

SAMPLING AND ANALYSIS PLAN

FOR

THE STA1-E FIELD SCALE

PSTA DEMONSTRATION PROJECT

PALM BEACH COUNTY, FLORIDA

FEBRUARY 2007



**US Army Corps
of Engineers®**

JACKSONVILLE DISTRICT

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LIST OF ACRONYMS AND ABBREVIATIONS

APA	Alkaline Phosphatase Activity
cfs	Cubic Feet per Second
COC	Chain-of-Custody
EAV	Emergent Aquatic Vegetation
EPA	Environmental Protection Agency
ET	Evapotranspiration
FAV	Floating Aquatic Vegetation
FCR	Field Change Request
FCRTF	Flying Cow Road Test Facility
FDEP	Florida Department of Environmental Protection
ft	Foot
FSP	Field Sampling Plan
FTL	Field Team Leader
gpm	Gallons per minute
HLR	Hydraulic Loading Rate
HRT	Hydraulic Retention Time
in	Inch
MS/MSD	Matrix Spike/Matrix Spike Duplicate
PARCC	Precision, Accuracy, Reproducibility, Completeness, And Comparability
PM	Project Manager
PSTA	Periphyton Stormwater Treatment Area
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SAV	Submerged Aquatic Vegetation
SFWMD	South Florida Water Management District
STA	Stormwater Treatment Area
STA-1E	Stormwater Treatment Area-1 East
STA-1W	Stormwater Treatment Area-1 West
TP	Total Phosphorus
USACE	U.S. Army Corps of Engineers

1 OVERVIEW AND PROJECT BACKGROUND

The U.S. Army Corps of Engineers (USACE), Jacksonville District has prepared this Sampling and Analysis Plan (SAP) for Field Sampling of the STA-1E PSTA Demonstration Project, Palm Beach County, Florida.

The SAP was prepared in accordance with the USACE Requirements for the Preparation of Sampling and Analysis Plans – USACE EM 200-1-3, February 1, 2001. The SAP consists of two main parts: the first part (Volume I) presents the Field Sampling Plan (FSP), and the second part (Volume II) presents the Quality Assurance Project Plan (QAPP).

This document represents the Field Sampling Plan (FSP) for studies to be performed at Cell 2 of STA-1E. A schematic diagram of STA-1E and the different cells in STA-1E is shown on Figure 1. Cell 2 of STA-1E is a periphyton applied demonstration project located in Northern Palm Beach County. Cell 2 of STA-1E is a pilot-scale test facility constructed in 2006 to demonstrate the use of periphyton mat communities to achieve the goals of Phase II of the Everglades Forever Act (EFA). The EFA Phase II mandated that the South Florida Water Management District (SFWMD) and the Florida Department of Environmental Protection (FDEP) conduct a research and monitoring program to include, among other things, the identification of treatment and/or management methods that are superior to stormwater treatment areas (STAs) in achieving optimum water quality and quantity for the benefit of the Everglades.

The goal of PSTA technology is to create the conditions for calcareous periphyton mats to form. Phosphorus is absorbed by actively growing periphyton mat organisms (green algae, cyanobacteria [blue-green algae], diatoms, and associated microbial community). Testing completed in 2003 and 2006 at the Flying Cow Road Test Facility (FCRTF) demonstrated the periphyton mat could efficiently remove phosphorus from the water column at high and very low concentrations (~ 100 to 10 ppb TP).

The overall goal of Phase II is the achievement of total phosphorus (TP) concentrations in agricultural and urban runoff that will result in no imbalance of flora and fauna in downstream receiving waters of the Everglades Protection Area (EPA). The Phase II TP concentration criterion has been established at 10 ppb, based on research conducted by the SFWMD, Southeast Environmental Research Center, U.S. Environmental Protection Agency (USEPA), and Everglades National Park (Department of Interior).

The purpose of this project is to further demonstrate the application of periphyton-based stormwater treatment areas (PSTA) technology on field-scale test cells prior to the implementation of full scale in STA-1E. Specific objectives of this study include: (1) demonstrating the treatment performance of different cell substrates; (2) providing sufficient information to further develop the operations of the PSTA at STA-1E; and (3) establishing design parameters for full-scale implementation. All tasks are in direct support of the design of the PSTA treatment and to gather the data needed to develop a concentration based PSTA model.

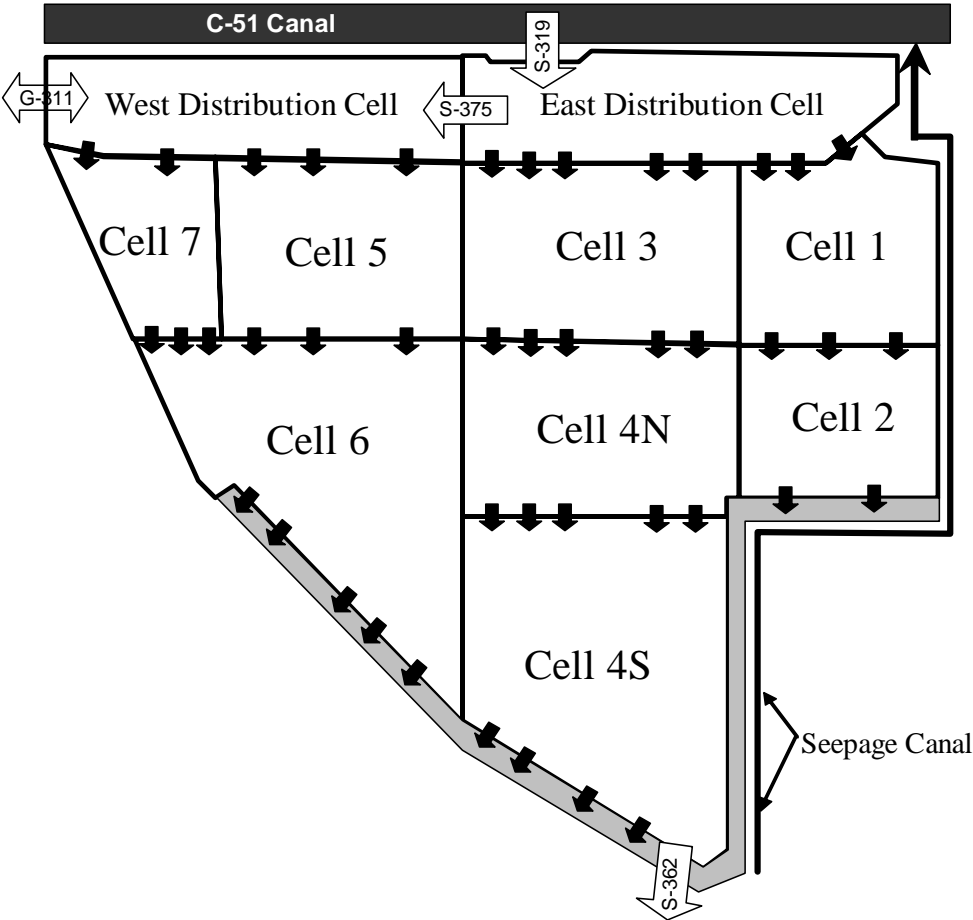


Figure 1. STA-1E Project Layout

2 PROJECT ORGANIZATION AND RESPONSIBILITIES

An organizational structure has been developed to identify the roles and responsibilities of the various parties involved with the project. The structure for this project includes USACE, Portland State University (PSU) and several subcontractors. This section provides the roles and responsibilities of the various parties for the project. Table 1 provides a list of project personnel and their roles.

The Jacksonville District of the USACE is the main agency overseeing the sample collection and analysis. Mr. John Keiser is the USACE Project Manager, while Mr. William Neimes is the Technical Point of Contact. PSU will provide support to USACE, and will receive technical, quality, and cost direction solely from the USACE.

Facility oversight and field leadership will be provided by a subcontract to PSU. PSU is responsible for the overall quality of the work performed by the field personnel. The subcontractor has the primary responsibility and authority for the day-to-day activities associated with the project, including identifying staff requirements; ensuring implementation of quality procedures and adherence to applicable codes and regulations; executing the technical, QA and administrative aspects of the field work; and monitoring performance in relation to the established scope, budget, and schedule. The subcontractor project manager (PM) is accountable for ensuring that the investigation is conducted in accordance with applicable plans and guidelines, including the FSP, and the Safety and Health Plan, and, when necessary, he will document any deviations from the approved plans/procedures for PSU and USACE approval prior to implementation. The PM has the responsibility for overseeing the preparation of project deliverables to be submitted by the contractor or their subcontractors.

PSU is the principal technical lead, responsible for providing the technical direction for the project and all the testing and sampling being conducted. The USACE and the SFWMD is responsible for day-to-day operations of STA-1E Cell 2.

A commercial lab will be contracted by USACE to procure subcontracted analytical services in the surface water for low level phosphorus, calcium, iron, potassium, sodium, chlorides, sulfate, total kjeldahl nitrogen (TKN), total dissolved solids, and total suspended solids during the Field Scale Demonstration Test. PSU will perform supplemental analysis on total phosphorus (TP) with ultra trace levels of TP. In addition, PSU will perform analysis on total organic carbon, dissolved organic carbon, ammonia, nitrate, nitrite, total nitrogen, and total dissolved solids. PSU will also provide the analysis on all sediment and periphyton samples being collected.

The quality management of the project is the responsibility of the Quality Assurance/Quality Control (QA/QC) Manager, ????. The QA/QC Manager is accountable for all QA/QC activities, including, verification of corrective actions, and supervision of data quality evaluation activities.

The field team leader responsible for the management and supervision of the sample collection program, providing consultation and decision-making on day-to-day issues relating to the sampling activities and facility operations. The field team leader oversees the sampling to determine that operations are consistent with approved plans and procedures, and that the data acquired meets the analytical and data quality needs. When necessary, the subcontractor will document any deviations from the plans/procedures for approval by the PM and USACE prior to implementation.

Facility landscape maintenance, and control system maintenance will be handled by subcontractors as needed or by the SFWMD. A document “PSTA Operation and Partnering Plan” details the responsible parties for system maintenance of Cell 2. The subcontractors will be retained and managed by PSU which will be responsible for their performance of maintaining structures that are under the control of the USACE. PSU and the USACE will coordinate their activities closely on all aspects of operations. Laboratory analysis will be coordinated by USACE or contractors identified above. All interaction between the sampling contractors will occur through the USACE Technical Point of Contact or his designee. When a need arises for the sampling contractor to contact any of the analytical laboratories, the sampling contractor will communicate its request to the USACE Technical Point of Contact, who in turn will communicate with the analytical laboratory to address the matter. The same protocol, working through the USACE Technical Point of Contact, will be used by the analytical contractor in communicating with the sampling contractor.

Table 1. Directory of Key Personnel

<p>Project Manager, USACE</p>	<p>John Keiser, P.E. US Army Corps of Engineers 701 San Marco Blvd. Jacksonville, FL 32207 Telephone: 904-232-1758 Fax: 904-232-1434</p>
<p>Technical Point of Contact USACE</p>	<p>Bill Neimes, P.E. US Army Corps of Engineers 701 San Marco Blvd. Jacksonville, FL 32207 Telephone: 904-232-3484 Fax: 904-232-3665</p>
<p>Alternate Technical Point of Contact USACE</p>	<p>Peter Besrutschko US Army Corps of Engineers 701 San Marco Blvd. Jacksonville, FL 32207 Telephone: 904-232-2298 Fax: 904-232-2237</p>
<p>Commercial Lab</p>	
<p>PSU Lead Scientist</p>	<p>Dr. Ronald D. Jones, Ph.D. 815 NW 57th Avenue, Suite 204 Miami, FL 33126 Telephone: 786-514-5455 Fax: 305-264-6116</p>
<p>Contractor's Field Team Leader</p>	

3 PROJECT SCOPE AND OBJECTIVES

The purpose of this project is to further demonstrate the application of PSTA technology in Cell 2 of STA-1E.

Specific objectives of this study include: (1) demonstrating the treatment performance of three different substrates; (2) providing sufficient information to further develop the operations of a Full Scale Test Facility; and (3) establishing design parameters for the full scale demonstration project. All tasks are in direct support of the design of the PSTA treatment and to gather the data needed to develop a concentration based PSTA model.

During the study, water flow rates, flow cell water depths, and hydraulic retention times (HRTs) will be varied within the test cells to evaluate several flow regime scenarios. There will be a start up scenario to establish the periphyton mat, a fixed flow scenario, a period of record operations scenario, and a simulated extreme condition scenario. Field measurements and appropriate data will be collected during each of the scenarios to fulfill the project objectives as described above.

4 FACILITY OVERVIEW

This section provides an overview of the facility's main elements and a simplified description of the flow of water through STA-1E (Figure 2) and the flow of water through the Demonstration Test Cells from the Eastern Distribution Cell through Cell 2 (Figure 3).

At the head of the treatment train will be EAV in Cell 1. Cell 1 is expected to discharge into a 55 acre SAV Cell in Cell 2. The SAV cell is designed to deliver flow in the eastern direction toward the inflow points of the three PSTA Cells, which are to discharge to the Cell 2 collection channel and then ultimately discharge from the STA through S-365 B.

4.1 Cell 1 EAV

Cell 1 is a 556 acre treatment cell that is the first step in the PSTA treatment train designated for EAV growth.

4.2 Cell 2 SAV Cell

The SAV Cell is a 55 acre treatment cell located along the northern extreme of Cell 2. This cell is both the second step in the PSTA treatment train and provides the hydraulic head for flows into the PSTA Demonstration Cells. The ground surface elevation of the SAV Cell within Cell 2 has been designed to be 15.0 feet National Geodetic Vertical Datum (NGVD).

4.3 PSTA Cells

The PSTA Cells are the final step within this treatment train and consist of three 46.5 acre cells comprising a total area of 139.5 acres. The ground surface elevation of these cells has been designed to be 16.25 ft NGVD. The remainder of the cell, referred to as the Cell 2 "Bypass," has a slightly irregular ground surface but is expected to be approximately 15.75 feet NGVD.

4.4 Cell 2 Bypass

The Cell 2 Bypass is 364 acres, located on the western side of Cell 2, and is used for both passing water through the cell and minimizing the head difference between the PSTA Cells and the remainder of Cell 2. Eight in-line risers with 48 in. culverts connect the SAV Cell to the Cell 2 Bypass; and the outfall is the S-365 A structure. If possible, the bypass area of Cell 2 will be maintained as SAV. However, if there is not adequate water or if the water levels in the bypass do not meet PSTA objectives, the bypass vegetation will not be managed for any particular treatment macrophyte community (EAV or SAV).

Schematic of STA-1 East (Not to Scale)

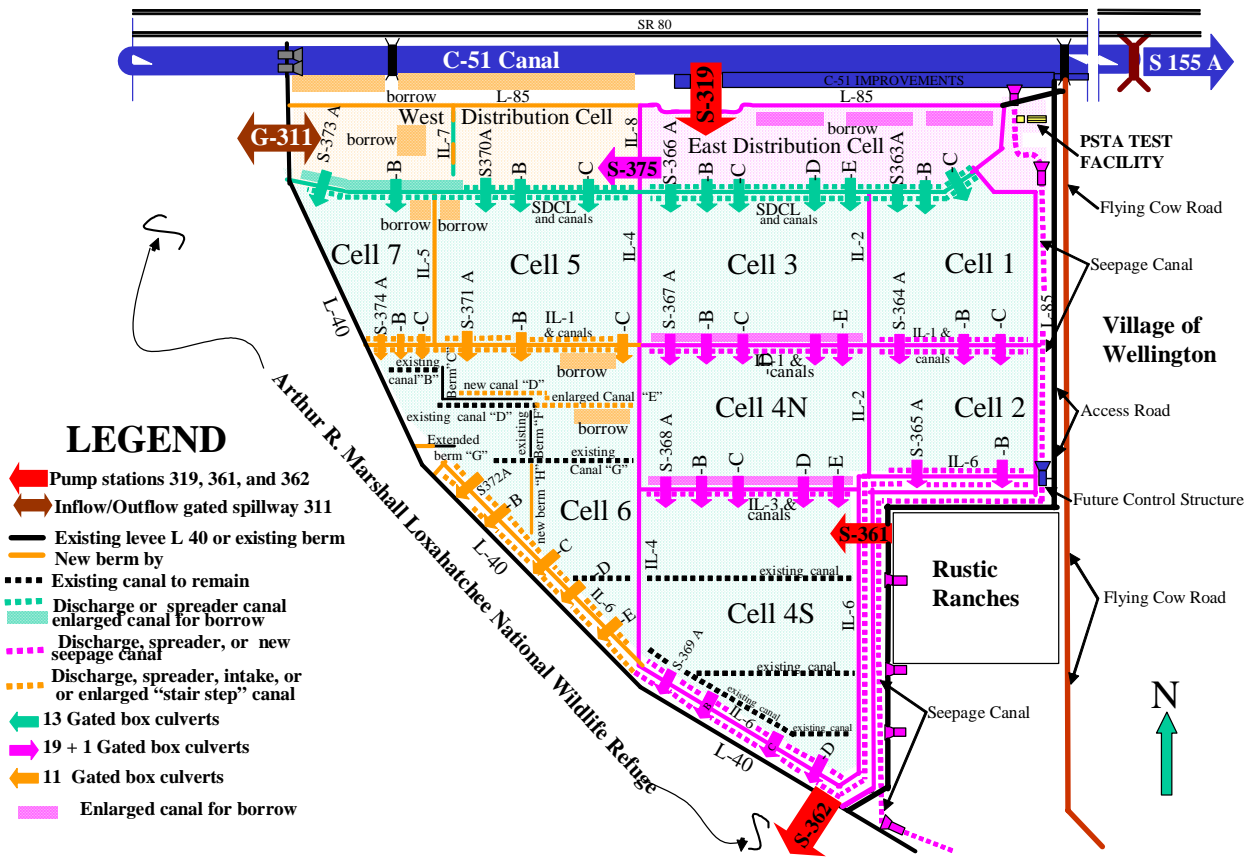


Figure 2. STA-1E Flow

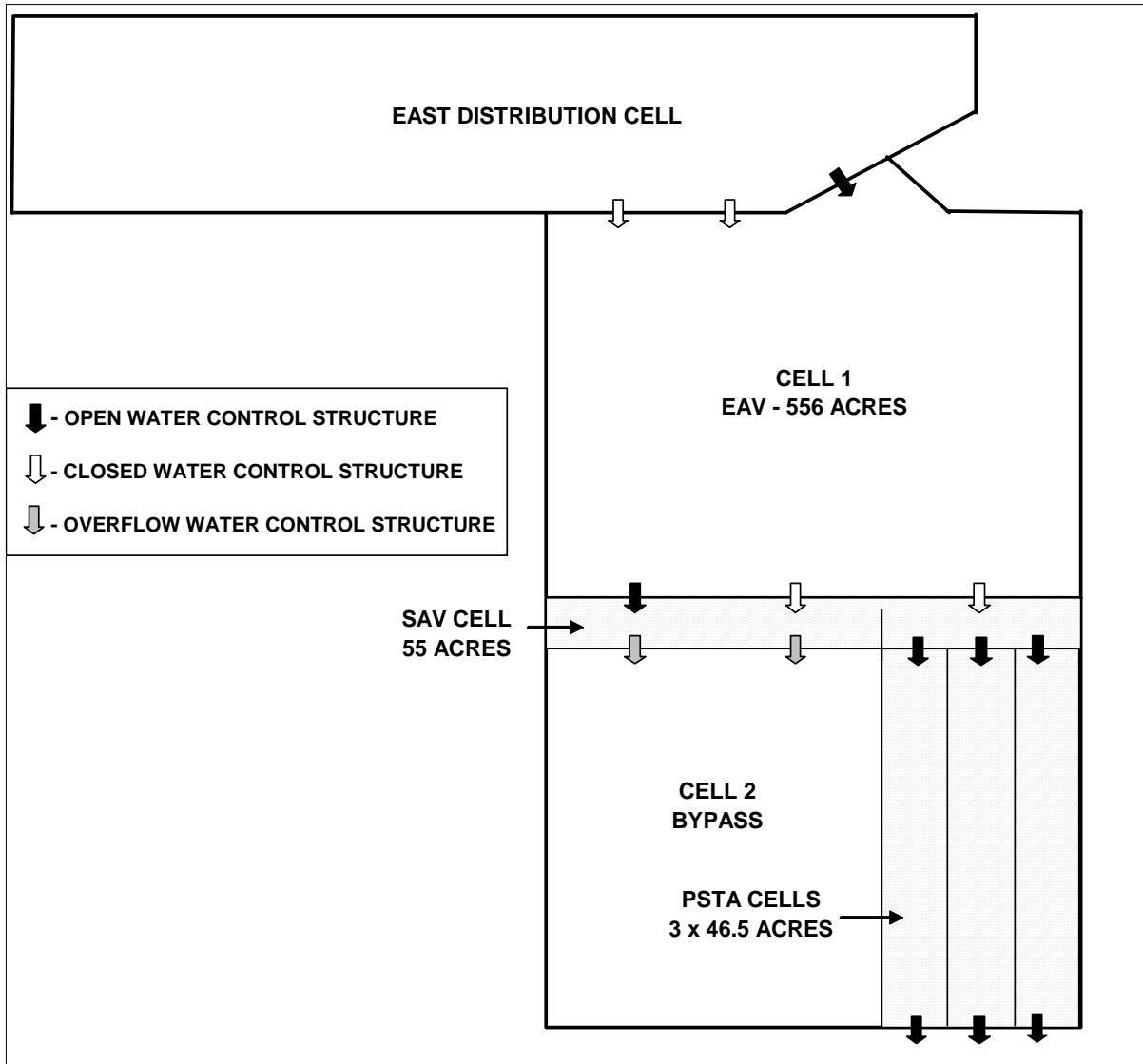


Figure 3. PSTA Demonstration Test Flow

5 OPERATION BASIS AND OBJECTIVES

The PSTA Field-Scale Demonstration Project in STA-1E Cell 2 has four operational objectives:

Startup (abiotic) Operations and Periphyton Mat Establishment and Activation: The objective of this phase will be to operate the cells in a manner that will result in an activated periphyton mat that can be used in the Phase 2 treatment technology known as PSTA. Flows and depths, including periods of dry-out and no inflow other than that necessary to maintain a

specific depth, will be necessary to grow and select for organisms that can both establish the periphyton mat and be “activated” so that they can be maintained in the conditions that will occur under the additional three operational objectives.

Fixed Scenarios: PSTA Demonstration Cell operations under conditions that result in depths, inflows, hydraulic loading rates (HLRs), and hydraulic retention times (HRTs) that duplicate Flying Cow Road Test Facility (FCRTF) test conditions.

POR Operations: PSTA Demonstration Cell operations under conditions experienced during the 10-year POR used for the demonstration project design. These conditions were determined using the *Dry-Out Analysis* (Burns and McDonnell 2000) and the S-5A antecedent rainfall during the POR, excluding all flows that resulted in an HRT of 21 days or greater. This operational phase consists of 53 weekly conditions ranked into “wet” and “dry” season conditions. This PSTA demonstration phase includes three artificially created 24 hr dry-season events (8 cfs per cell for 24 hrs) occurring near the beginning, middle, and end of the dry season and three artificially created wet-season events (18 cfs per cell for 24 hrs) occurring as two events in one month during the middle and one event near the end of the wet season.

Simulated Extreme Conditions: PSTA Demonstration Test Cell operations will simulate extreme conditions (maximum input flow of 55.0 cfs, maximum HLR of 23.8 cm/day, maximum output depth of 2.75 ft, and minimum HRT of 3.5 days) for a period of 7 days, dependent on water availability at the end of the demonstration. This operational condition would not have occurred naturally during either the 10- or 31-year POR. The purpose of operating the PSTA cells under the extreme condition parameters for 7 days is to evaluate the treatment efficiencies of PSTA and impacts of these extreme conditions on the periphyton community.

The extreme condition test scenario was determined by reviewing the *Dry-Out Analysis* (Burns and McDonnell 2000) POR. The POR analysis observed 3.5 day or greater HRT is possible. Although the PSTA cells are capable of being operated at the peak STA-1E flowway one flow rate (860 cfs), which equates to approximately 1-day HRT, there are no plans to test this flow scenario because the POR revealed that this scenario would not occur. When running the extreme condition scenario, it has been estimated, that approximately 71-75 cfs would be required to achieve the 55 cfs feed to the PSTA test cells. The additional water is required to compensate for seepage, infiltration, and evapotranspiration losses in the treatment train.

The PSTA Demonstrations Cells and the SAV pretreatment have been designed specifically to treat the water to achieve 10 ppb TP. The structural modifications for the SAV and the PSTA have been designed not to impede the overall operation of STA-1E during actual extreme storm events. These modifications are capable of passing 860 cfs. During an extreme storm event the PSTA demonstration would be terminated and the entire operation of STA-1E would be controlled by the SFWMD.

5.1 SEQUENCE OF OPERATIONS

The PSTA Cell planned operations assume USACE control of STA-1E Cells 1 and 2 and that the remainder of Cell 2 will be used only as bypass to limit seepage into and out of the PSTA cells. As indicated above, operations consist of four phases, which are Startup and Activation, Fixed-Scenario Operations, POR Operations, and Extreme Conditions.

These phases are further described in the following sections. Upon startup operations completion, the exact sequence of operations will be made adaptable to weather conditions and the season of the year that the operations begin. Table 3 describes the PSTA Operation Schedule for each of the four phases.

5.2 START UP AND ACTIVATION OPERATIONS

Due to construction schedules uncertainties and antecedent conditions caused by the wet and dry seasons in south Florida, startup operations for all components of Cell 1, Cell 2, and PSTA may need to be adjusted to compensate for these differences. The sequence of PSTA startup operations (Table 3) cannot be adjusted and will have to be conducted as a first step in order to ensure an activated periphyton mat for the additional portions of the demonstration.

5.2.1 Cell 1 EAV Cell

Startup activities within Cell 1 have been initiated and should be completed at operation commencement. These activities have been guided by the *Stormwater Treatment Area 1E Vegetation Management Plan (Serbesoff-King 2004)*.

5.2.2 Cell 2 SAV Cell

Prior to startup, nondesirable species of existing vegetation should be removed.

Water surface elevations will be increased incrementally within the SAV Cell to maximize light reaching the vegetation. The initial water surface elevation within the cell should be 16.5 ft NGVD and increased by 0.25 ft when 50% of the vegetation has reached the water surface or is within 2 in of the surface. Water levels will be increased until an elevation of 18 ft NGVD is reached.

Use of contact herbicide might be required within the SAV Cell if a significant coverage/density of FAV species — *Brachiara mutica*, *Panicum* sp., or *Typha* sp. — colonize the cell. Transplanting desirable SAV species may be required; this activity depends on seasonality, schedule, cost, and availability.

5.2.3 Cell 2 PSTA Cells

Expectation is that startup activities will commence immediately after PSTA Cell substrate emplacement and that the cells will be nominally free of vegetation.

During startup, treatment train water level manipulations will be most intense in the PSTA Cells. The steps in Table 2 will be conducted to foster an environment that encourages growth of a calcareous periphyton community and limits initial growth of emergent vegetation and nondesirable periphyton communities. If startup activities occur during the wet season, it is assumed that sufficient head will exist between head and tail waters of the S-365 B structure to drain the cell, assuming the S-362 structure is functioning.

Visual inspection of the emerging periphyton community should be conducted on a regular basis (weekly) to determine if water control operations require modification to prevent establishment of undesirable communities. Water quality, biomass, and substrate monitoring will be conducted prior to and during startup operations.

Table 2. Schedule of Water Elevations During Startup

Day	Water Surface Elevation (ft NGVD)				PSTA Cells
	EDC	Cell 1	SAV Cell	PSTA Cells	HRT (Days)
1–15	19.75	19.25	18.75	18.25	Static
16–30	19.25	18.75	18.25	16.75	Draining
31–45	19.25	18.75	18.25	16.25	Draining
46–60	19.25	18.75	18.25	16.75	Filling
61–90	19.25	18.75	18.25	16.75	14
91–105	19.25	18.75	18.25	16.25	Draining
106–120	19.25	18.75	18.25	16.75	Filling
121–150	19.25	18.75	18.25	16.75	14
151–165	19.25	18.75	18.25	16.25	Draining
166–180	19.25	18.75	18.25	16.75	Filling
181–195	19.25	18.75	18.25	16.75	14

This area will be used to provide water surface equalization to limit seepage into and out of the PSTA Cells; hence, the water elevations will mimic the PSTA cell elevations. PSTA demonstration operational needs require only maintaining the bypass surface water elevation within 3 in of the PSTA Cell water surface elevations when PSTA Cell elevations are at or below 17.75 feet NGVD. The other scenarios occur too quickly to allow for equalization of the Cell 2 Bypass. Flow requirements to meet these needs will be quantified when the amount of seepage loss from this area is determined during operations startup. The potential of this area to pass additional flows during normal operations should be more easily quantifiable once the treatment train effectiveness in reducing phosphorus concentrations is better known.

5.3 FIXED SCENARIOS

Fixed-condition operations that complement FCRTF conditions can be operated in a variable sequence, depending on water availability. However, because they are considered part of the initial portion of the demonstration, they must be conducted immediately following the startup and periphyton mat establishment and activation phase. The fixed scenario steps are noted as Step I through Step N in Table 3.

The fixed scenarios will consist of the following depth/flow/HLR/HRT characteristics:

0.5 ft, 2.6 cfs, 1.1 cm/day, 14 days

1.0 ft, 5.0 cfs, 2.2 cm/day, 14 days

1.0 ft, 10.7 cfs, 4.6 cm/day, 7 days

2.0 ft, 11.7 cfs, 5.1 cm/day, 7 days

PSTA input stop-log elevations will depend on antecedent SAV water elevations. Output stop-log elevations will be: 16.75, 17.25, 17.25 and 18.25 feet NGVD, respectively. An additional fixed scenario may be added based on the results from the FCRTF. If this is necessary, its specifics will be determined at that time.

5.4 POR OPERATIONS

The *Stormwater Treatment Area No. 1 East Period of Record Dry-Out Analysis (Burns and McDonnell 2000)* model was used to simulate flows encountered during the 1979–88 base period used for the STA sizing process. Figure 4 displays the projected flows into STA-1E for this time period scaled to the combined size of the three PSTA Cells and reordered to account for rainfall. This represents the base POR for operations. This figure also shows the targeted depth in the PSTA Cells during the 12 month POR operations. The depth and flow information from Figure 4 was then used to establish the PSTA cell HRTs (Figure 5) to be tested. In Figure 5, to fit as many tests as possible into the 2-year demonstration schedule, HRT conditions longer than 21 days (depth < 0.5 ft) have been eliminated.

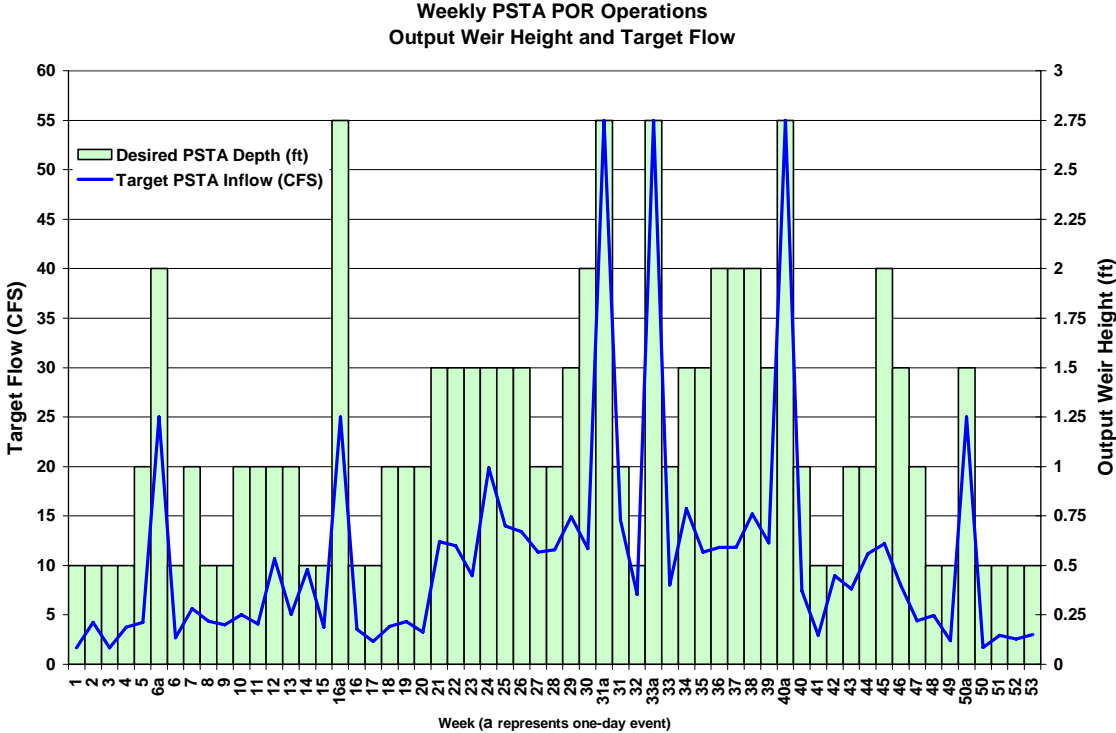


Figure 4. Target Flows and Depths within the PSTA Cells

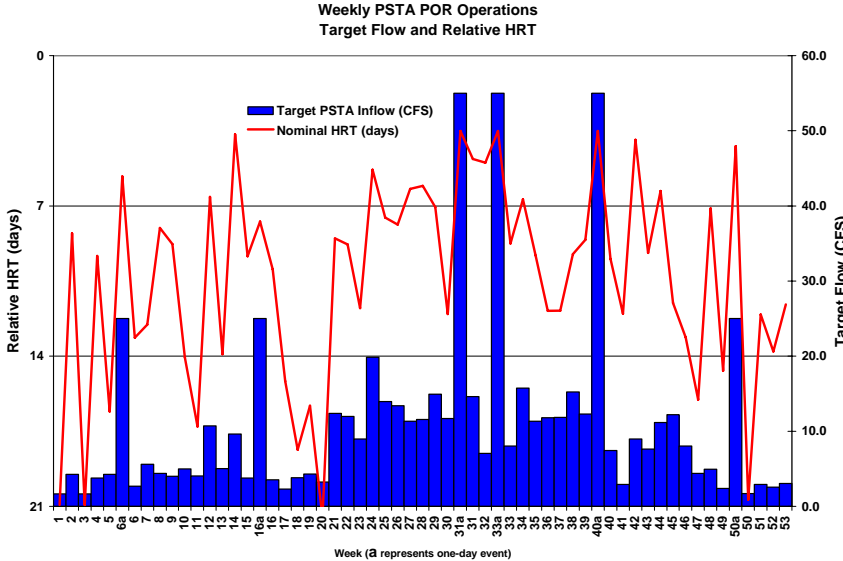


Figure 5. Target PSTA Flows and Resulting HRT

The SAV Cell water surface elevations combined with the targeted PSTA Cell inflows were utilized to establish the required stop-log settings as noted in the Operations Plan for the STA-1E Field Scale Demonstration Project. The exact flows will be calibrated during startup operations. Weir and SAV Cell elevations will be changed weekly and will not be readjusted to account for rainfall and Cell 3 and Cell 4N operations that will impact seepage; however, elevations will be monitored to back calculate depths and flows. Similar accounting will occur at the outflow weir.

5.5 SIMULATED EXTREME CONDITIONS OPERATIONS

PSTA Cells will be operated under simulated extreme conditions with maximum input flow of 55.0 cfs, maximum HLR of 23.8 cm/day, maximum output depth of 2.75 ft, and minimum HRT of 3.5 days for a period of 7 days. This operational condition would not have occurred naturally during either the 10- or 31-year PORs. However, the purpose of this condition will be to examine PSTA behavior under flood situations. The extreme condition steps are noted as Step P through Step R in Table 3.

Table 3. PSTA Operations Schedule

Phase I. Start Up and Activation Operations		
A.	0–0.5 months	Flood all cells to 2 ft with no outflow and an input Q necessary to maintain depth to remove non wetland emergent vegetation.
B.	0.5–1.0 months	Drain cells to a 6 in. ponding depth with no outflow and an input Q necessary to sustain this depth
C.	1.0–1.5 months	Dry out all cells and allow them to remain dry for 0.5 months.
D.	1.5–2.0 months	Flood all cells over a 0.5-month period to an operational depth of 0.5 ft.
E.	2.0–3.0 months	Operate all cells for 1.0 month at 0.5 ft and a 14-day HRT.
F.	3.0–3.5 months	Dry out all cells and allow them to remain dry for 0.5 months.
G.	3.5–5.5 months	Repeat steps D–F.
H.	5.5–6.0 months	Flood all cells over a 0.5-month period to an operational depth of 0.5 ft.
Phase II. Fixed Flow Scenario		
I.	6.0–6.5 months	Operate cells at 0.5 ft and a 14-day HRT.
J.	6.5–7.0 months	Flood all cells over a 0.5-month period to an operational depth of 1 ft.
K.	7.0–8.0 months	Operate cells at 1 ft and a 14-day HRT.
L.	8.0–9.0 months	Operate cells at 1 ft and a 7-day HRT.
M.	9.0–9.25 months	Raise depth of cells to 2 ft maintaining a 7-day HRT.
N.	9.25–10.0 months	Operate cells at 2 ft and a 7-day HRT.
Phase III. POR Operations		
O.	10.0–22.0 months	POR operations
Phase IV. Simulated Extreme Conditions Operations		
P.	22.0–22.25 mo	Pulse cell with an input Q equivalent of a 3.5-day HRT for 7 days and increase depth to 2.75 ft.
Q.	22.25–22.75 mo	Return Q to that necessary for a 7-day HRT and allow the depth to return to 2 ft.
R.	22.75–24.0 mo	Return Q to that necessary for a 14-day HRT and allow the depth to return to 1 ft.

6 FIELD SAMPLING ACTIVITIES

Field activities conducted at the Demonstration Project will be performed in general agreement with FDEP's Standard Operating Procedures (SOPs), USEPA's approved methodologies, and this plan. Field data collection activities will include: 1) SAV and PSTA surface water sample collection in Cell 2; 2) sediment and periphyton mat sample collection in Cell 2; and 3) groundwater, cell hydrologic, field parameter, and meteorological measurements.

6.1 CELL 2 PSTA SURFACE WATER SAMPLE COLLECTIONS

Rationale/Design

Surface water samples collected within Cell 2 will be used to examine the impacts of periphyton mats, cell substrates, and flow/depth regimes on the reduction in phosphorus concentrations within the water column. Additional samples will be collected to determine the impacts of other analytes on phosphorus removal. The data generated from both field and laboratory measurements will be used in the calibration of a concentration based model for PSTA cell sizing.

6.2 SURFACE WATER SAMPLE LOCATIONS

6.2.1 Surface Water Sample Locations

The objectives of water quality monitoring are two fold: (1) understanding the dynamics of phosphorus removal within the demonstration cells and (2) monitoring of other constituents at a lesser magnitude to quantify interactions impacting phosphorus removal and to answer questions regarding make up of the water discharged from a PSTA. Phosphorus dynamics within the demonstration cells will be elucidated through a tiered sampling approach that samples transect through the system (see Figure 6, Figure 7, and Figure 8).

The relationships will be incorporated into a multi parametric concentration-based model that will assist in PSTA sizing and operations. The grab-sampling schematic in the figures provides for a multi-tiered approach that can be adjusted to meet experimental needs. Tier I (Figure 6) is the lowest-intensity sampling effort and is collocated with shallow groundwater wells, multi-parameter meters, automatic samplers, and stage recorders. Tiers II and III sampling locations will be identified by small flags and will be used to identify sites for surface water, substrate and periphyton mat sample collection. Higher-number tiers are inclusive of lower-number tiers.

For example, Tier III stations include Tier I and II stations. Sampling stations not included on the centerline will be used to determine if water flow through the levees impacts water quality.

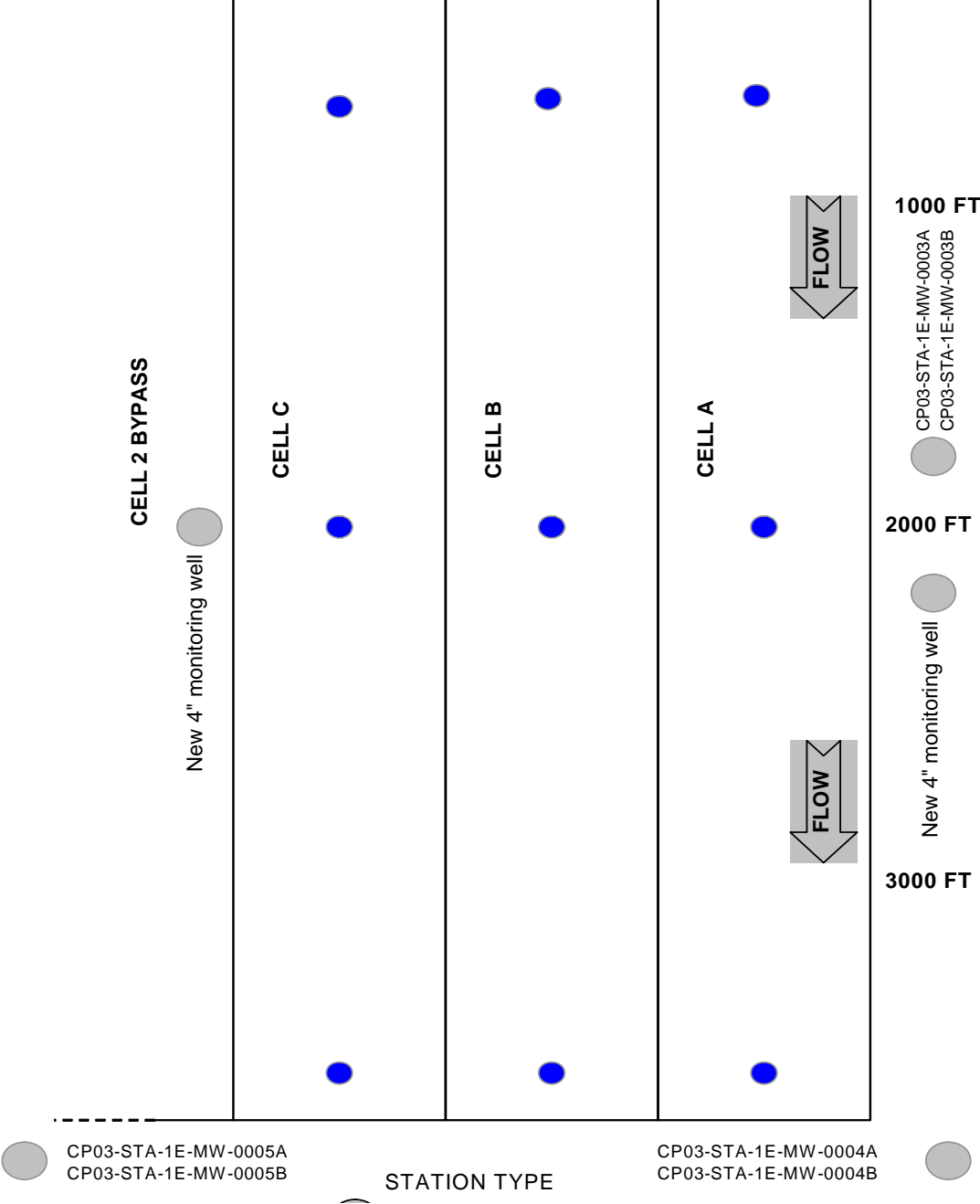


Figure 6. Tier I PSTA Cell Monitoring Sites

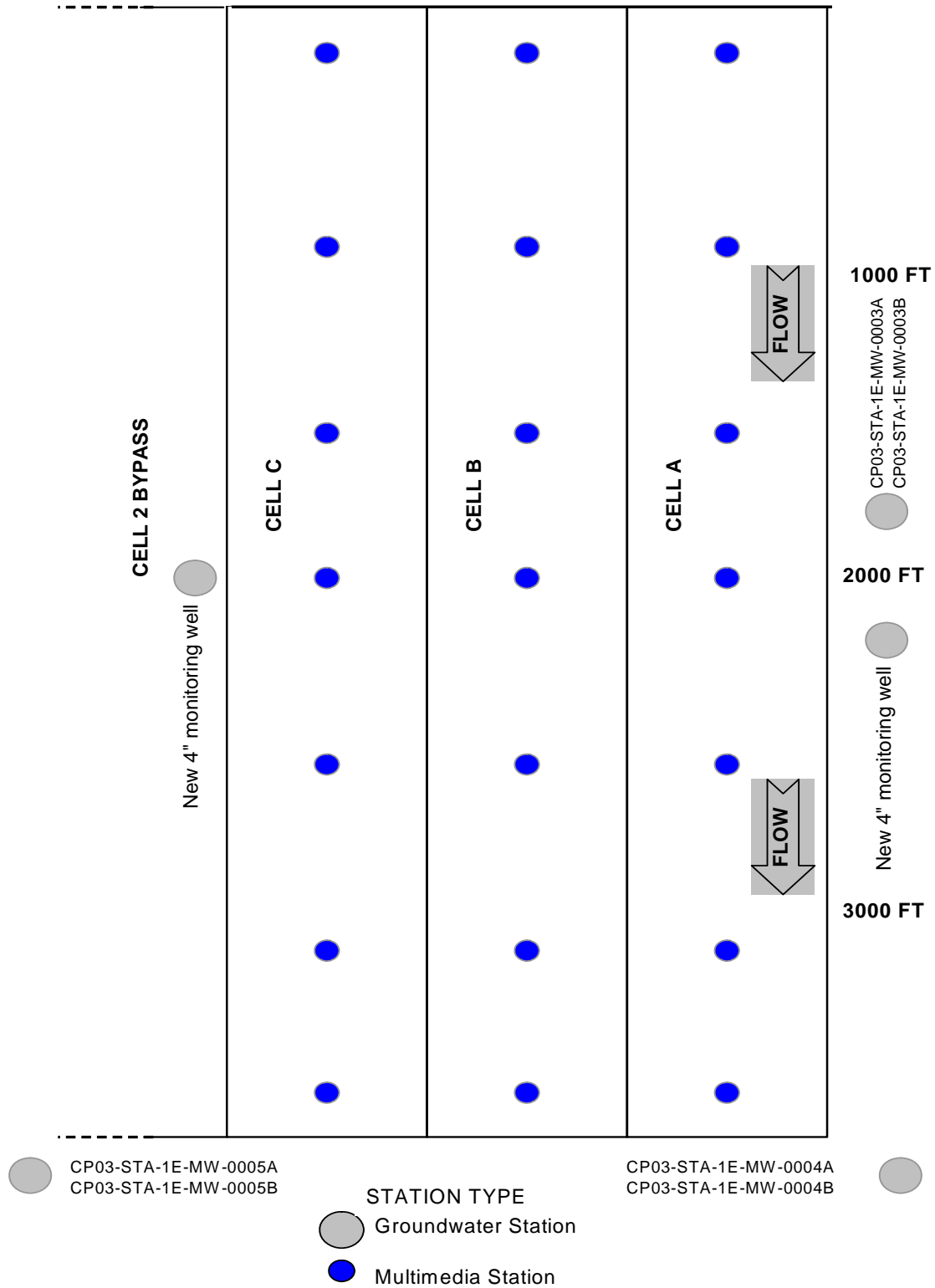


Figure 7. Tier II PSTA Cell Monitoring Sites

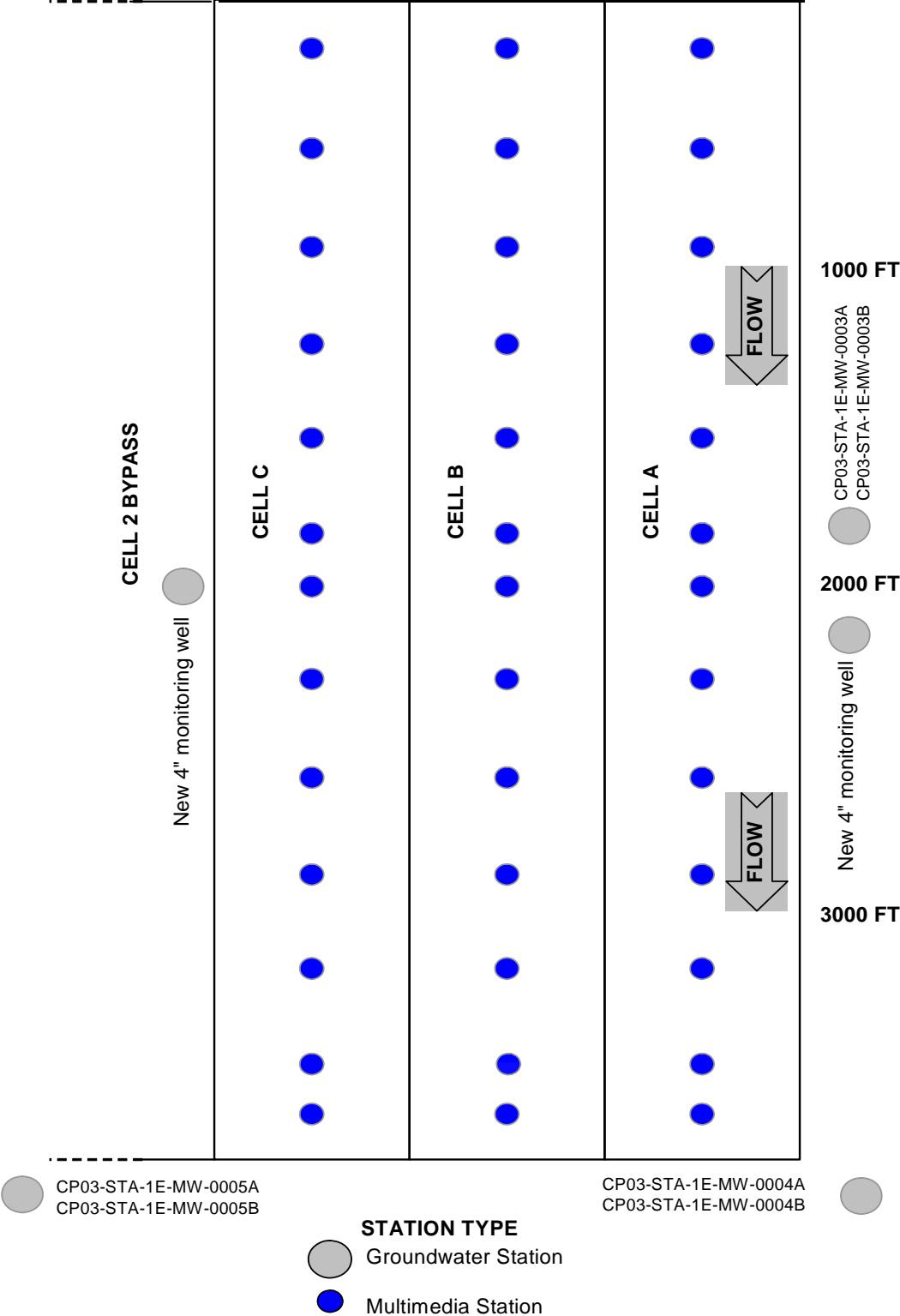


Figure 8. Tier III PSTA Cell Monitoring Sites

Where noted in Table 4, transect sampling will occur generally at the end of each flow regime, with a few exceptions, during times of dynamic flow. During these events, multiple discrete grab samples will be collected by immersion of sample bottles near the midpoint of the width of the test cell, and at multiple locations along the length of the test cell to allow for the calculation of turnover times. The sample stations from which grab samples will be collected for transect sampling will be determined in the field based on the results of earlier transect samples or alkaline phosphatase activity analysis conducted at FCRTF, to optimize the calibration of the concentration based model. Reasoning for the locations of grab samples collected as part of the transect sampling will be documented in the field logbook and explained within the appropriate monthly and quarterly reports. The sum of the total phosphorus surface water samples within Table 4 exceeds the individual sampling events to allow for flexibility during the course of this project.

Cell 1

During operation, a composite sample will be collected at the influent to Cell 1 and the influent to the SAV Cell on a weekly basis, and shipped for laboratory analysis. Sampling will occur at both the input and output of the system. These data will provide a weekly average of the removal by Cell 1 and a weekly average of the water delivered to the test cells. This phosphorus sampling is included within Table 4.

6.2.2 Sample Collection and Field and Laboratory Analysis

Surface water samples collected from Cell 2 of STA-1E will be shipped for laboratory analysis of the parameters shown in Table 4 and summarized in Table 7. The Quality Assurance Project Plan provides the analytical methods that will be used for these analyses, the required container types and sizes, preservatives and holding times.

Table 4. Laboratory Sample Collection Monitoring Frequencies

Parameter	Tier I	Tier II	Tier III
Ammonia	BW	M	Q
Calcium	Q		
Chloride	Q		
Dissolved Organic Carbon	BW	M	Q
Iron	Q		
Nitrite	BW	M	Q
Nitrite + Nitrate	BW	M	Q
Ortho Phosphorus	BW	M	Q
Potassium	Q		
Silica	Q		
Sodium	Q		
Sulfate	M	Q	
Total Dissolved Nitrogen	BW	M	Q
Total Dissolved Phosphorus	BW	M	Q
Total Dissolved Solids	M	Q	
Total Kjeldahl Nitrogen	M	Q	
Total Nitrogen	BW	M	Q
Total Organic Carbon	BW	M	Q
Total Phosphorus	Composite		BW
Total Suspended Solids	M	Q	

Plate 1. Surface Water Sampling Schedule

Phase Schedule	Start Up															Fixed Flow			POR			Extreme			Totals
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R							
	0 to 0.5	0.5 to 1.0	1.0 to 1.5	1.5 to 2.0	2.0 to 3.0	3.0 to 3.5	3.5 to 4.0	4.0 to 5.0	5.0 to 5.5	5.5 to 6.0	6.0 to 6.5	6.5 to 7.0	7.0 to 8.0	8.0 to 9.0	9.0 to 9.25	10.0 to	22.0 to	22.25 to	22.75 to						
Flows (cfs)				*			*		*		*	*		*			*	*	*						
Water Depth (ft)	2.0	0.5	0	0.5	0.5	0	0.5	0.5	0	0.5	0.5	1	1	1	2	2		2.75	2	1					
HRT (days)				14			14		14		14	7	7	7				3.5	7	14					
Ammonia as N				9			9		9		9	9	9	9	9	9	9	624	9	9	705				
Calcium				9			9		9		9	9	9	9	9	9	9	192	9	9	246				
Chlorida				9			9		9		9	9	9	9	9	9	9	192	9	9	246				
Dissolved Organic Carbon				9			9		9		9	9	9	9	9	9	9	624	9	9	678				
Iron				9			9		9		9	9	9	9	9	9	9	192	9	9	246				
Nitrite				9			9		9		9	9	9	9	9	9	9	624	9	9	705				
Nitrite + Nitrate				9			9		9		9	9	9	9	9	9	9	624	9	9	705				
Ortho Phosphorus				9			9		9		9	9	9	9	9	9	9	624	9	9	705				
Potassium				9			9		9		9	9	9	9	9	9	9	192	9	9	246				
Total Phosphorus				9			9		9		9	9	9	9	9	9	9	1586	9	9	1857				
Total Dissolved Phosphorus				9			9		9		9	9	9	9	9	9	9	642	9	9	705				
Silica				9			9		9		9	9	9	9	9	9	9	36	9	9	246				
Sodium				9			9		9		9	9	9	9	9	9	9	36	9	9	246				
Sulfate				9			9		9		9	9	9	9	9	9	9	192	9	9	246				
Total Dissolved Nitrogen				9			9		9		9	9	9	9	9	9	9	192	9	9	312				
Total Dissolved Solids				9			9		9		9	9	9	9	9	9	9	642	9	9	705				
Total Kjeldahl Nitrogen				9			9		9		9	9	9	9	9	9	9	57	9	9	312				
Total Nitrogen				9			9		9		9	9	9	9	9	9	9	642	9	9	1857				
Total Organic Carbon				9			9		9		9	9	9	9	9	9	9	642	9	9	678				
Total Suspended Solids				9			9		9		9	9	9	9	9	9	9	192	9	9	678				

* Indicates transect sampling
 ** The "maximum total" of the samples shown within this table does not equal the sum of samples listed within the table to allow some flexibility during the course of this project

6.2.3 QA/QC Samples and Frequencies

Quality assurance/quality control (QA/QC) samples that will be collected in conjunction with the surface water sampling will include field duplicates, equipment rinsate samples, field blanks, and matrix spike/matrix spike duplicate (MS/MSD) samples (as required for laboratory QA/QC). The TP field duplicates, equipment rinsate samples, and field blanks will be analyzed at a combined frequency of 10% (one in ten) of the primary samples. Also 10% of the primary sample volume will be collected in the field and shipped for laboratory analysis of MS/MSD samples. All QA/QC samples will be analyzed for the same parameters as the primary samples.

Table 5. Summary of Target Analyte Primary and QA/QC for Surface Water Samples

Parameter and Matrix	Number of Samples	Primary Samples	Field Duplicate Samples	Equipment Rinsate	Field Blanks	MS/MSD	QA
Surface Waters							
Ammonia as N	845	705	70	0	0	70	0
Calcium	296	246	25	0	0	25	0
Chloride	296	246	25	0	0	25	0
Dissolved Organic Carbon	814	678	68	0	0	68	0
Iron	296	246	25	0	0	25	0
Nitrite	845	705	70	0	0	70	0
Nitrite + Nitrate	845	705	70	0	0	70	0
Ortho Phosphorus	845	705	70	0	0	70	0
Potassium	296	246	25	0	0	25	0
Total Phosphorus	2515	1857	186	93	93	186	100
Total Dissolved Phosphorus	845	705	70	0	0	70	0
Silica	296	246	25	0	0	25	0
Sodium	296	246	25	0	0	25	0
Sulfate	296	246	25	0	0	25	0
Total Dissolved Nitrogen	376	312	32	0	0	32	0
Total Dissolved Solids	845	705	70	0	0	70	0
Total Kjeldal Nitrogen	376	312	32	0	0	32	0
Total Nitrogen	2415	1857	186	93	93	186	0
Total Organic Carbon	814	678	68	0	0	68	0

6.2.4 Sampling Methods for Surface Water

6.2.4.1 Composite Sampling

Composite sample collection will be conducted with ISCO 6712 Full-Size Portable Samplers or similar automated samplers. The automated samplers will be located at the fixed sampling location noted in Figure 9. The automated sampler tubing will be connected to a weighted polypropylene strainer located three inches above the ground surface. The sampler will collect 4-250 ml samples per day spaced 6 hours apart. The sample containers will be 2.5 gallon ISCO ProPak disposable sample bags. On a weekly basis sample will be retrieved utilizing a clean 140 ml syringe and deposited into laboratory-supplied sample containers. Sample containers will be triple-rinsed with a small portion of the collected sample, prior to filling the container. Sample bags will be disposed of and replaced after each sample collection period. The location and frequency of sampling will provide the average concentration of each analyzed parameter at a location analogous to the test cell discharge.

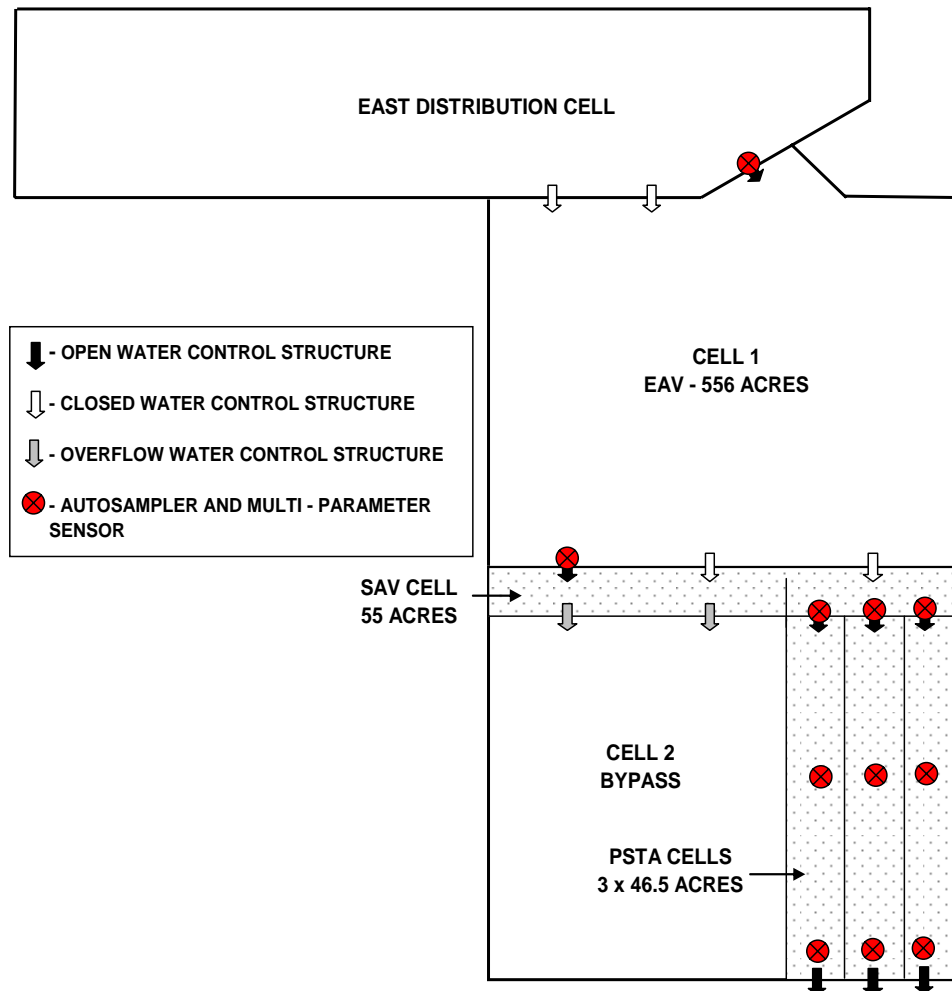


Figure 9. Fixed Sampling Locations

6.2.4.2 Grab Sampling

Grab samples will be collected by bottle immersion in accordance with Florida Department of Environmental Protection Standard Operating Procedure FS 2110, Section 1.1 Surface Water Sampling – Surface Grab Sampling.

6.2.5 Field Measurement Procedures and Criteria

The field measurements and criteria to be used as part of this project are provided in Section 7.1.

6.2.6 Sample Containers and Preservation Techniques

The Quality Assurance Project Plan provides the analytical methods that will be used for the surface water analyses. This table also provides the required container types and sizes, preservatives, and holding times. Manufacturer-certified clean sample containers will be provided by the laboratory. To assure timely shipping of the sample and shipping containers, approximately two weeks prior to sampling, the Field Team Leader will notify the USACE Technical Point of Contact by email of the planned sampling date, the number of samples to be taken and the analytical parameters to be sampled. The USACE will then notify the sampling contractor who in turn will assure that the appropriate number of sample and shipping containers are shipped to the Field Team Leader.

All sample containers will be triple rinsed with sample material prior to filling. Samples will be preserved by a combination of physical and chemical methods. Samples requiring chemical preservatives will be collected in triple-rinsed containers. Reagent-grade preservative will then be added to reach the required pH. Chemical preservation, of each container for which it is required, will be verified by pouring a small portion of the preserved sample over litmus paper. Additional preservative may be added to reach the required pH range. Chemical preservation materials will be obtained by the Field Team Leader. Certification of analysis of all chemical preservatives used will be obtained and maintained in the field notebook. Most sample fractions will require preservation by maintaining the sample at a temperature of 4°, ±2°C. All such sample fractions will be immediately placed and kept in a cooler filled with sufficient ice to maintain the required temperature.

6.2.7 Field Quality Control Sampling Procedures

Field QC samples to be collected in conjunction with the surface water samples include field duplicates, equipment rinsate samples and field blanks. Double or triple sample volume will be collected for samples which require laboratory duplicates or MS/MSDs. All QA/QC samples will be analyzed for the same parameters as the primary samples.

Field duplicates will be collected by filling twice the planned number of sample containers required for primary samples at a given sample location. Duplicates collected from composite samples will be split from the ISCO sample containers. At grab sampling locations, duplicate samples will be collecting by filling extra containers on an analyte-by-analyte basis. For example, a sufficient sample volume will be initially collected to fill containers for both the primary and duplicate phosphorous sample fractions. Additional sample volume will then be grabbed to fill sample containers for both the primary and duplicate containers for the next required sample fraction.

Equipment rinsate samples, used to document decontamination efficiency, will be collected only from sampling equipment that comes into direct contact with sample material, is

decontaminated, and used again. Equipment rinsate samples will not be collected from single-use sampling equipment. Following equipment decontamination, a piece, or set of equipment that is to be used for continued sampling will be rinsed with deionized water supplied by the USACE. This water will be contained in a clean glass or stainless steel vessel and be poured into the appropriate sample containers to form the equipment rinsate sample. A note will be made in the appropriate logbook as to the sample that is subsequently collected using the equipment from which the equipment rinsate was obtained.

Field blank samples, used to document the purity of the deionized water used for final equipment decontamination, will be collected by filling appropriate containers directly from the deionized water source on site.

Field duplicate samples will be labeled with a sample number which is different from the primary sample, so as to be blind to the analytical laboratory.

6.2.8 Decontamination Procedures

As much as possible, expendable, clean equipment and materials will be used to collect the surface water samples. These types of materials will be disposed of between samples. Where sample equipment is re-used it will be decontaminated prior to initial use and before and after each subsequent use. Decontamination will be conducted using the following procedure:

Wash and scrub as required using a solution of potable water and phosphate free detergent (i.e. Liquinox).

Rinse with potable water.

Rinse with deionized water.

Rinse again with deionized water.

Allow to air dry as long as possible.

Wrap clean equipment in aluminum foil or enclose in plastic bags to prevent contamination prior to use.

Decontamination will be conducted in an area established for this purpose. The area will be set up with bins corresponding to the steps of the decontamination procedure described above, to form a decontamination line. Each piece of equipment will be progressively cleaned or rinsed within the appropriate bin. Wastes from the decontamination process will be appropriately disposed.

6.3 GROUNDWATER

Figure 6 shows the PSTA cell groundwater monitoring sites. Sampling frequency will be determined during operations and sampling and, based on early results, will depend on groundwater flow, nutrient concentrations, and transport, and other factors. The parameters to be examined include total phosphorus, water velocity, and direction. The monitoring wells are either 20 feet deep or 40 feet deep. They are constructed from 4-inch PVC to allow insertion of the Doppler flowmeters and the Multi-parameter meters. Measurements similar to those used by the United States Geological Survey (USGS) and the USACE and described in USGS Water Resource Investigations Report 01-4139 will be used. This method consists of isolating sections of the bore hole with inflatable plugs and placing the Sontek Argonaut H-426 3D Velocity Meter between the plugs. After a sufficient time for stabilization, the flows will be

recorded and a bailer water sampler will be engaged to collect a water sample from the isolated section of the bore hole. In addition to these wells, additional wells are located adjacent to the seepage canal along the east side of the STA. These wells will be sampled as necessary to provide additional information on seepage loss and control.

6.4 SEDIMENT AND PERIPHYTON MAT SAMPLE COLLECTION

6.4.1 Rationale and Design

Sediment and periphyton mat samples will be collected and used to 1) determine the impact of different hydrologic regimes and phosphorus concentrations on periphyton mat species composition, 2) determine the fate of phosphorus within the mesocosm and compute a mass balance for each mesocosm, 3) monitor the growth and development of each mesocosm and impacts of proximity to water input. Sampling of the sediments and periphyton mat will occur prior to the beginning of operations to create a baseline and at the completion of each hydrologic regime

6.4.1.1 Sediment and Periphyton Mat Sample Locations

Sediment samples will be collected prior to the beginning of operations in accordance with Tier II sampling as shown on Table 11. This sampling will provide a baseline of the sediments in each of the three PSTA test cells. Sediment sampling will be performed during the six-month start-up operations after each dryout for a total of two sampling events (months 0-6). The sampling will be in accordance with the Tier II sampling. During the four month fixed-flow operations (months 6-10), sediments will be sampled in each test cell, after the completion of each flow scenario, in accordance with Tier I (three samples collected per test cell). During the one-year POR operations, the sediments will be sampled in accordance with Table 11. There will be no sediment samples collected during the extreme condition operation (months 22-24).

There will be no periphyton samples collected during baseline conditions. Periphyton sampling will be performed during the six-month start-up operations after each dryout for a total of two sampling events (months 0-6). The sampling will be in accordance with the Tier II sampling. During the four month fixed-flow operations (months 6-10), periphyton will be sampled in each test cell, after the completion of each flow scenario, in accordance with Tier I (three samples collected per test cell). During the one-year POR operations, periphyton will be sampled in accordance with Table 12. There will be no periphyton samples collected during the extreme condition operation (months 22-24).

Sample Collection and Analysis

Table 11 and Table 12 summarize the analyses to be performed on sediment and periphyton mat samples during the POR operations, respectfully. For sediment sampled under Tier III should be preserved in accordance with applicable preservation techniques. Results from the analysis from Tier I and Tier II sampling will determine if Tier III samples will be analyzed for the sediments.

Table 6. Substrate Monitoring Frequencies

Parameter	Tier I	Tier II	Tier III
Total Phosphorus (PSU)	Q	A	A*
Bulk Density (PSU)	Q	A	
Calcium (as CaCO ₃) (PSU)		A	A*
Organic Matter (AFDW) (PSU)	Q	A	A*
Percent Solids (PSU)	Q	A	A*
Total Nitrogen (PSU)	Q	A	A*
Total Organic Carbon (PSU)	Q	A	A*

Table 7. Periphyton Mat Monitoring Frequencies

Parameter	Tier I	Tier II
Alkaline Phosphatase (Field)	Q	A
Ash-Free Dry Weight (PSU)	Q	A
Bulk Density (PSU)	Q	A
Calcium (as CaCO ₃) (PSU)	Q	A
Chlorophyll a (Field)	Q	A
Mat Thickness (Field)	Q	A
Percent Water (PSU)	Q	A
Periphyton Species Composition	Q	A
Photo documentation (Field)	Q	A
Total Carbon (PSU)	Q	A
Total Nitrogen (PSU)	Q	A
Total Organic Carbon (PSU)	Q	A
Total Phosphorus (PSU)	Q	A

7.3.1.3 QA/QC Sampling and Frequency

Field QC samples to be collected in conjunction with the sediment and periphyton mat samples are restricted to field duplicates at a rate of 5% or once per sampling event, per parameter (Table 13). These samples will be preserved and shipped using the same methodology as the primary sample.

Table 8. Summary of Target Analyte Primary and QA/QC for Sediment and Periphyton Samples

Parameter and Matrix	Number of Samples	Primary Samples	Field Duplicate Samples	Equipment Rinsate	Field Blanks	MS/MSD
Sediments						
Total Phosphorus	106	96	5	0	0	5
Bulk Density	106	96	5	0	0	5
Calcium (as CaCO ₃)	106	96	5	0	0	5
Ash Free Dry Weight	106	96	5	0	0	5
Percent Solids	106	96	5	0	0	5
Total Nitrogen	106	96	5	0	0	5
Total Organic Carbon	106	96	5	0	0	5
Biologicals						
Biomass (AFDW)	106	96	5	0	0	5
Bulk Density	106	96	5	0	0	5
Calcium (as CaCO ₃)	106	96	5	0	0	5
Percent Water	106	96	5	0	0	5
Periphyton Species Composition	106	96	5	0	0	5
Total Carbon	106	96	5	0	0	5
Total Nitrogen	106	96	5	0	0	5
Total Organic Carbon	106	96	5	0	0	5
Total Phosphorus	106	96	5	0	0	5

6.4.2 Field Procedures

6.4.2.1 Sampling Methods

Sediment and periphyton samples will be collected utilizing a 3 in diameter polycarbonate corer. The corer is driven into ground at the sampling location to a depth at least 10 cm below the periphyton-sediment interface. Periphyton is separated from the sediment as a distinct layer and placed in a sample container. The top 10 cm of sediment is retained in a separate sample container.

6.4.2.2 Sample Containers and Preservation Techniques

The Quality Assurance Project Plan provides the analytical methods that will be used for the sediment and periphyton mat analyses. This table also provides the required container types and sizes, preservatives, and holding times. Manufacturer-certified clean sample containers will be provided by the laboratory. To assure timely shipping of the sample and shipping containers, approximately two weeks prior to sampling the Field Team Leader will notify the USACE Technical Point of Contact by email of the planned sampling date, the number of samples to be taken and the analytical parameters to be sampled. The USACE will then notify the sampling contractor who in turn will assure that the appropriate number of sample and shipping containers are shipped to the Field Team Leader.

All sample containers will be triple rinsed with decanted water from the sampler prior to filling. Only samples for biovolume analysis require chemical preservation. A 5% volume/volume solution of buffered formaline will be added to the containers used for this analysis by the laboratory. All sediment and mat samples will require preservation by maintaining the sample at a temperature of 4°C, $\pm 2^\circ\text{C}$. All such sample fractions will be immediately placed and kept in a cooler filled with sufficient ice to maintain the required temperature.

6.4.2.3 Field Quality Control Sampling Procedures

As previously described, only QA/QC field duplicate samples will be collected for periphyton mat and sediment samples. Duplicate samples will be collected by obtaining a second sample, immediately adjacent to the primary sample. The duplicate sample will be collected in the same manner as the primary sample. The duplicate sample number will be different from the primary sample.

6.4.2.4 Decontamination Procedures

The polycarbonate coring device and any supporting tools or equipment will be decontaminated following the procedure described in section 6.1.2.5 prior to use at each sampling station.

6.5 CELL 2 – SUBMERGED AQUATIC VEGETATION MONITORING

The SAV Cell is a 55-acre treatment cell located along the northern extreme of Cell 2. This cell is both the third step in the PSTA pretreatment train and provides the hydraulic head for flows into the PSTA demonstration cells. The ground surface elevation of the SAV Cell within Cell 2 has been designed to be 15.0 feet NGVD with a target water surface elevation of 18.0 feet NGVD and short-term increases to 19.1 feet NGVD during high-flow events.

6.5.1 Water Quality

Monitoring within this treatment cell will include water elevation and nutrient concentrations at the 364-A structure. Table 14 provides the sampling frequency at this location.

6.5.2 Biological Analysis

Biological analysis within this cell will be confined to vegetation monitoring required for cell maintenance and operation. Tracking and understanding changes in the species present and the area that they occupy will help guide cell operations to optimize treatment within the cell. Additionally, certain undesirable species may need to be removed when they are discovered.

Initial monitoring of this cell will require a ground survey by boat to describe and locate (using the Global Positioning System (GPS)) SAV and EAV species coverage. Surveys should be conducted on a quarterly basis. Subsequent surveys could be expedited by taking photographs from an airplane or helicopter to locate areas within the cell that have changed since the previous ground survey. These photographs could allow for ground surveying to be targeted if changes appear to be isolated.

In an effort to test the ability to synoptically capture the SAV communities' composition in the field, a spectrophotometer will be deployed at the time when the SAV is being visually inspected. The resultant spectra will be analyzed and compared to observations made during the visual inspection.

Table 9. SAV Cell Monitoring Frequencies

Parameter	Frequency
Flow Rate	Continuous
Dissolved Oxygen	Continuous
pH	Continuous
Photo Documentation (entire cell)	Quarterly
Redox Potential	Continuous
Specific Conductance	Continuous
Total Phosphorus	Composite
Turbidity	Continuous
Water Depth	Continuous
Water Temperature	Continuous

6.6 CELL 1 – EMERGENT AQUATIC VEGETATION

Cell 1 is a 556-acre treatment cell that is the second step in the PSTA treatment train and is designated for EAV as the dominant vegetation. Monitoring within this cell will be conducted to assist with treatment train management and operations.

6.6.1 Water Quality

Monitoring within this treatment cell will include water elevation, and nutrient concentrations at the 363-C structure. Table 10 provides the frequency of sampling at this location

6.6.2 Biological Analysis

Biological analysis will not be conducted within this cell; however, periodic visual inspections with photographic archiving will be performed to observe major changes within the cell, if any.

Table 10. EAV Cell Monitoring Frequency

Parameter	Frequency
Flow Rate	Continuous*
Dissolved Oxygen	Continuous
pH	Continuous
Photo Documentation (entire cell)	Quarterly
Redox Potential	Continuous

Specific Conductance	Continuous
Total Phosphorus	Composite
Turbidity	Continuous
Water Depth	Continuous
Water Temperature	Continuous

*Gate/pump settings and flows will be calibrated.

6.7 EASTERN DISTRIBUTION CELL MONITORING

The EDC delivers water to the EAV in Cell 1. This cell provides the hydraulic head for flows into the PSTA treatment train. The target surface water elevations in the EDC have yet to be fully identified.

6.7.1 Water Quality

Monitoring within this cell will include water elevation, and nutrient concentrations at the output structure into Cell 1. Table 11 provides the sampling frequency at this location.

6.7.2 Biological Analysis

Initial monitoring of this cell will require a ground survey by boat to describe and locate (using GPS) EAV species coverage. Surveys should be conducted on a quarterly basis. Subsequent surveys could be expedited by taking photographs from an airplane or helicopter to locate areas within the cell that have changed since the previous ground survey. These photographs could allow for ground surveying to be targeted if changes appear to be isolated.

Table 11. EDC Monitoring Frequency

Parameter	Frequency
Flow Rate	Continuous*
Dissolved Oxygen	Continuous
Ph	Continuous
Photo Documentation	Quarterly
Redox Potential	Continuous
Specific Conductance	Continuous
Total Phosphorus	Composite
Turbidity	Continuous
Water Depth	Continuous
Water Temperature	Continuous

*Gate settings will be calibrated

7 FIELD MONITORING

7.1 FIELD PARAMETER MEASUREMENT

General surface water quality parameters, test cell hydrologic conditions, and meteorological conditions are required to be measured to supplement the collected analytical data and to document test conditions. Required water quality measurements include: pH, specific conductivity, temperature, dissolved oxygen, alkaline phosphatase, and turbidity. Hydrologic conditions within the tests cells that need to be measured include: flow rate and water depth. Meteorological conditions that will be measured include: air temperature, humidity, solar radiation, wind speed and direction, rainfall, and evapotranspiration. The field parameters and frequencies are noted in Table 12.

Table 12. Field Monitoring Frequencies

Parameter	Tier 1	Tier 2	Tier 3
Alkaline Phosphatase			BW
Alkalinity	M	Q	A
Color	M	Q	A
Dissolved Oxygen	Continuous		BW
Flow Rate	Continuous*		
Ph	Continuous		BW
Photo Documentation			BW
Redox Potential	Continuous		BW
Specific Conductance	Continuous		BW
Turbidity	M	Q	A
Water Temperature	Continuous		BW

7.1.1 Field Measurement Locations

Surface Water Quality Parameters

All of the surface water quality parameters, except alkaline phosphatase and turbidity, will be measured using a Hydrolab DS5X. The Hydrolab DS5X will be mounted 3 inches from the ground surface. APA and turbidity will be measured at the same locations as those completed during the surface water quality transect sampling.

Hydrologic Conditions

Water depth and effluent flow measurements will be accomplished via the test cell control system. Water depth measurements will be made with a stage recorder and this data will be logged continuously. Effluent flow rates will be measured with a flow meter. Input flow

measurements will be made with George Fisher Type/SK71 No. 198.801.887 rotometers mounted at the head of each test cell.

Meteorological Conditions

Rainfall, solar radiation, humidity, wind speed and wind direction will be measured at a weather station located at the Flying Cow Road Treatment Facility. Evapotranspiration will be measured using data available from the SFWMD's DBHYDRO environmental data clearinghouse. The evapotranspiration station in nearest proximity to FCRTF with available data will be used.

Field Measurement Procedures and Criteria

The Hydrolab DS5X will be programmed to measure the water quality parameters at 1 minute intervals. Measurements will be made in each cell throughout each flow regime scenario. In general, all measurements will be conducted following DEP SOP 1900 *Continuous Monitoring With Installed Meters*. Field equipment shall be maintained at its proper functional status in accordance with the manufacturer manual specifications. Repairs will be performed (if necessary), and any potential spare parts (e.g., batteries, connectors, etc.) and maintenance tools will be kept on site, to minimize equipment downtime during the field activities. Visual checks of the equipment will be conducted on a routine basis. Routine preventive maintenance shall be performed to assure proper operation of the equipment. Maintenance performed on field equipment will be documented in a designated field notebook, and shall be undertaken only by personnel who have the appropriate skills in the type of maintenance required. Calibration and calibration verification of the instruments used to measure field water quality parameters are described in the QAPP. Calibration will be documented on a form similar to that provided in Table 13.

Calibration checks will be conducted once per week utilizing a newly calibrated handheld sensor. The field parameter values of the Hydrolab DS5X will be compared to the handheld sensor and, if the values are within tolerances, the Hydrolab will not require recalibration. The tolerances are as follows: Dissolved Oxygen 0.2 mg/l, pH 0.2 pH units, Conductivity 10%. If these tolerance limits are exceeded the Hydrolab will be removed from the test cell and recalibrated.

Table 13. Field Instrument Calibration Records (Typical)

INSTRUMENT (MAKE/MODEL#) _____

INSTRUMENT # _____

PARAMETER: [check only one]

- | | | |
|--------------------------------------|---------------------------------------|--------------------------------------|
| <input type="checkbox"/> TEMPERATURE | <input type="checkbox"/> CONDUCTIVITY | <input type="checkbox"/> SALINITY |
| <input type="checkbox"/> pH | <input type="checkbox"/> ORP | <input type="checkbox"/> DO |
| <input type="checkbox"/> TURBIDITY | <input type="checkbox"/> RESIDUAL CL | <input type="checkbox"/> OTHER _____ |

STANDARDS: [Specify the type(s) of standards used for calibration, the origin of the standards, the standard values, and the date the standards were prepared or purchased]

Standard A _____

Standard B _____

Standard C _____

DATE	TIME	STD	STD	INSTRUMENT	% DEV	CALIBRATED	TYPE	SAMPLER

7.1.2 Acidity and Alkalinity

The pH will be measured with a calibrated water quality meter such as the Hydrolab DS5X during all times of normal operations. The instrument will be calibrated before and after each sampling trip using a two-point calibration (pH 7 and pH 10 solutions). The procedures for instrument calibration, maintenance, and measurement will be in general agreement with those found in FDEP SOP FT 1000, FT 1100 and Hydrolab DS5X, DS5, and MS5 Water Quality Multiprobes Manual. The required steps of this procedure are summarized below:

7.1.2.1 Field Standards for pH

Standards: Use standard buffers with nominal values of 7.0 and 10.0 units.

7.1.2.1.1 Instrument Calibration and Use

Calibrate the meter/electrode system with at least two buffers following the manufacture's instructions. Always use a pH 7 buffer first followed by a pH 10 buffer.

To be acceptable, a calibration check must be within +/- 0.2 pH unit of the stated buffer value. For example, if checking the pH 10.0 buffer, the result must be in the 9.8 to 10.2 range.

To obtain an accurate reading, round the result to one decimal figure (e.g., 7.6 instead of 7.57 units).

Rinse the probe with de-ionized (DI) water before and between each standard buffer solution.

Record all calibration information (initial, continuing, and final) in the field notebook. The following information must be recorded with each check:

The calibration method and the type of standard(s) used.

Date, time and location of each calibration check;

The individual performing the check;

Whether the check met or failed acceptance criteria;

Readings associated with a failed check;

Corrective actions associated with failed check (such as re-calibration, removal from use, etc.); and Enter the meter name, and model number.

Reagent and Standards Documentation

Maintain documentation on calibration standards (e.g., buffers, potassium chloride (KCl)) and other reagents.

At a minimum, note the date of receipt, lot number, expiration dates (on the bottle label), and date of first use (on the standards container) in the field notebook.

Observe and follow expiration dates. If any standard or chemical is used after the expiration date, there must be documentation showing that the reagent is providing an acceptable response.

All expired standards and reagents must be properly disposed in accordance with local, state and federal requirements.

7.1.3 Specific Conductance

Specific conductance will be measured with a temperature-compensated conductivity meter such as the Hydrolab DS5X during all times of normal operations. The instrument will be calibrated using a two-point calibration (e.g. 1,000 micro-Siemens per centimeter [$\mu\text{S}/\text{cm}$]). The general procedures for instrument calibration, maintenance, and measurement will be in agreement with those found in FDEP SOP FT 1000 and FT 1200. An outline of the procedure is provided in the following paragraphs:

Instrument Calibration and Use

Record all calibration information (initial and continuing) in a field notebook including:\

The individual performing the check

Date, time and location of each calibration check

Meter name, and model number

Standard concentrations used

Results of each calibration check, including expected reading for the calibration standard and actual reading obtained from the instrument;

Whether the check met or failed acceptance criteria;

Sample readings associated with a failed check, either by direct listing or link to other records;

Corrective actions associated with failed check (such as re-calibration, maintenance; removal from use, etc.); and,

7.1.3.1 Initial Calibration

Purchase prepared standard KCl solutions with conductivity values that bracket the expected samples' range. Calibrate the meter prior to use according to the following steps:

Follow the instrument manufacturer's calibration instructions.

Use two standard potassium chloride solutions that bracket the range of expected sample conductivities.

Calibrate the instrument with the first standard.

Check the calibration of the instrument with the second standard, bracketing the range of expected sample values.

If the instrument can be calibrated with more than one standard, choose additional calibration standards within the range of expected sample values.

7.1.3.1.1 Acceptability

Accept the calibration if the meter reads within +/- 5% of the value of any calibration standard used to check the calibration. For example, the acceptance range for a 100 $\mu\text{mhos}/\text{cm}$ standard is 95 to 105 $\mu\text{mhos}/\text{cm}$. If the meter does not read within +/- 5% of each calibration check standard, determine the cause of the problem and perform corrective action prior to proceeding.

7.1.3.2 Continuing Calibration

Check the meter with at least one KCl specific conductance standard within the range of conductivity measured in environmental samples. The reading for the calibration check must also be within +/- 5% of the standard value.

If new environmental samples are encountered outside the range of the initial calibration, check the instrument calibration with two standards bracketing the expected range of sample values. If these calibration checks fail, recalibrate the instrument.

Measuring Specific Conductance of Samples

Follow manufacturer's instructions for sample measurement.

Immerse or place the conductivity probe or sensor *in-situ* at a measuring location representative of the sampling source.

Allow the conductivity instrument to stabilize.

If the conductivity meter has a set of positions that multiply the reading by powers of ten in order to measure the full range of potential conductivities, set this dial to the correct range in order to take a reading.

Record the sample conductivity measurement reading.

Rinse off the probe with DI water. Follow manufacturer's instructions for probe storage between use.

7.1.4 Temperature

Temperature will be measured with a Hydrolab DS5X water quality meter during all times of normal operations. The temperature sensor in the Hydrolab DS5X is factory-set and does not require recalibration. This temperature sensor has a range of -5 °C – 50 °C with an accuracy of ± 0.10 °C and a resolution of 0.01 °C.

7.1.5 Dissolved Oxygen

Dissolved oxygen (DO) will be measured with a water quality meter equipped with a specific DO probe such as the Hydrolab DS5X during all times of normal operations. The initial instrument calibration will be performed by the manufacturer (See Figure 4 and Figure 5). Instrument calibration checks will be recorded in the field notebook. The general procedures for instrument calibration, maintenance, and measurement will be in agreement with those found in FDEP SOPs FT 1000 and FT 1500. An outline of the procedure is provided below:

Table 14. Solubility of Oxygen in Water

Table 1: Solubility of Oxygen in Water at Atmospheric Pressure ^{1,2}			
Temperature °C	Oxygen Solubility mg/L	Temperature °C	Oxygen Solubility mg/L
0.0	14.621	26.0	8.113
1.0	14.216	27.0	7.968
2.0	13.829	28.0	7.827
3.0	13.460	29.0	7.691
4.0	13.107	30.0	7.559
5.0	12.770	31.0	7.430
6.0	12.447	32.0	7.305
7.0	12.139	33.0	7.183
8.0	11.843	34.0	7.065
9.0	11.559	35.0	6.950
10.0	11.288	36.0	6.837
11.0	11.027	37.0	6.727
12.0	10.777	38.0	6.620
13.0	10.537	39.0	6.515
14.0	10.306	40.0	6.412
15.0	10.084	41.0	6.312
16.0	9.870	42.0	6.213
17.0	9.665	43.0	6.116
18.0	9.467	44.0	6.021
19.0	9.267	45.0	5.927
20.0	9.092	46.0	5.835
21.0	8.915	47.0	5.744
22.0	9.743	48.0	5.654
23.0	8.578	49.0	5.565
24.0	8.418	50.0	5.477
25.0	8.263		

1. The table provides three decimal places to aid interpolation
 2. Under equilibrium conditions, the partial pressure of oxygen in air-saturated water is equal to that of the oxygen in water-saturated air

Calibration

Air Calibration and Checks: before use, check the meter in water-saturated air to make sure it is properly calibrated and operating correctly. Make a similar check at the end of the day or sampling event. Follow the manufacturer’s instructions for the specific instrument.

Allow an appropriate warm up and equilibration period before initial field calibration.

Once the probe/calibration chamber is stable at ambient temperature, check the air temperature and determine, from the DO versus temperature table (see **New Table Figure 10**), what the DO should measure. A stable and accurate temperature is required for a valid calibration.

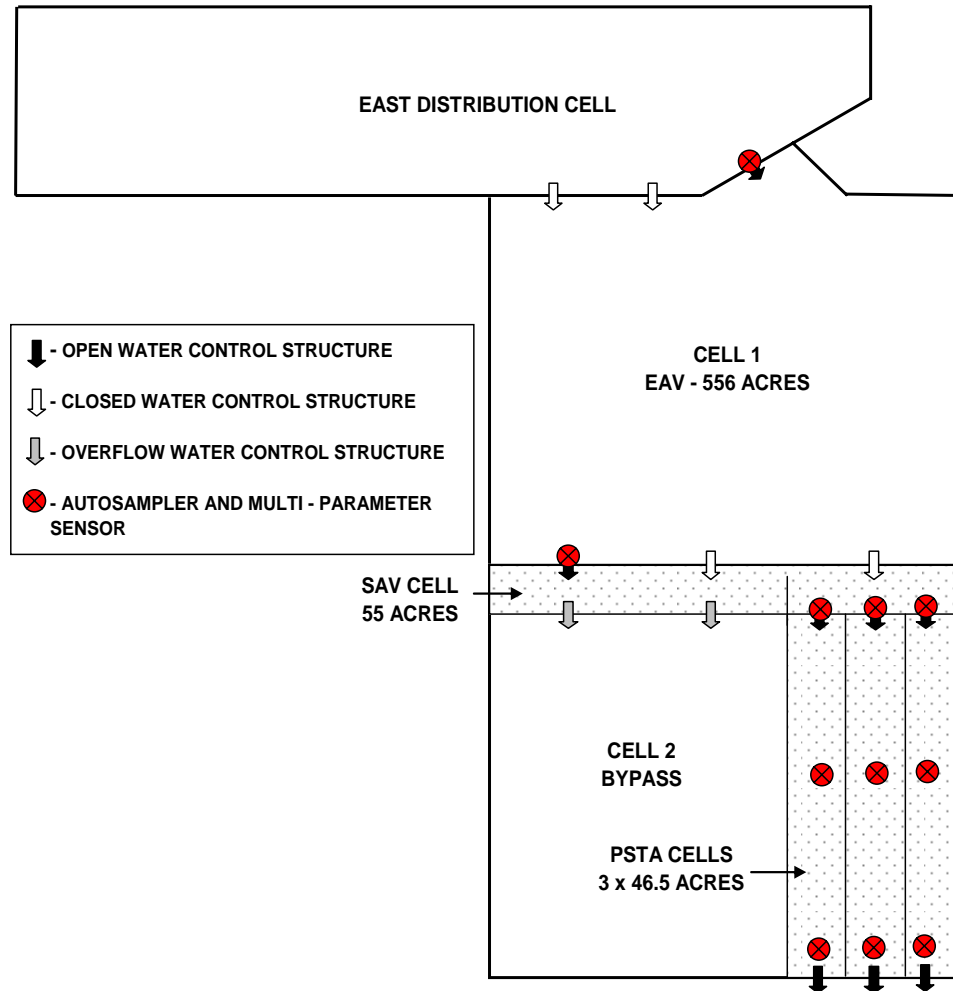


Figure 9. Fixed Sampling Locations

Air Calibration Chamber in Air: DO sensor or instrument is calibrated against air that is saturated with water at a known temperature and ambient atmospheric pressure. Use **New Table 14** to check calibration at specified temperature.

Wet the inside of the calibration chamber with water, pour out the excess water (leave a few drops) and insert the sensor into the chamber (this ensures 100-percent humidity).

Allow adequate time for the DO sensor and the air inside the calibration chamber to equilibrate.

Measure the temperature in the calibration chamber and observe the readings until the instrument stabilizes.

Use the oxygen solubility on Table 14 to determine the DO saturation at a measured temperature and atmospheric pressure.

Compare DO meter reading with value obtained from Table 14 to ensure continuous calibration.

Calibration: Record all calibration information (initial and continuing) in the field notebook. The following information should be recorded:

The calibration method (or SOP)

Date, time and location of each calibration check

Individual performing the check

Results of each calibration check, expected reading, and the actual reading

Whether the check met or failed acceptance criteria

Readings associated with a failed check

Corrective actions associated with failed check (such as, removal from use and sent back to the manufacturer for re-calibration)

Field measurement meter name, and model number

Samples: Samples are automatically logged and are available in real-time via the internet

7.1.6 Turbidity

Turbidity will be measured with a Hach 2100 P Turbidimeter, which meets U.S. EPA Method 180.1 criteria. This meter is factory calibrated but is supplied with primary and secondary standards for periodic re-calibration and calibration verifications. Prior to the instruments first use the secondary standards are assigned values based on the factory calibration. The secondary standards are then used, before and after sample measurement to verify calibration. After every three months, the unit is recalibrated using the primary standards. Re-calibration using the primary standards should be conducted more frequently if calibration checks are not within 5% of any of the secondary standards values. After re-calibration using the primary standards, the secondary standards are assigned new values (as appropriate) and are continued to be used for calibration verifications.

Prior to each use, the meters factory calibration will be checked using the secondary standards. A sample is then collected and transferred to a clean cell. The cell is wiped dry and placed in the turbidimeter. The read button is depressed and the turbidity value is displayed in nephelometric turbidity units. Calibration is verified at the end of each day the turbidimeter is used using the secondary standards.

7.1.7 Alkaline Phosphatase Activity

The APA assay measures the activity of alkaline phosphatase, an enzyme used by bacteria to mineralize phosphate from organic compounds. The assay is performed by adding a known concentration of an organic phosphate compound (3-*o*-methylfluorescein phosphate (MFP)) to an unfiltered water sample. Alkaline phosphatase in the water sample cleaves the phosphate from the MFP, leaving 3-*o*-methylfluorescein (MF), a highly fluorescent compound. The concentration of MF at the end of the assay is proportional to the APA of the sample.

Water Sample Preparation

APA measurements are made within 12 to 24 hr of sample collection. Duplicate 3 ml subsamples from each sample bottle are pipetted into disposable plastic cuvettes, and 30 μ l of the MFP solution are added to each.

The fluorescence of these subsamples are immediately measured in the fluorometer. Samples are incubated for 2 hr in an incubator at 25 °C. After the incubation period, the fluorescence of all the samples is measured again using the same excitation and emission wavelengths.

Fluorometer Operation

- a. Turn the machine on to warm up, preferably an hour.
- b. Set the excitation and emission wavelengths (Hit 2 ENTER, 430 ENTER, 507 RETURN).
- c. Set the response time to 4 seconds (Hit 3.5 ENTER, 4 RETURN).
- d. Calibrate the machine with an existing cuvette in slot 2. Hit calibrate.
- e. After calibration, set high voltage to 425 (Hit 3.2 ENTER, 425 RETURN).
- f. Put in blank (Trisma buffer) and see if it reads zero. If not, zero the instrument by hitting AUTO BLANK.
- g. Analyze each standard, pressing READ PRINT after each to record the relative fluorescence.
- h. Prepare the samples by placing 3 mL of sample into each of two disposable plastic cuvettes. Put 30 µL of stock MFP into each sample cuvette and mix with a disposable pipet.
- i. Insert each sample cuvette into slot 1, close the hood, and hit READ PRINT to record the relative fluorescence when the number stabilizes.
- j. Place the sample cuvettes into an incubator at 25°C for 2 hr, then repeat step *i*.

7.1.8 Alkalinity

7.1.9 Color

7.1.10 Meteorological

The meteorological results will be compared to nearby SFWMD weather stations to determine if any of the components require factory recalibration.

8 FIELD OPERATIONS DOCUMENTATION

This section presents the field documentation procedures that will be implemented to ensure accurate data collection. Both analytical and field data records collected throughout this project must be able to be uniquely traced back to a particular, location, date, and time when the data was collected.

8.1 FIELD NOTEBOOK

A description of field observations and activities will be entered in a bound waterproof field notebook for the duration of this project. In the event there are several field activities occurring simultaneously, there may be a need to use separate notebooks for each activity. Under these circumstances, a master field notebook will be used in addition to each task or activity

notebook. The master notebook will describe the ongoing operations and the general field activities (including personnel on-site), and will provide an inventory of the activity notebooks, as well as the task leaders. The FTL will be chiefly responsible for updating this notebook however other members of the contractor team may also need to update the notebook. The field notebook will be chiefly housed at the FCRTF with exception of when it is needed elsewhere for report writing or duplication.

If notebook corrections are necessary, they will be made by drawing a single line through the original entry (in such a manner that the original entry may be read) and writing the corrected entry alongside it. The correction will be initialed and dated. Complex correction of errors will require a footnote explaining the correction.

General guidelines for notebook preparation are provided below:

Notebooks with bound and consecutively numbered pages will be used.

A prohibition against removal of any pages, even if they are partially mutilated or illegible will be enforced.

Use objective and factual language.

The notebook will be returned to the project file at the completion of the field activity.

In particular, field notebooks will document deviations from the project work plans (FSP, QAPP) and the Safety and Health Plan, and any changes in personnel and responsibilities, as well as the reasons for the changes.

Procedures have been established to ensure that conditions adverse to data quality are promptly investigated, evaluated and corrected. The procedure for review and implementation of a change is as follows:

Define the problem.

Investigate the cause of the problem.

Develop a corrective action to eliminate the problem, in consultation with the personnel who defined the problem and who will implement the change.

Complete the required form describing the change and its rationale.

Obtain all required written approvals.

Implement the corrective action.

Verify that the change has eliminated the problem.

In each case, deviations will be approved by the Field Project Manager prior to implementation in the field. Changes or deviations from the FSP will be documented in the site notebook by the field team leader and a Field Change Request (FCR) Form will be initiated (See Figure 10.). The FCR form will be signed by the Field Team Leader, and Project Manager. Major changes (i.e., those that impact schedule and/or budget) will be discussed with the USACE Contracting Officer (CO) and USACE technical point of contact prior to implementation, and the FCR form will then also be signed by USACE personnel.

The completed form will be distributed to the Project Manager, the USACE technical lead, others (as warranted) and the project file. FCRs will be numbered serially, starting with the number "01". Copies of the FCR must be maintained by the sampling team on-site with the FSP.

Field Change Request (FCR)

FCR NO. _____	DATE INITIATED _____
PROJECT _____	
CONTRACT NO. _____	
REQUESTOR IDENTIFICATION	
NAME _____	ORGANIZATION _____ PHONE _____
TITLE _____	SIGNATURE _____
BASELINE IDENTIFICATION	
BASELINE(S) AFFECTED <input type="radio"/> Cost <input type="radio"/> Scope <input type="radio"/> Milestone <input type="radio"/> Method of Accomplishment	
AFFECTED DOCUMENT (TITLE, NUMBER AND SECTION) _____	
DESCRIPTION OF CHANGE: 	
JUSTIFICATION: 	
IMPACT OF NOT IMPLEMENTING REQUEST: 	
PARTICIPANTS AFFECTED BY IMPLEMENTING REQUEST: 	
COST ESTIMATE (\$) _____	ESTIMATOR SIGNATURE _____
PHONE _____	DATE _____
PREVIOUS FCR AFFECTED <input type="radio"/> YES <input type="radio"/> NO; IF YES, FCR NO. _____	
CLIENT PROJECT MANAGER _____	DATE _____
CLIENT QA SPECIALIST _____	DATE _____
SAIC H&S MANAGER SIGNATURE (IF APPLICABLE) _____	DATE _____

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Figure 10. Field Change Request (FCR)

8.2 PHOTOGRAPHIC RECORDS

Photographs will be taken during at the conclusion of each hydrologic scenario and additional photographs will be taken if deemed necessary to document an off-normal situation. A digital camera will be utilized to take photographs. An unedited copy will be stored using a compact disk in the file for use as a permanent record.

8.3 SAMPLE DOCUMENTATION

Field personnel will be responsible for uniquely identifying, labeling, preserving, and shipping the samples to the analytical laboratories.

8.3.1.1 Sample Labels

Immediately following collection, a sample label will be applied to each sample container. The following information will be included on each sample:

- Project name;
- Project number;
- Sample identification;
- Date of sample collection;
- Time of sample collection;
- Matrix;
- Require analysis;
- Preservation;
- Container type and volume.

The label information should be double-checked to ensure it is correct. The sample identifier and designated sampling point should also be recorded in the field notebook.

8.3.1.2 Sample Numbering System

A sample numbering scheme has been developed for this project to insure that each sample is assigned a unique identifier. The numbering system to be used identifies the matrix of the sample, the type of sample collected, the test scenario, week, and location of the sample.

For non-Period of Record operations, all sampling will be in accordance with Tier I sampling and the surface water samples will be numbered using an six character/number identifier, where:

The first character of the number represents the sample matrix (S = surface water).

The second character of the number designates the sample as either a composite or grab sample (C = composite, G = grab).

The third character identifies the flow test scenario during which the sample was collected (A through R).

The fourth character designates the cell from which the sample was collected, where cell 2A is assigned a value of A, cell 2B a value of B, and cell 2C a value of C. Samples from Cell 1 is assigned a value of D. Samples from the SAV cell are assigned a value of E.

The fifth character designates the sample station, within a given cell, from which the sample was obtained. These values would equal U for upstream station, M for midpoint station and D for downstream station.

The last character designates the sample as either a regular sample or as a field duplicate. The number 0 designates the sample as a regular sample; the number 1 designates the sample a field duplicate; the number 2 designates the sample as a field triplicate.

For example, sample number SGIAU0 would represent a surface water sample collected as a grab, during scenario I, in the test cell A, at the upstream sample station. The sample is a regular sample.

For sample identification during the POR operations, the sampling will be based on the Tier sampling.

The first character of the number represents the sample matrix (S = surface water).

The second character of the number designates the sample as either a composite or grab sample (C = composite, G = grab).

The third character identifies the flow test scenario during which the sample was collected (always O).

The fourth character designates the cell from which the sample was collected, where cell 2A is assigned a value of A, cell 2B a value of B, and cell 2C a value of C. Samples from Cell 1 is assigned a value of D. Samples from the SAV cell are assigned a value of E.

The fifth character designates the Tier level (Tier I =1, Tier II=2, Tier III=3, Tier IV=4).

The sixth through ninth character designate the sample station, within a given cell, from which the sample was obtained. These values can vary from the influent point (0000) to the effluent point (4400).

The tenth and eleventh character indicates the week within the scenario (01 through 52) in which the sample was collected. This would only be used during the POR operations.

The last character designates the sample as either a regular sample or as a field duplicate. The number 0 designates the sample as a regular sample; the number 1 designates the sample a field duplicate; the number 2 designates the sample a field triplicate.

For example, sample number SGOA22000230 would represent a surface water sample collected as a grab, during the POR, in the test cell A, during Tier II, at station 2200 feet downstream, during week 23. The sample is a regular sample.

Periphyton mat and sediment samples will be identified using an eleven character/number identifier, where:

The first character identifies the sample matrix as being either periphyton mat or sediment (M = periphyton mat, D = Sediment)

The second character identifies the flow test scenario during which the sample was collected (A for baseline sediment and K through R).

The third character designates the cell from which the sample was collected, where cell 2A is assigned a value of A, cell 2B a value of B, and cell 2C a value of C.

The fourth character designates the Tier level (Tier I =1, Tier II=2, Tier III=3, Tier IV=4).

The fifth through eighth character designate the sample station, within a given cell, from which the sample was obtained. These values can vary from the influent point (0000) to the effluent point (4400).

The ninth and tenth character indicates the week within the scenario (01 through 52) in which the sample was collected. This would only be used during the POR operations.

The last character designates the sample as either a regular sample or as a field duplicate. The number 0 designates the sample as a regular sample; the number 1 designates the sample a field duplicate; the number 2 designates the sample a field triplicate.

For example, sample number MOA22000230 would represent a periphyton sample collected during the POR, in the test cell A, during Tier II, at station 2200 feet downstream, during week 23. The sample is a regular sample.

Another example, sample number DAB210000 would represent a sediment sample collected during the baseline, in test cell B, at station 1000 feet downstream. This sample is a regular sample.

Groundwater samples will be identified using either a five or seven character/number identifier, where:

The first character identifies the sample matrix as being groundwater (G = groundwater)

The second character identifies the flow test scenario during which the sample was collected (A through R).

The third and fourth character designates the well from which the sample was collected, where MW-0003A is assigned a value of 3A, MW-0003B is assigned a value of 3B, etc.

The fifth and sixth character indicates the week within the scenario (01 through 52) in which the sample was collected. This would only be used during the POR operations.

The last character designates the sample as either a regular sample or as a field duplicate. The number 0 designates the sample as a regular sample; the number 1 designates the sample a field duplicate; the number 2 designates the sample a field triplicate.

For example, sample number GC5A0 would represent a groundwater sample collected during scenario C, at monitoring well MW-005A. The sample is a regular sample

Equipment rinsate samples will be numbered using a seven character/number identifier where:

The first two characters (EQ) designate the sample as an equipment rinsate sample.

The third character identifies the sample matrix for which the equipment will be used (eg.: S = surface water, M = periphyton mat, D = sediment, G = groundwater)

The fourth character identifies the flow test scenario during which the sample was collected (A through R).

The fifth and sixth character indicates the week within the scenario (01 through 52) in which the sample was collected.

The last two characters represent the sequential cumulative number of total equipment rinsate blanks collected.

For example, sample number EQSK116, would represent an equipment rinsate sample, collected on equipment used to collect surface water, during scenario K, week 1. The sample is the 16th equipment rinsate sample collected as part of the project.

Field blank samples will be identified using a six character/number identifier, where:

The first two characters (FB) designate the sample as a field blank.

The third character identifies the flow test scenario during which the sample was collected (A through R).

The fourth character indicates the week within the scenario (01 through 52) in which the sample was collected.

The last two characters represent the sequential cumulative number of total field blank samples collected.

For example, sample number FBK106, would represent a field blank sample, collected during scenario K, week 1. The sample is the 6th field blank sample collected as part of the project.

Where extra volume is collected for a laboratory MS/MSD, all containers for the sample will bear the same sample number, as these samples do not need to be blind to the lab.

8.3.2 Sample Chain-of-Custody Documentation

This section describes procedures for sample chain-of-custody (COC) and documentation. The purpose of these procedures is to ensure that the integrity and quality of the samples are maintained during collection through analysis. Formal sample custody procedures begin when the pre-cleaned sample containers are received from the contracted laboratory.

Sample identification documents must be carefully prepared so that sample identification and COCs can be maintained and sample disposition controlled.

Sample identification documents include:

Field notebooks;

Sample labels; and

COC records.

A critical aspect of overall sample custody involves the COC record. Information specified on the COC record will contain the same level of detail as found in the field notebook. The custody record will include the following information:

Site name and Project Identifier;

Names of the sampling the team members responsible for collection of the listed samples;

Date and time each sample was collected;

Type of sampling conducted (composite/grab);

Matrix (groundwater, surface water);

Subcontract laboratory;

Location of sampling station (using the sample code system);

Number of sample containers shipped;

Analyses requested;

Sample preservation information.

8.4 FIELD ANALYTICAL RECORDS

Field analytical measurements performed during this project are listed in Section 7. Each field instrument used for measurement or analysis will be calibrated in accordance with the manufacturer's specifications (see Section 7.1 of this FSP), and FDEP SOPs, and checked against two standards that bracket the expected range of data that will be collected. Calibration records will be maintained in the field notebooks. Malfunctioning equipment will be replaced, and any measurements that are in question will be noted in the notebook.

The field team leader or designee will be responsible for ensuring that the field instrumentation are of the proper range, type and accuracy for the test being performed, and that all of the equipment are calibrated at their required frequencies, according to their specific calibration protocols/procedures.

Field measurement instruments must be calibrated according to the manufacturer's instructions (see Section 7.1). Exceptions to this requirement will be permitted only for instruments that have fixed calibrations pre-set by the equipment manufacturer; however, calibration checks must be made. Calibration information will be documented in the designated field notebook. Project personnel using measuring equipment or instruments in the field must be trained in the calibration and usage of the equipment, and are personally responsible for ensuring that the equipment has been properly calibrated prior to its use.

In addition, field instruments must undergo response verification checks at the time that the user suspects or detects anomalies in the data being generated or as the manufacture specifies. The checks consist of exposing the instrument to a known source of analyte (e.g., the calibration solution), and verifying a response. If an unacceptable instrument response is obtained during

the check (i.e., not within specifications), the data shall be labeled suspect, the problem documented in the site notebook, and appropriate corrective action taken.

Field equipment found to be out of calibration must be immediately re-calibrated. When instrumentation is found to be out of calibration or damaged, an evaluation shall be made to ascertain the validity of previous test results since the last known good calibration check. If it is necessary to ensure the acceptability of suspect items, the originally required tests will be repeated (if possible), using properly calibrated equipment. Data or measurements that were collected since the last acceptable calibration that cannot be reproduced will be noted as suspect in the field notebook and further reviewed to determine the suitability of the data for its intended use.

Field instruments that are consistently found to be out of calibration must be repaired or replaced.

8.5 DOCUMENTATION PROCEDURES/DATE MANAGEMENT AND RETENTION

Data collected during operations will be assembled, reviewed, and evaluated to satisfy the objectives of the investigation. All original field records, COCs, sample forms, unaltered laboratory reports, and photographs will be maintained.

The materials kept in the project filing cabinet should be organized according to a project-specific filing system. Project correspondence will include a document control number in the upper right-hand corner (header) of the first page. Copies of correspondence listed in the document control files (including draft and final copies of reports) will be retained in the project files for five years. At the end of this period, the PM will contact USACE to determine the disposition of original project records, prior to the destruction of any records.

8.5.1 Data Management

Data management is a support task for all the other tasks. It consists of providing data quality review and database management to assist in data evaluation.

The laboratory will be required to deliver data in both hardcopy and electronic format deliverables. The laboratory contractor will conduct a data quality review of each data package received from the laboratories to ensure that the results in the electronic file match the hardcopy format provided by the laboratory. An unaltered copy of the electronic files will be maintained by the laboratory contractor on a CD-ROM in the project files. Copies of this record will be used to conduct data quality reviews and to prepare data for reporting in the format required by the USACE.

Additional information on data management and laboratory deliverables is provided in Sections ??? of the QAPP (Volume II).

8.5.2 Data Evaluation

The laboratory contractor will monitor analytical laboratory progress and review the data collected as a result of the field sampling effort. Analytical methods for operations were selected based on the precision, accuracy, reproducibility, completeness, and comparability (PARCC) necessary to satisfy intended end uses and requirements of various regulatory agencies that will be involved in the review process. The description and procedure to assess PARCC of the measurement data are presented in Section ??? of the QAPP.

Additional information pertaining to data management/evaluation is discussed in Section ??? of the QAPP.

8.5.3 Data Retention

Project records will be maintained by the contractor in a dedicated filing cabinet for a period of five years beyond the completion of tasks specified by the Scope of Work. Prior to disposal of project records, the PM must notify the USACE.

9 SAMPLE PACKAGING AND SHIPPING REQUIREMENTS

Sample containers will be shipped in insulated coolers. Samples will be packed in accordance with appropriate protocols:

Samples will be shipped inside sturdy plastic coolers lined with new plastic garbage bags.

The COC record will be placed in a sealed zip-seal bag.

After the cooler lid is closed, strapping tape will be wrapped around both ends of the cooler.

Signed and dated custody seals (two) will be placed on the front and side of the cooler, at the seam between the cooler and its lid, such that the seals are broken when the cooler is opened.

A label containing the name and address of the shipper and the delivery address will be placed on the lid of each cooler. Federal Express air bills will be contained in standard windows. Samples will be shipped via overnight courier to the laboratory.

A sample container checklist will be used by the field team to ensure that samples are properly packaged prior to shipment.

Table 1 provides the name and address of each analytical laboratory that will be employed on this project along with the point of contact information (name and phone number).

After receipt of the samples by the analytical laboratory, a sample receipt and log-in sheet will be emailed to the contractor confirming receipt of the samples for analyses. The sample log-in sheet will provide information such as the condition of the shipping container, temperature and preservation of the samples, broken bottles, the analyses requested for each sample received, and whether or not the sample labels and COC match-up.

Failure to properly handle or document project samples could jeopardize the usability of the sample results and ultimately the project. Prior to sending this cooler to the analytical laboratory, please check the following items:

Is the project clearly identified on the Chain-of-Custody?

Are all enclosed sample containers clearly labeled with waterproof (permanent) ink

Are the desired analyses indicated on the Chain-of-Custody?

Does the information on the Chain-of-Custody match the information on the sample container labels?

Have you placed the Chain-of-Custody in a plastic bag?

Have the samples been properly preserved (acid or base and cooling to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$)?

Is there a contractor point of contact including name and phone number clearly shown on the Chain-of Custody?

Is there sufficient ice in the cooler?

10 CORRECTIVE ACTIONS

Corrective actions may be required for two major types of problems: analytical/equipment problems and noncompliance with criteria. Analytical and equipment problems may occur during sampling, sample handling, sample preparation, laboratory instrumental analysis, and data review. Noncompliance with specified criteria and analytical/equipment problems will be documented through a formal corrective action program at the time the problem is identified. The person identifying the problem is responsible for notifying the Sampling Project Manager and the USACE Project Manager. When the problem is analytical in nature, information on the problem will be promptly communicated to the laboratory contractor Project Manager. Implementation of corrective action will be confirmed in writing.

Any nonconformance with the established QC procedures in the QAPP or FSP will be identified and corrected in accordance with the QAPP. The Sampling Project Manager or his/her designee will issue an NCR for each nonconforming condition (Figure 11).

Corrective actions will be implemented and documented in the field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are deemed insufficient, work may be stopped through a stop-work order issued by the sampling Project Manager and the USACE Project Manager.

NONCONFORMANCE REPORT	DATE OF NCR	NCR NUMBER	
	LOCATION OF NONCONFORMANCE		PAGE ____ OF ____
INITIATOR (NAME/ORGANIZATION/PHONE)	FOUND BY	DATE FOUND	
RESPONSIBLE ORGANIZATION/INDIVIDUAL	PROGRAM		PROJECT
DESCRIPTION OF NONCONFORMANCE	CATEGORY: _____		
<p>A INITIATOR _____ DATE _____ QA/QC OFFICER _____ DATE _____ CAR REQ'D <input type="checkbox"/> YES <input type="checkbox"/> NO</p> <p>DISPOSITION:</p> <p>PROBABLE CAUSE:</p> <p>ACTIONS TAKEN TO PREVENT RECURRENCE:</p>			
B PROPOSED BY: _____ NAME _____ DATE _____			
JUSTIFICATION FOR ACCEPTANCE			
C INITIATOR: _____ NAME _____ DATE _____			
VERIFICATION OF DISPOSITION AND CLOSURE APPROVAL			
REINSPECTION/RETEST REQUIRED YES <input type="checkbox"/> NO <input type="checkbox"/> IF YES, DATE _____ RESULT _____			
D QUALITY ASSURANCE: _____ NAME _____ DATE _____			

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Figure 11. Example Nonconformance Report Form

10.1 SAMPLE COLLECTION/FIELD MEASUREMENTS NONCONFORMANCE

Technical staff and project personnel will be responsible for reporting all suspected technical and QA nonconformances, or suspected deficiencies of any activity or issued document, by reporting the situation to the sampling Project Manager or his/her designee. The manager will be responsible for assessing the suspected problems in consultation with the sampling Project QA Manager to make a decision based on the potential for the situation to impact the quality of the data. When it is determined that the situation warrants a reportable nonconformance and corrective action, then an NCR will be initiated by the manager.

The manager will be responsible for ensuring that corrective actions for nonconformances are initiated by:

- evaluating all reported nonconformances,
- controlling additional work on nonconforming items,
- determining disposition or action to be taken,
- maintaining a log of nonconformances,
- reviewing NCRs and corrective actions taken, and
- ensuring that NCRs are included in the final site documentation project files.

If appropriate, the sampling Project Manager will ensure that no additional work dependent on the nonconforming activity is performed until the corrective actions are completed.

Corrective actions for field measurements may include:

- repeating the measurement to check the error;
- checking for all proper adjustments for ambient conditions such as temperature;
- checking the batteries;
- re-calibrating the equipment;
- checking the calibration;
- modifying the analytical method including documentation and notification (i.e., standard additions);
- replacing the instrument or measurement devices; and
- stopping work (if necessary).

The sampling Project Manager or his/her designee is responsible for all site activities. In this role, he/she may at times be required to adjust the site activities to accommodate site-specific needs. When it becomes necessary to modify a program, the responsible person notifies the sampling contractor Project Manager of the anticipated change and implements the necessary changes after obtaining the approval of the sampling contractor Program Manager and the USACE Program Manager. All changes in the program will be documented on the FCR that will be signed by the initiators and the sampling contractor Project Manager. The FCR for each

document will be numbered serially as required. The FCR shall be attached to the file copy of the affected document. The sampling contractor Project Manager must approve the change in writing or verbally before field implementation. If unacceptable, the action taken during the period of deviation will be evaluated in order to determine the significance of any departure from established program practices and action taken.

The sampling contractor Project Manager for the site is responsible for the controlling, tracking, and implementation of the identified changes. Reports on all changes will be distributed to all affected parties, including the USACE Project Manager. The USACE will be notified whenever program changes in the field are made.

11 INVESTIGATION DERIVED WASTE

Anticipated waste streams for the project include: used interim sample containers, decontamination waste water, and sanitary trash. No source of contamination exists at the test facility and no chemical wastes will be generated, therefore, special provisions for the storage, labeling, management, and disposal of project wastes are not required. In general, all solid wastes will be bagged and disposed of as municipal waste.

12 HEALTH AND SAFETY

The STA-1E has an existing facility Safety and Health Plan (SHP) that all personnel working at the facility, including contractors and subcontractors, are required to review and follow.

Prior to the initiation of activities under this FSP, the SHP will reviewed and updated to assure compliance with the *U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM385-1-1 (USACE 2003)*, relevant Occupational Safety and Health Administration regulations, and applicable contractor health and safety policies.

13 REFERENCES

- USACE, 2001, Requirements for the Preparation of Sampling and Analysis Plans, EM200-1-3, 1 February 2001.
- USACE, 2006, Monitoring Plan for the STA-1E Cells 1-2 PSTA/SAV Field-Scale Demonstration Project, June 2006.
- USACE, 2006, Operations Plan for the STA-1E Cells 1-2 PSTA/SAV Field-Scale Demonstration Project, June 2006.
- USACE, 2006, Operations and Partnering Plan for the STA-1E Cells 1-2 PSTA/SAV Field-Scale Demonstration Project.
- FDEP, Florida Department of Environmental Protection Standard Operating Procedure, FS2110.
- Burns and McDonnell, 2000. Stormwater Treatment Area 1 East Period of Record Dry-out Analysis.
- Serbesoff-King, 2004. Stormwater Treatment Area 1 East Vegetation Management Plan.
- USACE, 2003. U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM385-1-1.