationships among TP, PP and turbidity. Concentrations of non-volatile suspended solids (NVSS), a measure inorganic particulate matter (Phlips et al. 1995), will be calculated from the difference in TSS and VSS. If turbidity is found to be a good surrogate for water column P, then it is possible that real-time turbidity monitoring can provide guidance for optimizing future FEB operations, in a manner so as to minimize the export of P. Further, the chlorophyll α analyses will provide insight as to whether phytoplankton are a primary component of the suspended particulate matter, rather than the sediments that accumulate in the FEB.

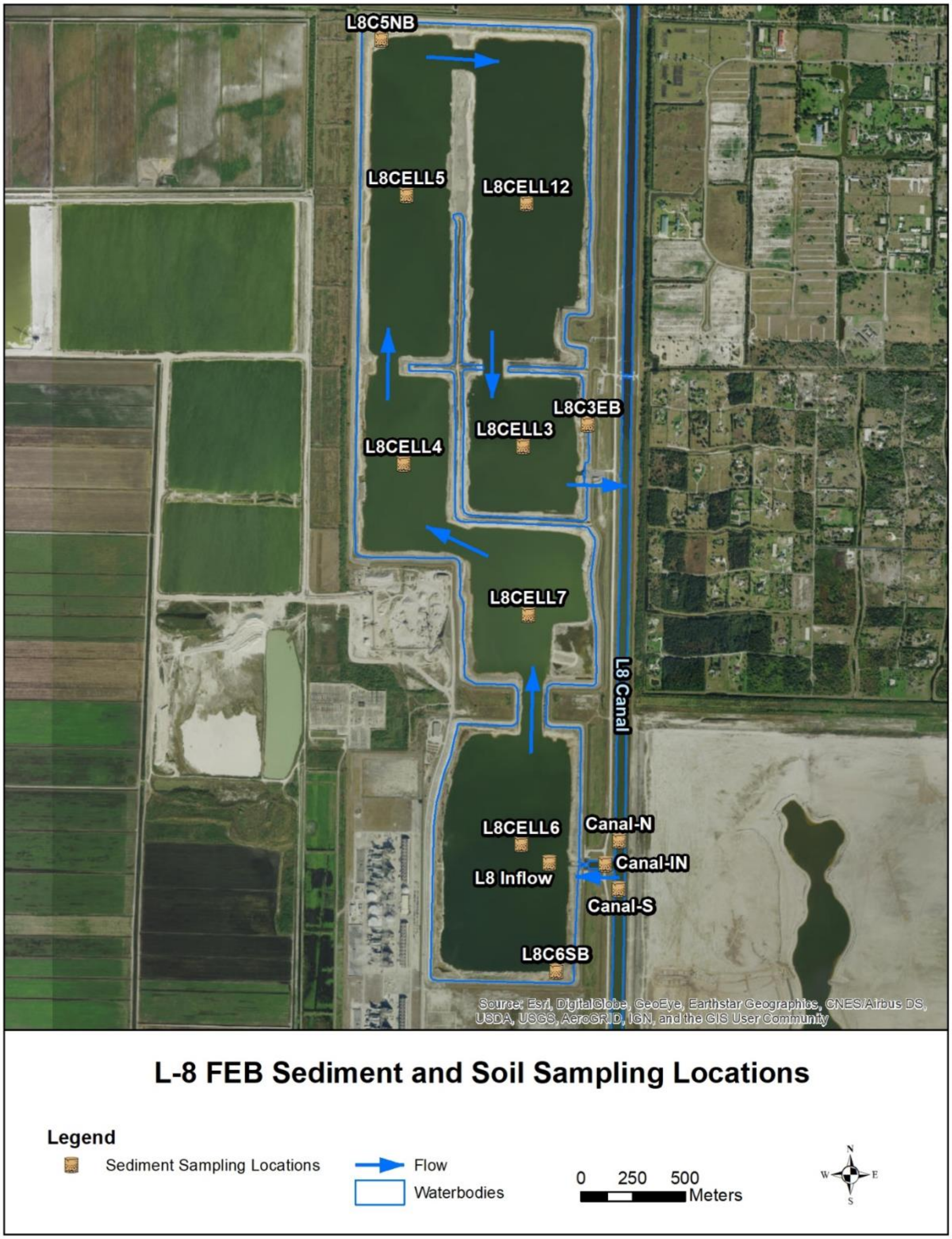

Figure 2. L-8 FEB Sediment and soil sampling locations.

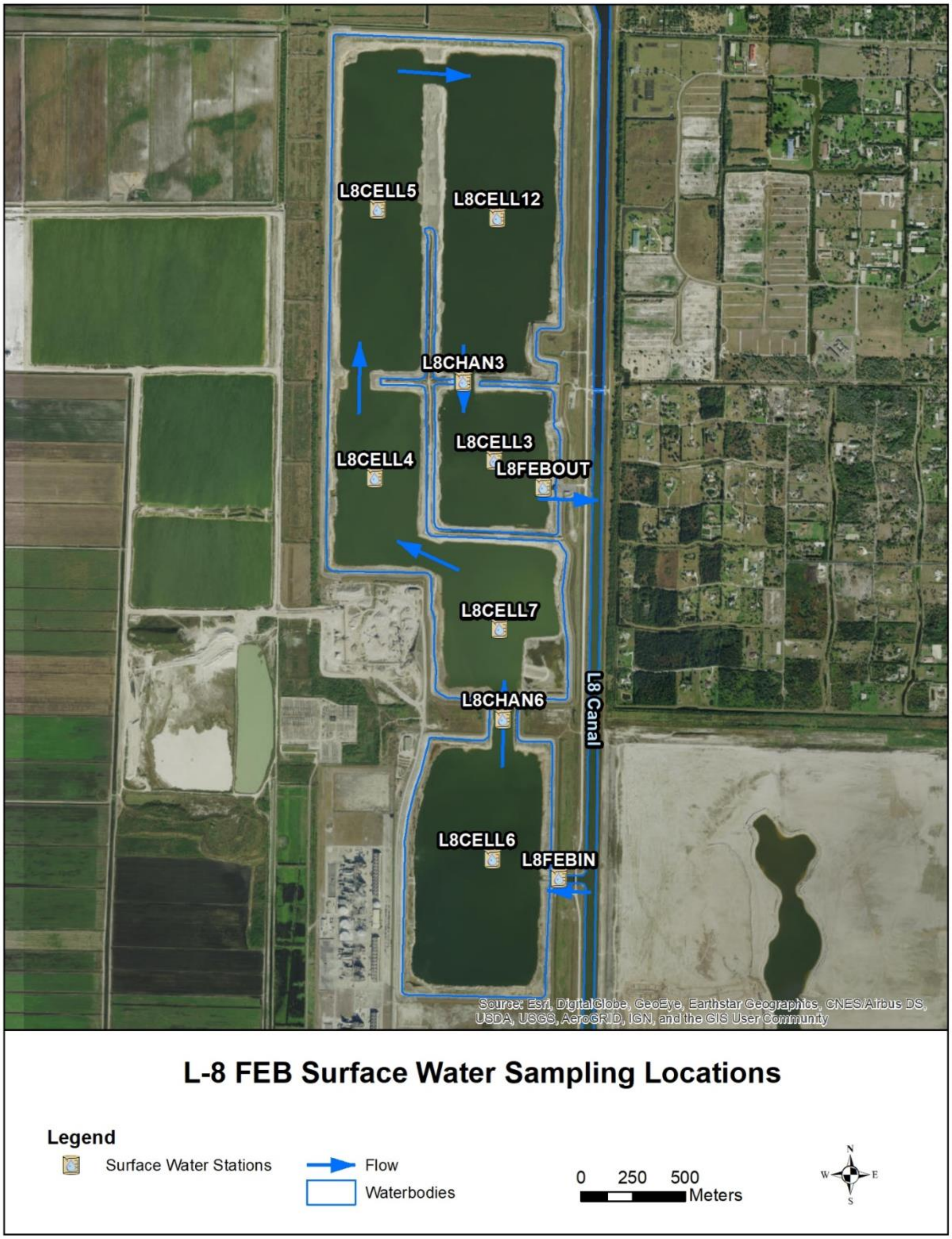

Figure 3. L-8 FEB Surface water sampling locations

Potential Phase III Investigations

A potential Phase III investigation may consist of follow-on sampling (e.g., of sediments, water column, etc.) and/or data analysis efforts suggested from the Phase II findings. Additionally, it may be appropriate to conduct an additional Phase III effort (see below) to assess the impacts of biota on water column P concentrations.

Impacts of Biota

If water column P concentrations are higher within the L-8 FEB than the L8 inflow and the data indicate that groundwater, levee erosion and sediment resuspension are not likely sources, the effects of operations on biota could be considered. A sampling program that addresses the standing crop biomass and P contents of biotic components could improve the overall understanding of P dynamics and potential biological P sources within the operational FEB environment and begin to address Hypothesis 4. Based on the results of the event-based water sampling in Phase 2, additional water samples could be collected from the L-8 FEB and analyzed for chlorophyll α to better characterize the phytoplankton contribution to water column P. Supporting data from sondes equipped with turbidity and/or chlorophyll α sensors could be used to capture the response of the phytoplankton community to operational conditions. In addition to phytoplankton, other biological sources of P to the water column could also be considered. Invertebrate populations (mussels, clams, snails, etc.) within the basin could be estimated and samples collected for analysis of TP content to calculate the potential TP mass contribution through desiccation during drawdown. Phosphorus mass storage in the fish population could also be estimated through fish density surveys and TP measurements of tissue samples.

1.4.3 Data Management and Reporting

All data and field notes will be maintained for the project by the study leader. All data products and associated metadata shall undergo a quality assurance/quality control screening. All sampling procedures laboratory analyses, and documentation will comply with Chapter 62-160, FAC and the associated field sampling SOPs. Accuracy and precision in laboratory analysis will be validated and reflected in the data sets and reports.

In addition, a Data Management Plan (DMP) has been created and will be maintained throughout the lifespan of the study (SFWMD 2019). The DMP will address planning prior to the acquisition of data; the actual data collection effort; quality assurance / quality control (QA/QC) measures; data back-up, security, and preservation plans; and publishing and sharing considerations.

1.4.4 Study Schedule

Phase I:	Initiate work – FY2019
	Complete work – FY2019
Phase II and beyond:	Initiate work – FY2020
	Complete work – FY2021 or FY2022

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