Appendix 3-1: Annual Permit Report for the Everglades Stormwater Treatment Areas

Permit Report (May 1, 2012–April 30, 2013)

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SUMMARY

As part of Everglades restoration, the construction and operation of large freshwater treatment wetlands are mandated by the Everglades Forever Act (EFA) (Chapter 373.4592, Florida Statutes). These wetlands, known as the Everglades Stormwater Treatment Areas (STAs), have been constructed as part of the Everglades water quality restoration efforts (www.sfwmd.gov/sta). The total area of the STAs including infrastructure components is approximately 68,000 acres, with approximately 57,000 acres of effective treatment area currently permitted to operate, including recently completed treatment cells in Compartments B and C. For this reporting period, the South Florida Water Management District (SFWMD or District) was not able to operate these expansion areas until the issuance of operating permits by the Florida Department of Environmental Protection (FDEP) on September 10, 2012. Collectively, the STAs have been constructed south of Lake Okeechobee to remove excess total phosphorus (TP) from surface waters prior to entering the Everglades Protection Area (EPA) (**Figure 1**).

The Everglades STAs [STA-1 East (STA-1E), STA-1 West (STA-1W), STA-2, STA-3/4, STA-5/6] (**Figure 2**) operate pursuant to EFA and National Pollutant Discharge Elimination System (NPDES) permits and their associated Consent Orders (COs). This appendix serves as the reporting mechanism for requirements contained in those permits and COs for the STAs during Water Year 2013 (WY2013) (May 1, 2012–April 30, 2013). The detailed annual report for the Everglades STAs is presented in this appendix and Volume I, Chapter 5.

Based on FDEP permit reporting guidelines, **Table 1** lists key permit-related information associated with this report. **Table 2** lists the attachments included with this report. **Table A-1** in Attachment A lists specific pages, tables, graphs, and attachments where project status and annual reporting requirements are addressed. This annual report satisfies the reporting requirements specified in the permit.

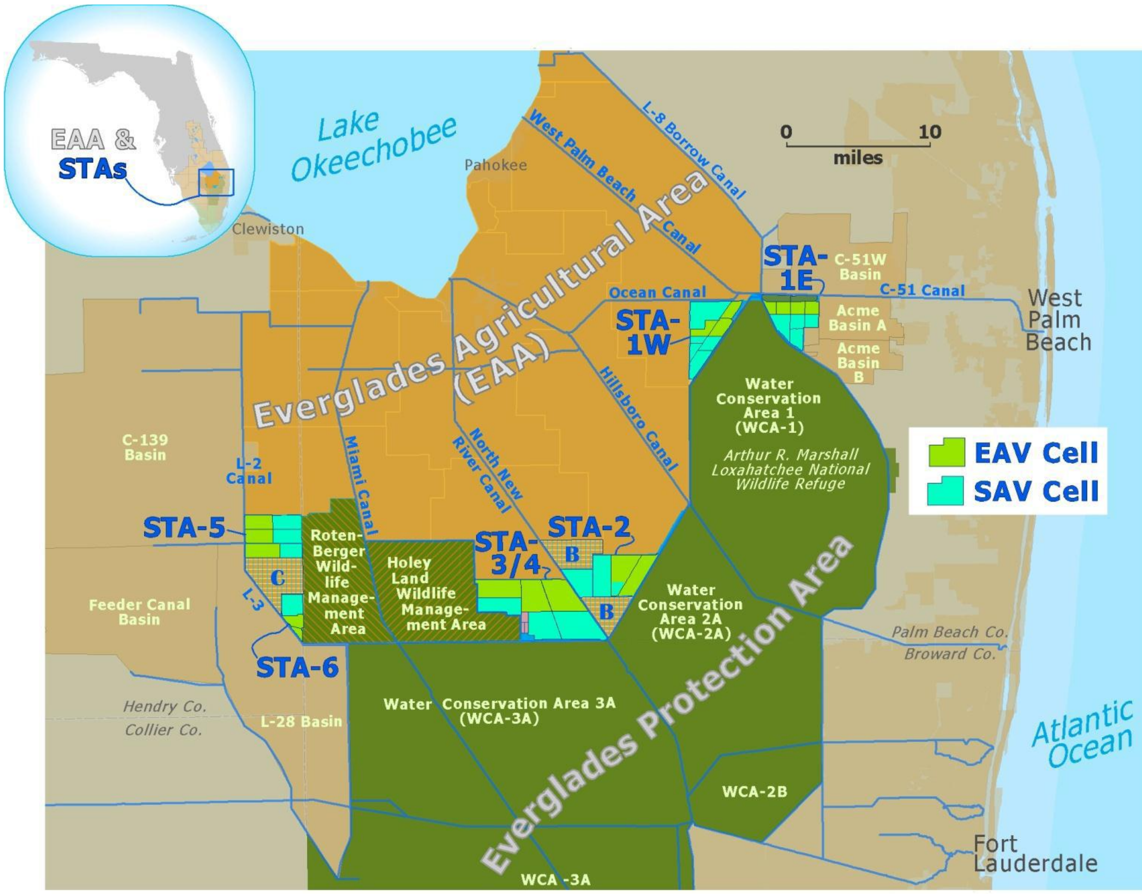

Figure 1. Location of the Everglades STAs.

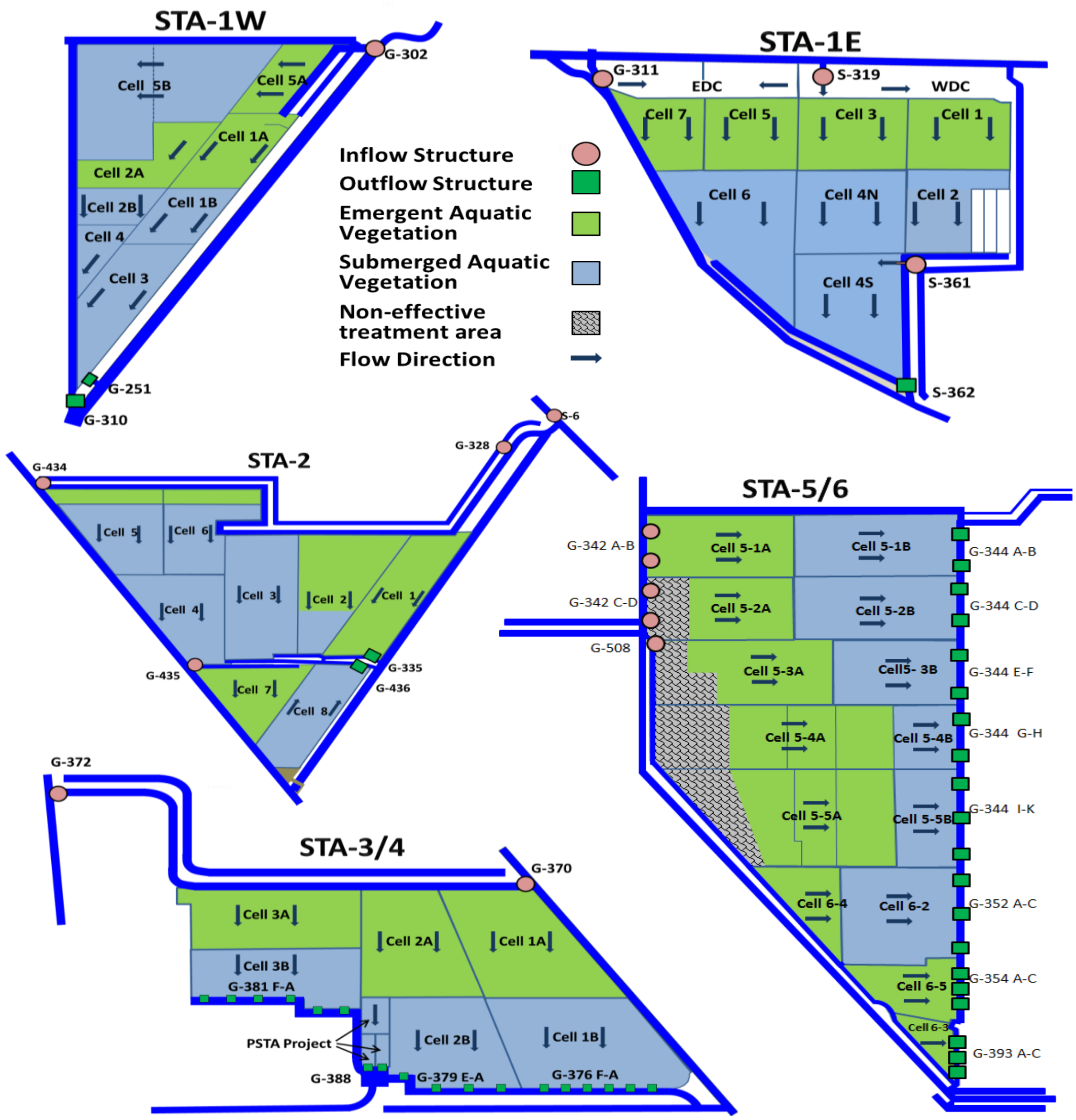

Figure 2. STA schematics showing configurations of the treatment cells, flow direction, dominant vegetation type, and locations of inflow and outflow structures.

Table 1. Key permit-related information.

Project Name:	Everglades Construction Project
Permit Numbers:	0311207 (EFA), FL0778451 (NPDES), Consent Order-OGC FILE NO.12-1149 (EFA) and OGC FILE NO. 12-1148 (NPDES)
Issue and Expiration Date:	Issued: 9/10/2012; Expires: 9/9/2017 (EFA & NPDES)
Project Phase:	Operation
Permit Specific Condition Requiring Annual Report:	25
Reporting Period:	May 1, 2012–April 30, 2013
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Table 2. Attachments included with this report.

Attachment	Title
A	Specific Conditions and Cross-References
B	Water Quality Data
C	Annual Permit Compliance Monitoring Report for Mercury in the STAs
D	Rotenberger Wildlife Management Area Restoration and STA Downstream Transect Monitoring
E	STA Herbicide Application Summary for Water Year 2013
F	Annual Permit Compliance Monitoring Report for Other Toxicants in the STAs

INTRODUCTION

In 1994 the EFA authorized the Everglades Agricultural Area (EAA) Best Management Practices (BMPs) and the Everglades STAs. As a major component of Everglades restoration, the STAs are intended to remove excess TP from surface waters prior to those waters entering the EPA. STAs are constructed wetlands that retain nutrients through several mechanisms including plant growth, accumulation of dead plant material in a layer of peat, settling and sorption, precipitation, and microbial activities.

This appendix reports on the permit compliance aspect of the Everglades STAs: STA-1E, STA-1W, STA-2, STA-3/4, and STA-5/6 (**Figures 1** and **2**). The STAs operate under EFA, NPDES permits and COs. Varying in size, configuration, and period of operation, the STAs are shallow freshwater marshes divided into treatment cells by interior levees. Water flows through these systems via water control structures, such as pump stations, gates, or culverts. The dominant plant communities in the treatment cells are broadly classified as emergent aquatic vegetation (EAV), submerged aquatic vegetation (SAV), and floating aquatic vegetation (FAV). Both native and nonnative vegetation play a role in phosphorus removal in the STAs. Vegetation management activities include control of undesirable species that impact the hydraulics.

This appendix summarizes STA performance during WY2013 to fulfill various permit reporting mandates and other water quality parameters, including dissolved oxygen (DO), mercury (Hg) and other toxicants, and other nutrients and major ions. Attachments A through F provide supplementary information for this report (**Table 2**).

STA PERFORMANCE

This section presents the annual data required by STA operating permits, COs, and downstream monitoring. A cross-reference listing for the permit reporting requirements is presented in Attachment A.

PERMIT STATUS AND REPORTING REQUIREMENTS

Permit Compliance for Phosphorus

As part of the permit compliance for phosphorus, annual STA performance will be evaluated in comparison to the water quality-based effluent limitations (WQBEL) when all CO corrective actions have been completed. Until such time, only comparisons with the WQBEL will be made (see **Table 3** and **Figure 3**); determination of compliance with the WQBEL is not required until all such corrective actions have been completed. The reader is referred to CO OGC FILE NO. 12-1149 accompanying EFA Permit 0311207 for more information. The WQBEL was developed to be protective of the EPA and allow for the achievement of the phosphorus criterion established in Rule 62-302.540, Florida Administrative Code (F.A.C.). The criterion, and therefore the WQBEL, was based on the best available science and the understanding of the biogeochemical processes of the receiving water body at the time the criterion was adopted.

The WQBEL consists of two components (1) a maximum TP annual flow-weighted mean (FWM) of 19 parts per billion (ppb) in any water year; and, (2) a TP long-term flow-weighted mean (LTFWM) of 13 ppb not to be exceeded in more than three out of five water years on a rolling basis. The term FWM means the annual flow-weighted mean for all of the combined outflow structures for an individual STA.

Any factors or activities that impacted the STAs treatment capabilities are noted in **Table 4.** STA performance for WY2013 is presented in **Tables 5** and **6. Table 5** shows the total volume, flow and flow-weighted mean results for each STA during WY2013. **Table 6** shows the annual flow, load and flow-weighted mean results for each permitted site by STA. The information fulfilling the permit-related reporting requirement for the amount of water diverted around the STAs in WY2013 is presented in **Table 7**.

Table 3. Proposed pre-compliance tracking of WQBEL using AFWM phosphorus concentration at STA outflows (ppb).

Water Year	Facility						
	STA-1E	STA-1W	STA-2	STA3/4	STA-5/6[2]	STA-5	STA-6
2009	21	36	18	13	67	56	94
2010	94	40	37	15	51	51	49
2011	22	25	15	16	31	47	25
2012	21	22	12	19	40	32	75
2013	26	36	22	14	17		

[1] Determination of compliance with the WQBEL will begin after completion of all corrective actions described in the COs, estimated to occur in 2025.

[2] With the construction of Compartment C, STAs 5 and 6 are considered one facility (STA-5/6) under the permits issued September 10, 2012. STA-5 and STA-6 data were combined to provide a single tracking value for water years prior to 2013.

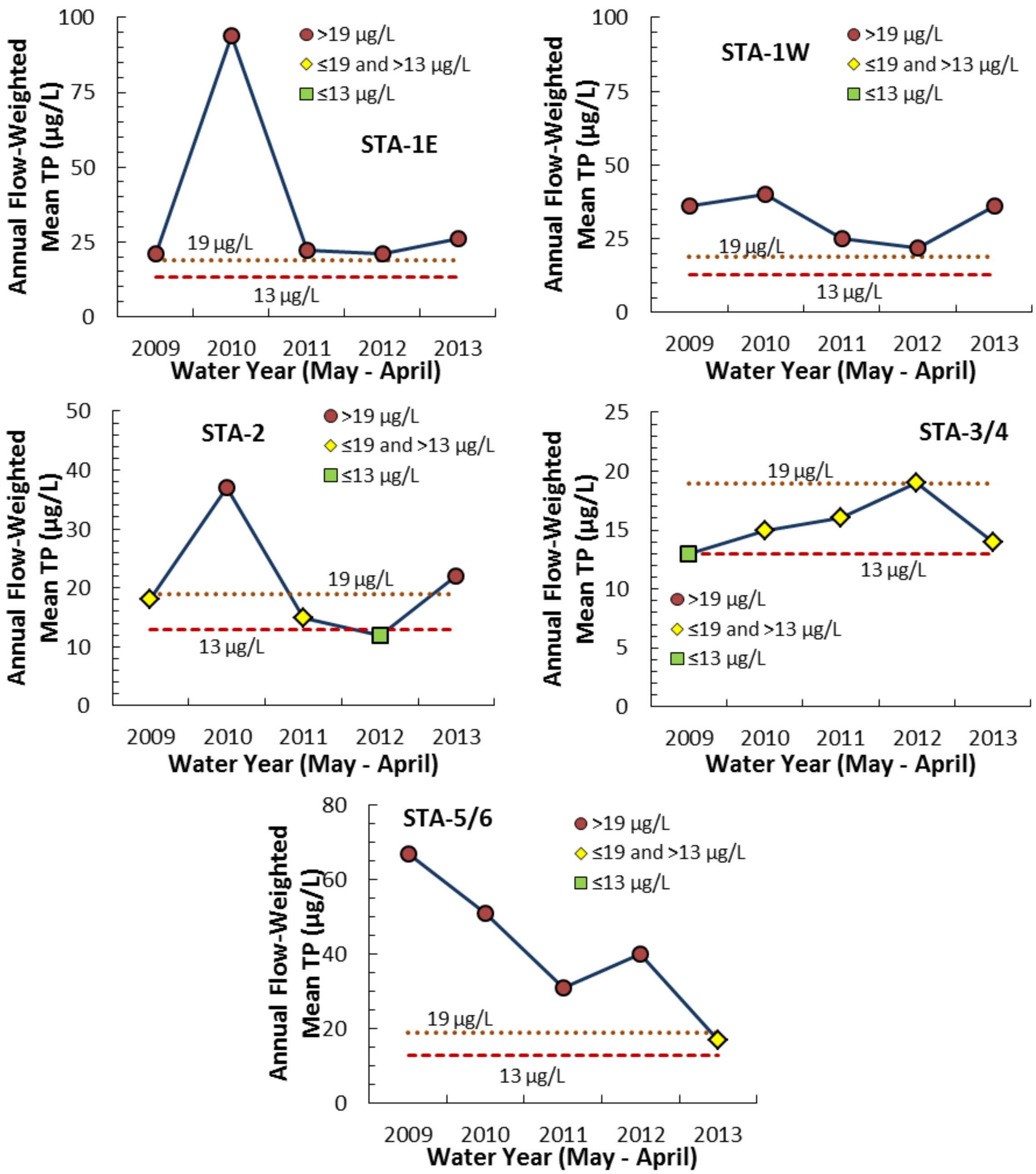

Figure 3. Annual flow-weighted TP concentrations for combined STA outflows compared to the WQBEL Two Part Criteria. The two reference lines shown on the plots above identify the long-term (13 micrograms per liter [µg/L]) and the annual (19 µg/L) limits of the WQBEL.

Table 4. Factors/activities impacting STA treatment capabilities.

STA	Long-Term Plan Enhancements	Recovery	Maintenance	Outside of Agency Control
STA-1E		Recovery of SAV in Cell 6 continued into WY2013 and southern naiad has replaced Hydrilla over a portion of the cell. Plantings of giant bulrush improved emergent plant cover in Cell 7.	Herbicide applications to eliminate floating plants in SAV cells (4N and 6) and to reduce encroachment by floating plants, floating mats and primrose willow in emergent cells (5 and 7) with bulrush plantings. Additional plantings of giant bulrush in Cell 7 and giant bulrush and *Thalia* in a 46-acre unvegetated area in the southeast corner of Cell 6.	The eastern flow-way remains offline due to the activities associated with the decommissioning of the United States Army Corps of Engineers' (USACE's) Periphyton-Based Stormwater Treatment Area (PSTA) Demonstration Project, numerous culvert repairs were made throughout the STA, and S-375 structure repairs were completed. Until the Comprehensive Everglades Restoration Plan (CERP) Loxahatchee River Watershed Project (L-8 Diversion Project) and the USACE's work is complete, the status is expected to remain in the current phase. Structure repairs are projected to be completed by 2016. Performance of the western flow way of STA-1E has been impacted by topographic deficiencies and deep water conditions in Cells 5 and 7 and a major uprooting/loss of hydrilla in Cell 6. Control of floating plants in Cell 4N was limited by snail kite nesting from January 2013 through the end of the water year.
STA-1W			Herbicide applications to eliminate floating plants in the northern flow-way (Cells 5A and 5B), reduce cattail cover in SAV cells (3 and 4), and to reduce encroachment of floating plants and floating mats in Cell 1A. Bulrush plantings to enhance emergent plant cover in Cells 5A and 1A and increase compartmentalization of Cells 5B, 2A and 4. Translocation of southern naiad in Cells 2A and 4.	
STA-2	Cell 2 vegetation conversion was initiated in WY2010 and continued in WY2013. Compartment B startup	Reestablishment of SAV in Cell 4, which had dried out during Compartment B construction.	Herbicide applications to eliminate cattail cover for incremental conversion of Cells 2, 5 and 6 to SAV and for reestablishing SAV cover in Cell 4, and to reduce cover of willow and primrose willow in Cells 5 and 6. Plantings of giant bulrush to close gaps in the emergent vegetation strip in the south end of Cell 3	Dryout of Cell 4 and associated loss of SAV during Compartment B construction
STA-3/4			Herbicide applications to eliminate floating plants in Cells 1A and 2A and to reduce regrowth of cattail in SAV cells (1B, 2B and 3B). Spring drawdown of water levels to revitalize emergent plant cover in the northern portion of Cell 2A. Plantings of giant bulrush to enhance emergent cover in Cell 1A.	
STA-5/6	Compartment C startup		Herbicide applications to reduce cover of willow and primrose willow in emergent cells (Cells 1A, 2A and 4A), convert Cell 3B to SAV, eliminate floating plants from SAV cells (1B and 2B), and eliminate exotic plants from the non-effective treatment areas of Cells 4A and 5A of Compartment C. Inoculations of southern naiad to Cell 3B and southern naiad and chara to Cell 4B. Plantings of giant bulrush to close gaps in emergent vegetation strips in Cells 1B and 2B and to enhance emergent cover in Cell 1A.	Cultural resources delayed startup measures in flow-ways 4 and 5 of Compartment C

Table 5. STA performance for WY2013.

	STA-1E	STA-1W	STA-2	STA-3/4	STA-5/6	All STAs
				Inflow		
Total Inflow Volume (acre-feet)	134,822	166,113	321,477	479,761	58,773	1,160,945
Total Inflow TP Load (metric tons)	34.402	50.125	42.095	62.143	9.500	198.265
AFWM Concentration Inflow TP (ppb)	207	245	106	105	131	138
				Outflow		
Total Outflow Volume (acre-feet)	141,185	194,829	327,430	500,655	42,711	1,206,830
Total Outflow TP Load (metric tons)	4.487	8.546	9.059	8.881	0.900	31.872
FWM Outflow TP (ppb)	26	36	22	14	17	21
TP Retained (metric tons)	**29.915**	**41.580**	**33.037**	**53.261**	**8.594**	**166.254**

Table 6. STA annual performance by station for WY2013

STA	Flow Structures Represented	WQ Station Name	Annual Flow (acre-feet)	Annual TP-Load (metric tons)	AFWM TP (ppb)
STA-1E	S-319 (inflow)	S-319 (inflow)	119,790	32.576	220
	G-311 (inflow)	G-311 (inflow)	10,671	1.485	113
	S-361 (inflow)	S-361 (inflow)	4,360	0.341	63
	S-362 (outflow)	S-362 (outflow)	141,185	4.487	26
STA-1W	G-302 (inflow)	G-302 (inflow)	166,113	50.125	245
	G-251 (outflow)	G-251 (outflow)	13	0.0004	27
	G-310 (outflow)	G-310 (outflow)	194,817	8.545	36
STA-2	S-6 (inflow)	S-6 (inflow)	260,806	38.377	119
	G-328 (inflow)	G-328 (inflow)	37,600	1.454	31
	G-434 (inflow)[2]	G-434 (inflow)[2]	22,645	2.218	79
	G-435 (inflow)[2]	G-435 (inflow)[2]	990	0.071	58
	Additional (Inflows)[3]	Additional (Inflows)[3]	-564	-0.024	35
	G-335 (outflow)	G-335 (outflow)	290,338	8.071	23
	G-436 (outflow)[2]	G-436 (outflow)[2]	37,092	0.987	22
STA-3/4	G-370 (inflow)	G-370 (inflow)	194,189	25.857	108
	G-372 (inflow)	G-372 (inflow)	285,572	36.286	103
	G-376A-C (outflow)	G-376B (outflow)	114,990	2.032	14
	G-376D-F (outflow)	G-376E (outflow)	81,508	1.540	15
	G-379A-C (outflow)	G-379B (outflow)	89,488	1.950	18
	G-379D-E (outflow)	G-379D (outflow)	32,420	0.538	13
	G-381A-B (outflow)	G-381B (outflow)	92,705	1.524	13
	G-381C-F (outflow)	G-381E (outflow)	89,543	1.297	12
STA-5/6	G-342A (inflow)	G-342A (inflow)	12,291	1.863	123
	G-342B (inflow)	G-342B (inflow)	14,052	1.732	100
	G-342C (inflow)	G-342C (inflow)	13,349	1.786	108
	G-342D (inflow)	G-342D (inflow)	14,360	3.392	192
	G-406 (inflow)	G-406 (inflow)	-45	-0.009	170
	G-508 (inflow)[2]	G-508 (inflow)[2]	4,675	0.729	126
	Additional (Inflows)[4]	Additional (Inflows)[4]	90	0.007	64
	G-344A (outflow)	G-344A (outflow)	7,630	0.121	13
	G-344B (outflow)	G-344B (outflow)	13,472	0.266	16
	G-344C (outflow)	G-344C (outflow)	13,406	0.282	17
	G-344D (outflow)	G-344D (outflow)	6,809	0.124	15
	G-344E (outflow)	G-344E (outflow)	9	0.0002	16
	G-344F (outflow)	G-344F (outflow)	5	0.0001	17
	G-344G (outflow)[2]	G-344G (outflow)[2]	20	0.0005	20
	G-344H (outflow)[2]	G-344H (outflow)[2]	23	0.001	22
	G-344I - K (outflow)[1]	G-344I - K (outflow)[1]	NA	NA	NA
	G-352A-C (outflow)	G-352B (outflow)	21	0.001	27
	G-354A-C (outflow)	G-354C (outflow)	190	0.021	88
	G-393A-C (outflow)	G-393B (outflow)	1,127	0.083	60

[1] Flow-way five was offline during WY2013 due to environmentally sensitive areas found in the flow-way (See Chapter 5B pages 5B-46 and 5B-49 for more information).
[2] These locations did not contain 12-months of data during WY2013.
[3] Additional inflows G328I,G338 and G339 will be added or subtracted depending on the direction of flow to get the total inflow.
[4] Additional inflows G342O and G407 will be added or subtracted depending on the direction of flow to get a total inflow.

Table 7. Information fulfilling the permit-related reporting requirement for the amount of water diverted around the STAs in WY2013.

STA	Structure	A. Low Flow Water Supply			B. Other Diversion		
		Low Flow Water Supply, Gate Maintenance, etc.			*Flood Control, Avoid Damage of Treatment Facilities, Environmentally Sensitive Areas and Other Federal Species Protection Requirements and Migratory Bird Treaty Act*		
		Volume (acre-feet)	TP Load (metric tons)	FWM TP (ppb)	Volume (acre-feet)	TP Load (metric tons)	FWM TP (ppb)
STA-1E	G-300	--	--	--	21,850	9.999	371
	Total	**--**	**--**	**--**	**21,850**	**9.999**	**371**
STA-1W	G-301	--	--	--	6,026	3.129	421
	Total	**--**	**--**	**--**	**6,026**	**3.129**	**421**
STA-2	G-338	--	--	--	--	--	--
	G-339	10	<0.0001	24	--	--	--
	Total	**10**	<0.0001	**24**	**----**	**----**	**----**
STA-3/4	G-371	26	0.001	41	--	--	--
	G-373	193	0.013	53	--	--	--
	Total	**219**	**0.014**	**52**	**----**	**----**	**----**
STA-5/6	G-407	47	0.004	61	----	----	----
	Total	**47**	**0.004**	**61**	**----**	**----**	**----**
All STAs	***Total***	***276***	***0.018***	**52**	***27,876***	***13.128***	***382***

Other Water Quality Permit Requirements

Water quality parameters with Florida Class III standards are identified in **Table 8**. Compliance with the EFA permit is determined based on the following three-part assessment:

1. If the annual average outflow concentration does not cause or contribute to violations of applicable Class III water quality standards, then the STA shall be deemed in compliance.
2. If the annual average concentration at the outflow causes or contributes to violations of applicable Class III water quality standards, but does not exceed or is equal to the annual average concentration at the inflow stations, then the STA shall be deemed in compliance.
3. If the annual average concentration at the outflow causes or contributes to violations of applicable Class III water quality standards and also exceeds the annual average concentration at the inflow station, then the STA shall be deemed out of compliance.

The determination as to whether an STA is contributing to a violation for a specific parameter is a comparison of the average annual inflow concentration to the average annual outflow concentration relative to the three-part assessment. The District has performed all sampling and analysis in compliance with Chapter 62-160, F.A.C., and the District's Laboratory Quality Manual (SFWMD, 2013a) and Field Sampling Quality Manual (SFWMD, 2013b). The annual permit compliance monitoring report for mercury in the STAs is presented in Attachment C. Compliance with the specific conductance (or conductivity) criteria for Class III fresh waters is described in Section 62-302.530, F.A.C., as measured values that are not more than 50 percent above background or do not exceed 1,275 microsiemens per centimeter (µS/cm), whichever is greater. Because the samples are collected in freshwater systems, conductivities at STA inflows and outflows are typically lower than 1,275 µS/cm.

The Class III criterion for turbidity, as specified under Section 62-302.530, F.A.C., states that measured values shall not be more than 29 nephelometric turbidity units (NTUs) above natural background conditions. Under Chapter 62-303, F.A.C., natural background is defined as follows:

> …the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department [FDEP]. The establishment of natural background for an altered water body may be based upon a similar unaltered water body or on historical pre-alteration data...

Because the FDEP has not compiled any information on what it considers natural background, the District has determined that any measured value that is greater than 29 NTUs exceeds the turbidity criterion.

Table 8. Water quality parameters with Florida Class III criteria specified in Section 62-302.530, F.A.C.

Parameter	Units	Florida Class III Criteria[a]
Dissolved Oxygen	mg/L	≥ 5.0 mg/L
Specific Conductance	µS/cm	Not > 50 percent of background or > 1,275 µS/cm, whichever is greater
pH	SU	Not < 6.0 or > 8.5
Turbidity	NTU	≤ 29 NTUs above background conditions
Alkalinity	mg $CaCO_3$/L	Not < 20 mg/L

mg/L – milligrams per liter; µS/cm – microsiemens per centimeter; SU – standard units; NTU – nephelometric turbidity units; mg CaCO3/L – milligrams calcium carbonate per liter

[a] Because the STAs are freshwater systems, the background concentration for specific conductance is assumed to be less than 1,275 µS/cm, and the background concentration for turbidity cannot exceed 29 NTUs.

Water Year 2013 Performance for Other Water Quality Parameters

For water quality parameters that do not have a Florida Class III standard, excursions are noted when the annual outflow FWM concentrations are higher than the annual inflow FWM concentrations. An STA may have individual excursions yet be in overall compliance if it meets the remaining components of the EFA three-part assessment.

WY2013 monitoring data for permitted water quality parameters other than TP at the STA inflows and outflows are also presented in Attachment B. Annual FWM concentrations at inflows and outflows of the STAs, including excursion analysis, are summarized in **Table 9**. During WY2013, no excursions occurred at any of the STAs. Also, none of the annual FWM concentrations measured at the outflows of each STA exceeded the Class III criteria and were lower than annual FWM concentrations at the inflows to the STAs.

The Everglades Marsh DO Site Specific Alternative Criteria (SSAC) is used to evaluate dissolved oxygen levels at marsh monitoring locations in the EPA. When marsh stations (potentially influenced by STA discharges) are not in compliance with the SSAC, a determination needs to be made if the discharge from the STA affected the DO at these marsh locations. Additional details are presented in the *Dissolved Oxygen* section of this appendix.

Inflow and outflow FWM concentrations were compared statistically with a significance level (α) of 0.05. The Shapiro-Wilk test of normality was used to determine if data sets deviated significantly from normality. Those data sets that did not deviate significantly from a normal distribution (i.e., $p > 0.05$) were analyzed using the Student's t-test. Data sets that deviated significantly from normality ($p < 0.05$) were tested using the Mann-Whitney U test (a non-parametric equivalent of the Student's t-test).

During WY2013, 20 data sets did not deviate from normal distribution and five data sets did show deviation. Therefore, both the Mann-Whitney U and Student's t-test were used to compare the inflow and outflow FWM concentrations. These statistical comparisons are summarized in **Table 10** by parameter and STA. Of the 25 data sets evaluated, ten comparisons exhibited statistically significant differences between inflow and outflow FWM concentrations. For all ten data sets, inflow FWM concentrations were significantly higher than outflow FWM concentrations.

Table 9. Summary of annual FWM concentrations of parameters other than TP for inflow and outflow of the STAs during WY2013. [Note: n – sample size; Conc. – concentration]

Stormwater Treatment Areas	**Annual Flow-Weighted Mean[a]**			
	Inflow		**Outflow**	
Parameters	**Number of Observations[b]**	**Results**	**Number of Observations[b]**	**Results**
STA1E				
Specific Conductance (µS/cm)	76 (156)	517	39 (53)	453
Dissolved Sulfate (mg/L)	53 (95)	34.6	20 (27)	19.8
Total Alkalinity (mg $CaCO_3$/L))	53 (95)	155.87	20 (27)	131.39
Nitrate+Nitrite (mg N/L)	53 (95)	0.122	19 (26)	0.023
Total Nitrogen (mg/L)	53 (95)	1.62	19 (26)	0.97
STA1W				
Specific Conductance (µS/cm)	23 (51)	1006	37 (72)	746
Dissolved Sulfate (mg/L)	15 (28)	64.1	19 (40)	48.5
Total Alkalinity (mg $CaCO_3$/L))	15 (28)	213.37	19 (40)	160.45
Nitrate+Nitrite (mg N/L)	15 (28)	0.687	19 (40)	0.07
Total Nitrogen (mg/L)	15 (28)	3.4	19 (40)	1.8
STA2				
Specific Conductance (µS/cm)	79 (184)	1052	61 (87)	993
Dissolved Sulfate (mg/L)	57 (122)	58.6	29 (42)	42.9
Total Alkalinity (mg $CaCO_3$/L))	41 (68)	275.71	29 (39)	237.73
Nitrate+Nitrite (mg N/L)	56 (121)	1.072	28 (41)	0.022
Total Nitrogen (mg/L)	58 (123)	3.54	30 (43)	1.9
STA3/4				
Specific Conductance (µS/cm)	52 (102)	980	241 (306)	801
Dissolved Sulfate (mg/L)	28 (58)	70.3	148 (184)	49.1
Total Alkalinity (mg $CaCO_3$/L))	19 (36)	272.66	99 (108)	195.53
Nitrate+Nitrite (mg N/L)	28 (58)	1.791	138 (174)	0.021
Total Nitrogen (mg/L)	28 (58)	4.07	149 (185)	1.76
STA5/6				
Specific Conductance (µS/cm)	119 (281)	534	91 (390)	463
Dissolved Sulfate (mg/L)	70 (148)	15.9	46 (116)	7.5
Total Alkalinity (mg $CaCO_3$/L))	52 (80)	172.78	39 (97)	138.23
Nitrate+Nitrite (mg N/L)	68 (146)	0.082	46 (114)	0.007
Total Nitrogen (mg/L)	70 (148)	1.65	46 (116)	1.33

mg/L – milligrams per liter; µS/cm – microsiemens per centimeter; mg CaCO3/L – milligrams calcium carbonate per liter; N/L nitrogen per liter.

[a] Annual flow-weighted means are computed for inflows and outflows by combining the data from individual stations

[b] Total number of samples collected with flow (total number of samples collected regardless of flow)

Table 10. Statistical comparison of monthly FWM concentrations at inflows and outflows of the STAs for other water quality parameters for WY2013.

Parameter	Variable	Stormwater Treatment Area				
		STA1E	STA-1W	STA-2	STA-3/4	STA-5/6
Alkalinity	p-Value[a]	0.058	0.161	0.257	0.320	***<0.001***
	Structure[b]	Inflow	Inflow	Inflow	Inflow	***Inflow***
	Statistical Test[c]	2-Sample t-Test	2-Sample t-Test	2-Sample t-Test	2-Sample t-Test	***2-Sample t-Test***
Nitrate+Nitrite	p-Value[a]	***0.004***	***0.035***	***<0.001***	***<0.001***	***0.013***
	Structure[b]	***Inflow***	***Inflow***	***Inflow***	***Inflow***	***Inflow***
	Statistical Test[c]	***2-Sample t-Test***	***Mann-Whitney***	***2-Sample t-Test***	***Mann-Whitney***	***Mann-Whitney***
Specific Conductance	p-Value[a]	0.669	0.312	0.951	0.166	1.000
	Structure[b]	Outflow	Inflow	Inflow	Inflow	Equal
	Statistical Test[c]	2-Sample t-Test	2-Sample t-Test	2-Sample t-Test	Mann-Whitney	2-Sample t-Test
Sulfate	p-Value[a]	0.688	0.380	***0.002***	0.085	***0.002***
	Structure[b]	Inflow	Inflow	***Inflow***	Inflow	***Inflow***
	Statistical Test[c]	2-Sample t-Test	2-Sample t-Test	***2-Sample t-Test***	Mann-Whitney	***2-Sample t-Test***
Total Nitrogen	p-Value[a]	0.311	0.211	***<0.001***	***0.019***	0.897
	Structure[b]	Inflow	Inflow	***Inflow***	***Inflow***	Inflow
	Statistical Test[c]	2-Sample t-Test	2-Sample t-Test	***2-Sample t-Test***	***2-Sample t-Test***	2-Sample t-Test

[a] Probability level (p-value) computed using appropriate comparison test. A significance level (α) of 0.05 was used. When p-value was less than 0.05, the parameter concentrations were significantly different between the inflow and outflow. Significant p-values are presented in the table as italicized and bolded values.

[b] STA structure group (pooled inflow or pooled outflow) exhibiting higher parameter concentrations during the water year.

[c] Statistical test used to compare inflow and outflow water quality data. Choice of test was based on distributional assumptions. If the distribution of data did not significantly deviate from normality, the Student t test (t Test) was used. When the distribution of data deviated significantly from normality, the Mann-Whitney test (non-parametric equivalent) was used.

Dissolved Oxygen

DO concentrations below 5.0 milligrams per liter (mg/L) occur commonly throughout the EPA, including interior marsh sites minimally impacted by nutrient enrichment or cattail invasion. Frequent DO levels below 5.0 mg/L are typical in macrophyte-dominated wetlands where photosynthesis and respiration result in wide diel swings in DO levels. Because low DO concentrations often measured in the EPA represent natural variability in this type of ecosystem, the FDEP, pursuant to Subsection 62-302.800(1), F.A.C., has promulgated a SSAC for DO in the Everglades. This SSAC addresses the natural fluctuations that influence background DO levels. Weaver et al. (2008) explains the SSAC and its development and application in assessing DO excursions. The specific methods for determining compliance are set forth in the DO SSAC (Weaver and Payne, 2004), which was adopted by Secretarial Order on January 26, 2004, and approved by the U.S. Environmental Protection Agency (USEPA) as a revision to the State of Florida's water quality standards on June 16, 2004.

Previous reports (Jorge et al., 2002; Goforth et al., 2003, 2004, 2005; Pietro et al., 2006, 2007) provided monitoring results, comparisons, and evaluations for diel DO in the STAs. These reports were used to assess the impact of STA discharges on the downstream Everglades ecological system or downstream water quality with respect to DO and pursuant to EFA permits and associated administrative orders for STA-1E, STA-1W, STA-2, STA-3/4, and STA-5/6. These reports also provided data to the FDEP for developing the DO SSAC. DO SSAC comparisons have been used to assess the STAs (except STA-5/6) since WY2007 (Pietro et al., 2008). STA-5/6 did not have a diel DO permit requirement when the DO SSAC was adopted.

The SSAC is now included in the EFA permit (Permit Number 0311207) for the eastern (STA-1E and STA-1W), central (STA-2 and STA-3/4), and western (STA-5/6) flow-paths. Under the permit issued for the Everglades STAs, the District is required to provide the FDEP with an annual report consisting of an analysis demonstrating that DO levels in STA discharges do not adversely change the downstream Everglades ecology or the downstream water quality. As the DO SSAC has been adopted by the FDEP and formally approved by the USEPA, assessment on possible downstream impacts by the outflows from STAs during WY2013 is predicated upon DO compliance of marsh stations to the DO SSAC, which may or may not be influenced by discharge from the facilities (i.e., STA outflows).

Biweekly DO concentrations measured at STA discharge points during WY2013 are provided in Attachment B. A summary of annual DO levels at these permitted outflows for each STA are provided in **Table 11**. Monthly DO concentrations for WY2013 are presented as mean ± standard deviation for the combined outflow structures from each STA in **Figure 4**. Annual DO concentrations (presented as mean ± standard deviation) for individual outflow structures from each STA are compared in **Figure 5**. DO concentrations in **Figures 4** and **5** are referenced to the present Class III criterion of 5.0 mg/L, pursuant to Section 62-302.530, F.A.C. During WY2013, DO concentrations for all STAs exhibited a typical seasonal pattern with higher DO concentrations generally occurring during the cooler dry season (November through April) and lower DO concentrations generally occurring during the warmer wet season (May through October). The highest DO concentration during WY2013 (9.63 mg/L) was observed at STA-3/4 with the lowest concentration (0.33 mg/L) observed at STA-1W (**Table 11**). Overall, STA-1E exhibited the highest annual average DO concentration (5.91 mg/L) with STA-5/6 exhibiting the lowest annual average concentration, 3.56 mg/L (**Table 11**). Annual average DO concentrations across STA-3/4 outflow structures varied by less than 1.0 mg/L and ranged from 4.2 to 5.0 mg/L (**Figure 5**). Typically, lower annual average DO concentrations at outflow structures are associated with stagnant conditions. For example, at the STA-1W outflow structure, ENR012, the annual DO concentration averages 3.03 mg/L compared with outflow structure, G310, which exhibits an annual average DO concentration of 5.24 mg/L (**Table 11**). Based on flow records for these two structures, G310 flow was four orders of magnitude higher than at ENR012. ENR012 is the water quality station that corresponds to the permitted discharge point G251.

Table 11. Summary of WY2013 annual DO levels at outflow stations for each STA as well as across the entire STA.

STA	Outflow Structures	Number of Observations	Mean ± Standard Deviation[1]	Minimum	Maximum	Percent DO Below 5 mg/L
STA-1E	***S362***	***52***	***5.91 ± 1.47***	***2.80***	***8.84***	***23.1%***
STA-1W	ENR012	20	3.03 ± 1.67	0.33	5.93	95.0%
	G310	51	5.24 ± 1.83	0.43	8.41	43.1%
	All	***71***	***4.61 ± 2.04***	***0.33***	***8.41***	***57.7%***
STA-2	G335	51	3.82 ± 1.28	1.04	7.40	82.4%
	G436	35	4.83 ± 1.32	1.71	7.92	60.0%
	All	***86***	***4.23 ± 1.38***	***1.04***	***7.92***	***73.3%***
STA-3/4	G376B	50	5.02 ± 1.95	1.18	9.63	52.0%
	G376E	50	4.99 ± 1.57	1.44	8.03	52.0%
	G379B	50	4.17 ± 1.50	1.22	7.34	68.0%
	G379D	50	4.89 ± 1.36	2.44	8.11	56.0%
	G381B	50	4.51 ± 1.63	1.30	8.07	66.0%
	G381E	50	4.85 ± 1.42	1.57	8.03	54.0%
	All	***300***	***4.74 ± 1.60***	***1.18***	***9.63***	***58.0%***
STA-5/6	G344A	47	3.65 ± 2.20	0.40	8.30	74.5%
	G344B	47	3.27 ± 1.92	0.69	7.77	80.9%
	G344C	49	3.69 ± 1.78	0.54	8.32	79.6%
	G344D	49	3.79 ± 1.81	0.67	8.42	77.6%
	G344E	31	2.45 ± 1.27	0.55	5.74	96.8%
	G344F	31	2.51 ± 1.19	0.58	5.48	93.5%
	G344G	24	5.12 ± 1.44	1.75	8.19	45.8%
	G344H	24	6.28 ± 1.45	3.51	8.54	20.8%
	G352B	24	3.94 ± 1.29	2.00	6.45	87.5%
	G354C	22	2.41 ± 1.35	0.35	6.07	95.5%
	G393B	22	2.18 ± 1.03	0.34	4.21	100.0%
	All	***363***	***3.56 ± 1.92***	***0.34***	***8.54***	***79.6%***

[1] Arithmetic mean ± Standard Deviation (SD)

[2] ENR012 is the water quality monitoring station which corresponds to discharge structure G251.

STA-1E, STA-1W, STA-2, STA-3/4 and STA-5/6 EFA Permit No. 0311207 and NPDES Permit No. FL0778451.

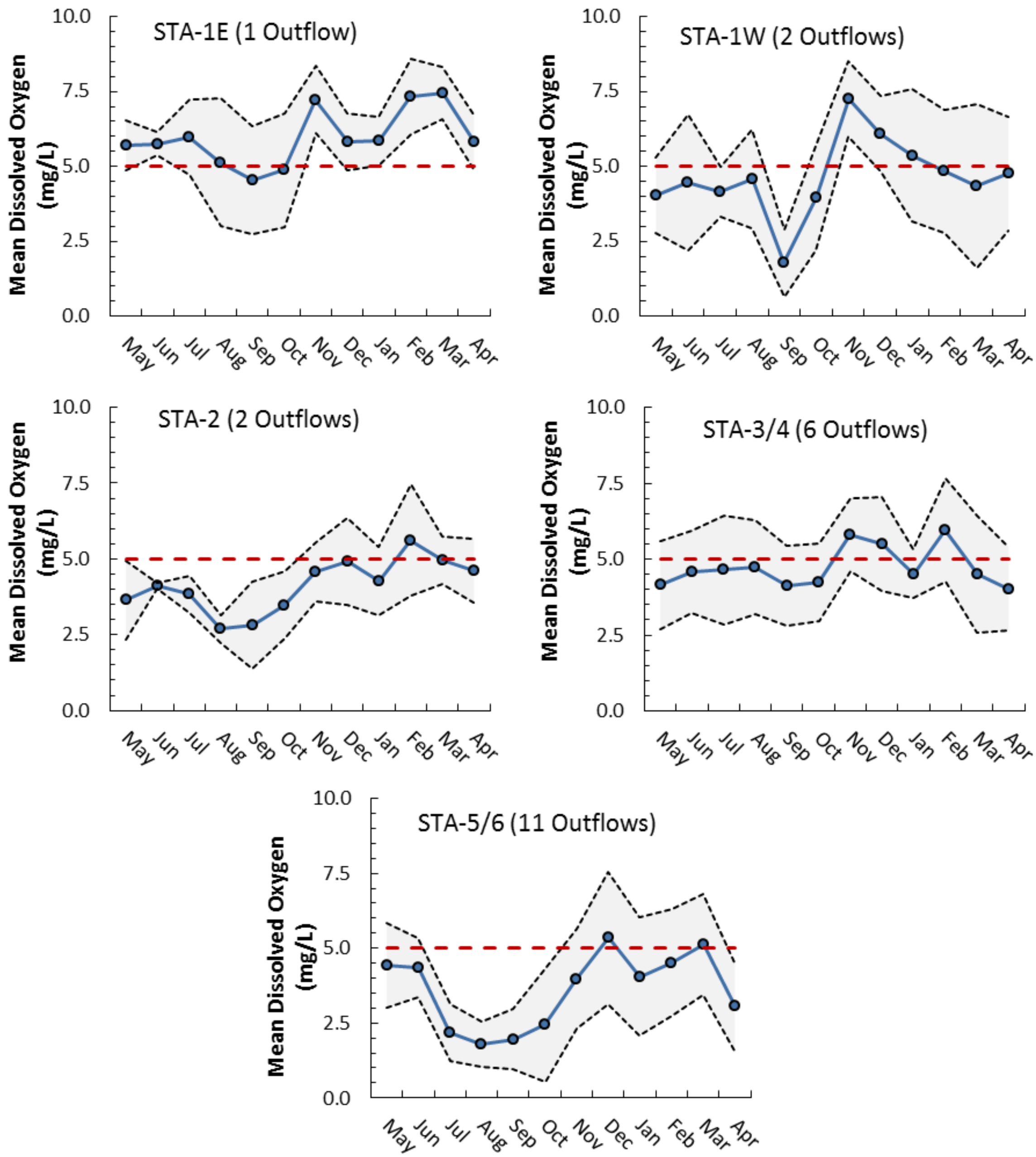

Figure 4. Mean monthly DO concentration during WY2013 for the five permitted STAs referenced to the Class III criterion of 5 mg/L (red dashed line). Shaded region represents one standard deviation around the mean.

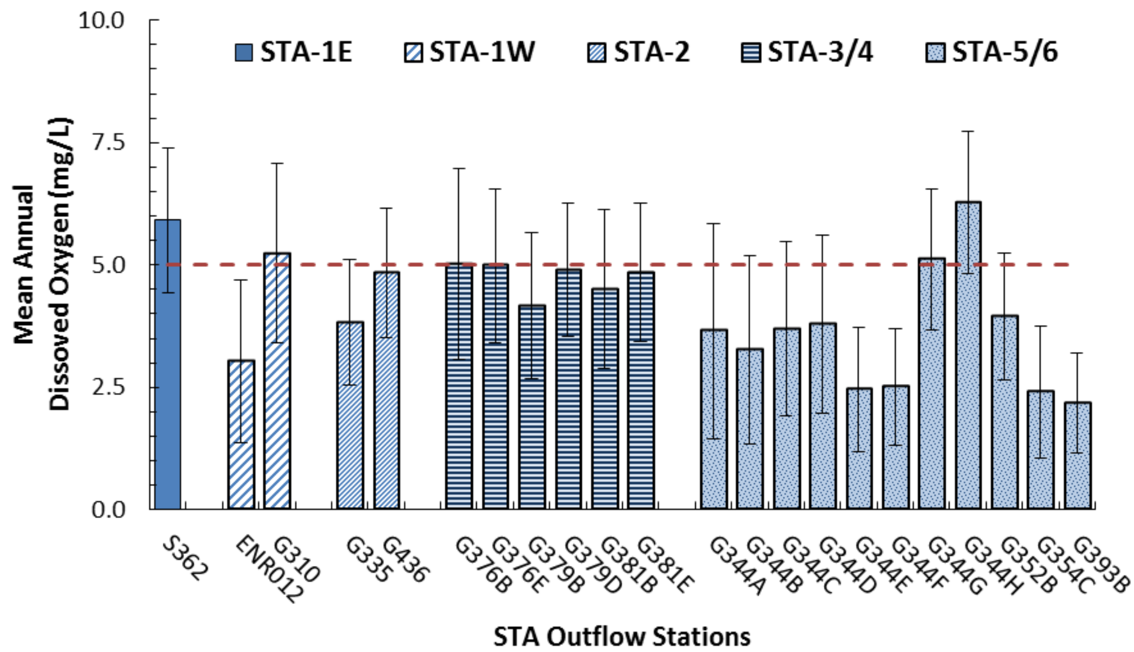

Figure 5. Bar plot depicting mean annual DO concentrations (± standard deviation) for each outflow structure at the five permitted STAs. The red dashed line represents the Class III criterion for DO at 5.0 mg/L. ENR012 is the water quality station that corresponds to discharge structure G251.

DO concentrations less than the 5 mg/L Class III criterion occurred 23 percent of the time during WY2013 at structure S362 (STA-1E). Three other outflow structures had DO concentrations lower than the Class III criterion less than 50 percent of the time, G344G and G344H at STA-5/6 and G310 at STA-1W (**Table 11**). Monitoring at the two STA-5/6 structures did not begin until September 2012 and the preponderance of data was collected during the period from November through April resulting in DO concentrations skewed towards the cooler and drier period of the water year.

Most STA outflow structures had DO concentrations below the Class III criterion more than 50 percent of the time. Since these structures are conveying water discharge from treatment marshes, which undergo the same diel processes as natural marsh systems. Further, macrophyte dominated wetlands have normally low DO concentrations due to natural marsh processes (Weaver 2004).

Compliance with the DO SSAC at marsh stations is analyzed in Volume I, Chapter 3A. A summary table for individual marsh stations in the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge), Water Conservation Areas (WCAs) 2 and 3, and Everglades National Park (ENP or Park) is provided in Volume I, Appendix 3A-3. Based on these results of the SSAC analysis, nine marsh stations did not pass the DO SSAC assessment in WY2013. These stations are LOXA104.5, LOXA136, LOXAZ1 and LOXAZ2 (Refuge); 404Z, WCA2F1 and WCA2F2 (WCA-2); and CA318 and CA36 (WCA-3). All marsh stations in the ENP exceeded calculated SSAC limits.

As discussed in Volume I, Chapter 3A, four stations in the Refuge (LOXA104.5, LOXA136, LOXAZ1, and LOXAZ2) did not pass compliance with the DO SSAC with two stations (LOXAZ1 and LOXAZ2) being sampled four times during the reporting period (January through

April, 2013). All four marsh stations were below the SSAC annual DO limit by less than 0.6 mg/L. Marsh stations LOXAZ2 and LOXA136 failed the DO SSAC limit by 0.02 and 0.06 mg/L, respectively. Marsh stations LOXA104.5 was lower the SSAC limit by 0.24 mg/L, while LOXAZ1 had an annual mean DO concentration 0.54 mg/L lower than the SSAC limit.

Two marsh stations (LOXA104.5 and LOXA136), located along downstream transects from STA-1W and STA-1E, respectively, are located less than 1 kilometer (km) from the STA outflows and approximately 0.5 km from the rim canal (see Figure 3A-1 of Volume I, Chapter 3A). **Figure 6** compares the DO concentrations for rim canal and marsh stations along downstream transects from the two STAs. It is evident from the plots that LOXA104.5 and LOXA136, which are located under 1 km from the rim canal, exhibited the lowest average DO concentrations of all transect stations. DO concentrations at these two stations averaged 2.41 mg/L at LOXA104.5 and 2.81 mg/L at LOXA136 (see Volume I, Appendix 3A-3). Rim canal DO concentrations averaged approximately 5.1 mg/L, which are comparable to the mean annual DO from STA-1E and STA-1W (**Table 11**). Transect stations located more than 1 km from the rim canal exhibited higher DO concentrations and were in compliance with the DO SSAC. Both stations did not meet the DO SSAC over the past five years and had annual average DO concentrations less than recorded in the rim canal during the same period.

The other two marsh stations in the Refuge (LOXAZ1 and LOXAZ2) are located more than 15 km from either STA-1W or STA-1E discharges. Comparisons of DO concentrations for monitoring locations along this downstream transect are also shown in **Figure 6**. The information shown in the plot for this transect show that DO concentrations in the rim canal located less that 0.5 km from LOXAZ1 were approximately three times higher than at the marsh station. Due to the proximity of these transect stations from STA-1W and STA-1E, it is not believed that the excursions from the DO SSAC at stations LOXAZ1 and LOXAZ2 are related to discharges from the STAs.

Marsh stations WCA2F1 and WCAF2 in WCA-2 had a mean annual DO level of 1.86 mg/L and 1.85 mg/L (or approximately 1.0 mg/L below the SSAC limit; see Volume I, Appendix 3A-3). These marsh stations are located 2 km and 4 km downstream of the S-10C structure, respectively, and approximately 14 km east of the STA-2 discharge canal, L-6 (see Figure 3A-2 of Volume I, Chapter 3A). Based on the location of both stations, it unlikely that DO levels measured at these stations were influenced by discharges from STA-2. Additionally, marsh station 404Z1 located in WCA-2 had an annual average DO concentration of 1.32 mg/L and also did not meet the SSAC. This monitoring station was sampled two times during WY2013 (see Volume I, Appendix 3A-3) in September and November 2012. As a result of the limited sampling and its proximity to the STA-2 outflow structure (approximately 5 km), the observed DO concentrations are not attributable to STA operation. **Figure 7** shows the annual DO concentrations for three downstream marsh transect monitoring locations for STA-2. All stations were found to be in compliance to the DO SSAC.

The two marsh stations in WCA-3 (CA318 and CA36) are also not believed to have been influenced by STA discharges. Both stations are at least 20 km from the nearest STA discharge (see Figure 3A-2 of Volume I, Chapter 3A). In addition, all other marsh stations located around these two marsh stations exhibited mean annual DO levels above the SSAC limit. The depressed DO levels may reflect natural processes as well as localized effects.

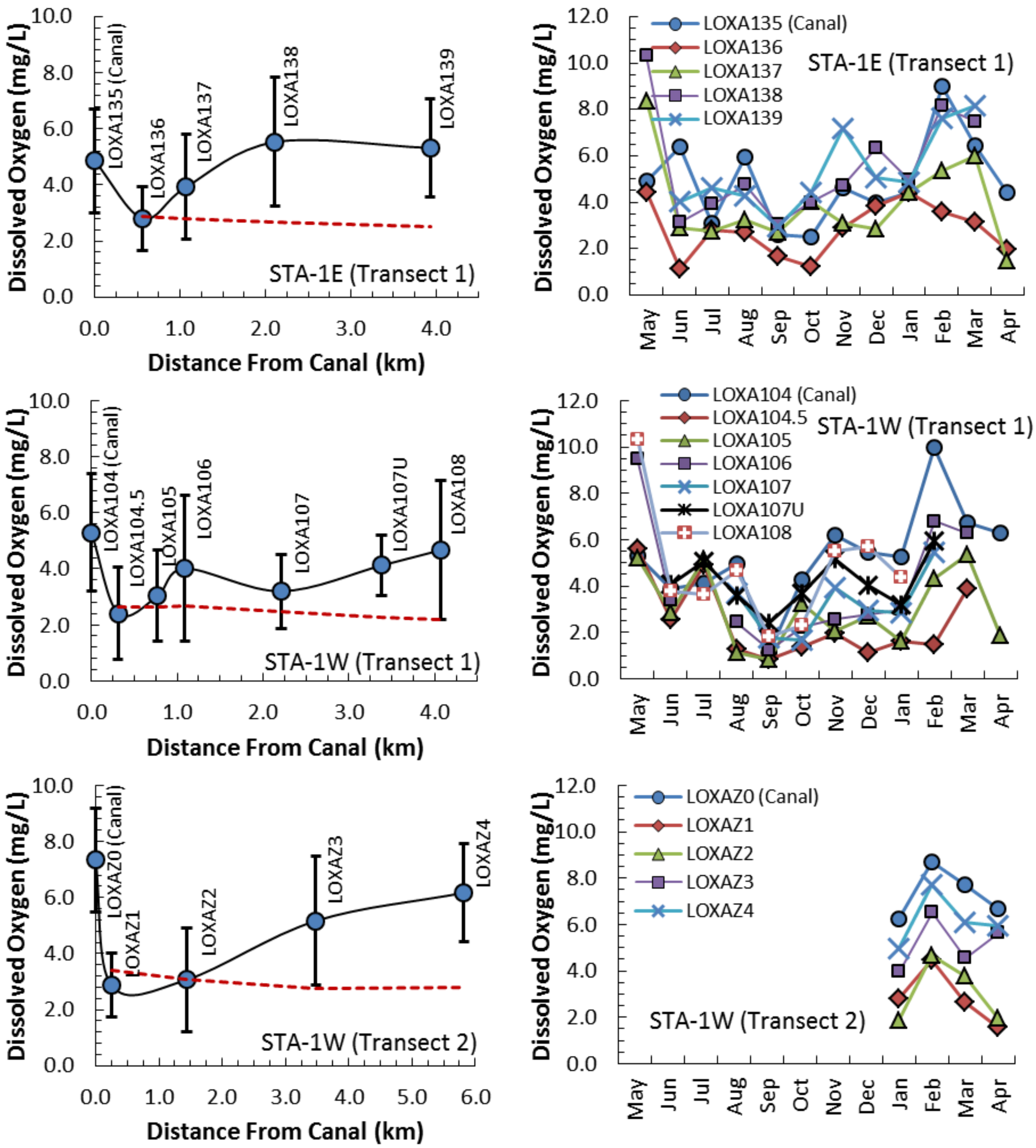

Figure 6. Transect stations in the rim canal and marsh stations downstream from STA-1E and STA-1W outflows to the Refuge. Plots on the left show mean annual DO concentrations (± standard deviation) for each transect station as a function of distance from the rim canal with the SSAC limit depicted as a red dashed line. Plots on the right show monthly DO concentrations for each of the transect stations.

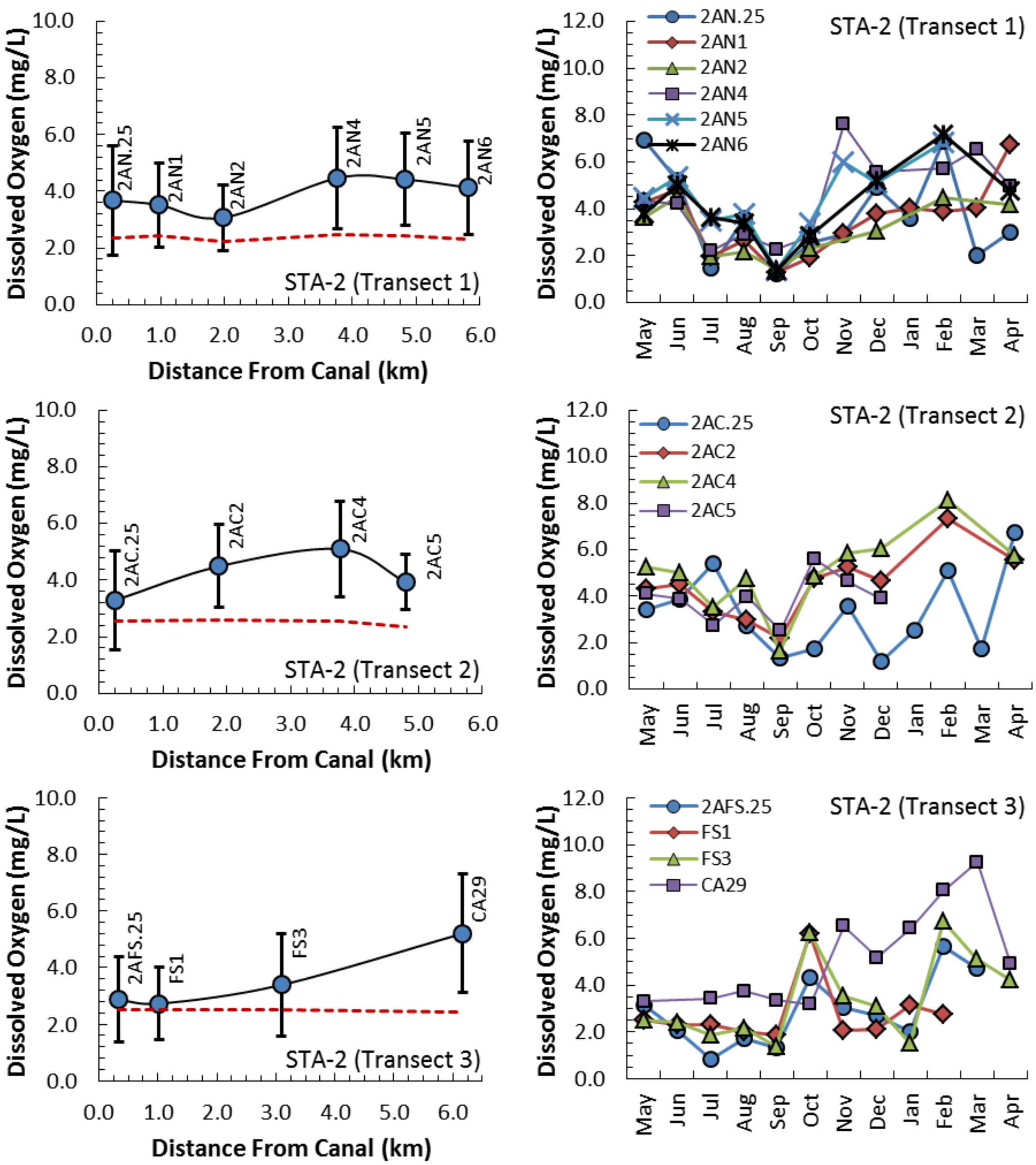

Figure 7. Transect stations in the rim canal and marsh stations downstream from STA-2 outflows to WCA-2. Plots on the left show mean annual DO concentrations (± standard deviation) for each transect station as a function of distance from the rim canal with the SSAC limit depicted as a red dashed line. Plots on the right show monthly DO concentrations for each of the transect stations.

Mercury

During WY2013, there were no violations of the Florida Class III numerical water quality standard of 12 nanograms (ng) of total mercury (THg) per liter in any surface water samples at any STA. The total outflow mercury load was lower than the inflow load. Surface water samples are collected in STA-1E, STA-2, and STA-5/6 for THg and methylmercury (MeHg) analysis. Surface water mercury monitoring within STA-1E, STA-1W and STA-3/4 was terminated in accordance with the guidelines listed in *A Protocol for Monitoring Mercury and Other Toxicants* (SFWMD and FDEP, 2011) (see Attachments C and F). Currently, mercury monitoring in STA-1E is in Phase 3 – Tier 1; STA-1W is in Phase 3 – Tier 3; STA-2 Cells 1, 2 and 3 are currently in Phase 3 – Tier 3. The North Built-out and South Built-out (Compartment B) are in Phase 2 – Tier 1. STA-3/4 is in Phase 3 – Tier 3; STA-5/6 flow-ways 1, 2, 7 and 8 and STA-5/6 flow-ways 3, 4, 5 are in Phase 2 – Tier 1.

During WY2013, the annual average THg concentrations in mosquitofish (*Gambusia holbrooki*) at the marsh interior and downstream sites were below USEPA predator protection criteria for trophic level 3 fish (77 nanograms per g [ng/g]). STA-5/6 showed the lowest THg concentration in mosquitofish while STA-1E, STA-2 and STA-3/4 showed similar THg concentrations in mosquitofish. For sunfish (*Lepomis* spp.), the lowest THg concentration was also found in STA-5/6 and the highest concentration was found in STA-2. The annual average THg concentrations in sunfish at the marsh sites were below USEPA predator protection criteria for trophic level 3 fish while annual average THg concentration was below (STA-5/6 flow-ways 3, 4 and 5) and above (STA-5/6 Cell 4) USEPA predator protection criteria for trophic level 3 fish, but all were below 75^{th} percentile of THg concentration in sunfish collected from EPA. For largemouth bass (LMB, *Micropterus salmoides*), the lowest THg concentration was found in STA-2 and the highest was found in STA-5/6. The annual average THg concentrations in LMB at the marsh interior and downstream sites were below USEPA predator protection criteria for trophic level 4 fish (346 ng/g). Based on U.S. Fish and Wildlife Service (USFWS) and USEPA predator protection criteria, fish-eating wildlife foraging within all STAs appear to be at an overall moderate risk to mercury exposure. STA mercury performance is evaluated on an annual basis. If respective action levels are exceeded, corrective measures will be taken in accordance with the FDEP-approved monitoring plans. Additional information on fish mercury concentrations, including spatial and temporal trends within and downstream of each STA, are presented in Attachment C.

Rotenberger Wildlife Management Area Restoration and STA Transect Monitoring

The District monitors adjacent wetland areas that receive discharges from the STAs, which include the Refuge (adjacent to STA-1E and STA-1W), WCA-2A (adjacent to STA-2), and the Rotenberger Wildlife Management Area (adjacent to STA-5) (**Figure 1**). Water and sediment quality, flow, stage and vegetation data are collected at inflow points and along prescribed transects to assess changes in conditions as water moves south. In accordance with the annual reporting requirements of related permits, these WY2013 data are provided in Attachment D.

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Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions, actions taken, and cross-references presented in this report for the Stormwater Treatment Areas, which are authorized under the Everglades Forever Act (EFA) and Florida Department of Environmental Protection (FDEP) permit 0311207.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in *2014 South Florida Environmental Report* (Note: "V1" = Volume I, Ch. 5; "V3" = Volume III, App. 3-1)			
				Narrative (page #'s)	Figure	Table	Attachment
3	Public Use	All	Recreational facilities were maintained in accordance with the permit requirements.	V2: 6B			
4	Project Construction	Construction	STA-1E, Comp. B and Comp. C were still under construction, no official ops yet.				
6	As-Built Certification and Record	Construction	G-434, G-435, and G-436 certifications submitted 9/26/12; Environmentally Sensitive Areas and STA-6 Redundant levee removal certifications submitted 3/25/13.				
7	Pump Station and Structure Maintenance	Maintenance	Documentation of temporary maintenance operations of discharge and diversion structures is kept by SFWMD Operations Control Center (OCC) staff in log books. Corresponding flow and concentration measurements were also taken as required.				
8	Contamination Sites and Residual Agrichemicals	Construction	No contaminated sites discovered.				
9	Vegetation and Operational Enhancements	Operations	STA-1E Cell 7 herbicide appl. and planting (3/6/13); STA1W Cells 5A, 1A, 2B, 4 herbicide treatments, inoculations, bulrush plantings (3/5/13); STA3/4 Cell 1A boat ramp (3/26/13); STA-3/4 Cell2A drawdown (1/28/13); STA-5 weather shelter (12/11/12).				
10	STA Operation Plans and Modifications	Operations	There were no updates to STA Operation Plans in WY2013.				
12	Rotenberger Wildlife Management Area Restoration	Operations/ Maintenance		V3: 23			V3: D
15	Phosphorus Criterion	Operations		V3: 5,6	V3: 3	V3: 3,5, 6	
16	Diversion	Operations/ Maintenance	After Action Report for STA-1E, -1W, and -3/4 Diversions (TS Andrea) were submitted on 6/27/13.	V3: 6		V3: 7	

Table A-1. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in *2014 South Florida Environmental Report* (Note: "V1" = Volume I, Ch. 5; "V3" = Volume III, App. 3-1)			
				Narrative (page #'s)	**Figure**	**Table**	**Attachment**
18	Dissolved Oxygen	Operations		V3: 13,16,19,20	V3: 4,5,6,7	V3: 11	
19	Factors Outside Permittee's Control	All	There were no non-compliance events or failures to achieve permit conditions.				
20	Endangered Species/Migratory Bird Treaty Act	All	No non-compliance events occurred.				
21(A-C)	Turbidity Monitoring	Construction/ Maintenance	SFWMD provided turbidity monitoring results for projects that could generate turbidity in receiving waters to FDEP as required.				
22	Transect Monitoring	Operations		V3: 23			V3: D
23A	Mercury Monitoring Program	Operations		V3: 23			V3: C, F
23B	Long Term Monitoring	Operations		V1: 5B			
24 (24A-B)	Annual Levee and Structure Inspections and Reports	Operations	Annual STA Structure & Levee Report was submitted on 3/28/13				
24B	Periodic (5-Year) Levee and Structure Inspections and Reports	Operations	STA-2 Cells1-3 5 yr Periodic Structure and Levee Report submitted 4/9/13				
25	Annual Monitoring Reports	Operations	Annual report completed as required				
25A	Quality Assurance and Quality Control	Operations	Sampling and analysis were performed according to permit requirements and per Chapter 62-160, F.A.C., and the SFWMD's water quality monitoring plan.				V3: B
25B	Water Quality Data	Operations					V3: B
25C	Performance Evaluation	Operations		V3: 5–6,14	V3: 3	V3: 3, 5, 6, 9, 10	
25D	Herbicide and Pesticide Tracking	Operations					V3: E
25E 1	Implementation Activities; Trend analysis of Flows and Loads to the Facilities	All		V1: 5B		V1: 5B-1	
25E 2	Facility design mods	Construction/ Maintenance	N/A				

Table A-1. Continued.

Specific Condition	Description	Applicable Phase	Action Taken	Reported in *2014 South Florida Environmental Report* (Note: "V1" = Volume I, Ch. 5; "V3" = Volume III, App. 3-1)			
				Narrative (page #'s)	Figure	Table	Attachment
25E 4	Delays	All	N/A				
25E 5	Facility Recovery Plans	All	No plans being implemented				
25E 6	Noncompliance	All	None				
25E 8	Water quality, sediment and vegetation monitoring of downstream transects	Operations					V3: D
25E 9	Recommended revisions to facilities	All	None				
25E 10	Summary of reports required in Specific Condition 15	Operations	Summary of Annual Discharge Performance Report was submitted on 7/28/13	V3: 5–6	V3: 3	V3: 3	
25E 11	Summary of STA Ops Impacts from ESA / MBTA	Operations		V1: 13; 17 (1E); 24 (1W); 33 (2); 39 (3/4); 48 (5/6)			App. 5B-2
26	Removal of Parameters	Operations	No parameters were removed during WY2013				
27	Public Health, Safety, or Welfare	All	No additional parameters requested to be monitored by FDEP				
28	Temporary Suspension of Sampling	All	Sampling was not suspended during WY2013				
29	Permit Renewal	All	EFA permit was renewed on 9/10/2012				
30	Permit Modifications	All	Modification 0311207-002 for S-6 Communication Tower was issued on 3/6/13				
32	Reopener Clause	All	N/A				

Attachment B: Water Quality Data

This project information is required by Specific Condition 25 of the Everglades Construction Project Stormwater Treatment Areas permit (0311207), and is available upon request. All sampling and monitoring data referenced in this attachment were collected, analyzed, reported, and retained in accordance with Chapter 62-160, F.A.C.

Attachment C: Annual Permit Compliance Monitoring Report for Mercury in the STAs

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KEY FINDINGS AND OVERALL ASSESSMENT

This report summarizes data from compliance monitoring of mercury (Hg) storage, reduction, release, and biomagnification in the Stormwater Treatment Areas (STAs) for Water Year 2013 (WY2013) (May 1, 2012–April 30, 2013). Key findings are listed below.

ALL STAS

There were no violations of the Florida Class III numerical water quality standard of 12 nanograms (ng) of total mercury (THg) per liter (ng/L) during the reporting year at any of the STAs and the projects have met all action level requirements listed in *A Protocol for Monitoring Mercury and Other Toxicants* (SFWMD and FDEP, 2011). Except one mosquitofish composite and several bluegill sunfish, THg concentrations in mosquitofish, sunfish, and largemouth bass in STA interior stations for WY2013 did not exceed U.S. Fish and Wildlife Service (USFWS) and U.S. Environmental Protection Agency (USEPA) predator protection criteria. In general, THg concentration in fish for all trophic levels collected from STA interior are lower than those collected from the Everglades Protection Area (see Appendix 3-2 in this volume).

STA-1W

Since WY2009, mercury monitoring in STA 1 West (STA-1W) has been under Phase 3 – Tier 3 (see the *Phase 3: Operational Monitoring* section of this attachment).

STA-1E

During WY2013, STA 1 East (STA-1E) mercury monitoring is under Phase 3 – Tier 1. Surface water THg and MeHg collections were terminated on February 29, 2012. Collection for mosquitofish was on semiannual basis; collection of large-bodied fishes was on triennial basis with no sample collection in WY2013. Mercury levels in mosquitofish from the interior marshes were the second lowest of all STAs. Mercury levels in the downstream Water Conservation Area (WCA)-1 marsh site exceeded the USEPA's predator protection Trophic Level (TL) fish 3 criterion of 77 ng/g.

[1] Contributed as SFWMD staff during the SFER production cycle.

STA-2

During WY2013, mercury monitoring at STA-2 Cells 1, 2 and 3 is under Phase 3 – Tier 3, which terminates mercury monitoring. Mercury monitoring in the North Builtout (NBO), which includes Cells 4, 5, and 6, and the South Buildout (SBO), which includes Cells 7 and 8, is under Phase 2 – Tier 1. Both THg and MeHg in NBO and SBO were among the lowest concentrations in both inflow and outflow relative to other STAs and displayed a net reduction of 48 percent for THg and 21 percent for MeHg. The average THg level in mosquitofish from STA-2 marsh interior and the downstream site was 33 ng/g and 29 ng/g, respectively in WY2013. Sunfish displayed the highest THg level (59 ng/g) and largemouth bass displayed the lowest THg level (155 ng/g) from interior cells among STAs. Except one composite sample mosquitofish, within and downstream of STA-2 contained mercury levels below both the USFWS and USEPA predator protection criteria for TL 3 fish. The average THg levels in all sunfish from the interior and downstream locations were below the USFWS criterion of 100 ng/g for TL 3 fish. All largemouth bass from the STA interior and downstream contained THg level below the USEPA criterion (346 ng/g) for TL 4 fish.

STA-3/4

Consistent with the *Protocol for Monitoring Mercury and Other Toxicants* (SFWMD and FDEP, 2011), mercury monitoring in STA-3/4 was moved to Phase 3 – Tier 3 on February 20, 2013 after receiving concurrence from FDEP. Prior to this approval, THg levels in mosquitofish composite samples collected on November 2, 2012 were 10 ng/g for the interior marshes (an average of three cells) and 22 ng/g for a downstream site, respectively, which were well below USEPA predator protection criteria for TL 3 fish.

STA-5/6

Flow-way 1 (Cells 5-1A and 5-1B) and 2 (Cells 5-2A and 5-2B) are under Phase 3 – Tier 3 monitoring. Flow-way 3 (Cells 5-3A and 5-3B) has been under Phase 2 – Tier 1 monitoring. The newly constructed Flow-ways 4 (Cells 5-4A and 5-4B) and 5 (Cells 5-5A and 5-5B) passed the start-up monitoring in calendar year (CY)2012 and are currently under Phase 2 - Tier 1 monitoring. Water column concentrations of both THg and MeHg in these flow-ways were moderate for the inflows and outflows during WY2013 and well below USEPA surface water criterion for THg (12 ng/L). At the outflow, net reductions of THg and MeHg loads were 19 percent and 58 percents, respectively. Mosquitofish collected from Flow-ways 3, 4 and 5 interior and downstream in WY2013 contained the lowest annual mean THg levels among STAs currently under monitoring for mercury. The average annual mosquitofish composite for WY2013 and each individual mosquitofish composite for all locations within these flow-ways and the downstream site did not exceed USEPA predator protection criterion for TL 3 fish (77 ng/g) and the period of record (POR) 75th percentile for all downstream Everglades sampling locations. Sunfish collected from the interior marsh contained one of the lowest THg levels among STAs. Sunfish from downstream in WY2013 contained THg levels, which was slightly above Florida Fish and Wildlife Conservation Commission (FWC) criterion (100 ng/g). Largemouth bass that were collected in the interior of the flow-ways, displayed an annual average level well below the USEPA TL 4 fish criterion and the POR 75th percentile for all downstream locations.

STA5/6 Cells 6-3 and 6-5 are currently under Phase 3 – Tier 3. Cells 6-2 and 6-4, which are a component of the Compartment C Buildout Project, are currently under Phase 2 – Tier 1. Surface water THg concentrations were well below USEPA surface water criterion (12 ng/L). Load reductions for both THg and MeHg were considerably high (> 80 percent). Levels of mercury in mosquitofish from the interior of STA5/6 Cell 4 for WY2013 remained the highest of all the

STAs, but together with mosquitofish in the downstream location, were well below the 77 ng/g USEPA criterion. Sunfish from both the interior marsh and downstream monitoring sites were the lowest among the actively monitored STAs and did not exceed the USEPA criterion and the POR 75th percentile for all downstream locations. Largemouth bass samples collected at the flow-way interior and the downstream site were below both USEPA Trophic Level 4 criterion and the POR 75th percentile for all downstream locations.

INTRODUCTION

This attachment contains the annual permit compliance monitoring report for mercury in the Everglades STAs by the South Florida Water Management District (District or SFWMD) and summarizes the mercury-related reporting requirements of Florida Department of Environmental Protection (FDEP) permit number 0311207 Specific Condition 23A (STA-1W and STA-1E), STA-2, STA-3/4 and STA-5/6 under the Everglades Forever Act (EFA) [Chapter 373.4592, Florida Statutes (F.S.)].

This report summarizes the results of monitoring in WY2013 for surface water in STA-2, STA-3/4, STA-5/6 and fish of multiple trophic levels in STA-1E, STA-2, STA-5/6. The results of mercury monitoring downstream of the STAs in accordance with these permits, as well as non-Everglades Construction Project (non-ECP) discharge structures (Permit Number 06.502590709), are reported separately in Appendix 3-2, Attachment F of this volume.

This report consists of key findings and overall assessment, an introduction and background, a summary of the Mercury Monitoring and Assessment Program (MMAP), and monitoring results. The background section briefly summarizes previously identified and published concerns regarding possible impacts of STA operations on South Florida's mercury problem. The following sections summarize MMAP, quality assurance/quality control (QA/QC), and statistical applications, followed by a summary and discussion of monitoring results. The monitoring results section comprises the bulk of new discussion. The last section of this attachment provides updates on mercury monitoring network optimization in each STA.

BACKGROUND

STAs are constructed wetlands designed to remove phosphorus from stormwater runoff originating from upstream agricultural areas and other areas, including Lake Okeechobee releases. The original six STAs, totaling over 65,000 acres and approximately 45,000 acres of effective treatment area, were built as part of the Everglades Construction Project (ECP) authorized under the EFA (Chapter 373.4592, F.S.).

Even before passage of the EFA in 1994, concerns were being raised that attempts to reduce downstream eutrophication could inadvertently aggravate the mercury problem known to be present in the Everglades (Ware et al., 1990; Mercury Technical Committee, 1991). These concerns stemmed from studies in other areas that showed flooded soils in new impoundments were sources of inorganic mercury (Cox et al., 1979). Of greater concern, studies also showed wetlands to be a significant site of mercury methylation.

MeHg is more bioaccumulative and toxic than the inorganic or elemental form of mercury (St. Louis et al., 1994; Rudd, 1995). Decomposition of flooded terrestrial vegetation and soil carbon in new reservoirs was reported to stimulate the sulfate-reducing bacteria that methylate inorganic mercury (Kelly et al., 1997; Paterson et al., 1998). Environments that favor methylation also drive bioaccumulation. For example, Paterson et al. (1998) found that annual fluxes of MeHg increased 10 to 100 times through a zooplankton community after impoundment.

Newly created reservoirs were also found to contain fish with elevated mercury levels (Abernathy and Cumbie, 1977; Bodaly et al., 1984; Bodaly and Fudge, 1999). This so-called “reservoir effect” can persist for several decades after initial soil flooding (Bodaly et al., 1984; Verdon et al., 1991; Fink et al., 1999). For instance, Verdon et al. (1991) reported that THg levels in northern pike (*Esox lucius*) increased from 0.61 to 2.99 parts per million (ppm or milligrams per liter) and continued to increase nine years after the initial soil flooding. Given these observations, Kelly et al. (1997) recently recommended that in siting a new reservoir, total land area flooded should be minimized, and flooding of wetlands, which contain more organic carbon than uplands, should be avoided.

However, applying these recommendations directly to the Everglades is problematic because most of the observations were made in deepwater lakes or reservoirs in temperate regions. In a report to the SFWMD on the potential impact of nutrient removal on the Everglades mercury problem, Watras (1993) stated that “the boreal and temperate watersheds, wetlands and reservoirs studied to date are very different geologically, hydrologically, meteorologically and ecologically from the subtropical systems in the Everglades.” Watras recommended monitoring and integrating mass balance and process-oriented studies to understand how this subtropical system would behave. Such studies were initiated in 1994 with the start-up of the prototype STA, the Everglades Nutrient Removal (ENR) Project (later incorporated within STA-1W). Baseline collections at the ENR Project found no evidence of MeHg spikes in either surface water (PTI, 1994 attributed to KBN, 1994a; Watras, 1993, 1994) or resident fish [mosquitofish (*Gambusia holbrooki*) and largemouth bass (*Micropterus salmoides*)] (PTI, 1994 attributed to KBN, 1994b].

During the first two years of operation, median concentrations of THg and MeHg in unfiltered surface water were reported to be 0.81 and 0.074 ng/L, respectively (Miles and Fink, 1998). These low levels persisted in later years: from January 1998 through April 1999, median water-column concentrations in the interior marsh (i.e., excluding inflows and outflows) were 0.81 ng THg per liter (/L) and 0.04 ng MeHg/L (Rumbold and Fink, 2002b). Resident fish also continued to have only low mercury levels: 8–75 ng/g in mosquitofish, and 100–172 ng/g largemouth bass age-standardized to three years (age 3) (Miles and Fink, 1998; SFWMD, 1999a; Lange et al., 1999). Finally, a mass balance assessment found the ENR Project to be a net sink for both THg and MeHg, removing approximately 70 percent of the inflow mass (Miles and Fink, 1998). Nonetheless, to provide continuing assurance that EFA implementation does not exacerbate the mercury problem, the FDEP construction and operating permits issued for the STAs require the SFWMD to monitor levels of THg and MeHg in various abiotic (e.g., surface water and sediment) and biotic (e.g., fish and bird tissues) media, both within STAs and the downstream receiving waters (see also Appendix 3-2, Attachment F of this volume).

Results from monitoring programs at STAs constructed and operated since 1999 (after the ENR Project) have revealed transitory spikes in MeHg production (see previous reports published by the SFWMD, including Rumbold and Fink, 2002b). Combined with the results of a 1999 field study on the effect that drought and muck fires had on mercury cycling in the Everglades (Krabbenhoft and Fink, 2001), these monitoring results demonstrated that spikes can sometimes occur following dryout and rewetting. Accumulating evidence suggests that oxidation of sulfide pools in the sediments (e.g., organic sulfide, disulfides, and acid volatile sulfides) during dryout can lead to increased methylation upon rewetting of the marsh either by providing free sulfate, which stimulates sulfate-reducing bacteria or, in highly sulfidic areas, by reducing porewater sulfide, which can inhibit methylation (Benoit et al., 1999a, b).

SUMMARY OF THE MERCURY MONITORING AND ASSESSMENT PROGRAM

The following section provides information on current monitoring and reporting activities used for the District's MMAP (SFWMD, 1999c). The MMAP was initially developed for the ECP, the Central and Southern Florida Project, and the EPA. The SFWMD developed and submitted a plan to the FDEP, the USEPA, and the U.S. Army Corps of Engineers (USACE) in compliance with the permit requirements (SFWMD, 1999b) and was later approved. Details on the procedures for ensuring the quality of and accountability for data generated under this monitoring program were set forth in the SFWMD's Quality Assurance Project Plan (QAPP) for the MMAP (SFWMD, 1999c), which was also approved on issuance of the FDEP permit. QAPP revisions were approved by the FDEP on June 7, 1999.

On February 13, 2006, a revised sampling protocol was approved by the FDEP and the District, which was entitled A Protocol for Monitoring Mercury and Other Toxicants (Protocol). Adapted from Rumbold and Pfeuffer (2005), this new plan was developed to replace the initial plan developed under the MMAP. The primary drivers of the Protocol are to (1) streamline sampling procedures, (2) eliminate the need for extended, open-ended sampling activities, and (3) phase out surface water sampling. The Protocol continues to use the QAPP modified in 1999. As of May 16, 2008, all mercury monitoring within each STA follows the Protocol. On September 29, 2009, additional modifications to the Protocol were approved by FDEP that involved altering the fish collection length for largemouth bass to the current range of 307–385 millimeters (mm). The Protocol was formally updated in April 2011 (SFWMD and FDEP, 2011) to reflect the agreed-upon change in the size of fish collected for analysis and is in agreement with Comprehensive Everglades Restoration Plan (CERP) *Guidance Memorandum 42: Toxic Substances Screening Process – Mercury and Pesticides* (CGM 42; USACE and SFWMD 2010). The change in size reflects a more appropriate age for evaluating contaminant concentrations.

PROTOCOL FOR MONITORING MERCURY AND OTHER TOXICANTS

Phase 1: Baseline Collection and Assessment

Phase 1 baseline collection and assessment is meant to provide information regarding the likelihood that a constructed facility under an EFA project may exacerbate or create a mercury (or other toxicant) problem. Identifying problematic areas will allow managers to avoid sites or areas that may present risk. Phase 1 is operated under three levels: Tier 1 (Compilation and Review of Available Data), Tier 2 (Field Sampling), and Tier 3 (Bioaccumulation Tests and Dynamic Modeling). Under Tier 1, the Environmental Site Assessment (ESA) is evaluated to determine (1) if any corrective actions were taken during the ESA, (2) there was potential for contamination, or (3) the time interval between the ESA and project construction. If information data gaps exist, or where the preponderance of baseline data demonstrates a potential problem, then Phase 1 – Tier 2 or Tier 3 is initiated. Under Phase 1 – Tier 2, three representative soil/sediment cores are collected and analyzed from five locations within each operable unit [i.e., Operating Unit (OU) - each independently operated treatment train] or each 1,000 acre parcel, whichever is smaller, At each location, three cores from the 0-to-4 centimeter horizon are collected and composited as a single soil sample and analyzed for several constituents that help evaluate MeHg production and mercury bioaccumulation.

Phase 1, Tier 3 is initiated if at least one of the following occurs: (1) absolute concentrations of MeHg or average percent MeHg in sediments/soils from an OU exceeds the 90 percent upper confidence level of the basin average or, if not available, the 75th percentile concentration (percent MeHg) for all basins; or (2) ambient fish collected with the project boundary demonstrate excessive bioaccumulation that exceeds the 90 percent upper confidence level of the basin-wide average or, if that value is not available, the 75th percentile concentration for all basins. Phase 1 – Tier 3 is used to evaluate extending uncertainties surrounding mercury bioaccumulation. This is accomplished through the use of bioaccumulation testing and modeling.

Phase 2: Monitoring During Three-Year Stabilization Period

If Phase 1 monitoring is not necessary, then Phase 2 – Tier 2 monitoring can occur following OU flow-through. Under Phase 2 – Tier 1, one surface water sample is collected and analyzed for THg and MeHg on a quarterly basis at inflow and outflow structures. Additionally, at least 100 mosquitofish are collected quarterly from multiple locations within each OU to be composited and analyzed for THg. Sunfish (*Lepomis* spp.) and largemouth bass (LMB) ($n \geq 5$) are collected and analyzed for THg annually.

Six criteria are used to evaluate the performance of each OU with respect to mercury bioaccumulation and enhancement (SFWMD and FDEP, 2011). These criteria are related to long-term trends in fish tissue concentrations, surface water THg/MeHg loading, and water quality standards. If any of the action criteria is exceeded, then Phase 2 – Tier 2 is triggered. Tier 2 sequentially involves (1) notifying the permitting authority, (2) resampling the media that triggered Tier 2 monitoring, (3) evaluating the spatial and temporal extent of the mercury bioaccumulation/enhancement accompanied with bioaccumulation modeling, and (4) developing an adaptive management plan.

Phase 3: Operational Monitoring

If after the first three years of monitoring, neither downstream loading nor residue levels in fish have exceeded action levels in the two years prior, then the project can move into Phase 3 – Tier 1. Under Phase 3 – Tier 1, (1) surface water sampling is discontinued, (2) the frequency of mosquitofish collection is reduced to semiannually, and (3) the frequency of large-bodied fish collection is reduced to one collection every three years. If the conditions are not met within the first three years, then criteria can be reevaluated annually based on the preceding two-year period.

Phase 3 – Tier 2 is triggered if (1) the annual average THg levels in mosquitofish progressively increase over time, (2) any semiannual mosquitofish composite exceeds the 90 percent upper confidence level of the basinwide annual average (or, if basin-specific data are lacking, exceeds the 75th percentile concentration for the period of record for all basins), or (3) if triennial monitoring of large-bodied fish (i.e., in years 6–9) reveal tissue mercury levels have statistically increased over time (i.e., over two or more years) or have become elevated to the point of exceeding the 90 percent upper confidence level of the basinwide annual average (or if basin-specific data are lacking, exceeds the 75th percentile for the period of record for all basins).

If fish under Phase 3 operational monitoring have not exceeded action levels by the ninth year, project-specific mercury monitoring can be moved into Phase 3 – Tier 3. Under Phase 3 – Tier 3, all of the project's mercury-related monitoring is discontinued; however, project managers are cautioned that action levels may be revised in the future.

QUALITY ASSURANCE MEASURES

QA/QC are integral to all monitoring programs. A stringent QA/QC program is especially critical when dealing with ultra-trace concentrations of analytes in natural and human-impacted environments. Quality assurance includes design, planning, and management activities conducted prior to implementing the project to ensure that the appropriate types and quantities of data will be collected with the required representativeness, accuracy, precision, reliability, and completeness. The goals of QA are to ensure (1) standard collection, processing, and analysis techniques will be applied consistently and correctly, (2) the number of lost, damaged, and uncollected samples will be minimized, (3) the integrity of the data will be maintained and documented from sample collection to entry into the data record, and (4) data are usable based on project objectives.

QA measures are incorporated during the sample collection and laboratory analysis to evaluate the quality of the data. These measures give an indication of measurement error and bias (or accuracy and precision). Aside from using these results to indicate data quality, an effective QA program must utilize QC results to determine areas of improvement and implement corrective measures. QC measures include both internal and external checks. Typical internal QC checks include replicate measurements, internal test samples, method validation, blanks, and the use of standard reference materials. Typical external QC checks include split and blind studies, independent performance audits, and periodic proficiency examinations. Data comparability is a primary concern because mercury-related degradation of water quality is defined here as relative to baseline data generated by one or more laboratories. It is important to establish and maintain comparability of the performance and results among participating laboratories assessing the reporting units and calculations, database management processes, and interpretative procedures. Comparability of laboratory performance must be ensured if the overall goals of the monitoring program are to be realized.

Laboratory Quality Control

Data for this program was generated by the District and the FDEP, both of which are certified by the Florida Department of Health under the National Environmental Laboratory Accreditation Program. The following methods were utilized when analyzing samples for THg and MeHg during WY2012: FDEP–USEPA Method 1631E (Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry); USEPA Draft Method 1630 (Methylmercury in Water and Tissues by Distillation, Extraction, Aqueous Phase Ethylation, Purge and Trap, Isothermal GC Separation, Cold Vapor Atomic Fluorescence Spectrometry); USEPA Method 245.6 [Mercury in Tissues by Cold Vapor AAS (uses liquid digestion)]; EPA 7471A [Mercury in Solids by Cold Vapor AAS (uses liquid digestion)]; District–EPA 7473 [Mercury in Solids and Tissues by Direct Thermal Decomposition, Amalgamation and AA (does not incorporate liquid digestion)]. All of these methods use performance-based standards employing the appropriate levels of QA/QC required by the National Environmental Laboratory Accreditation Conference (NELAC), the specific reference method, and the Protocol.

Field Quality Control Samples

For WY2013, 29 field quality control (QC) samples, including equipment blanks [both laboratory-cleaned equipment blanks (EB) and field-cleaned equipment blanks (FCEB)], and replicate samples were collected for both THg and MeHg surface water samples at STA-2 and STA-5/6. These field QC check samples represented approximately 40 percent of the 29 water samples collected during this reporting period. The results of the field QC blanks are summarized in **Table C-1**. A field kit prep blank (FKPB) is a sample of the deionized distilled water (DDW) for field QC that remains at the lab to monitor low-level background inorganic mercury contamination of the laboratory DDW system, which can vary over time. FKPB were discontinued effective 6/16/12 according to the Water Quality Monitoring Division Quality Assurance Team Investigation Report QATI 110616-1. An EB is collected at the beginning of every sampling event, and a FCEB is collected at the end of the event. A trip blank (TB) is a blank sample (DDW) that is used to identify potential contamination during field transport. For this field collection blank, DDW is carried through the field collection trip, remains sealed in a container, and is then analyzed with all other samples at the FDEP laboratory. TBs were discontinued effective June 16, 2012 according to the Water Quality Monitoring Division Quality Assurance Team Investigation Report QATI 033111-1. For WY2012, there were no flagged QA/QC samples for THg and MeHg samples.

The sample corrective action criterion for FCEBs and EBs is currently 10 times the FCEB/EB level. All routine samples associated with an FCEB or EB are flagged if its value is less than 10 times the method detection limit of 0.1 ng/L for THg, or 0.022 ng/L for MeHg.

Table C-1. Field QC blanks from STA-2 and STA-5/6 for WY2013. Method detection limits (MDLs) are 0.1 ng/L for THg and 0.022 ng/L for MeHg.

Field QC	THg						MeHg					
	Sample Size (n)[a]	Collection Frequency (%)	Mean (ng/L)[b]	n>MDL	n Flagged	% Flagged[c]	Sample Size (n)[a]	Collection Frequency (%)	Mean (ng/L)[b]	n>MDL	n Flagged	% Flagged[c]
EB	9	10.7	-0.1	0	0	0	10	11.9	-0.022	0	0	0
FCEB	5	5.3	-0.1	0	0	0	5	5.3	-0.022	0	0	0

[a] Total number (n) of respective QA/QC samples

[b] Mean concentration of QC samples

[c] Percentage of all (QA/QC+ monitoring) samples collected for WY2013 (n = 43 for THg and n = 52 for MeHg)

Analytical and Field Sampling Precision

Field replicates samples are collected from the same source as the routine sample using the same sampling equipment. The resulting data are compared to the results of routine samples to evaluate sampling precision.

Laboratory replicates are aliquots of the same sample that are prepared and analyzed within the same run. The results from duplicate analyses are used to evaluate analytical precision.

WATER SAMPLES

To assess the precision of field collection and analysis, 40 replicate, unfiltered surface water samples (10 THg and 15 MeHg) and mosquitofish composites (15 THg) collected at STA-1E, STA-2, and STA-5/6 were processed during WY2013. **Table C-2** reflects the results of sample analyses. Two replicate samples were matched with one surface water sample. For WY2013, all the THg and MeHg relative standard deviations were below the required 20 percent QA/QC precision level.

Table C-2. Relative standard deviations (RSD) for samples collected within STA-2 and STA-5/6 during WY2013.

Media	Sample Size (n)	% Relative Standard Deviation*		
		Minimum	Maximum	Mean
Surface Water THg	10	3.3	14.3	9.0
Surface Water MeHg	15	7.3	11.4	6.5
Mosquitofish THg	15	0	7.9	5.3

* RSD = standard deviation/average x 100. RSD is calculated for each sampling event with replicate samples separately (1 sample value + two replicate samples)

MOSQUITOFISH COMPOSITE SAMPLES

To monitor spatial and temporal patterns in mercury residues in small-bodied fish, mosquitofish (at least 100 individuals) are collected at various locations in the STAs, ECP, and non-ECP marshes. These individuals are then composited for each site. Composite sampling can increase sensitivity by increasing the amount of material available for analysis, reduce inter-sample variance effects, and dramatically reduce analytical costs. However, subsampling from a composite introduces uncertainty if homogenization is incomplete. Since 1999, the District has used a Polytron homogenizer to homogenate composited mosquitofish. Until late 2001, the homogenate was subsampled in quintuplicate and each subsample analyzed for THg. Based on the apparent degree of homogenization as evidenced by the low relative standard deviation (RSD) among aliquots reported in Atkeson and Axelrad (2004), the District revised its standard operating procedure after consultation with and approval by the FDEP, reducing subsampling of the homogenate from five to three. In 2007, replicates were further reduced from three to one homogenate [This reduction was approved by the FDEP in 2007 and documented in the *2009 South Florida Environmental Report (SFER) – Volume 1*, Appendix 5-4, page 7 under the heading Prey Fish (Gabriel et al. 2009)]. Laboratory replicates of mosquitofish were processed by the SFWMD and analyzed for THg. For WY2013, the mean percent RSD between replicate and routine samples for the 15 aliquots was 8 percent (**Table C-2**) which is lower than WY2012 (mean of 9 percent).

SEDIMENT COMPOSITE SAMPLES

For WY2013, no sediment samples were collected for mercury analysis.

Inter-laboratory Comparability Studies

To ensure further reproducibility between ongoing mercury sampling initiatives and to evaluate the performance of contract laboratories used for mercury analysis, round-robin studies for water, fish, and sediment are routinely initiated. These studies are performed by the District and contracted laboratories (Battelle et al., 2011; Wageningen Evaluating Programmes for Analytical Laboratories, 2011; ERA, Colorado).

SURFACE WATER AND FISH

As in previous years, inter-laboratory studies were conducted by the FDEP to assess the comparability of THg and MeHg analysis in water for several laboratories. Participating laboratories receive nine samples of ambient water from the Everglades for analysis of THg and/or MeHg. In WY2013, the District participated in the Quality Assurance of Information for Marine Environmental Monitoring in Europe studies Round 70 and Round 72, to assess their performance in quantifying mercury in fish.

SEDIMENT

In WY2013, the District laboratory participated in ERA's Soil 80 and Soil 82 Proficiency Testing (PT) studies to obtain a regular independent assessment of a laboratory's performance and meet requirements for certification for THg in sediment/soil. NELAC certification requires participation in PT studies every six months.

SELECTION OF FISH SPECIES AND SIZE RANGE

The proper interpretation of residue levels in tissues can sometimes prove problematic due to the confounding influences of age or species of collected animals. For comparison, special procedures are used to normalize the data (Wren and MacCrimmon, 1986; Hakanson, 1980). To be consistent with the reporting protocol used by the FWC (Lange et al., 1998, 1999), mercury concentrations in largemouth bass were standardized to an expected mean concentration in three-year-old fish at a given site by regressing mercury against age. Currently, the FWC targets largemouth bass between lengths of 307–385 mm, which includes age-3 fish. This length range is targeted to eliminate the need for fish aging. Sunfish were not aged. Instead, arithmetic means were reported. Additionally, the distribution of the different species of sunfish [warmouth (*Lepomis gulosus*), spotted sunfish (*L. punctatus*), bluegill (*L. macrochirus*), and redear sunfish (*L. microlophus*)] that were collected during electroshocking was also qualitatively considered as a potential confounding influence on mercury concentrations prior to each comparison. The target sunfish species is bluegill.

SITE DESCRIPTIONS

Site descriptions and operational plans for STA-1W, STA-1E, STA-2, STA-3/4, STA-5/6 are published elsewhere. Maps of selected monitoring locations are given with the data for each STA in the *Monitoring Results* section of this attachment.

MONITORING RESULTS

Mercury monitoring in STAs follows the *Protocol for Monitoring Mercury and Other Toxicants* (SFWMD and FDEP, 2011). For WY2013, surface water samples were collected from STAs 2 and 5/6 for THg and MeHg analysis, and mosquitofish, sunfish and largemouth bass sample were collected from STA-1E, STA-2 and STA-5/6 for THg analysis. Results from each STA will be discussed in the following sections.

Table C-3. THg and MeHg inflow and outflow loadings[a] in grams for WY2013.

	Inflow Load		Outflow Load		% Reduction[b]	
STA	THg	MeHg	THg	MeHg	THg	MeHg
STA-1W	Terminated					
STA-1E	Terminated					
STA-2 NBO	132.4	11.3	68.7	8.9	48.1	21.2
STA-2 SBO	45.5	5.2	27.4	2.7	39.9	48.1
STA-5/6 Flow-ways 3,4,5	77.9	63.0	12.2	5.1	19.2	57.9
STA-5/6 Flow-way 6	9.3	1.2	2.3	0.1	75.5	90.0

[a] Calculated as total flow volume for water year (m^3) x average THg or MeHg concentration (grams per cubic meter)

[b] (inflow–outflow/inflow)*100

Table C-4. Concentration of THg [nanograms per grams (ng/g), wet weight] in mosquitofish (*Gambusia holbrooki*) composite samples from STAs during WY2013.

STA	Quarterly Collection	Interior Fish	Outflow/ Downstream Fish
STA-1W	Monitoring terminated		
STA-1E*	Oct-12	19	122
STA-2 (NBO and SBO)	Nov-12	25	24
	Feb-13	32	35
	Apr-13	42	27
	WY2013 mean	33	29
STA-3/4*	22-Oct	10	22
STA-5/6 (Flow-ways 3, 4 5)	Sep-12	12	28
	Nov-12	19	14
	Feb-13	15	21
	WY2013 mean	15	21
STA-5/6 (Flow-way 6)	Nov-12	32	85
	Feb-13	36	58
	WY2013 mean	34	72

* no water year means were calculated for these STAs due to lack of multiple quarter data.

STA-1W

Monitoring was under Phase 3 – Tier 3 which terminates mercury monitoring.

STA-1E

Monitoring water-column concentrations of THg and MeHg began in January 2005 at STA-1E (**Figure C-1**). Both the central flow-way (Cells 3, 4N, and 4S) and the westernmost flow-way (Cells 5–7) met the start-up criteria, as specified in EFA Permit Number 0195030-001-GL. The USACE constructed a Periphyton-Based Stormwater Treatment Area (PSTA) Demonstration Project in the easternmost flow-way (Cells 1 and 2) of STA-1E. The most recent eastern flow-way passed start-up in 2007. On February 29, 2012 the FDEP approved the transfer of STA-1E mercury monitoring from Phase 2 – Tier 1: Routine Monitoring during Stabilization Period to Phase 3 – Tier 1: Routine Operational Monitoring from Year 4 to Year 9 for all flow-ways (Western, Central and Eastern), which include cells 1, 2, 3, 4N, 4S, 5, 6 and 7 of STA-1E. As the result of this approval, sampling for surface water mercury was terminated (**Table C-3**), mosquitofish monitoring frequency was reduced from quarterly to semiannually, bass and sunfish monitoring frequency was reduced from annually to triennially, and the number of bass and sunfish monitoring stations were reduced from all flow-ways to one flow-way with the historically highest mercury concentrations (station ST1EC2A in Cell 2 of the Eastern Flow-way) and one downstream station (ST1ELX). Please refer to previous reports for information on surface water mercury in STA-1E.

THg in mosquitofish from STA-1E sites at interior marshes (three flow-ways) and the single downstream site (ST1ELX) at the WCA-1 marsh began during the third quarter of 2005 (**Figure C-2** and **Table C-4**). The THg level in mosquitofish from the interior marsh in WY2013 was 19 ng/g. This value did not exceed the POR 75th percentile for all Everglades downstream sampling locations during WY2013. However, the THg level in downstream mosquitofish (122 ng/g) exceeded the USEPA predator protection criterion for TL 3 (77 ng/g). THg concentration in both interior and downstream site was similar to that in WY2012. It has been speculated that seasonal dryout/reflooding, which may cause the release of inorganic mercury from sediment and high mercury methylation rate is likely one of the reasons for high THg in fish in the Everglades marsh.

Regarding risks to fish-eating wildlife, interior mosquitofish (TL 2 or 3) did not exceed the USEPA’s 77 ng/g criterion; however, the mosquitofish from the downstream location did exceed this criterion.

Collection of large-bodied fish is on triennial basis for STA1-E and was not conducted in WY2013. The next sampling event is expected to take place in WY2014 and data will be reported in this volume of the 2015 annual compliance report.

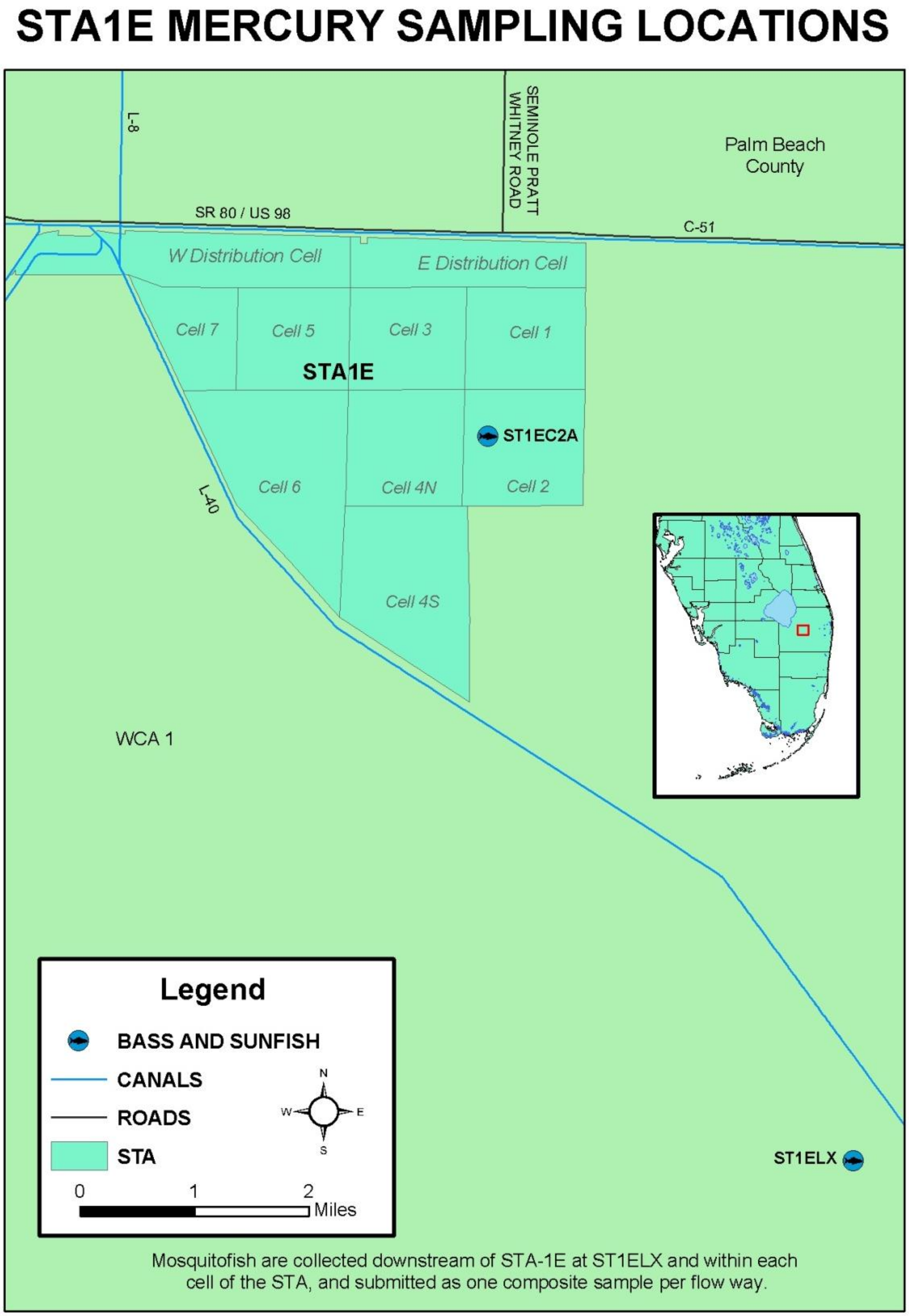

Figure C-1. Map of STA-1E showing mercury monitoring sites. Mosquitofish are collected downstream of STA-1E at ST1ELX and within each cell of the STA, and submitted as one composite sample per flow-way.

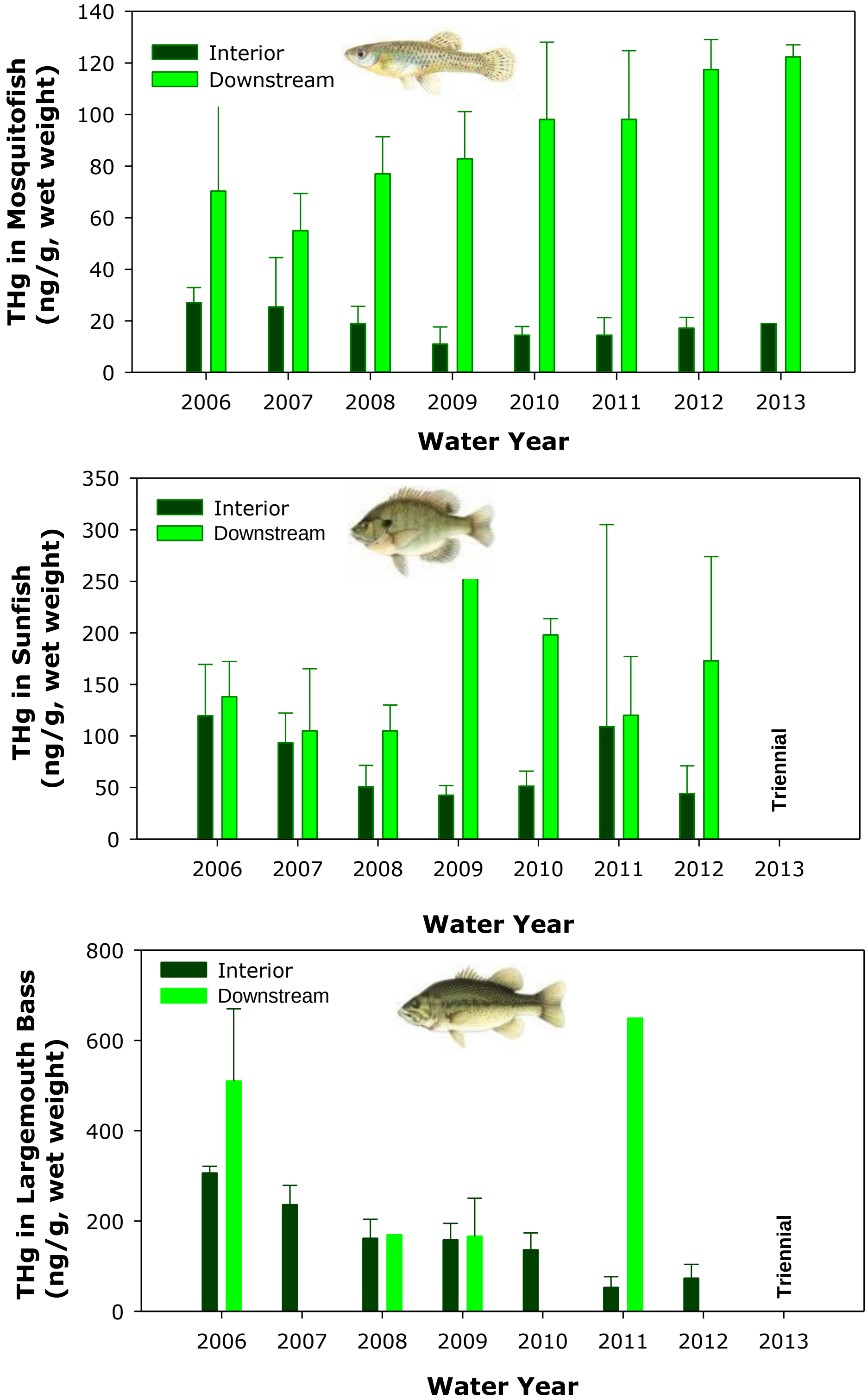

Figure C-2. THg concentrations (ng/g, wet weight) in mosquitofish composites [± standard deviation) SD] (top), whole sunfish (arithmetic mean ± SD) (middle), and fillets of largemouth bass (arithmetic mean ± SD) (bottom) collected at STA-1E. During Phase 3, Tier 1, large-bodied fish samples were not taken in WY2013.

STA-2

STA-2 Cells 2 and 3, met mercury start-up criteria in September 2000 and November 2000, respectively. In August 2001, flow-through operation of Cell 1 was approved under a permit modification. Cell 1 met start-up criteria in November 26, 2002. Operational monitoring for mercury at STA-2 began during the third quarter of 2001 after completion of the S-6 connection (Rumbold and Fink, 2002b, 2003b; Rumbold 2004, 2005; Rumbold et al., 2006). The most recently developed area, Cell 4, passed mercury start-up criteria and flow-through began in 2007. February 29, 2012, the FDEP approved transfer of STA-2 mercury monitoring from Phase 2 – Tier 1: Routine Monitoring during Stabilization Period for STA-2 Cells 1, 2 and 3 to Phase 3 – Tier 3: Routine Operational Monitoring After Year 9, and Phase 3 – Tier 1: Routine Operational Monitoring From Year 4 to Year 9 for STA-2 Cell 4. Phase 3 – Tier 3 implemented the termination of all site specific mercury monitoring at STA-2 Cells 1, 2, and 3 (**Figure C-3**).

The District constructed two new flow-ways in STA-2, known as EAA Compartment B Buildout Project (Compartment B). These new flow-ways consist of the NBO, which includes Cells 4, 5, and 6 and the SBO, which includes Cells 7 and 8. Compartment B incorporates the existing Cell 4 (**Figure C-3**). Start-up monitoring (sediment and mosquitofish) in Compartment B began on October, 2011. On December 20, 2012, FDEP approved the start-up monitoring be moved to Phase 2 – Tier 1: Routine Monitoring during the Stabilization Period, which requires quarterly collection of surface water samples for THg and MeHg, quarterly and annual collection of mosquitofish composite and large-bodied fish samples for THg analysis. Surface water samples were collected at the STA-2 inflow (S6, G328, G434 and G435) and outflow stations (G335 and G436). Mosquitofish composite samples were collected from NBO and SBO and a downstream station (CA2NF) in WCA-2. Large-bodied fish samples were collected in Cell 4 (STA2C4A) of NBO, Cell 8 (STA2C8A), and WCA-2 (CA2NF).

Only two sampling events for surface water mercury were taken in WY2013. Results show that THg concentrations at the in inflow and outflow did not exceed the Florida Class III numerical water quality standard of 12 ng/L (**Figure C-4**). The average THg concentration from the two STA-2 inflow sites (G328 and S6) in WY2013 was higher than the average outflow concentration (G335 and G436). The THg concentrations at the inflow site to NBO (G434) and to SBO (G435) were also higher than the outflow sites. THg concentrations at all sites collected on December 2012 were greater than those collected in March 2013 (**Figure C-4**). The average MeHg concentration at inflow was greater than that at the outflow although the lowest concentration was found at the major STA-2 inflow site (S6) (**Figure C-4**). Load estimates using average inflow and outflow concentration and total hydrologic loading to STA-2 indicated that a total of 132.4 grams of THg and 11.3 grams of MeHg were loaded to STA-2 during WY13 and a total of 68.7 grams of THg and 8.9 grams of MeHg were discharged from STA-2 (**Table C-3**). STA-2 reduction of mercury during WY2013 was 48 percent for THg and 21 percent for MeHg.

The annual mercury loading to NBO (Cells 4, 5 and 6) via G434 was 29.9 grams of THg and 2.2 grams of MeHg. The annual mercury loading to SBO (Cells 7 and 8) via G435 was 27.4 grams of THg and 2.7 grams of MeHg. The total annual mercury load of Compartment B (NBO and SBO) was 45 grams of THg and 5.2 grams of MeHg. Because NBO and SBO shared the same outflow, we cannot evaluate the mercury reduction for NBO and SBO separately. The outflow mercury load using the same hydrologic loading rate from the Compartment B inflow was 27.4 grams of THg and 2.7 grams of MeHg which represented a reduction of nearly 40 percent for THg and 48 percent for MeHg (**Table C-3**).

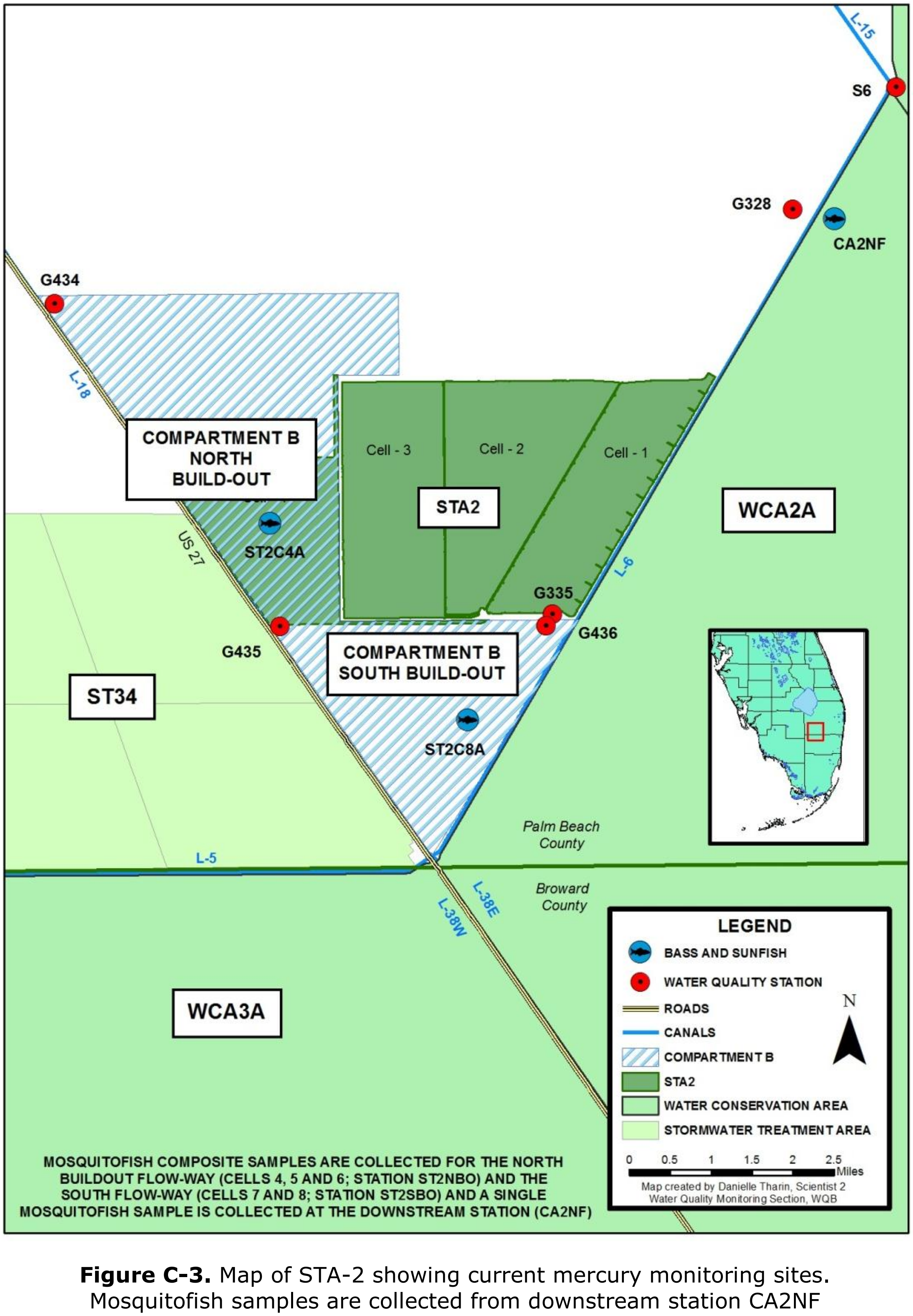

Figure C-3. Map of STA-2 showing current mercury monitoring sites. Mosquitofish samples are collected from downstream station CA2NF and in each cell, and then submitted as a composite for each flow-way.

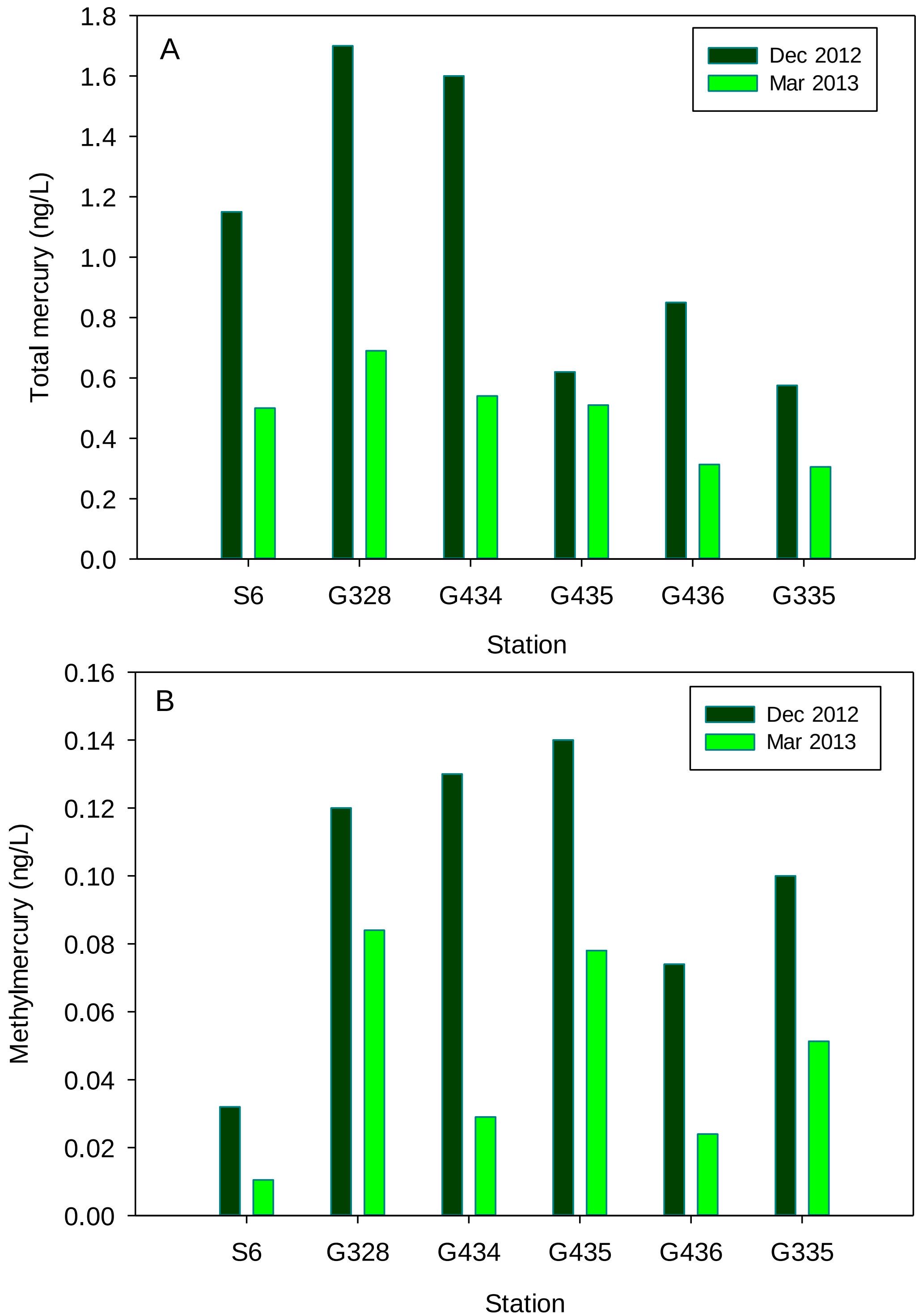

Figure C-4. Concentrations of THg (top) and MeHg (bottom) in unfiltered surface water collected at inflow (S6, G328, G434 and G435) and outflow stations (G436 and G335) from STA-2 during WY2013.

Table C-4 and **Figure C-5** summarize the results from the operational monitoring of mercury concentrations in STA-2 Compartment B (ST2C4A and ST2C8A) mosquitofish for WY2013. The THg level in mosquitofish from the STA-2 marsh interior remained the lowest among actively monitored STAs. In WY2013, the average mosquitofish composite for the NBO and SBO was 33 ng/g with a range from 7 to 78 ng/g, which was well below USEPA or USFWS TL 3 fish criterion (77 ng/g and 100 ng/g). The average THg levels of mosquitofish at the downstream site was 29 ng/g, which was well below USEPA or USFWS TL 3 fish criterion and the POR 75th percentile for the downstream Everglades sampling locations.

The THg level of sunfish from STA-2 Compartment B (STA2C4A and STA2C8A) remained low (59 ng/g) in WY2013 (**Table C-5** and **Figure C-5**). The downstream site (CA2NF) displayed slightly higher THg level (97 ng/g) than WY2012. Seven bluegills of the 20 sunfish contained THg level, which exceeded the USFWS TL 3 fish criterion of 100 ng/g. In WY2013, the average annual sunfish concentration for all STA-2 Compartment B and downstream did not exceed the POR 75th percentile for all downstream Everglades sampling locations.

Concentrations of THg in fillets of resident largemouth bass from STA-2 (**Table C-6** and **Figure C-5**) in the length range of 307–385 mm reflect an overall average of 155 ± 114 ng/g collected across Cell 4 and Cell 8. The downstream site displayed an average THg that is considerably lower than that in WY2013 (**Figure C-5**). Historically, fish THg levels within this STA have been high compared with the other STAs, which may be related to the previous land use within this area. Annual LMB concentration for Compartment B did not exceed the POR 75th percentile for all Everglades downstream receiving water sampling locations (see Appendix 3-2, Attachment F, of this volume). The THg level in LMB collected from the downstream receiving water (CA2NF) averaged at 194 ng/g in WY2013. This represents nearly 60 percent decrease compared to the average THg level (451 ng/g) in WY2012 (**Figure C-5**).

Regarding the risk to fish-eating wildlife, in WY2013, except for one mosquitofish composite and several bluegills, the average THg levels of mosquitofish composite or sunfish from the interior and downstream sites did not exceed the USEPA predator protector criteria of 77 ng/g for TL 3 species or the USFWS criteria of 100 ng/g. There was no exceedance of the USEPA criterion of 346 ng/g for TL 4 fish species in LMB in Compartment B interior and the downstream site. Overall, fish-eating wildlife foraging preferentially within and downstream of STA-2 continue to appear to have an overall moderate risk of mercury exposure.

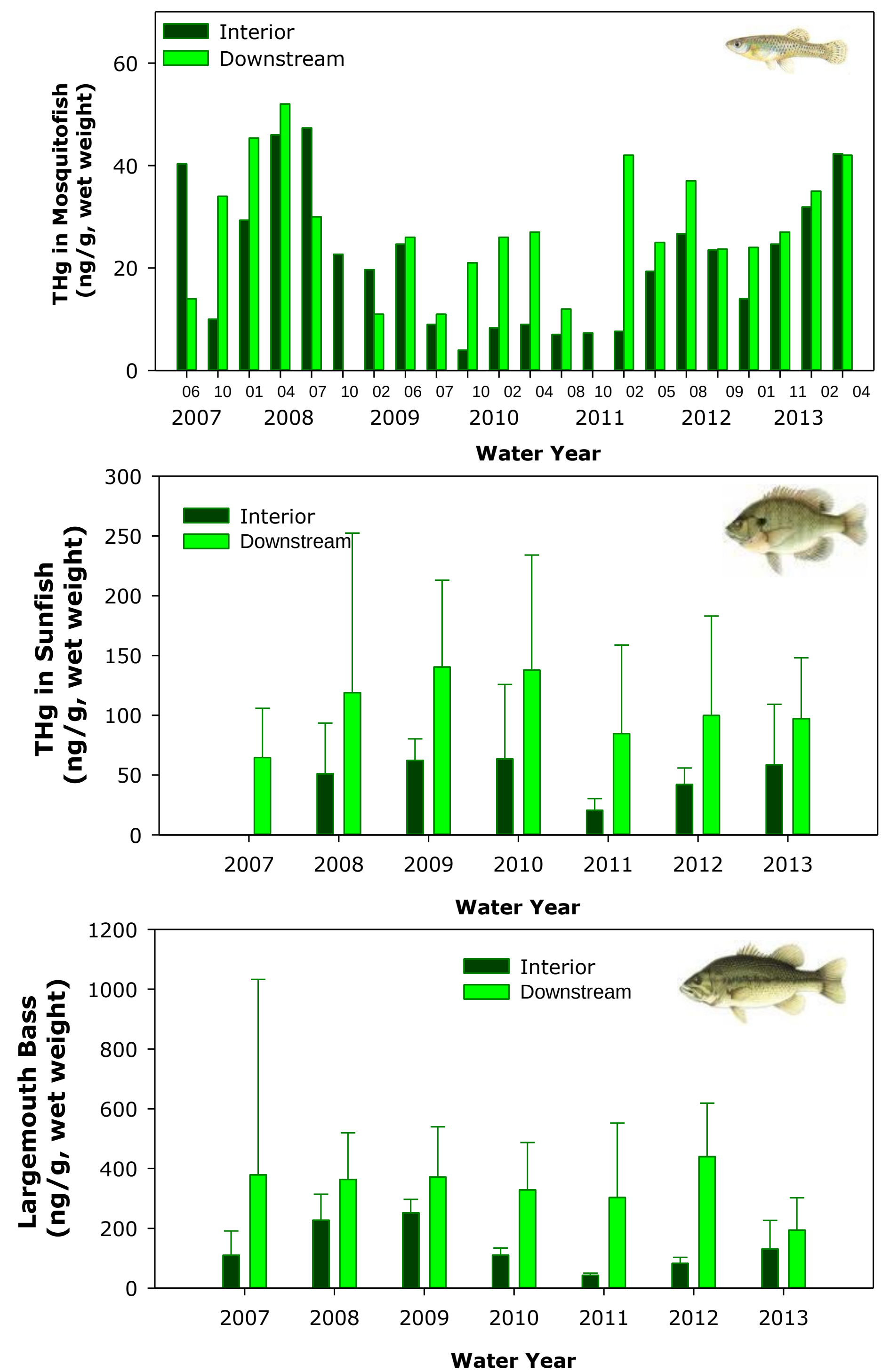

Figure C-5. Mercury concentrations (ng/g, wet weight) in mosquitofish composites (± SD) (top), whole sunfish (±SD) (middle), and fillets of largemouth bass (arithmetic mean, ± SD) (bottom) collected at STA2C4A (WY2007 to WY2013) and STA2C8A (WY2013 only) and the downstream site at WCA-2 (CA2NF).

Table C-5. Concentration of THg (ng/g, wet weight) in sunfish collected from STAs in WY2013 (mean ± standard deviation). Sample size is in parentheses. Cumulative mean includes all data for the period of record.

STA	Interior Fish	Outflow/Downstream Fish
STA-1W	*No Results; Monitoring terminated in 2009*	
STA-1E	*No Results; Monitoring on triennial basis*	
Cumulative mean	68	165
STA-2*	59±50 (10)	97±51(20)
Cumulative mean	82	112
STA-3/4	*No Results; Monitoring terminated in 2013*	
STA-5/6 Flow-ways 3, 4 and 5	53±22 (15)	109±66 (5)
Cumulative mean	82	135
STA-5/6 Flow-way 6	48±(5)	59±26 (5)
Cumulative mean	70	100

*Data are from Compartment B (STA2C4A and STA2C8A)

Table C-6. Contains largemouth bass THg concentrations (ng/g, wet weight) collected in the STAs between 307–385 mm for WY2013 (mean ± standard deviation, sample size). In parentheses all data is presented, which includes data within and outside of the 307–385 mm range. Cumulative mean includes all fish for the period of record.

STA	Interior Fish	Outflow/Downstream Fish
STA-1W	*No Results Monitoring terminated in 2009*	
STA-1E	*No Results; Monitoring on triennial frequency*	
STA-2	155±114, 7 (131±97,10)	212±63, 9 (194±166,20)
Cumulative mean	147	387
STA 3/4	*No Results; Monitoring terminated in 2013*	
STA-5/6 Flow-ways 3, 4, 5	187±8, 4 (161±58,9)	NA (257,1)
Cumulative mean	279	362
STA-5/6 Flow-way 6	231±54,5 (231±54,5)	333±90,4 (312±91, 5)
Cumulative mean	332	423

*Data are from Compartment B (STA2C4A and STA2C8A)

** Data are from Flow-ways 3, 4 and 5.

*** Data are from Cell 4

STA-3/4

On February 20, 2013 the FDEP approved the transfer of STA-3/4 mercury monitoring from Phase 3 – Tier 1: Routine Operational Monitoring from Year 4 to Year 9 to Phase 3 – Tier 3: Routine Operational Monitoring After Year 9. This implemented the termination of all site specific mercury monitoring at STA-3/4. Prior to this approval, THg level in mosquitofish composite samples collected on October 22, 2012 was 10 ng/g for the interior marshes (an average of three cells) and 22 ng/g for a downstream site, respectively (which were well below USEPA predator protection criteria for TL 3 fish.

STA-5/6

On December 31, 2009, the FDEP approved the District's request to move mercury monitoring in Flow-ways 1 and 2 from Phase 3 – Tier 1 to Phase 3 – Tier 3. This implemented termination of all site-specific mercury monitoring in those flow-ways. Flow-way 3 is under Phase 2 – Tier 1 Monitoring: Routine Monitoring during the Stabilization Period (**Figure C-6**). The newly constructed Flow-way 4 (consisting of Cells 5-4A and 5-4B) and Flow-way 5 (consisting of Cells 5-5A and 5-5B), along with STA-5/6 Cells 6-4 and 6-6, are Compartment C, which passed the start-up monitoring in 2012 and is currently under Phase 2 – Tier 1 monitoring (**Figure C-6**).

As shown in **Figure C-7**, water column concentrations of THg and MeHg from Flow-way 3 in WY2013 displayed some of the lowest values for the POR. No THg sample was above the 12 ng/L water quality standard. For WY2013, there was a net reduction of nearly 20 percent of THg and 58 percent of MeHg (**Table C-3**).

Mosquitofish collected from Flow-ways 3, 4 and 5 in WY2013 contained low annual mean mercury levels (**Figure C-8**), compared to other STAs (**Table C-4**). The average annual mosquitofish composite for WY2013 (15 ng/g) and each individual mosquitofish composite (12–25 ng/g) for all locations within STA-5/6 and the downstream site (RA1) did not exceed the POR 75th percentile for all downstream Everglades sampling locations.

Sunfish collected from the Flow-ways 3, 4 and 5 interior marsh in WY2013 contained an average THg level of 53 ng/g, which is below the TL 3 fish standard (77 ng/g and 100 ng/g) by USEPA and USFWS, respectively. Sunfish from downstream in WY2013 contained an average THg level of 109 ng/g, which is slightly higher than WY2012 and slightly exceeds the USFWS standard (**Table C-5**).

In previous years, the FWC (under contract to the District to collect large-bodied fish for mercury monitoring) encountered difficulties in filling sample quotas for STA-5/6. For WY2013, nine individuals of largemouth bass were caught from Flow-ways 3, 4 and 5. Among these fishes, four individuals fell into the range of total length (307 to 385 mm) required by the Protocol with an average THg of 187 ng/g (**Table C-6**), which is below the USEPA TL 4 fish standard (346 ng/g). One individual of largemouth bass was caught at the downstream site (RA1) with a THg level of 257 ng/g. LMB collected from all sampling sites of STA-5 showed relatively low levels in WY2008, WY2009 and WY2013 (**Figure C-8**).

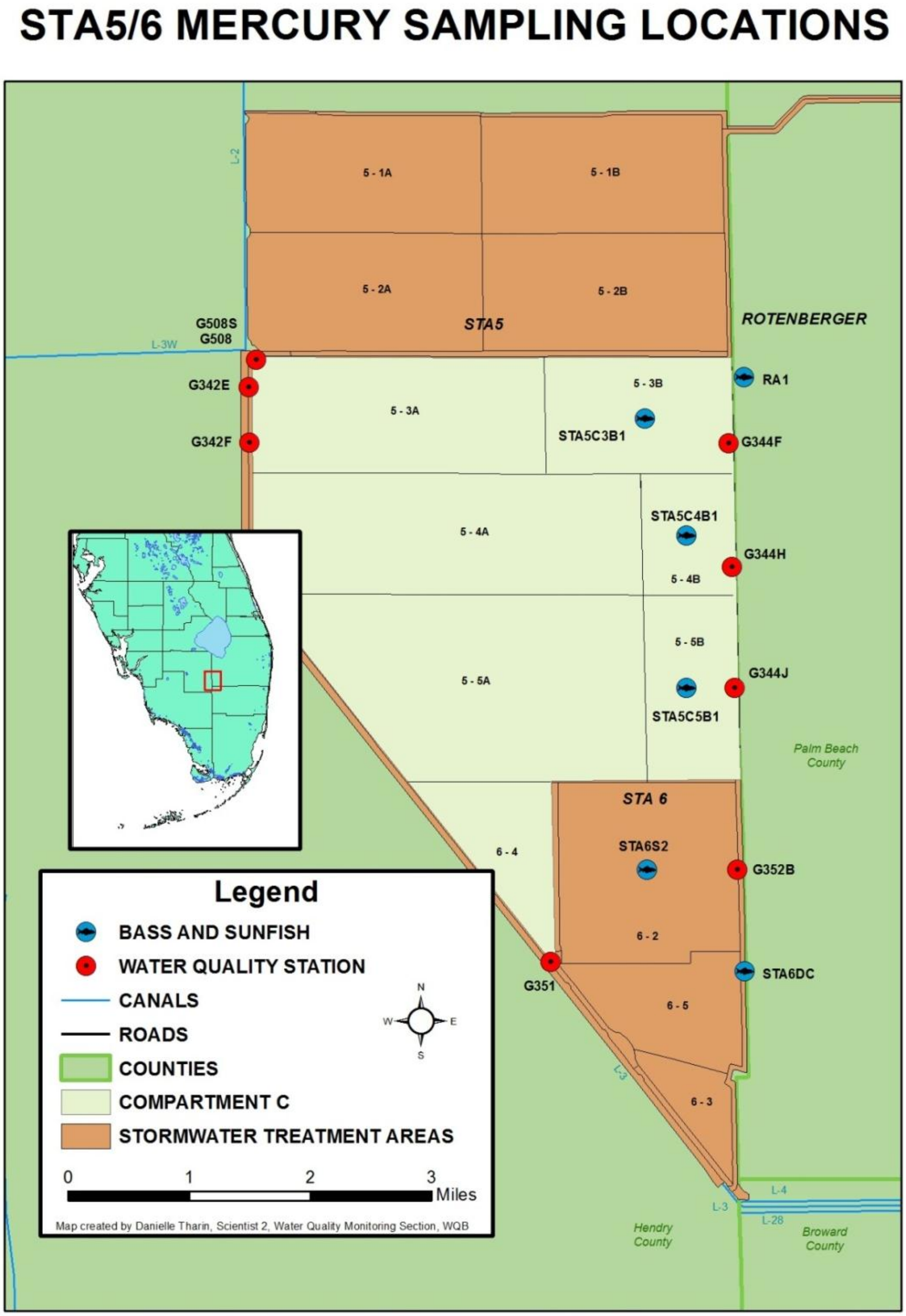

Figure C-6. Map of STA-5/6 showing current mercury monitoring sites. Mosquitofish composite samples are collected for each flow-way and composited, and collected at two downstream sites (RA1) and (STA6DC). Large-bodied fish are collected at each flow-way and two downstream sites (RA1) and (STA6DC).

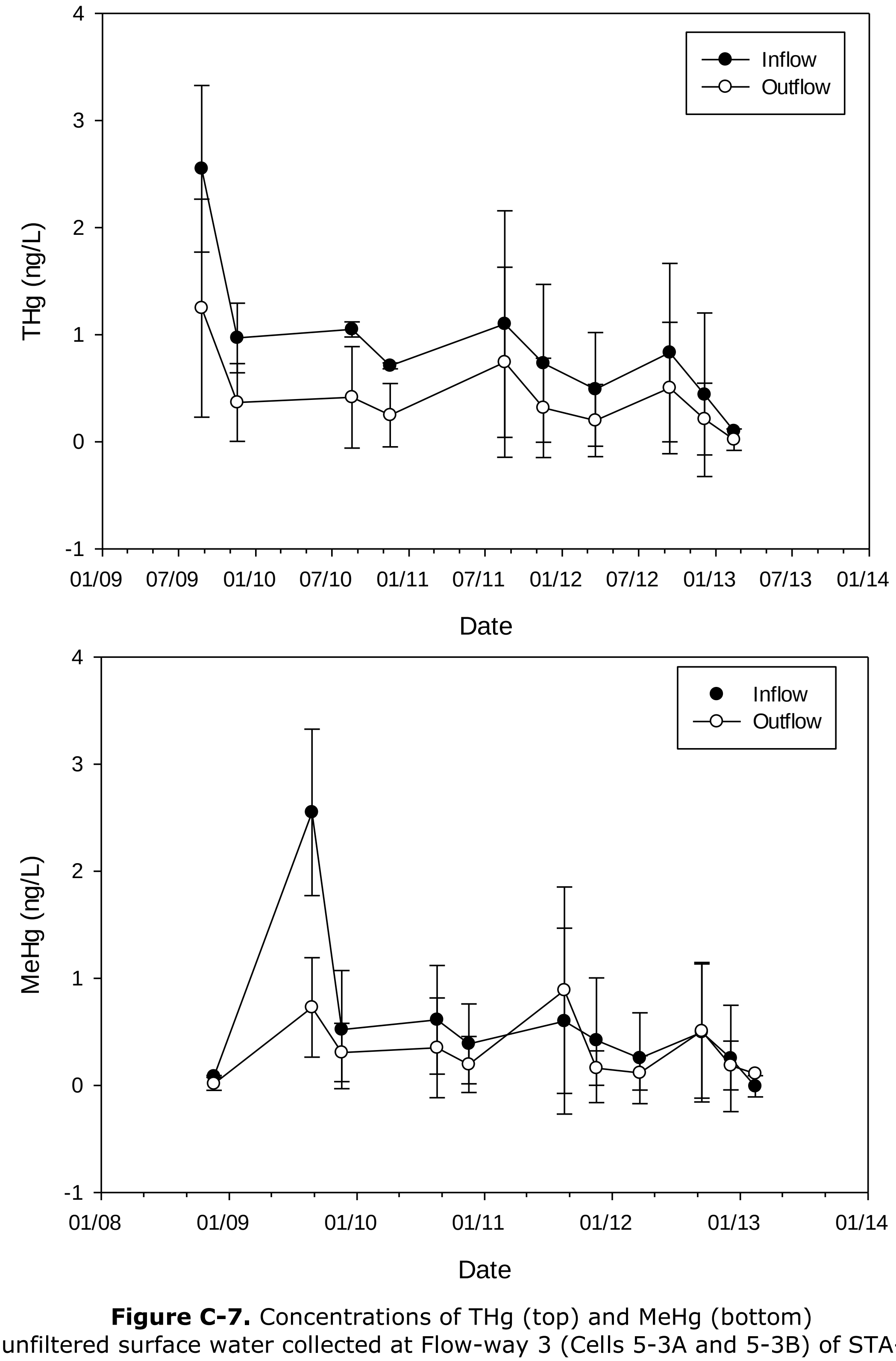

Figure C-7. Concentrations of THg (top) and MeHg (bottom) in unfiltered surface water collected at Flow-way 3 (Cells 5-3A and 5-3B) of STA-5/6.

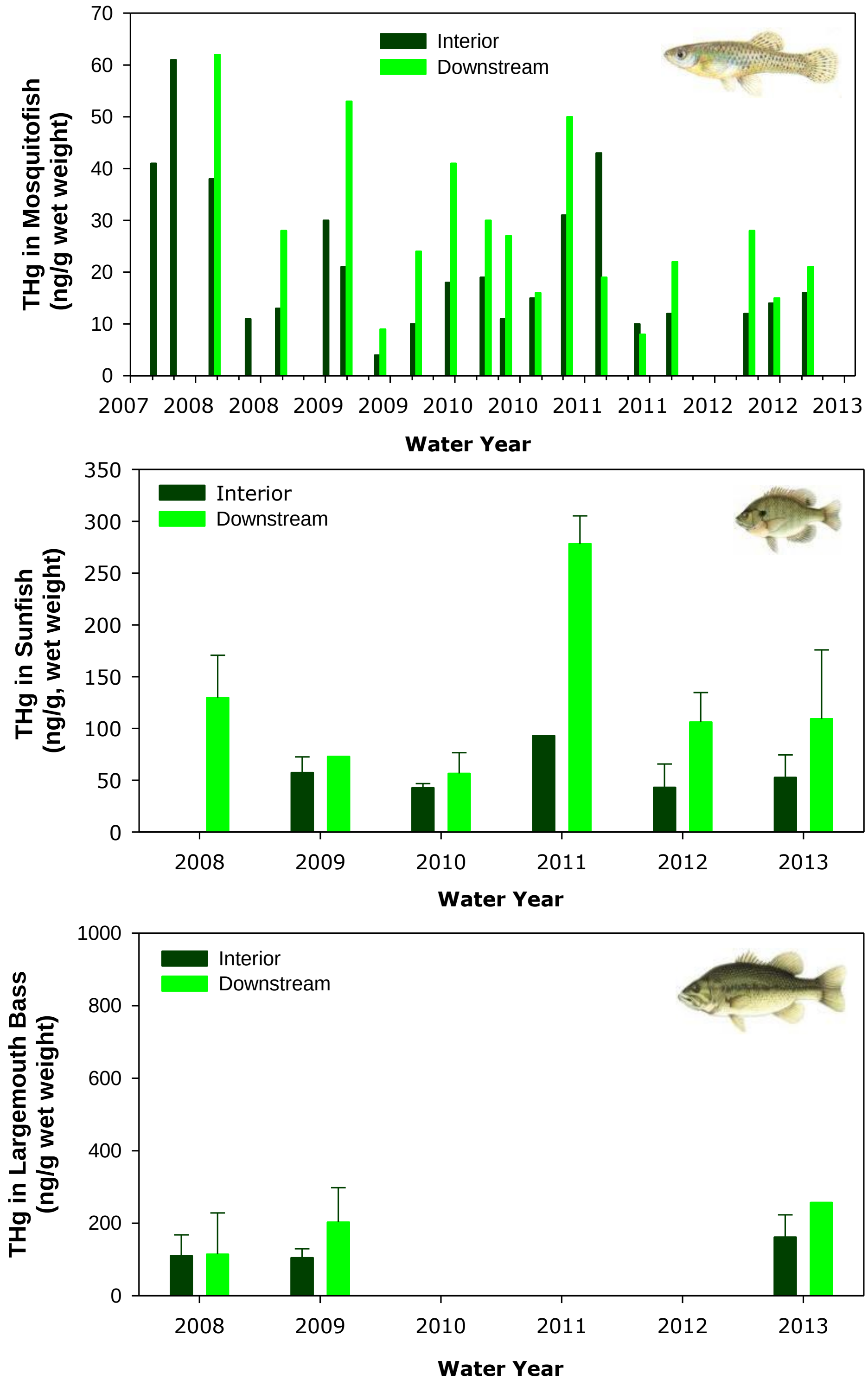

Figure C-8. Mercury concentrations (ng/g, wet weight) in mosquitofish composites (± SD) (top), whole sunfish (± SD) (middle), and fillets of largemouth bass (arithmetic mean, ± SD) (bottom) collected at Flow-ways 3, 4 and 5 (mosquitofish and sunfish) and all sites (largemouth bass) of STA-5/6.

Mercury monitoring in STA-5/6 Cells 3 and 5 is currently in Phase 3 – Tier 3: Routine Operational Monitoring after Year 9. Phase 3 – Tier 3 implemented the termination of all site specific mercury monitoring. STA-5/6 Cell 6-2 met the mercury startup criteria as specified in Exhibit "C" of EFA Permit Number 0236905-001 in September 2007, and began flow-through operation in December 2007. Routine monitoring of mercury in STA-5/6 Cell 6-2 was initiated January 2008, and is currently in Phase 2 – Tier 1: Routine Monitoring during Stabilization Period.

The District has recently constructed and began to operate the G-508 pump station, STA-5/6 Flow-way 4 (consisting of Cells 5-4A and 5-4B), STA-5/6 Flow-way 5 (consisting of Cells 5-5A and 5-5B), and STA-5/6 Cell 6-4 as part of the Compartment C Buildout Project. As a result of the construction of the new wetland and pumping station, and based on the guidance contained in the Protocol, the consolidated mercury and other toxicants monitoring plan requires the District to conduct monitoring for STA-5/6 as follows:

- Phase 3 – Tier 3: Routine Operational Monitoring After Year 9 for Cells 6-3 and 6-5**.**
- Phase 1 – Tier 2: Field Sampling for Initial Startup Monitoring Prior to Discharge for Cells 6-2 and 6-4

The District performed start-up monitoring (mosquitofish composite and sediment sampling and analysis) for STA-5/6 Cells 2 and 4 between September and October 2011 and met the mercury startup criteria for mercury monitoring guidance contained in the Protocol, and began flow-through operation in December 2012. Monitoring of mercury in STA-5/6 Cells 6-2 and 6-4 is currently in Phase 2 – Tier 1: Routine Monitoring during Stabilization Period.

Surface water samples for THg and MeHg analysis were taken at G508 (inflow) and G352B (outflow) for STA-5/6 Cell 2 and 4 on December 5, 2012 and February 13, 2013 (**Figure C-9**). THg levels (only data are available for December 5, 2012) at both inflow and outflow are well below the Class III water quality standard (12 ng/L). THg and MeHg load and load reduction based on limited sample events displayed low total load due to small flow volume and high percent load reduction for both THg and MeHg (**Table C-3**).

Quarterly mosquitofish composite samples were collected at STA-5/6 Cells 2 and 4 marsh interior (STA6C4COM) and outflow (STA6DC) on November 15, 2012 and February 18, 2013. The respective THg concentrations are summarized in **Table C-4** and **Figure C-10**. Levels of mercury in mosquitofish from the interior of STA-5/6 Cells 6-2 and 6-4 for WY2013 remained the highest of all STAs. The persistent high levels in STA-5/6 are inconsistent with the historically low surface water MeHg levels, leading to the speculation that food chain dynamics enhance mercury bioaccumulation. However, potential changes in porewater MeHg may also be a factor. The average annual composite for WY2013 and each individual mosquitofish composite for STA-5/6 Cells 6-2 and 6-4 did not exceed USEPA TL 3 fish criterion and the POR 75th percentile for all downstream Everglades sampling locations.

As shown in **Table C-5** and **Figure C-10**, the average sunfish THg level in STA-5/6 Cells 2 and 4 from the interior marsh were comparable to those in WY2011 and WY2012. The THg levels for the previous three water years were considerably lower than those for WY2008 to WY2010. The average THg level in the downstream decreased by 55 ng/g or nearly 50 percent to 59 ng/g in WY3013. The average annual sunfish Hg concentration for the interior marsh and the downstream of STA-5/6 did not exceed the USEPA TL 3 fish criterion or the 75th percentile for the POR for all receiving waters sampled in downstream Everglades locations during WY2013.

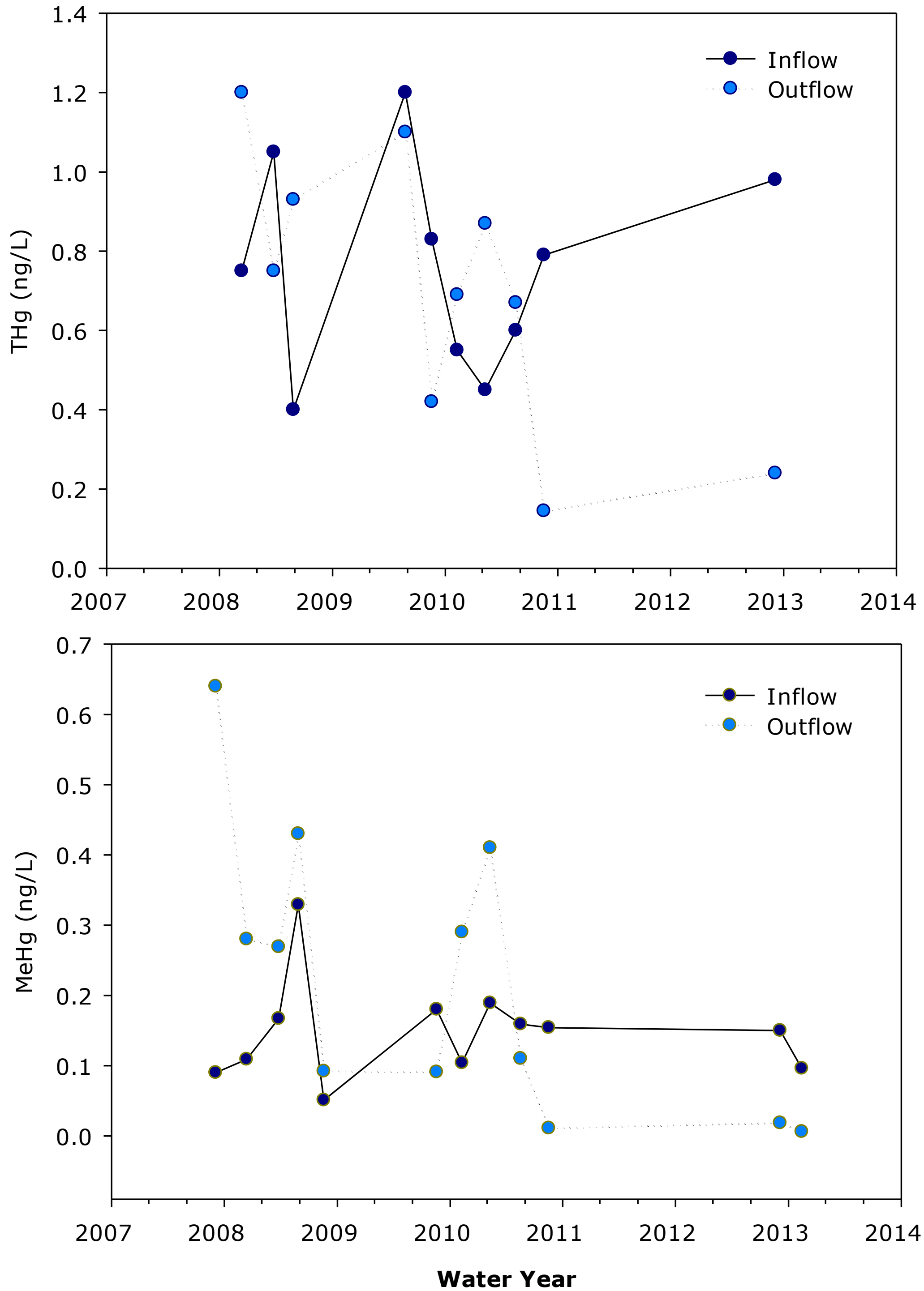

Figure C-9. Concentrations of THg (top) and MeHg (bottom) (ng/L) in unfiltered surface water collected at STA-5/6 Cells 2 and 4. Data from inflow structures (G396B and G308) and outflow structure (G352B) are used. Three missing values are filled by linear integration.

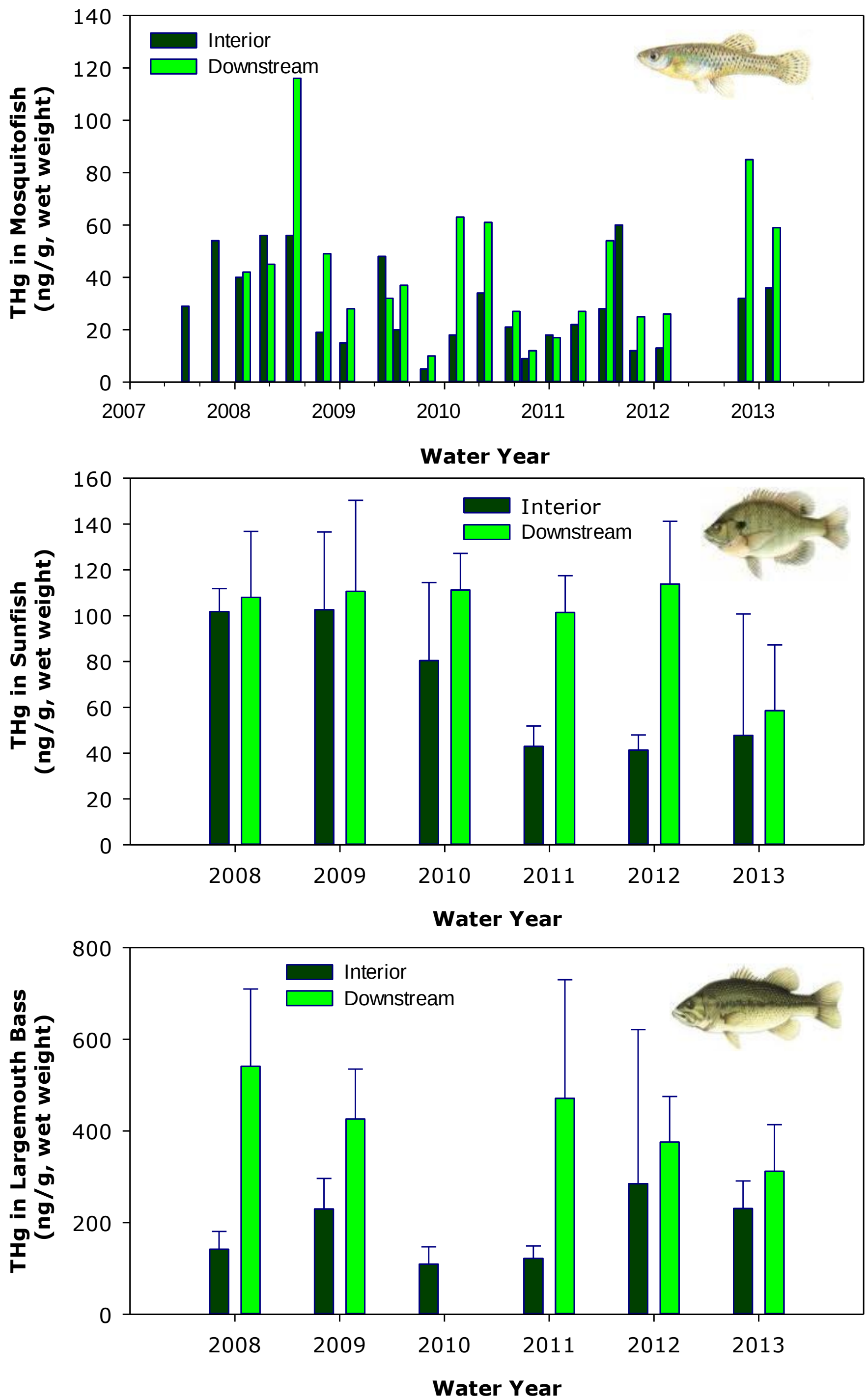

Figure C-10. Mercury concentrations (ng/g, wet weight) in mosquitofish composites (± SD)(top), whole sunfish (± SD)(middle), and fillets of largemouth bass (arithmetic mean ± SD)(bottom) collected at STA-5/6 Cells 2 and 4 interior and downstream sites.

All five largemouth bass samples collected in STA-5/6 Cells 2 and 6 interior fell between the standard length range of 307 and 385 mm in WY2013 while four of five individuals collected from the downstream also met the standard length range requirement (**Table C-6**). The average THg level for the five largemouth bass in the interior STA was 231 ng/g, which represents an average reduction of 54 ng/g from WY2012 (**Table C-6**). The downstream large mouth bass contained an average THg level of 311 ng/g which was substantially lower than the average (375 ng/g) in WY2012. In all water years, the downstream THg levels were consistently greater than the levels from the STA interior (**Figure C-10**). The average annual largemouth bass collected for WY2013 in STA-6 Cells 6-2 and 6-4 interior and downstream did not exceed USEPA TL 4 fish criterion (346 ng/g) or the POR 75th percentile for all downstream Everglades sampling locations.

Regarding the risk to fish-eating wildlife, the resident mosquitofish within and downstream from STA-5/6 contained average mercury levels below the USEPA criterion of 77 ng/g for TL 3 fish species. Two bluegills from Flow-way 4 and two bluegills from a downstream site exceeded the USEPA criterion (77ng/g) of TL 3 fish, but were below the 75th percentile of the THg level of all sunfish collected from the EPA. No largemouth bass from the interior marsh and only one individual from a downstream site was above the USEPA criterion of TL 4 fish (346 ng/g). Therefore, the risk of mercury exposure to fish-eating wildlife foraging preferentially at interior and downstream locations within STA-5/6 is low.

MERCURY MONITORING NETWORK OPTIMIZATIONS

The summaries below provide information on the current mercury monitoring phase for each STA. These phases are concurrent with guidance contained in the Protocol.

STA-1W

The permit modification for moving from Phase 3 – Tier 1 to Phase 3 – Tier 3 was issued August 21, 2009. Phase 3 – Tier 3 terminates all mercury monitoring in STA-1W (mosquitofish stations ST1W13COM, ST1W24COM, ST1WC5COM, ENR012 (G251), G310, and ST1WLX; and bass and sunfish stations ST1W51, ENR012 (G251), G310, and ST1WLX).

STA-1E

Mercury monitoring in STA-1E is currently in Phase 3 – Tier 1. On February 29, 2012, the FDEP approved transfer of STA-1E mercury monitoring from Phase 2 – Tier 1: Routine Monitoring during Stabilization Period to Phase 3 – Tier 1: Routine Operational Monitoring from Year 4 to Year 9 for all flow-ways (Western, Central and Eastern), which include Cells 1, 2, 3, 4N, 4S, 5, 6 and 7 of STA-1E. Phase 3 – Tier 1 terminated all mercury surface water monitoring at STA-1E (stations G-311, S-362, S-361, and S-319), reduced the mosquitofish monitoring frequency from quarterly to semiannually, bass and sunfish monitoring frequency from annually to triennially, and reduced the number of bass and sunfish monitoring stations from all flow-ways to one flow-way with the historically highest mercury concentrations (station ST1EC2A in Cell 2 of the Eastern Flow-way) and one downstream station (ST1ELX). Bass and sunfish monitoring was terminated in the Central (station ST1EC4SA in Cell 4S) and Western (station ST1EC6A in Cell 6) flow-ways.

STA-2

Mercury monitoring in STA-2 is currently in Phase 3 – Tier 3: Routine Operational Monitoring After Year 9 for Cells 1, 2, and 3 and Phase 2 – Tier 1: Routine Monitoring During Stabilization Period for Compartment B Cells 4, 5, 6, 7 and 8.

On February 29, 2012, the FDEP approved the transfer of STA-2 mercury monitoring from Phase 2 – Tier 1: Routine Monitoring during Stabilization Period for Cells 1, 2 and 3 of STA-2 to Phase 3 – Tier 3: Routine Operational Monitoring After Year 9 and Phase 3 – Tier 1: Routine Operational Monitoring From Year 4 to Year 9 for Cell 4 of STA-2. Phase 3 – Tier 3 implemented the termination of all site specific mercury monitoring at STA-2 Cells 1, 2, and 3 (mosquitofish stations ST2C1COM, ST2C2COM, and ST2C3COM).

In August 2012, the District completed construction of the EAA Compartment B Buildout Project (Compartment B). Compartment B includes three pump stations (G-434, G-435, and G-436) and two flow-ways: the NBO, which includes Cells 4, 5, and 6 and the SBO, which includes Cells 7 and 8. Compartment B incorporated the existing Cell 4. Startup monitoring for mercury and other toxicants was performed for Compartment B in September (mosquitofish) and October (sediment) 2011 to capture the "first-flush effect" when NBO and SBO were initially inundated. Compartment B met the mercury and other toxicant startup criteria as specified in Specific Condition 23 of EFA Permit Number 0311207 in October 2011 (see data summary provided in correspondence from H. Andreotta, SFWMD dated December 14, 2012). On December 20, 2012, the FDEP approved transfer of monitoring from Phase 1 – Tier 2: Field Sampling for Initial Startup Monitoring Prior to Discharge to Phase 2 – Tier 1: Routine Monitoring during Stabilization Period for Compartment B (Cells 4, 5, 6, 7 and 8).

STA-3/4

Mercury monitoring in STA-3/4 is currently in Phase 3 – Tier 3 In October 2012, all Phase 3 – Tier 1 mercury monitoring criteria were met (see correspondence from H. Andreotta, SFWMD, dated January 17, 2013). On February 20, 2013 the FDEP approved transfer of STA-3/4 mercury monitoring from Phase 3 – Tier 1: Routine Operational Monitoring from Year 4 to Year 9 to Phase 3 – Tier 3: Routine Operational Monitoring After Year 9. This implemented the termination of all site specific mercury monitoring at STA-3/4 (semiannual mosquitofish monitoring at stations STA34C1COM, STA34C2COM, and STA34C3COM and triennial bass and sunfish monitoring at stations STA34C22 and L5F1.)

STA-5/6

Mercury monitoring at STA-5/6 is currently in Phase 3 – Tier 3: Routine Operational Monitoring After Year 9 for STA-5/6 Flow-ways 1, 2, 7, and 8 and Phase 2 – Tier 1: Routine Monitoring during Stabilization for STA-5/6 Flow-ways 3, 4, 5, and 6. STA-5/6 Flow-ways 1 and 2 met Phase 3 – Tier 3 conditions in November 2008 (see data summary provided in correspondence from G. Vince, SFWMD, dated October 12, 2009 and data for the final November 2009 fish collection submitted to the FDEP in December 2009 by H. Andreotta, SFWMD).

The FDEP issued minor permit modification 0236905-001 June 6, 2008, approving transfer of mercury monitoring from Phase 2 – Tier 1: Routine Monitoring during Stabilization Period to Phase 3 – Tier 3: Routine Operational Monitoring from Year 4 to Year 9 for STA-5/6 Cells 6-3 and 6-5 (previously referred to as Section 1). Phase 3 – Tier 3 implemented the termination of all site specific mercury monitoring at STA-5/6 Cells 6-3 and 6-5.

In September 2012, the District completed construction of the EAA Compartment C Buildout Project (Compartment C). Compartment C includes the G-508 pump station, STA-5/6 Flow-way 4 (consisting of Cells 5-4A and 5-4B), STA-5/6 Flow-way 5 (consisting of Cells 5-5A and 5-5B), and STA-5/6 Cell 6-4. STA-5/6 Cell 6-4, combined with the existing Cell 6-2, formed Flow-way 6. The entire STA-5, STA-6, and Compartment C Buildout complex is now referred to as STA-5/6.

Startup monitoring for mercury and other toxicants was performed for Compartment C in September (mosquitofish) and October (sediment) 2011 to capture the "first-flush effect" when the project was initially inundated. Compartment C met the mercury and other toxicant startup criteria as specified in Specific Condition 23 of EFA Permit Number 0311207 in October 2011 (see data summary provided in correspondence from H. Andreotta, SFWMD, dated December 14, 2012). On December 20, 2012, the FDEP approved transfer of monitoring from Phase 1 – Tier 2: Field Sampling for Initial Startup Monitoring Prior to Discharge to Phase 2 – Tier 1: Routine Monitoring during Stabilization Period for Compartment C (Flow-ways 4, 5, and 6).

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Attachment D: Rotenberger Wildlife Management Area Restoration and STA Downstream Transect Monitoring

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In addition to the information provided in this attachment, additional supplemental information is required by Specific Conditions 12(a,b), and 25(b), of the EFA Permit Number 0311207. This supporting information is available upon request.

HYDROPATTERN RESTORATION AND STA DISCHARGE MONITORING ON THE DOWNSTREAM AREAS

This section presents results from monitoring conducted in the areas downstream of the Everglades Stormwater Treatment Areas (STAs), including the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge or WCA-1; **Figure D-1**), Water Conservation Area (WCA)-2A (**Figure D-4**), and the Rotenberger Wildlife Management Area (RWMA; **Figure D-8**). Everglades Forever Act (EFA) Permit Number 0311207, EFA Consent Order OGC FILE NO. 12-1149 and National Pollutant Discharge Elimination System (NPDES) Consent Order OGC FILE NO. 12-1148 requires the characterization of the effects of STA discharges on adjacent marsh areas. This characterization is based on monthly samples collected for specific conductance (conductivity) and total phosphorus (TP). Water quality monitoring stations in the marsh areas have been chosen along a transect from the discharge points and are categorized as "impacted" or "unimpacted" based on sediment TP levels. Those transect stations in areas where sediment TP levels are greater than 500 milligrams per kilogram (mg/kg) are identified as impacted. Monitoring data for each transect are provided in Attachment B. A summary of specific conductance and TP collected for these transects is provided in **Tables D-1** and **D-2**, respectively. These water quality data are also graphically presented as notched box-and-whisker plots along with the results of the monitoring conducted as part of the hydropattern restoration monitoring, which includes vegetation and water level.

[2] Florida Fish and Wildlife Conservation Commission, Miami/Fort Lauderdale area

Table D-1. Summary statistics for specific conductance in microsiemens per centimeter (µS/cm) measurements collected during Water Year 2013 (WY2013) (May 1, 2012–April 30, 2013) at transect stations from STA outflows.
[Note: km – kilometers]

STA Transects		Station Information: Station	Station Information: Category[1]	Distance (km)[2]	No. of Obs.	Mean ± SD[3]	Min	Percentiles[4]: 25th	Percentiles[4]: 50th	Percentiles[4]: 75th	Max	Geometric Mean
STA-1E	1	LOXA135	Rim Canal	0.00	12	725 ± 254	380	537	685	961	1116	684
		LOXA136	Impacted	0.56	12	335 ± 151	169	271	309	338	785	314
		LOXA137	Impacted	1.07	12	260 ± 70	128	218	261	307	372	250
		LOXA138	Unimpacted	2.11	11	215 ± 60	114	172	231	251	303	207
		LOXA139	Unimpacted	3.93	10	166 ± 49	98	117	171	198	249	159
STA-1W	1	LOXA104	Rim Canal	0.00	12	748 ± 200	376	612	746	931	994	720
		LOXA104.5	Impacted	0.31	11	447 ± 103	336	385	417	514	681	437
		LOXA105	Impacted	0.77	12	352 ± 91	234	303	334	374	570	342
		LOXA106	Unimpacted	1.09	10	307 ± 77	226	274	284	314	471	299
		LOXA107	Unimpacted	2.21	7	203 ± 60	150	167	186	209	329	197
		LOXA107U	Unimpacted	3.38	9	158 ± 60	108	121	143	168	308	151
		LOXA108	Unimpacted	4.07	9	140 ± 58	77	103	123	155	270	131
	2	LOXAZ0	Rim Canal	0.00	4	804 ± 145	637	684	818	925	943	794
		LOXAZ1	Impacted	0.25	4	519 ± 119	394	422	514	616	655	509
		LOXAZ2	Impacted	1.44	4	260 ± 17	247	250	255	271	285	260
		LOXAZ3	Unimpacted	3.48	4	161 ± 15	143	150	162	172	177	161
		LOXAZ4	Unimpacted	5.82	4	136 ± 9	126	130	136	142	147	136

Table D-1 (Continued).

STA Transects		Station Information: Station	Category[1]	Distance (km)[2]	No. of Obs.	Mean ± SD[3]	Min	Percentiles[4]: 25th	50th	75th	Max	Geometric Mean
STA-2	1	2AN.25	Impacted	0.25	12	1070 ± 73	947	1019	1075	1103	1208	1068
		2AN1	Impacted	0.98	12	1072 ± 73	969	1016	1067	1118	1203	1070
		2AN2	Unimpacted	1.98	9	1063 ± 80	976	1001	1068	1103	1211	1061
		2AN4	Unimpacted	3.77	11	1090 ± 141	903	942	1126	1169	1342	1082
		2AN5	Unimpacted	4.83	9	1048 ± 202	812	844	1023	1234	1354	1031
		2AN6	Unimpacted	5.82	9	997 ± 221	749	809	966	1167	1338	976
	2	2AC.25	Impacted	0.25	12	1073 ± 78	941	1028	1065	1114	1220	1070
		2AC2	Impacted	1.88	10	1069 ± 134	920	935	1055	1176	1307	1062
		2AC4	Impacted	3.77	10	969 ± 238	682	731	941	1147	1334	943
		2AC5	Unimpacted	4.80	8	989 ± 216	732	807	947	1172	1328	969
	3	2AFS.25	Impacted	0.34	11	1087 ± 115	941	1007	1045	1180	1311	1082
		FS1	Impacted	1.02	10	1081 ± 114	939	998	1069	1116	1321	1076
		FS3	Impacted	3.09	12	1065 ± 234	721	848	1130	1256	1333	1040
		CA29	Unimpacted	6.17	12	929 ± 239	598	734	969	1083	1353	900
STA-5/6	1	ROTC1	Impacted	0.23	11	654 ± 101	479	592	641	734	807	647
		ROTC2	Impacted	2.30	9	562 ± 154	345	425	540	706	752	543
		ROTC3	Impacted	4.20	9	562 ± 178	324	425	531	749	796	536

[1] Categories of "impacted and "unimpacted" refer to station identification based on sediment phosphorus concentrations, Impacted stations have sediment total phosphorus concentrations of 500 milligrams per kilogram.

[2] Distance along transect from canal in kilometers (km)

[3] SD = Standard Deviation

[3] 50th Percentile - Median

Table D-2. Summary statistics for TP in micrograms per liter (µg/L) measurements collected during WY2013 at transect stations from STA outflows.

STA Transects		Station Information: Station	Station Information: Category[1]	Distance (km)[2]	No. of Obs.	Mean ± SD[3]	Min	Percentiles[4]: 25th	Percentiles[4]: 50th	Percentiles[4]: 75th	Max	Geometric Mean
STA-1E	1	LOXA135	Rim Canal	0.00	11	26.9 ± 9.9	10.0	22.0	24.0	31.8	48.0	25.2
		LOXA136	Impacted	0.56	11	16.8 ± 10.6	7.0	12.0	13.0	20.5	45.0	14.7
		LOXA137	Impacted	1.07	11	10.1 ± 3.9	8.0	8.0	8.0	11.3	21.0	9.6
		LOXA138	Unimpacted	2.11	10	7.0 ± 2.5	4.0	5.0	7.0	7.0	13.0	6.6
		LOXA139	Unimpacted	3.93	9	7.1 ± 1.3	6.0	6.0	7.0	7.3	10.0	7.0
STA-1W	1	LOXA104	Rim Canal	0.00	11	30.4 ± 14.9	16.0	25.0	27.0	31.3	72.0	28.1
		LOXA104.5	Impacted	0.31	10	32.3 ± 42.6	13.0	16.0	19.0	24.0	153.0	22.8
		LOXA105	Impacted	0.77	11	22.3 ± 23.3	8.0	11.3	13.0	22.5	89.0	16.9
		LOXA106	Unimpacted	1.09	9	11.2 ± 5.6	6.0	7.8	9.0	13.0	24.0	10.3
		LOXA107	Unimpacted	2.21	6	7.7 ± 1.2	6.0	7.0	7.5	9.0	9.0	7.6
		LOXA107U	Unimpacted	3.38	8	7.1 ± 1.4	5.0	6.0	7.5	8.0	9.0	7.0
		LOXA108	Unimpacted	4.07	8	8.1 ± 3.2	6.0	6.0	7.0	9.0	15.0	7.7
	2	LOXAZ0	Rim Canal	0.00	4	22.0 ± 2.4	19.0	20.5	22.0	23.5	25.0	21.9
		LOXAZ1	Impacted	0.25	9	15.3 ± 6.9	8.0	12.0	14.0	16.0	32.0	14.3
		LOXAZ2	Impacted	1.44	4	11.3 ± 3.3	8.0	8.5	11.0	14.0	15.0	10.9
		LOXAZ3	Unimpacted	3.48	4	7.3 ± 1.7	5.0	6.0	7.5	8.5	9.0	7.1
		LOXAZ4	Unimpacted	5.82	4	5.8 ± 2.2	4.0	4.5	5.0	7.0	9.0	5.5

Table D-2 (Continued).

STA	Transects	Station Information: Station	Category[1]	Distance (km)[2]	No. of Obs.	Mean ± SD[3]	Min	Percentiles[4] 25th	50th	75th	Max	Geo-metric Mean
STA-2	1	2AN.25	Impacted	0.25	12	19.3 ± 8.5	12.0	13.5	17.0	22.5	43.0	18.1
		2AN1	Impacted	0.98	12	16.8 ± 7.9	9.0	11.0	14.5	18.0	33.0	15.4
		2AN2	Unimpacted	1.98	9	10.1 ± 2.5	7.0	8.8	9.0	11.5	15.0	9.9
		2AN4	Unimpacted	3.77	11	7.7 ± 2.8	5.0	6.0	7.0	8.8	15.0	7.4
		2AN5	Unimpacted	4.83	9	8.2 ± 3.2	6.0	6.0	7.0	8.5	16.0	7.8
		2AN6	Unimpacted	5.82	9	7.1 ± 2.7	5.0	5.0	7.0	8.3	13.0	6.7
	2	2AC.25	Impacted	0.25	12	12.8 ± 3.9	8.0	10.0	11.5	16.5	19.0	12.2
		2AC2	Impacted	1.88	10	8.0 ± 3.6	5.0	6.0	7.0	9.0	17.0	7.5
		2AC4	Impacted	3.77	10	6.7 ± 2.4	5.0	5.0	6.0	7.0	13.0	6.4
		2AC5	Unimpacted	4.80	8	5.3 ± 1.0	4.0	4.5	5.0	6.0	7.0	5.2
	3	2AFS.25	Impacted	0.34	11	20.3 ± 7.8	13.0	13.5	19.0	24.3	39.0	19.1
		FS1	Impacted	1.02	10	17.1 ± 7.5	12.0	13.0	14.5	16.0	37.0	16.1
		FS3	Impacted	3.09	12	7.4 ± 2.2	5.0	6.0	7.0	8.5	13.0	7.1
		CA29	Unimpacted	6.17	12	6.2 ± 4.0	3.0	4.0	5.0	6.5	18.0	5.5
STA-5/6	1	ROTC1	Impacted	0.23	11	19.6 ± 5.3	11.0	17.0	21.0	23.0	28.0	18.9
		ROTC2	Impacted	2.30	9	9.8 ± 3.6	6.0	6.8	9.0	11.5	17.0	9.2
		ROTC3	Impacted	4.20	9	10.7 ± 3.7	7.0	7.8	10.0	13.0	18.0	10.2

[1]Categories of "impacted and "unimpacted" refer to station identification based on sediment phosphorus concentrations, Impacted stations have sediment total phosphorus concentrations of 500 milligrams per kilogram.

[2] Distance along transect from canal in kilometers (km)

[3] SD = Standard Deviation

[3] 50th Percentile - Median

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Transects in the Refuge (**Figure D-1**) exhibited a substantial decrease in both specific conductance and TP concentrations within 1 kilometer (km) of the rim canal (**Figures D-2** and **D-3**). Geometric mean specific conductance measured in the western transect (downstream of STA-1W outflows) decreased by 58 percent or 421 microsiemens per centimeter (µS/cm) and geometric mean TP concentrations decreased by approximately 63 percent or 18 micrograms per liter [(µg/L) or parts per billion (ppb)] within 1 km of the rim canal station. The eastern transect (downstream of the STA-1E outflow) exhibited a decrease of approximately 63 percent or 434 µS/cm in specific conductance and 62 percent or 16 ppb in TP within 1 km of the rim canal. An additional transect (LOXAZ0 to LOXAZ4) was added to the monitoring requirement. This transect is located in the southwestern portion of the Refuge. Geometric mean specific conductance for this transect decreased by 67 percent or 534 µS/cm approximately 1 km from the rim canal. Geometric mean TP concentrations decreased by 50 percent or 11 ppb. Stations on both transects more than 1 km from the rim canal had geometric mean TP concentrations ranging from 7 to 11 ppb with geometric mean specific conductance values less than 300 µS/cm (**Tables D-1** and **D-2**). Typical specific conductance values for rain-fed marshes in the Everglades are less than 200 µS/cm (McCormick et al. 2011). All specific conductance levels measured at Refuge transect stations were below the Class III criterion of 1,275 µS/cm.

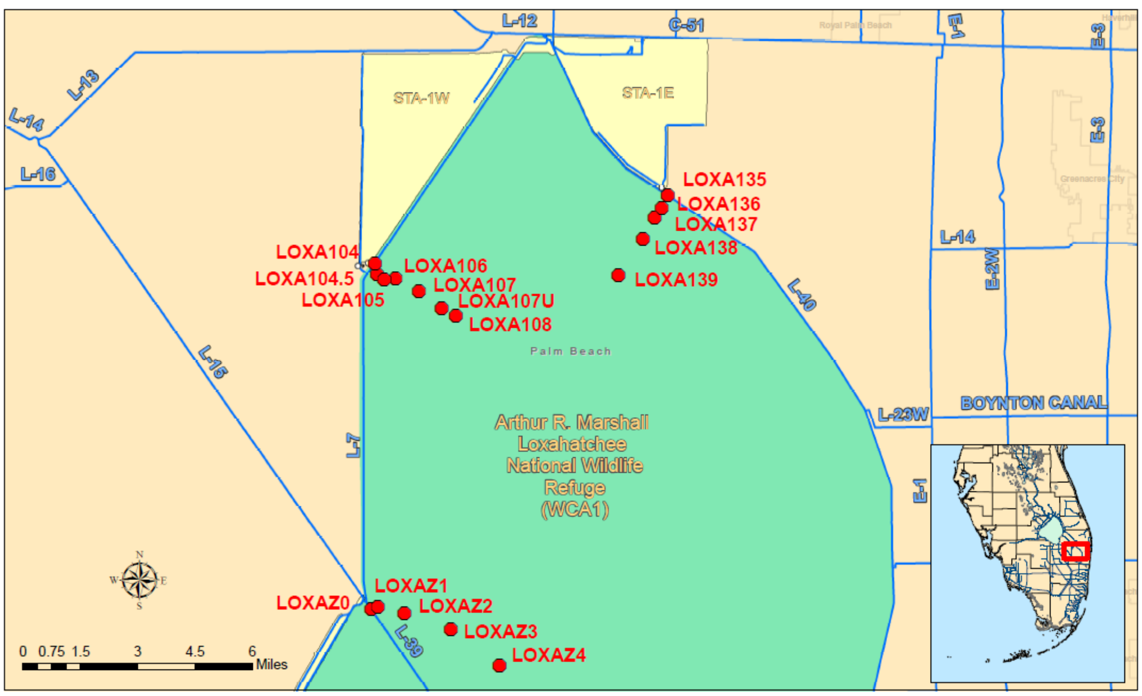


Figure D-1. Locations of marsh transect stations in the Refuge and outflow structures from STA 1 West (STA-1W) and STA 1 East (STA-1E).

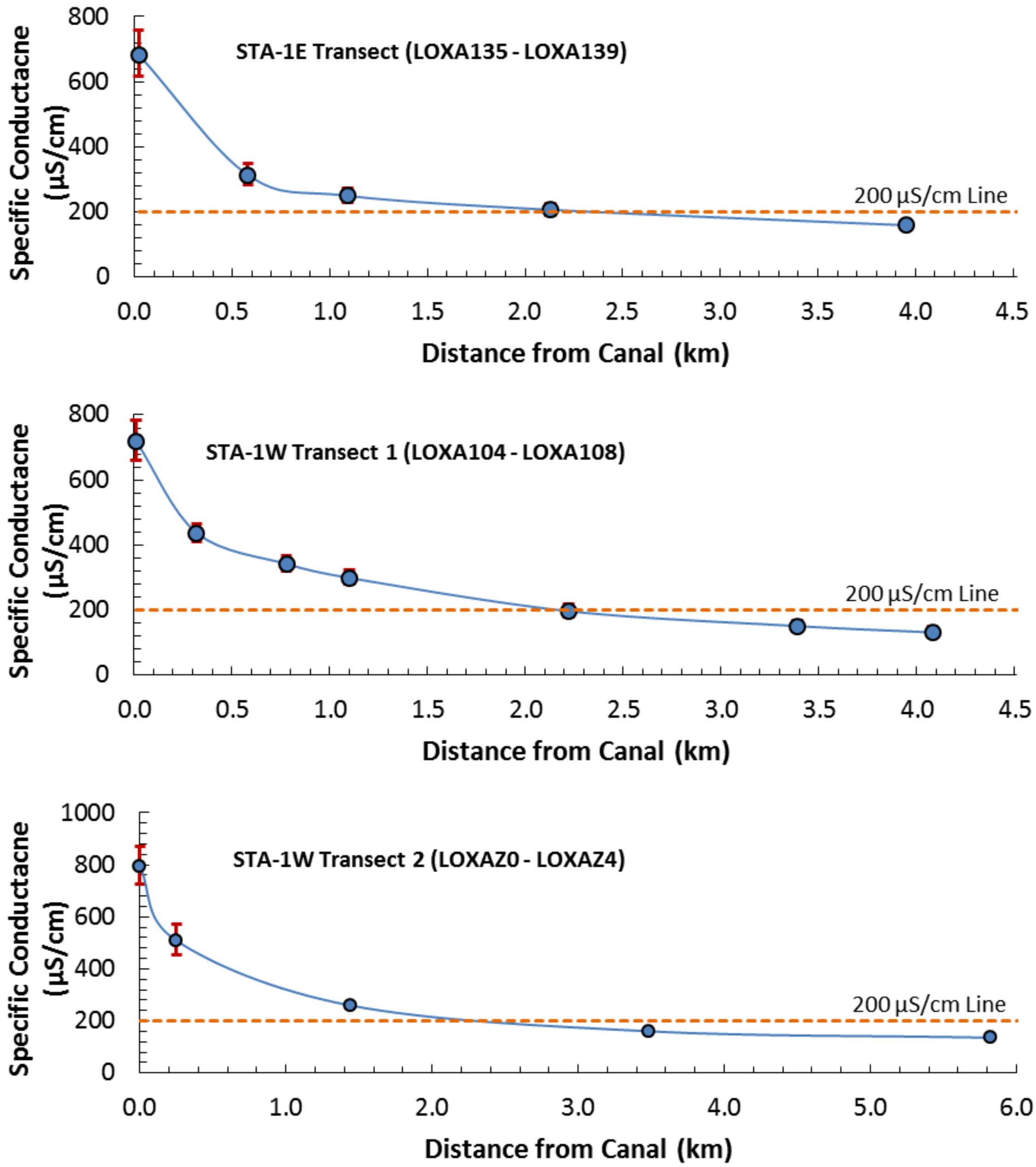


Figure D-2. Plots of geometric mean specific conductance measured at transect stations downstream of STA-1W and STA-1E during Water Year 2013 (WY2013) (May 1, 2012–April 30, 2013). The error bars represent the standard error around the calculated geometric mean. The 200 µS/cm reference line is presented to identify the upper specific conductance limit observed in "rain-driven" portions of the Refuge.

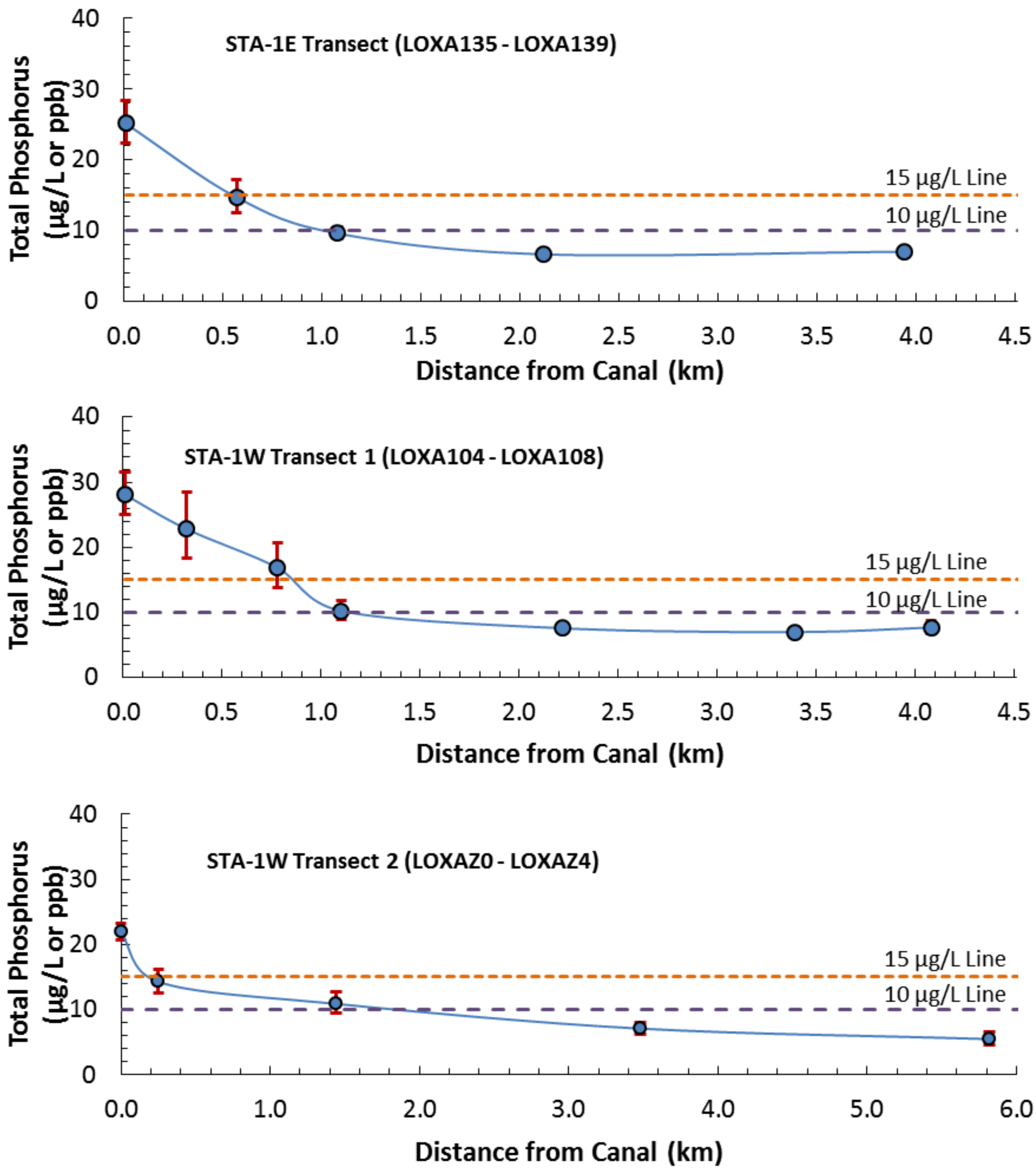


Figure D-3. Plots of geometric TP concentrations measured at transect stations downstream of STA-1W and STA-1E during WY2013. The error bars represent the standard error around the calculated geometric mean. Two reference lines (10 and 15 µg/L) are only presented to identify long-term and annual limit used in the Phosphorus Rule.

The average specific conductance levels for the STA-1E transect were 584 ± 337 µS/cm (geometric mean = 471; median = 618) and 348 ± 246 µS/cm (geometric mean = 289; median = 268) for Water Year (WY)2012 (May 1, 2011–April 30, 2012) and WY2013, respectively. A Mann-Whitney test indicated that a statistically significant decrease was observed for WY2013 (p-value = 0.002). The average TP concentration from this transect was 20 ± 16 µg/L (geometric mean = 16; median = 16) for WY2012 and 14 ± 10 µg/L (geometric mean = 11; median = 9) for WY2013 with WY2013 being statistically lower (Mann-Whitney test, p-value = 0.013). The STA-1W Transect 1 had specific conductance averaging 605 ± 313 µS/cm (geometric mean = 492; median = 708) for WY2012 and 361 ± 230 µS/cm (geometric mean = 298; median = 311) for WY2013. Based on the specific conductance data for these two years, WY2013 had statistically lower levels than WY2012 (Mann-Whitney test, p-value < 0.001). A comparison of TP concentration between these two water years for this transect also showed a statistical decrease in TP concentrations (p-value = 0.037) with averages of 20 ± 12 µg/L (geometric mean = 17; median = 19) for WY2012 and 19 ± 14 µg/L (geometric mean = 14; median = 12) for WY2013. No comparison could be performed for the second transect associated with STA-1W discharge due to no data being available for WY2012 since this transect was activated in WY2013. Additional statistical summaries for transects associated with STA-1E and STA-1W outflows are provided in **Tables D-3** and **D-4**.

Table D-3. Comparison of surface water specific conductance collected at permit compliance stations in the Refuge during WY2012 and WY2013.

STA (Transect)	Station	Specific Conductance (µS/cm)					
		WY2012			WY2013		
		No. of Samples	Mean ± SD	Geometric Mean	No. of Samples	Mean ± SD	Geometric Mean
STA-1E (Transect 1)	LOXA135	12	938 ± 207	918	12	725 ± 254	684
	LOXA136	8	581 ± 186	546	12	335 ± 151	314
	LOXA137	6	460 ± 164	427	12	260 ± 70	250
	LOXA138	5	249 ± 84	236	11	215 ± 60	207
	LOXA139	4	131 ± 18	130	10	166 ± 49	159
STA-1W (Transect 1)	LOXA104	12	848 ± 131	839	12	748 ± 200	720
	LOXA104.5	8	782 ± 189	757	11	447 ± 103	437
	LOXA105	8	715 ± 201	683	12	352 ± 91	342
	LOXA106	3	488 ± 125	477	10	307 ± 77	299
	LOXA107	3	191 ± 9	191	7	203 ± 60	197
	LOXA107U	4	150 ± 21	148	9	158 ± 60	151
	LOXA108	4	153 ± 39	150	9	140 ± 58	131

Table D-4. Comparison of TP concentrations collected at permit compliance stations in the Refuge during WY2012 and WY2013.

STA (Transect)	Station	Total Phosphorus (µg/L)					
		WY2012			WY2013		
		No. of Samples	Mean ± SD	Geometric Mean	No. of Samples	Mean ± SD	Geometric Mean
STA-1E (Transect 1)	LOXA135	12	32.2 ± 17.3	29	11	26.9 ± 9.9	25
	LOXA136	7	23.0 ± 14.9	20	11	16.8 ± 10.6	15
	LOXA137	6	15.8 ± 6.7	15	11	10.1 ± 3.9	10
	LOXA138	5	7.8 ± 1.3	8	10	7.0 ± 2.5	7
	LOXA139	5	9.0 ± 4.6	8	9	7.1 ± 1.3	7
STA-1W (Transect 1)	LOXA104	11	23.5 ± 3.9	23	11	30.4 ± 14.9	28
	LOXA104.5	7	37.1 ± 14.5	35	10	32.3 ± 42.6	23
	LOXA105	7	18.1 ± 5.5	17	11	22.3 ± 23.3	17
	LOXA106	5	14.2 ± 3.9	14	9	11.2 ± 5.6	10
	LOXA107	2	13.5 ± 3.5	13	6	7.7 ± 1.2	8
	LOXA107U	4	6.8 ± 1.3	7	8	7.1 ± 1.4	7
	LOXA108	4	8.5 ± 5.0	8	8	8.1 ± 3.2	8

WCA1 Macrophyte Composition along the Permit Compliance Transects

Macrophyte surveys in WCA-1 were initiated in 2012. There are three transects in WCA-1, LOXA104.5 to LOXA108 is located in the west central region of WCA-1 and is closest to the discharge from STA-1 West (STA-1W), LOXA136 to LOXA139 is located in the east central region nearest the discharge from STA-1 East (STA-1E) and LOXAZ1-LOXAZ4 is located in the southwest region downstream of the future STA-1W expansion.

The frequency of occurrence of several dominant macrophyte species was measured along fixed transects biannually from 2012 through 2013. Using point-intercept survey methodology, the presence of sawgrass (*Cladium jamaicense*) and cattail (*Typha* spp.) at one-meter intervals along 10 meter transects was recorded. Only data from the permit compliance sites are presented in this report. **Tables D-5**, **D-6** and **D-7** show the frequency of occurrence of cattail and sawgrass along each transect. At the western transect, site LOXA104.5 (0.31 km from the nearest discharge point), was dominated by cattail. At LOXA105 approximately 0.77 km from the discharge point, sawgrass was the dominant plant species. Sawgrass was dominant at the remainder of the sites (LOXA106, LOXA107 and LOXA107U) on the western transect except at LOXA108. Sawgrass was present at LOXA108 but was not the dominant species. LOXA108 is a wet prairie site dominated by Tracy's beakrush (*Rhynchospora tracyi*).

The east central transect consisted of four marsh sites LOXA139, LOXA138, LOXA137 and LOXA136 and one canal site, LOXA135. LOXA136 is approximately 0.5 km from the inflow point and cattail is present but not dominant. Cattail was not present at any of the other sites on the east central transect. Sawgrass was present at LOXA137, LOXA138 and LOXA139 but was not dominant at any site.

Table D-5. Number of points (out of 10 possible points at one meter intervals along each line transect) of WCA-1 at monitoring locations in WY2013.

Date	LOXA104.5		LOXA105		LOXA106		LOXA107		LOXA107U		LOXA108	
	CAT	SAW	CAT	SAW	CAT	SAW	CAT	SAW	CAT	SAW	CAT	SAW
Oct 2012	10	0	0	8	0	10	0	10	0	10	0	0
May 2013			0	8	0	10	0	10	0	10	0	0
Jun 2013	10	0										

Table D-6. Number of points (out of 10 possible points at one meter intervals along each line transect) of WCA-1 at monitoring locations in WY2013.

Date	LOXA136		LOXA137		LOXA138		LOXA139	
	CAT	SAW	CAT	SAW	CAT	SAW	CAT	SAW
Oct 2012	0	0	0	3	0	2	0	2
Jun 2013	2	0	0	0	0	3	0	2

At the southwest transect, LOXAZ1 was 0.25 km from the inflow point. Cattail was dominant at LOXAZ1. Sawgrass and cattail were co-dominant at LOXAZ2, which is roughly 1.5 km from the inflow point. No cattail was present at sites LOXAZ3 and LOXAZ4, which are approximately 3.5 and 6 km from inflow point, respectively. Sawgrass was present at LOXAZ3 and LOXAZ4 but was not a dominant species (**Table D-7**). LOXAZ3 and LOXAZ4 were characterized by a slough natural community co-dominated by fragrant waterlily (*Nymphaea odorata*) and eastern purple bladderwort (*Utricularia purpurea*).

Table D-7. Number of points (out of 10 possible points at one meter intervals along each line transect) of WCA-1 at monitoring locations in WY2013.

Date	LOXAZ1		LOXAZ2		LOXAZ3		LOXAZ4	
	CAT	SAW	CAT	SAW	CAT	SAW	CAT	SAW
Oct 2012	9	0	5	4	0	0	0	0
Jun 2013	9	0	7	5	0	0	0	0

NORTHWESTERN WATER CONSERVATION AREA 2A

WCA-2A Monitoring Objectives

In accordance with the EFA, the South Florida Water Management District (District or SFWMD) has been monitoring the effect of water discharged from STA-2 into the northwestern region of WCA-2A. These releases are intended to restore the hydropattern and ecological functionality of the marshes downstream of STA-2. The STA-2 EFA permit requires that the District implement a monitoring and assessment program to monitor and evaluate ecological changes associated with STA-2 discharges into the area. This annual report addresses the (1) beneficial environmental effects, including changes in water quality, soil, vegetative conditions, inundation, and timing of discharges, and (2) any adverse environmental effects, including imbalances in natural populations of flora or fauna, changes in periphyton communities, or other undesirable consequences of the hydropattern restoration.

WCA-2A Configuration

STA-2 primarily discharges into WCA-2A through six culverts (G-336A–F structures) (**Figure D-4**). STA-2 discharges are also released through G-336G into the discharge canal south of STA-2. Approximately 1 km northeast of the S-7 pump station, the levee separating this discharge canal from WCA-2A is degraded, allowing discharge passing through G-336G to passively enter WCA-2A. Three transects (N-, C-, and S-transects) were established in 1998 to monitor environmental and ecological changes in the area. In 2005, a new transect (FS-transect) was established to monitor the STA-2 discharges through the degraded levee northeast of S-7. The FS-transect includes locations at 0.25, 1, 2, and 3 km from the degraded levee. There are two EFA permit compliance monitoring transects that consist of selected stations from the N-, C-, and FS-transects and also include station CA29.

WCA-2A Hydropattern Restoration

Hydropattern improvements resulting from STA-2 discharges are presented in Pietro et al. (2009) and Garrett and Ivanoff (2008). Permanent stage recorders were installed at WC2AN1 and WC2AS1 (**Figure D-4**) stations in WY2009 and both gauges began recording data in June 2009. Stage data were available for WY2010, WY2011, WY2012 and WY2013 for sites WC2AN1 and WC2AS1. Water depths were determined by subtracting estimated ground elevation from the stages. Results showed that in WY2013, the north station was inundated for the water year except for two days. The south station was inundated 92 percent of the time (**Figure D-5**). Mean water depth when water level was above ground ranged from 19.6 inches (in) at WC2AN1 to 7.5 in at WC2AS1. Compared to WY2012, depths and number of inundation days were higher. Water depths at the north station fluctuated between 18 and 46 inches in the wet season. Water depths at the south station fluctuated between 5 and 27 inches in the wet season. At the south site, water levels went below ground in part of January and February, 2013.

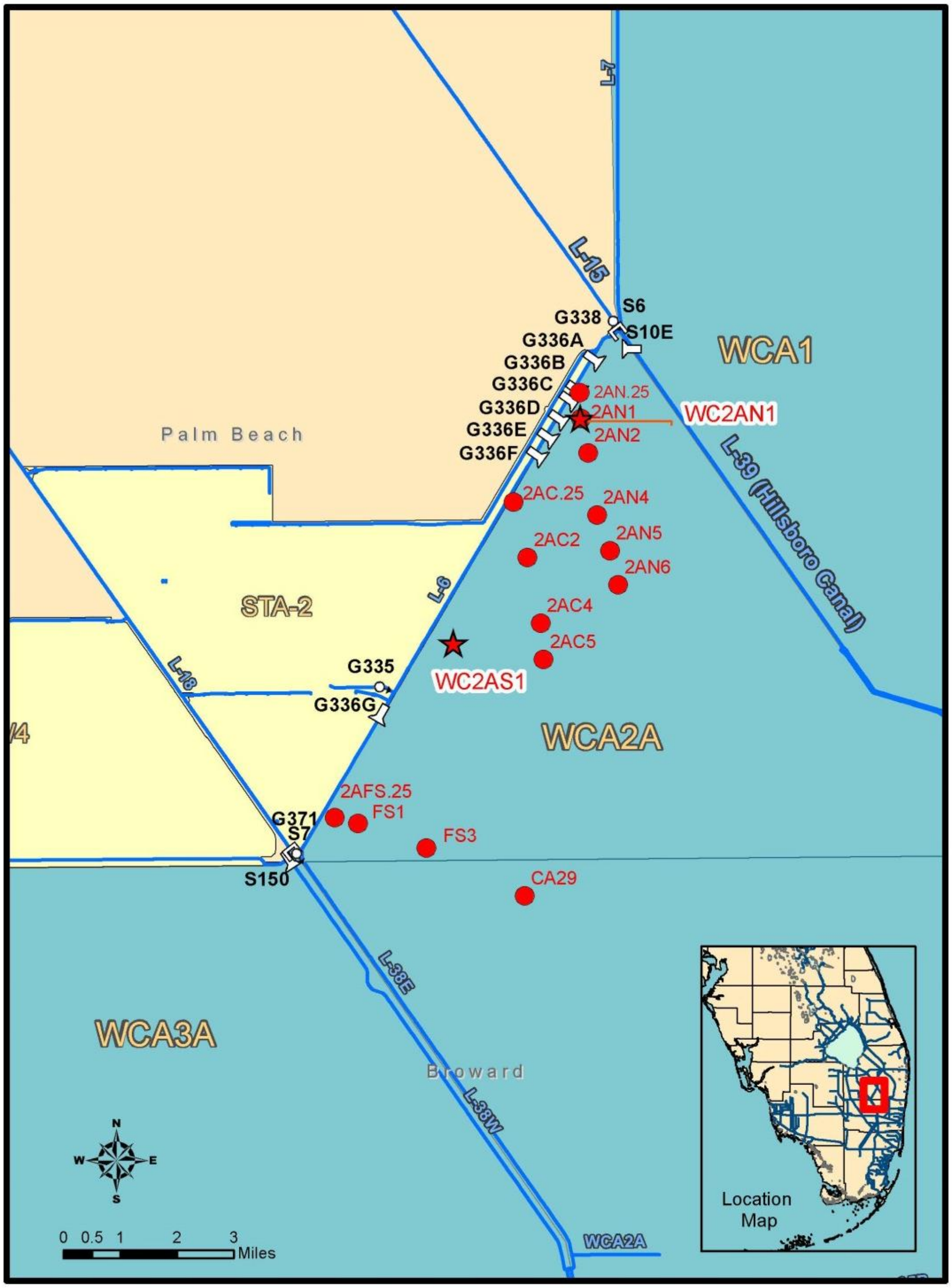


Figure D-4. Location of STA-2 discharge structures, including the G-336A–G discharge culverts in relation to sampling stations along transects in the northwestern section of WCA-2A

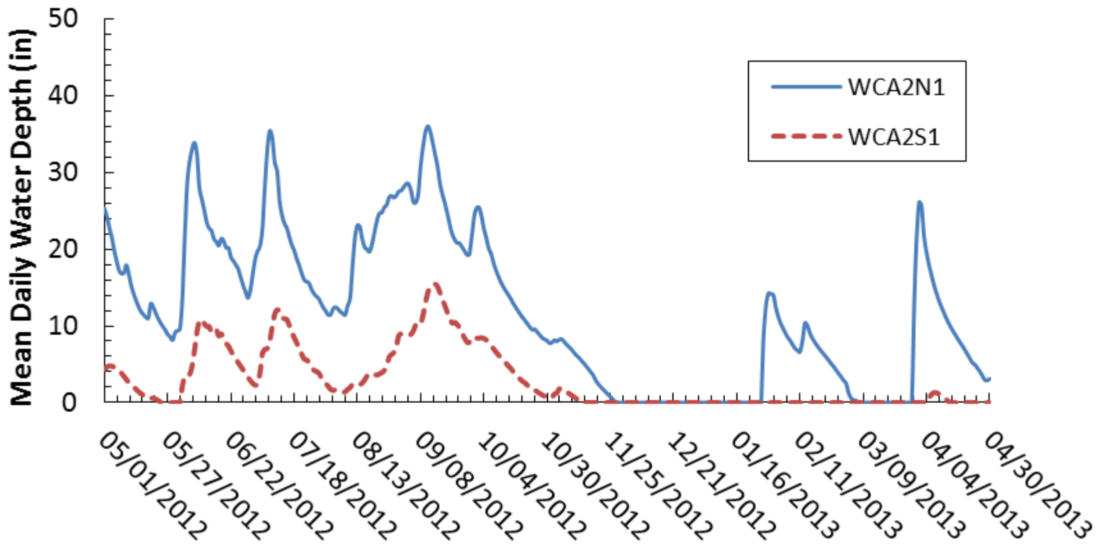


Figure D-5. Mean daily water depths for WY2013 derived from two stage recorders deployed along the northwest region of WCA-2A. See **Figure D-4** for the location of these stations.

EFA Permit Compliance Transect Total Phosphorus and Specific Conductance at STA-2 Downstream Area (WCA-2A)

Three EFA permit compliance transects are downstream of the STA-2 discharge. These transects are monitored to characterize the effects of STA-2 discharges on the marsh. They are in the western part of the WCA, with Transect 1 in the northern portion, Transect 2 in the central portion and Transect 3 in the southern portion (**Figure D-4**). Transect 1 is near the G-336A-G structure and consists of six marsh monitoring stations (2AN.25, 2AN1, 2AN2, 2AN4, 2AN5, and 2AN6) extending approximately 5 km into the WCA. Transect 2 is located 4 km south of Transect 1 and consists of four marsh monitoring stations (2AC.25, 2AC2, 2AC4 and 2AC5). The third transect is downstream of the G-336G structure and consists of four marsh monitoring stations (2AFS.25, FS1, FS3, and CA29) extending approximately 6 km into WCA-2A.

Geometric mean specific conductance during WY2012 ranged from 900 to 1,082 µS/cm for the three transects (**Table D-8**). Specific conductance levels along the northern transect between 0.25 and 4 km from L-6 ranged from 1,068 to 1,082 µS/cm and decreased to 976 µS/cm at 5 km into the marsh (**Figure D-6**). Geometric mean specific conductance levels changed little along the central and southern transects during WY2013, 943 to 1070 and 900 to 1082 µS/cm, respectively (**Figure D-6**). Four measurement along the northern transect, three along the central transect, and six along the southern transect exceeded the Class III criterion of 1,275 µS/cm. These high specific conductance values were recorded during the dry period of the year (December through March). A statistical comparison of specific conductance for WY2012 and WY2013 is provided in **Table D-8**. No statistically significant difference was observed between specific conductance measure in WY2012 and WY2013 for the northern, central and southern transects (Mann-Whitney p-values 0.06, 0.22 and 0.60, respectively).

Geometric mean TP concentrations in WY2013 ranged from 5.2 to 19.1 µg/L across the three transects with stations located closer to the canal exhibiting higher TP concentrations (**Table**

D-9). By 4 km from the canal, TP concentrations for all three transects were below 8 µg/L (**Figure D-7**). TP concentrations in the northern transect decreased from a mean concentration of 18.1 µg/L at 2AN.25 to 6.7 µg/L at 5 km from the discharge point. In the central transect, geometric mean TP concentrations decrease from 12.2 µg/L at the station closest to the discharge canal to 5.2 µg/L, approximately 5 km into the marsh. Along the southern transect, the geometric mean TP concentration near the inflow was 19.1 µg/L and decreased to 5.5 µg/L approximately 6 km into the marsh. All transects exhibited a significant reduction in TP concentrations at 1 to 2 km from the inflow.

A Mann-Whitney test was used to determine statistically significant difference for TP data between WY2012 and WY2013. Based on the analysis, no statistically significant differences were observed for the northern, central and southern transects (p-values 0.70, 0.89, and 0.67, respectively) between the two water years. However, geometric mean TP concentrations were slightly higher during WY2013 by approximately 1 µg/L.

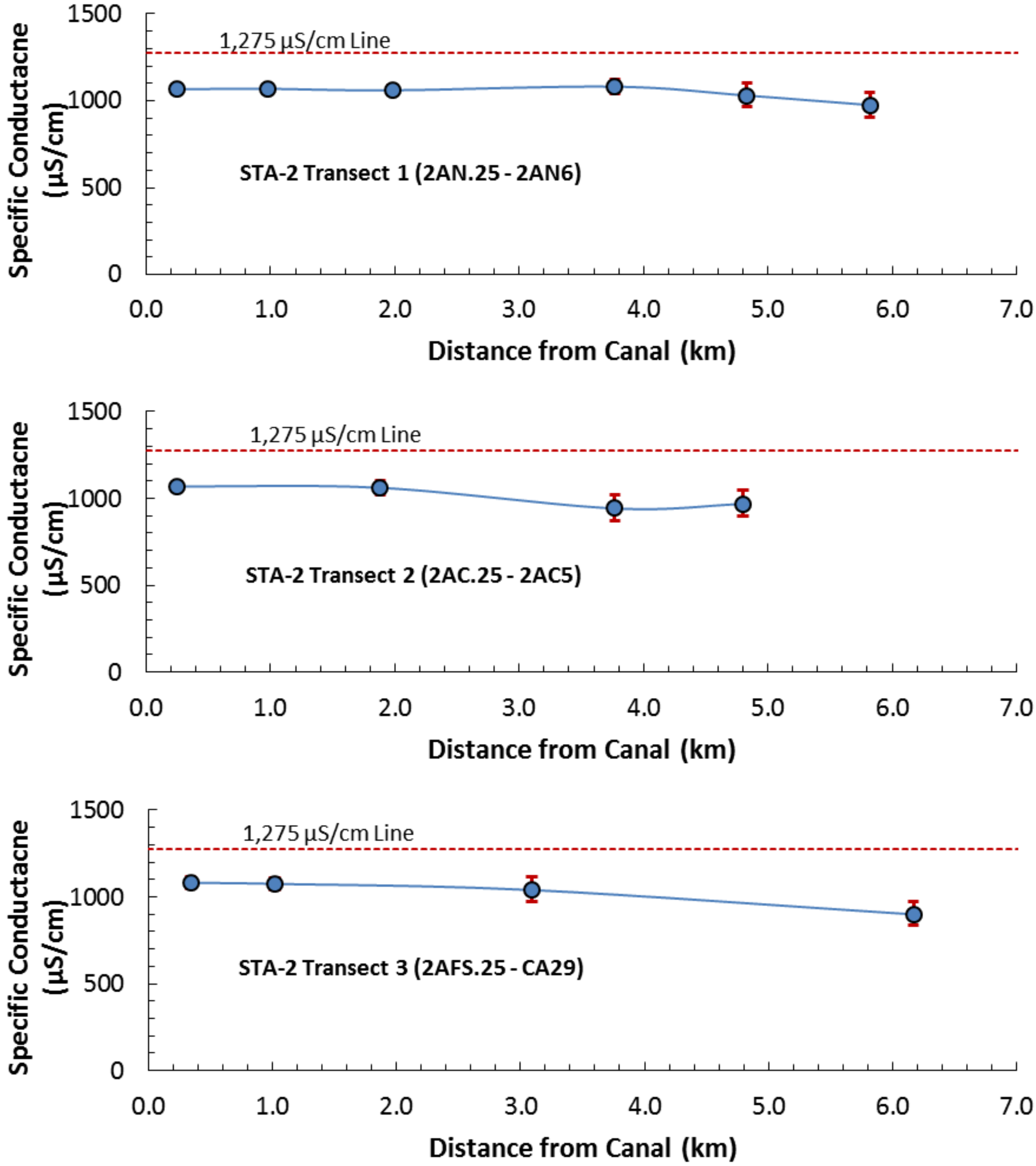


Figure D-6. Plots of geometric mean specific conductance measured at transect stations in WCA-2 downstream of STA-2 during WY2013. The error bars represent the standard error around the calculated geometric mean. The 1,275 µS/cm reference line is presented to identify the Class III freshwater criterion.

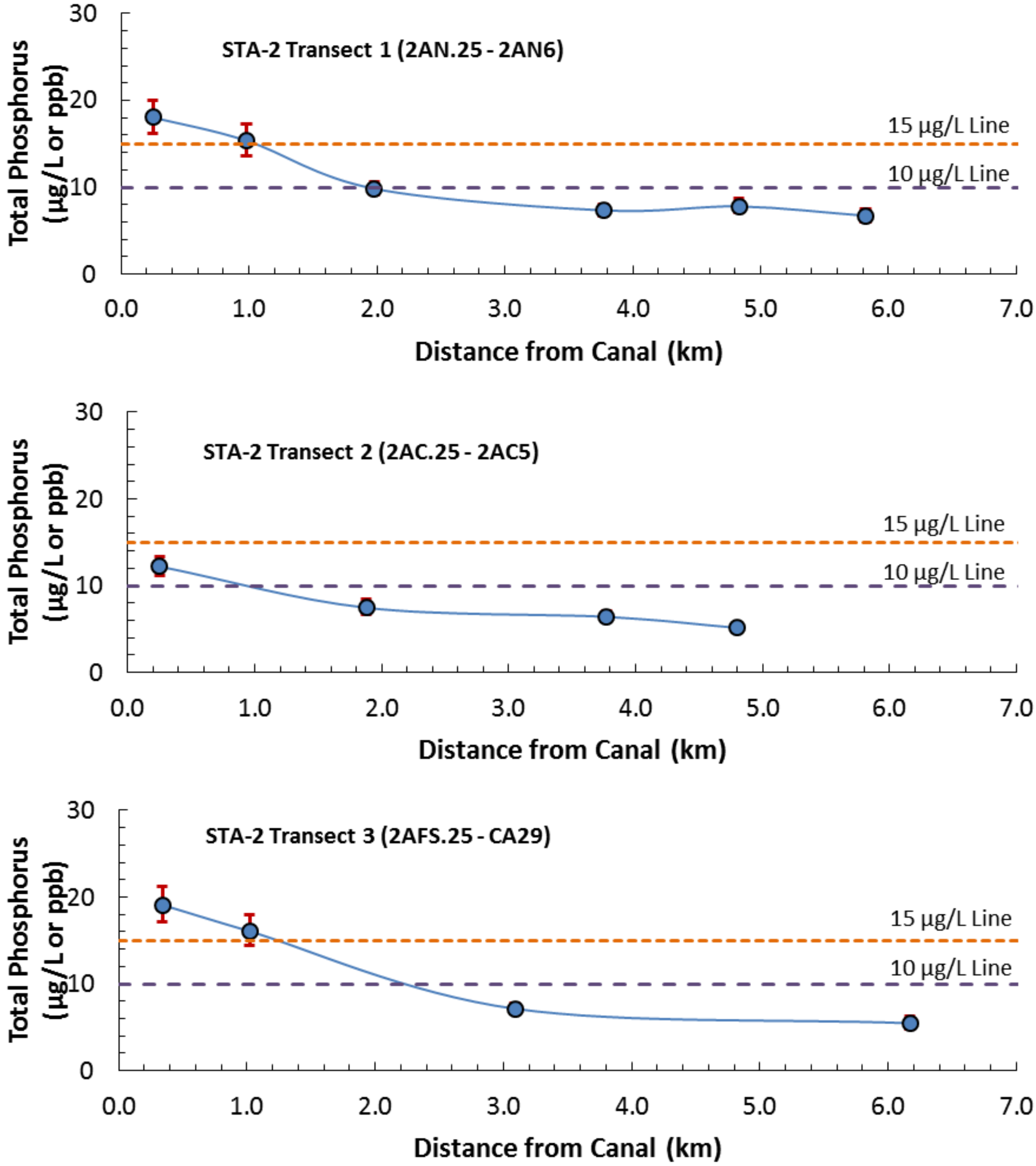


Figure D-7. Plots of geometric total phosphorus (TP) concentrations measured at transect stations in WCA-2 downstream of STA-2 during WY2013. The error bars represent the standard error around the calculated geometric mean. Two reference lines (10 and 15 µg/L) are presented to identify long-term and annual limit used in the Phosphorus Rule.

Table D-8. Comparisons of surface water specific conductance between WY2012 and WY2013 at the permit compliance transect stations in WCA-2.

STA (Transect)	Station	Specific Conductance (µS/cm)					
		WY2012			WY2013		
		No. of Samples	Mean ± SD	Geometric Mean	No. of Samples	Mean ± SD	Geometric Mean
STA-2 (Transect 1)	2AN.25	10	1161 ± 133	1154	12	1070 ± 73	1068
	2AN1	10	1170 ± 146	1161	12	1072 ± 73	1069
	2AN2	7	1110 ± 150	1101	9	1063 ± 80	1061
	2AN4	7	1084 ± 140	1075	11	1090 ± 141	1082
	2AN5	6	1004 ± 152	994	9	1048 ± 202	1031
	2AN6	6	985 ± 150	974	9	997 ± 221	976
STA-2 (Transect 2)	2AC.25	10	1191 ± 144	1182	12	1073 ± 78	1070
	2AC2	8	1100 ± 151	1091	10	1069 ± 134	1062
	2AC4	6	1007 ± 142	998	10	969 ± 238	943
	2AC5	6	962 ± 169	949	8	989 ± 216	969
STA-2 (Transect 3)	2AFS.25	8	1145 ± 102	1140	11	1087 ± 115	1082
	FS1	7	1077 ± 117	1072	10	1081 ± 114	1076
	FS3	9	936 ± 280	884	12	1065 ± 234	1040
	CA29	10	921 ± 209	899	12	929 ± 239	900

Table D-9. Comparisons of surface water TP concentrations between WY2012 and WY2013 at the permit compliance transect stations in WCA-2.

STA (Transect)	Station	Total Phosphorus (µg/L)					
		WY2012			WY2013		
		No. of Samples	Mean ± SD	Geometric Mean	No. of Samples	Mean ± SD	Geometric Mean
STA-2 (Transect 1)	2AN.25	10	15.6 ± 5.1	15	12	19.3 ± 8.5	18
	2AN1	10	14.7 ± 7.3	14	12	16.8 ± 7.9	15
	2AN2	7	11.9 ± 3.5	11	9	10.1 ± 2.5	10
	2AN4	7	6.7 ± 0.8	7	11	7.7 ± 2.8	7
	2AN5	6	6.8 ± 2.1	7	9	8.2 ± 3.2	8
	2AN6	6	6.3 ± 1.0	6	9	7.1 ± 2.7	7
STA-2 (Transect 2)	2AC.25	10	10.9 ± 2.6	11	12	12.8 ± 3.9	12
	2AC2	8	7.6 ± 2.1	7	10	8.0 ± 3.6	7
	2AC4	6	5.5 ± 0.8	5	10	6.7 ± 2.4	6
	2AC5	6	6.0 ± 2.1	6	8	5.3 ± 1.0	5
STA-2 (Transect 3)	2AFS.25	8	19.5 ± 9.4	18	11	20.3 ± 7.8	19
	FS1	7	16.7 ± 8.2	15	10	17.1 ± 7.5	16
	FS3	9	7.8 ± 2.2	7	12	7.4 ± 2.2	7
	CA29	10	5.8 ± 2.2	5	12	6.2 ± 4.0	5

WCA-2A Macrophyte Composition along the Permit Compliance Transects

The frequency of occurrence of several dominant macrophyte species was measured along fixed transects each year from 2005 through 2013 for most sites in WCA-2A. In 2010 four additional sites, 2AN5, 2AN6, 2AC5 and CA29 were added to the transects in WCA-2A. Using point-intercept survey methodology, the presence of sawgrass (*Cladium jamaicense*) and cattail (*Typha* spp.) at one-meter intervals along 10 meter transects was recorded. Only data from the permit compliance sites are presented in this report. **Tables D-10** and **D-11** show the frequency of cattail and sawgrass along each transect. At the northern transect, site 2AN.25 (0.25 km from the nearest G-336 discharge point), was dominated by cattail with little sawgrass present. At 2AN1 approximately 1 km from the discharge point on the northern transect, cattail and sawgrass were co-dominant. No cattail was present at sites 2AN2, 2AN4, 2AN5 and 2AN6 located between 2 and 6 km from the inflow point over the survey period (**Table D-10**).

The C transect is located in-between the northern and southern transects. Site 2AC.25 is closest to the L6 canal and 2AC5 is the furthest away. Although only 0.1 km from the L6 canal, 2AC.25 is approximately 1.5 km from the nearest inflow point, G336F. Sawgrass and willow (*Salix caroliniana*) are co-dominate at 2AC.25 and cattail is conspicuously absent at the site. Sawgrass is dominant at 2AC2, 2AC4 and 2AC5 (**Table D-11**).

At the southern transect, sites 2AFS.25 and FS1 are located approximately 0.25 km and 1 km from the inflow point, respectively. Both sawgrass and cattail were co-dominant at 2AFS.25 and FS1. No noteworthy change in the frequency in occurrence of either sawgrass or cattail was recorded at 2AFS.25 or FS1 since 2010. Sawgrass was dominant at sites FS3 and CA29 (**Table D-12**). Sawgrass and maintained a constant frequency of occurrence at FS3 since 2005 when monitoring was initiated at this site. Sawgrass presence slightly decreased at CA29 from 2011 to 2013.

Table D-10. Number of points (out of 10 possible points at one-meter intervals along each transect) at the northern transect locations of WCA-2A where sawgrass (Saw) or cattail (Cat) was present in WY2013.

Date	2AN.25		2AN1		2AN2		2AN4		2AN5		2AN6	
	CAT	SAW	CAT	SAW	CAT	SAW	CAT	SAW	CAT	SAW	CAT	SAW
Oct 2012	10	2	8	9	0	10	0	10	0	10	0	10
May 2013	10	2	10	10	0	10	0	10	0	10	0	10

Table D-11. Number of points (out of 10 possible points at one-meter intervals along each transect) at the central transect locations of WCA-2A where sawgrass (Saw) or cattail (Cat) was present WY2013.

Date	2AC.25		2AC2		2AC4		2AC5	
	CAT	SAW	CAT	SAW	CAT	SAW	CAT	SAW
Oct 2012	0	10	0	10	0	10	0	10
May 2013	0	10	0	10	0	10	0	10

Table D-12. Number of points (out of 10 possible points at one-meter intervals along each transect) at the southern transect locations of WCA-2A where sawgrass (Saw) or cattail (Cat) was present.

Date	2AFS.25		CA29		FS1		FS3	
	CAT	SAW	CAT	SAW	CAT	SAW	CAT	SAW
Oct 2012	10	9	0	8	6	8	0	10
May 2013			0	6			0	10
Jun 2013	10	9			10	10		

ROTENBERGER WILDLIFE MANAGEMENT AREA

Restoration and Monitoring Objectives

The Rotenberger Hydropattern Restoration Project is a component of the District's Everglades restoration efforts. The project goal is to slow, halt, and eventually reverse the ecosystem degradation within the RWMA (**Figure D-8**), primarily by restoring a more natural hydropattern. The degradation was caused by overly dry conditions that have resulted in repeated peat fires, soil oxidation and compaction, nutrient release from surface soils, and conversion of obligate wetland vegetative communities to upland-type communities. Anticipated benefits of the restoration efforts include the preservation and encouragement of additional desirable wetland vegetation species and the initiation of peat formation.

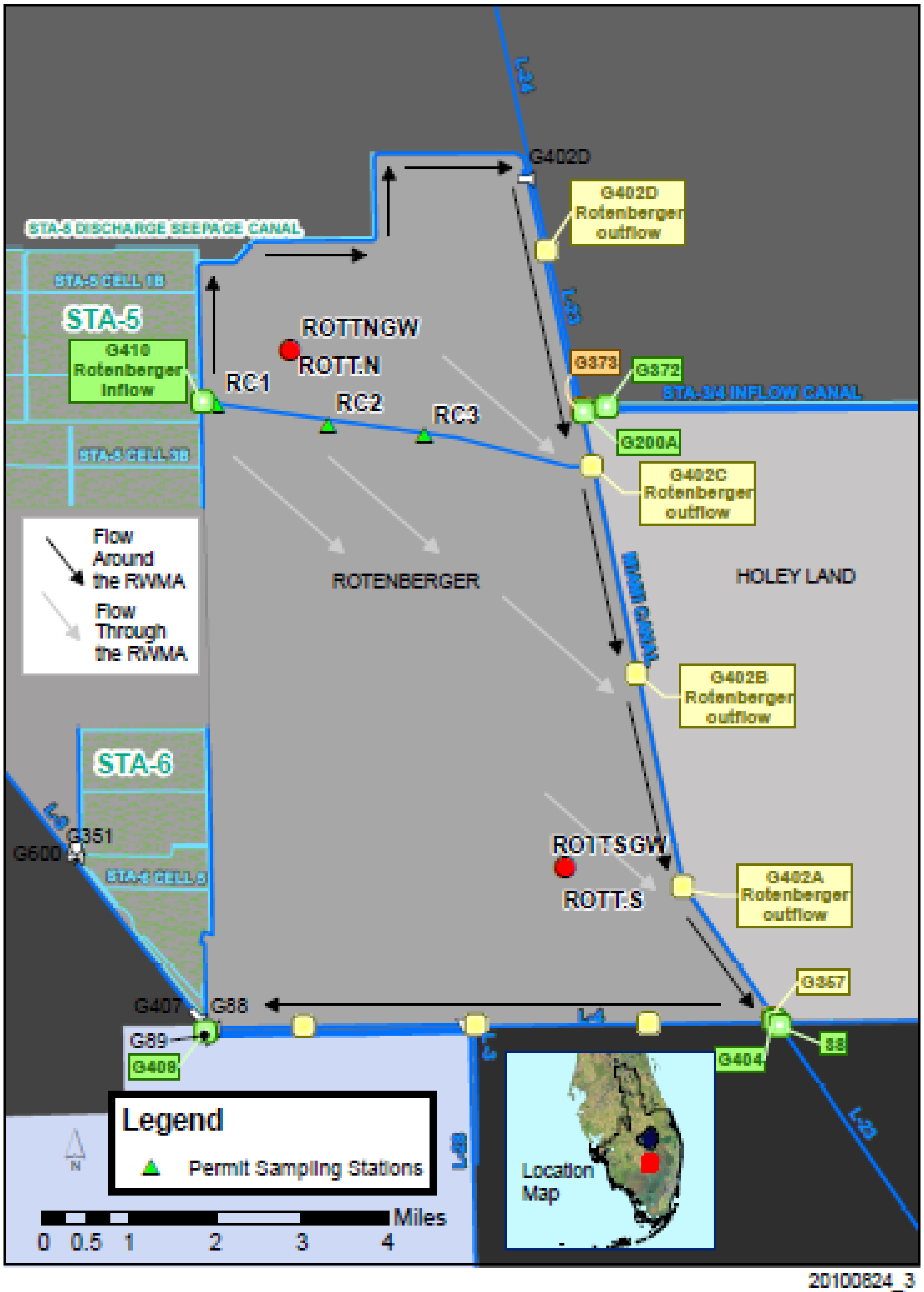


Figure D-8. Map of the Rotenberger Wildlife Management Area (RWMA) showing major structures and monitoring transect RC (permit compliance monitoring transect). Rott.N and Rott.S are the locations of the permanent stage recorders and newly installed groundwater wells.

Configuration

Project features include a 240-cubic foot per second (cfs) electric pump station (G-410) to withdraw treated water from the STA-5/6 discharge canal for release into the RWMA. This pump station distributes water through a 10-mile spreader canal located parallel to the west perimeter levee of the area. Surface water that is released out of the RWMA goes into the Miami Canal (L-28 canal) through four gated culverts (G-402A through G-402D) along the eastern boundary of the RWMA. There is a quarter-mile collection canal upstream of each outlet structure.

The RC1, RC2, and RC3 stations are EFA permit compliance locations within the RWMA. Monitoring data for the stations downstream of STA-5/6 can be located within two District databases, Everglades Research Database Production and DBHYDRO. Water levels have historically been monitored at the Rott.N and Rott.S stage gauges.

Water Budget

Annual water budgets from 2003 to 2013 are presented in **Table D-13**. Historically, Eighty percent of the inflows are attributed to rainfall and eighty seven percent of the outflows are attributed to evapotranspiration (ET) in the water budget. Both rainfall and surface water inflow through G-410 were above average and higher than WY2012. Surface water outflows were below average but higher than WY2012. ET was above average but a bit lower than WY2012. Seepage values were not accounted for in these calculations. Errors include seepage losses or gains and measurement errors. Water levels were above ground throughout the water year. Since the ending stage is higher, there was net gain in surface water storage. Daily average head and tail water fluctuation at the G410 pump is shown in **Figure D-9a**. Daily average head and tail water fluctuation at the G402 A, B and C culverts are shown in **Figure D-9b**.

Table D-13. Water budgets calculated for WY2003–WY2013. Inflows in acre-feet (ac-ft) represent discharges into the RWMA from the G-410 structure and outflows represent water releases from the G-402A–C structures.

Water Year	Inflow	Rainfall	Total Inflow	Outflow	ET	Total Outflow	Change in storage	Error %
	(ac-ft)							
2003	54,306	111,179	165,485	25,312	125,410	150,722	70	-9.3
2004	16,849	114,620	131,469	352	123,546	123,898	-20	-5.9
2005	44,414	113,868	158,282	33,788	123,847	157,635	33	-0.4
2006	29,886	114,605	144,491	54,648	124,451	179,099	-792	20.9
2007	16,195	85,538	101,733	4,630	123,403	128,033	-731	22.3
2008	11,646	108,725	120,371	0	124,900	124,900	11,431	13.0
2009	32,297	102,125	134,422	25,126	128,177	153,303	-11,187	5.3
2010	40,582	152,423	193,005	21,295	125,578	146,873	1,018	-26.5
2011	17,922	116,675	134,597	21,622	138,200	159,822	-13,365	8.1
2012	32,472	135,025	167,497	5,192	137,575	142,767	16,050	-5.6
2013	*37,055*	*146,325*	*183380*	*11,009*	*134,125*	*145,134*	*13,200*	*-15.2*
Total	***333,624***	***1,301,108***	***1,634,732***	***202,974***	***1,409,212***	***1,612,186***	***15,707***	***-0.4***
	G-410 Inflow	**Rainfall**					**G-402 Outflow**	**ET**
% of inflow	20%	80%				% of Outflow	13%	87%

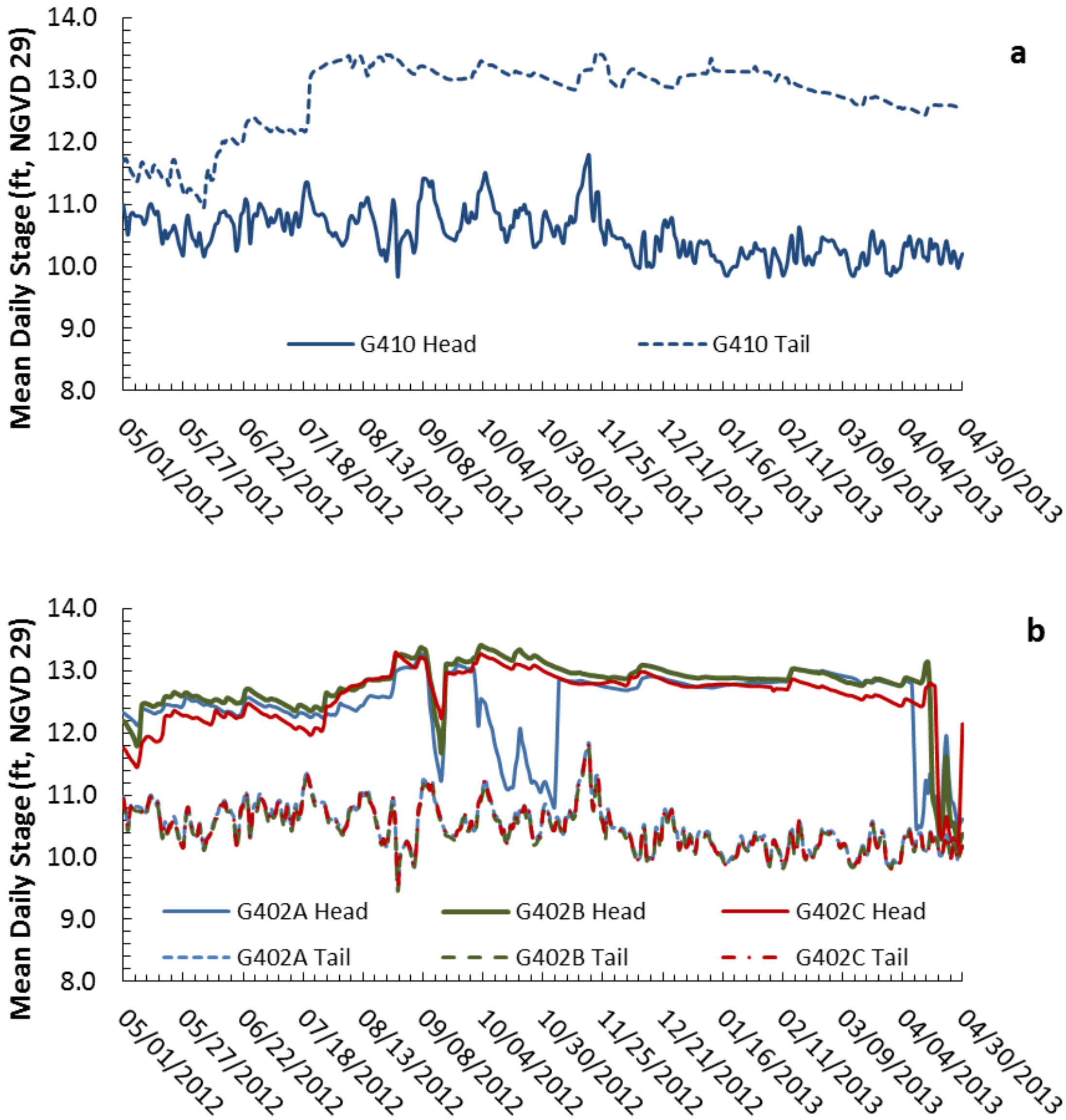


Figure D-9. (a) Daily head and tailwater fluctuation at G410 pump station. (b) Daily head and tailwater fluctuation at G402 A, B, C culverts.

Hydrologic and Total Phosphorus Loads

A total of 37,054 acre-feet (ac-ft) of STA-5/6 water was conveyed into the RWMA through the G-410 pump station in WY2013 (**Figure D-10**). This volume is approximately 4,600 ac-ft less than for the WY2012 discharge. An estimated 0.67 metric tons (mt) of phosphorus was imported to the RWMA during WY2013, resulting in an inflow flow-weighted mean (FWM) TP concentration of 15.0 µg/L. Both the TP load and FWM concentration in WY2012 were higher than those reported in WY2013 (TP load = 0.81 mt; TP FWM = 20.3 ppb). A simple regression analysis of FWM TP concentrations with time exhibited a statistically significant decreasing trend in WY2013 ($r = -0.73$, p-value < 0.0001). A similar analysis for TP load indicated that while loads exhibited a decreasing trend, the slope of the line was not statistically different from zero ($r = -0.20$; p-value = 0.12).

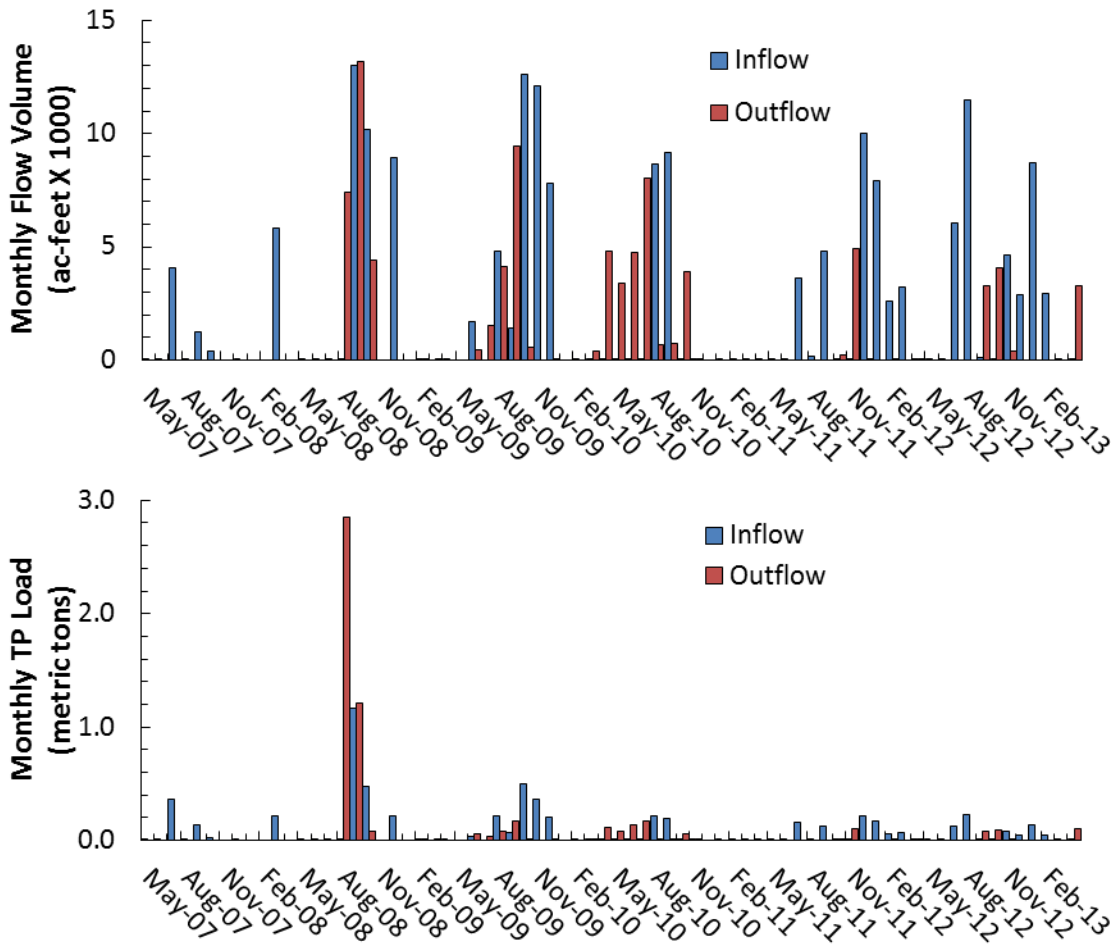


Figure D-10. Monthly flow volumes (top) and TP loads (bottom) for inflow and outflow structures at the RWMA for WY2008 through WY2013.

Approximately 11,009 ac-ft of water was released through the G-402A–C structures during WY2013, approximately 5,800 ac-ft more than in WY2012. The total load of TP released from the RWMA through the G-402A-C structures during WY2013 was 0.29 mt, or 0.18 mt higher than discharged from the wildlife management area in WY2012. The resulting annual FWM TP concentration for WY2013 at the RWMA outflow was 21.0 µg/L (**Figure D-11**). Both the outflow load and FWM concentration for WY2013 were higher than in WY2012 (TP Load = 0.11 mt; FWM TP = 16.6 µg/L). Additionally, outflow loads and FWM TP concentrations exhibited a statistically significant decrease during WY2013 based on a simple regression of each parameter with time ($r = -0.38$, p-value = 0.042 for TP load; and $r = -0.43$, p-value = 0.021 for FWM TP).

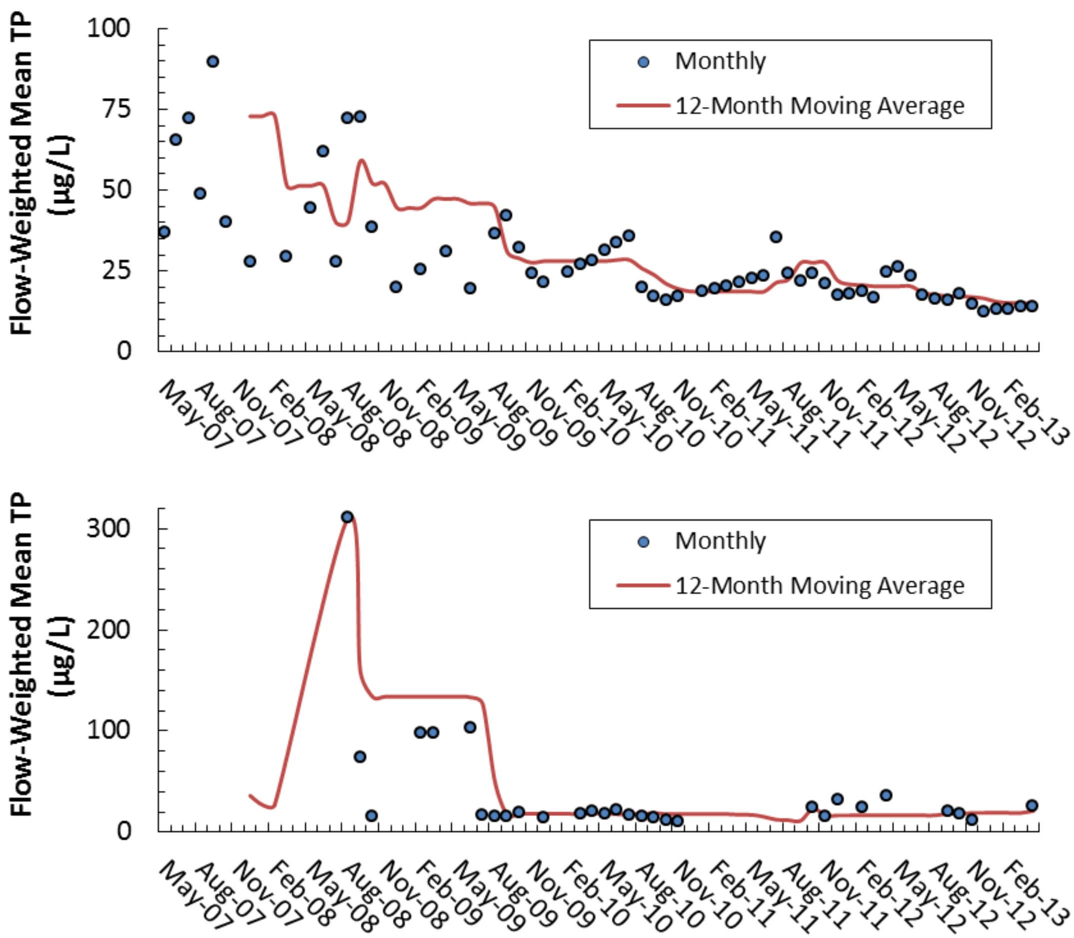


Figure D-11. Comparison of monthly flow-weighted mean TP concentrations with the 12-month moving average of the flow-weighted means for the RWMA inflow (top) and outflow (bottom) structures during WY2008 through WY2013.

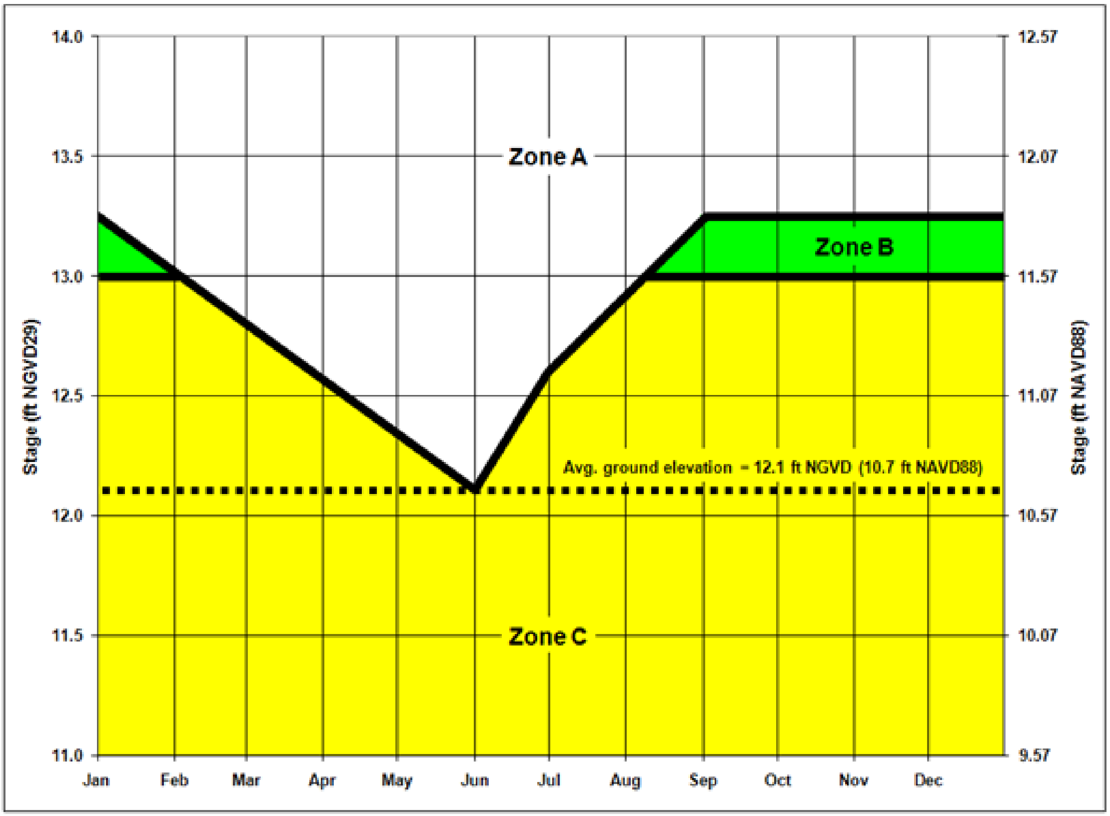
Although the annual outflow FWM TP concentration from the RWMA was higher than the annual inflow concentration to the RWMA, the inflow TP load during WY2013 was higher than the outflow TP load by 0.40 mt. The higher TP load into the RWMA probably resulted from an excess of 26,000 ac-ft conveyed through the G-410 inflow pump station compared to the combined outflow structures (G402A-C).

Hydropattern Restoration

Starting in June 2008, the District began meeting with the Florida Fish and Wildlife Conservation Commission (FWC) and the Florida Department of Environmental Protection (FDEP) to review the RWMA Operation Plan (SFWMD, 2004) and revise and improve the interim regulation schedule in an effort to better achieve the hydropattern restoration goals for the RWMA. An initial step in the process was to obtain an updated survey of the RWMA, which was completed in December 2008. The RWMA was surveyed in 2004 and 2008. The calculated ground elevation from the 2008 survey was 12.14 feet National Geodetic Vertical Datum 1929 (ft NGVD).

The daily target stages for the RWMA in the previous years were set based on the District's Natural System Model (NSM) values plus 0.25 feet (ft). The 0.25 ft was added to minimize the potential for excessive dry-out during the dry season. In April 2009, consensus was reached on a modified interim regulation schedule that attempts to maintain the hydropattern restoration goals while also addressing the diverse biological needs of the RWMA and minimizing the risk of muck and/or peat fires. The biological needs considered were those of tree islands, native open-marsh vegetation [e.g., sawgrass and maidencane (*Panicum hemitomon*)], periphyton, wading birds, aquatic macrofauna [e.g., crayfish (*Procambarus alleni*)], and upland faunal species (e.g., mammals). It is recognized that during severe droughts when no supplemental water is available, the RWMA will dry out.

In the modified regulation schedule (**Figure D-12**), when water levels are within either Zone A or Zone C and regional water conditions allow RWMA inflow and outflow structures will be managed in an effort to return water levels to the regulation schedule or Zone B. The District continues to communicate all water management actions to the FWC (SFWMD, 2010).



Zone	Operational Direction
A	Manage inflows (G-410) and/or outflows (G-402A, G-402B, G-402C, and G-402D) to return to regulation schedule or Zone B.
B	Discretionary Zone: manage inflows and/or outflows to maintain water levels within Zone B if possible, based on an assessment of historical, climatic, and regional water conditions. Coordination with FWC required.
C	If regional water conditions allow, manage inflows and/or outflows to return to regulation schedule or Zone B.

Figure D-12. Modified interim regulation schedule for RWMA.

Monitoring has ended at the ROTT.N (ROTTN-L) and ROTT.S (ROTTS-L) surface water monitoring sites, but the substitute monitoring sites, ROTTNGW and ROTTSGW, respectively, have replaced them (**Figure D-8**). WY2012 and WY2013 daily average RWMA stages, average ground elevation and the interim operation plan target stages are depicted in **Figure D-13**. Water level was above ground from the beginning to the end of WY2013, closely matching the operation plan target. This is a reflection of near average rainfall in the area.

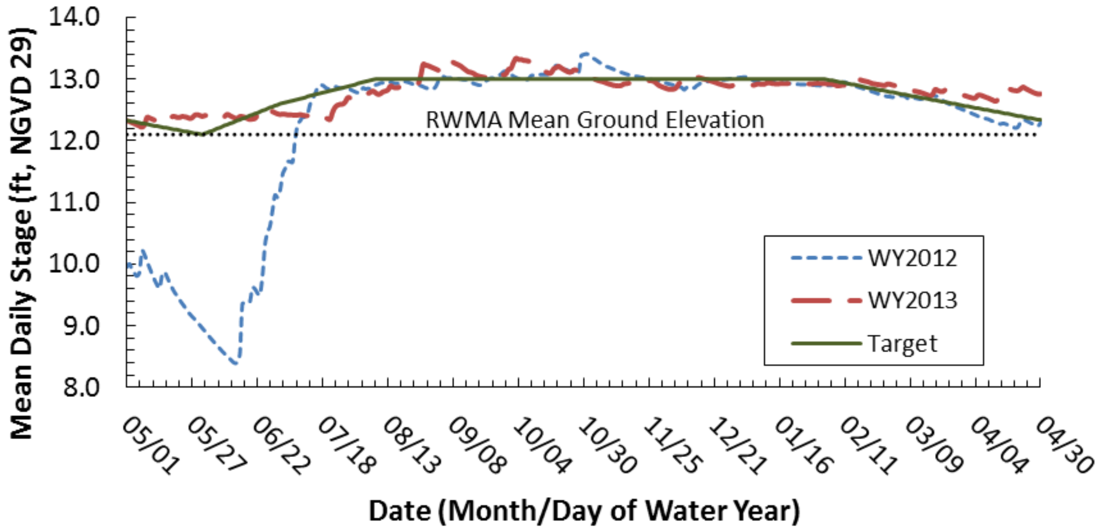


Figure D-13. Daily mean RWMA stages, average ground elevation, and interim operation plan target stages.

EFA Permit Compliance Transect Total Phosphorus and Specific Conductance at STA-5/6 Downstream Area

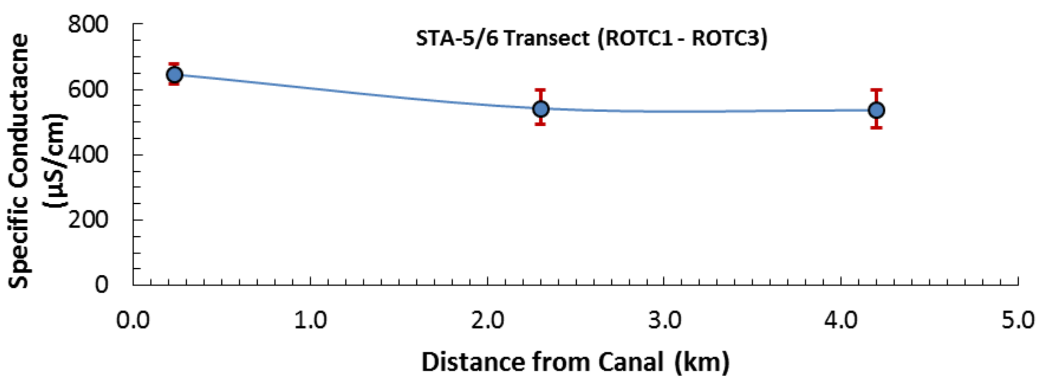
As previously mentioned, the RWMA EFA permit compliance transect comprises three monitoring stations (RC-1, RC-2, and RC-3) that extend approximately 4 km downstream of pump station G-410 (**Figure D-8**). All stations along this transect are identified as impacted.

All specific conductance levels measured along the RWMA transect were well below the 1,275 µS/cm for Class III waters during WY2013 (**Table D-1**). Geometric mean specific conductance levels in WY2013 decreased by approximately 17 percent along the RWMA transect. Geometric mean TP concentrations exhibited a decrease of approximately 46 percent from 18.9 µg/L at the marsh station closest to the inflow to 10.2 µg/L at a distance of 4 km from the canal (**Figure D-14**).

A comparison of specific conductance and TP concentrations for WY2012 and WY2013 is provided in **Table D-14**. No statistically significant difference was observed between specific conductance data from WY2012 and WY2013 (Mann-Whitney p-value = 0.67). Specific conductance in WY2012 (geometric mean = 477 µS/cm; median = 580 µS/cm) was lower than in WY2013 (geometric mean = 578 µS/cm; median = 599 µS/cm). No statistically significant difference was observed between TP data for WY2012 and WY2013 (p-value = 0.62) with concentrations for both years being similar (geometric mean = 13 µg/L; median = 13 µg/L).

Table D-14. Comparison of the surface water mean (± 1 SD) specific conductance and TP concentration between WY2012 and WY2013 at the permit compliance stations in the RWMA.

STA (Transect)	Station	WY2012			WY2013		
		No. of Samples	Mean ± SD	Geometric Mean	No. of Samples	Mean ± SD	Geometric Mean
				Specific Conductance (µS/cm)			
STA-5/6 (Transect 1)	ROTC1	10	686 ± 168	666	11	654 ± 101	646
	ROTC2	9	533 ± 261	475	9	562 ± 154	542
	ROTC3	9	403 ± 282	330	9	562 ± 178	536
				Total Phosphorus (µg/L)			
	ROTC1	10	22.2 ± 9.9	20	11	19.6 ± 5.3	19
	ROTC2	9	10.6 ± 3.0	10	9	9.8 ± 3.6	9
	ROTC3	9	12.0 ± 4.8	11	9	10.7 ± 3.7	10



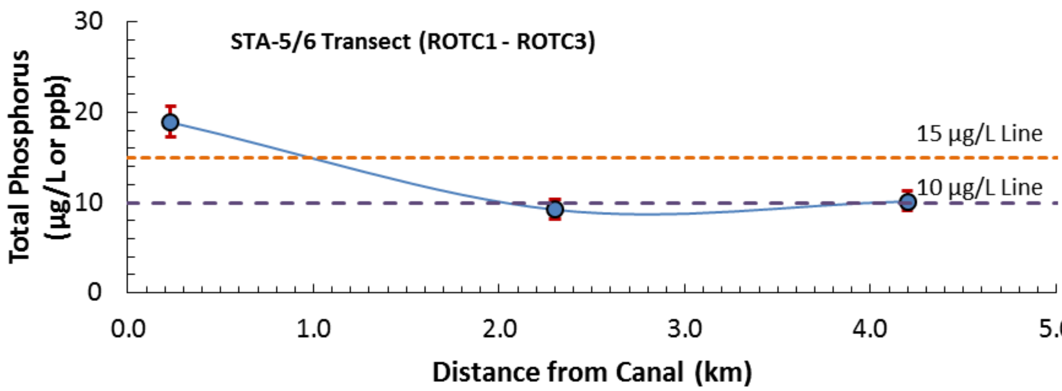


Figure D-14. Plots of geometric mean specific conductance and TP concentrations measured at transect stations in RWMA downstream of STA-5/6 during WY2013. The error bars represent the standard error around the calculated geometric mean. The 1,275 µS/cm reference line on specific conductance plot is presented to identify the Class III freshwater criterion. Two reference lines (10 and 15 µg/L) on the TP plot are presented to identify long-term and annual limit used in the Phosphorus Rule.

MACROPHYTE COVERAGE

Using point intercept survey methodology, the areal coverage of dominant macrophyte species has been surveyed at three permit-mandated stations along fixed 10-meter transects twice a year (dry and wet seasons) since 2004. The presence of sawgrass and cattail at 1-meter intervals was recorded (**Table D-15**). Sawgrass coverage remained stable and cattail coverage increased at the RC1 station during the previous four-year survey period. Sawgrass was the dominant macrophyte in RC2 and RC3 where surface water TP concentrations were also low (**Table D-14**). RC3 has exhibited very little variation in vegetation community remaining consistently sawgrass dominant during the survey period, 2004–2013. RC2 is a mixed cattail sawgrass marsh. Although there was a decrease in cattail from 2012 to 2013 there is not a clear trend toward a sawgrass dominated marsh and the site remains mixed cattail and sawgrass marsh for the time being. RC1 has demonstrated a change in the vegetation community. In 2004–2011, RC1 was a cattail dominated marsh with sparse to moderate sawgrass present. During 2012 to 2013, RC1 became increasingly cattail dominated, culminating with sawgrass not being found during the spring 2013 survey (data not shown).

Table D-15. Number of points (out of 10 possible points at one-meter intervals along each transect) where sawgrass (Saw) or cattail (Cat) was present in WY2013.

Date	RC1		RC2		RC3	
	CAT	SAW	CAT	SAW	CAT	SAW
Jun 2012	8	2	1	8	0	10
Oct 2012	10	1	1	7	0	10

Restoration Activities

In 2009, the District, in cooperation with the FWC, began restoration of 19 acres of tree islands in the southwest corner of the RWMA. Restoration began with the treatment and removal of exotic species including Brazilian pepper (*Schinus terebinthifolius*) and primrose willow (*Ludwigia peruviana*). These tree islands were initially planted with 3,000 native tree and shrub species, which are protected from wildlife damage with metal exclosures. The FWC planted an additional 384 trees and shrubs on these islands in 2010–2011. These islands are cooperatively maintained on an annual basis for both exotic plants and metal exclosure upkeep.

The FWC conducts various other restoration activities in RWMA each year. For 2012–2013, approximately 170 acres were treated for exotic plants, including tree islands, levee, and marsh habitats. Other restoration activities conducted in RWMA included the prescribed burning of 718 acres, metal exclosure maintenance for all planted tree islands in RWMA (3,970 exclosures on 15 tree islands), and the additional planting of 879 trees and shrubs on tree islands. Additionally, annual aerial cattail surveys are conducted to monitor cattail expansion within RWMA.

The FWC completed restoration of the old farms located within RWMA in 2011. This multi-year project included the mechanical removal or degradation of 10.7 miles of berms and canals. These features altered surface flow throughout 1,758 acres along the eastern boundary of the area. The work was funded by the FWC Aquatic Habitat Restoration and Enhancement program, and performed by Rio-Bak Corporation from May 2009 to May 2011 at a cost of $109,000. Photo-monitoring is performed periodically to document the effects of the restoration activities. Additional restoration activities are planned for the future, including the removal of an unimproved road leading to an abandoned drill pad island. The drill pad island has undergone several restoration efforts, including exotic plant control and native tree and shrub planting, and provides habitat similar to a natural tree island. The road alters marsh habitat, and plans include the removal of the road and retention of the drill pad island.

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Attachment E: STA Herbicide Application Summary for Water Year 2013

Louis Toth

Table E-1 summarizes herbicide treatments (acres treated and gallons of herbicides used) in the Everglades Stormwater Treatment Areas (STAs) during Water Year 2013 (WY 2013) (May 1, 2012– April 30, 2013). No pesticides were applied with the Everglades STAs during WY 2013.

Herbicides were used to control the following:

- Four species of floating plants – water lettuce (*Pistia stratiotes*), water hyacinth (*Eichhornia crassipes*), crested floating heart (*Nymphoides cristata*) and yellow water lily (*Nymphaea mexicana*)
- Six species of emergents – cattail (*Typha domingensis* and *Typha latifolia*), wild taro (*Colocasia esculenta*), spikerush (*Eleocharis cellulosa)* and pennywort (*Hydrocotyle umbellata* and *Hydrocotyle ranuculoides*)
- Four species of grasses – torpedo grass (*Panicum repens*), paragrass (*Urochloa mutica*), bermudagrass (*Cynodon dactylon*) and napier grass (*Pennisetum purpureum*);
- Three species of shrubs – Brazilian pepper (*Schinus terebinthifolius*), primrose willow (*Ludwigia peruviana*), and Carolina willow (*Salix caroliniana*)
- One tree species – melaleuca (*Melaleuca quinquenervia*)
- One species of submerged exotic – hydrilla (*Hydrilla verticillata*).

Large area herbicide treatments were needed for the following reasons:

- To reduce cover of willow and primrose willow for the start-up of Cells 5 (1,180 acres) and 6 (1,598 acres) in the North Buildout of STA-2.
- In Cell 5-4A (362 acres) of STA-5/6 to treat Category 1 and 2 exotics
- In the non-effective treatment areas of Cells 4A (568 acres) and 5A (559 acres) of Compartment C to reduce cover of cattail in submerged aquatic vegetation (SAV)
- Cell 4 (686 acres) of STA-2
- Cell 1B (790 acres) of STA-3/4
- To convert Cell 2 (440 acres) of STA-2 and Cell 5-3B (396 acres) of STA-5/6 to SAV.

Herbicide applications also were used regularly to control floating plants near the inflow and outflow structures of all cells and in SAV cells. Frequent treatments were needed for water lettuce in Cell 4N (311 acres) of STA-1 East, Cell 5B (382 acres) of STA-1 West, and Cells 5-1B (246 acres) and 5-2B (870 acres) of STA-5/6.

APPLICATION RATE

Water lettuce, water hyacinth, and crested floating heart were treated with either diquat dibromide (37.3 percent solution) at a rate of 1 quart per acre, 2,4D (46.3 percent) at 2 quarts per acre, or with a mix of diquat and imazapyr (28.7 percent) at 2 quarts per acre or 2,4D. Two new growth-regulating herbicides also were used to treat floating plants, particularly in locations where giant bulrush was planted. Flumioxazin (51 percent) was particularly effective in eliminating water lettuce at 6 ounces per acre. Penoxsulam (21.7 percent) was applied at 4–6 ounces per acre alone and in a mix with flumioxazin at 6–10 ounces per acre to treat water hyacinth and pennywort. Applications of triclopyr (44.4 percent) at a rate of 1–2 gallons per acre or a mix of glyphosate (53.8 percent) at 7.5 pints per acre and imazapyr (28.7 percent) at 2 quarts per acre were applied to willow, primrose willow and Brazilian pepper. Carfentrazone-ethyl (21.3 percent) also was evaluated at 8 and 13.5 ounces per acre on primrose willow but failed to provide adequate control of this species. Cattails were treated with glyphosate or with a mix of glyphosate and imazapyr. Glyphosate or the glyphosate/imazapyr mix also was used to treat yellow water lily, torpedograss, paragrass, napier grass, bermudagrass and pennywort. Wild taro was treated with imazamox (12.1 percent) at a rate of 2 quarts per acre. Endothall (40.3 percent) was used at a rate of 2.6 gallons per acre foot to treat hydrilla.

APPLICATION CERTIFICATION STATEMENT

The South Florida Water Management District ensures that all herbicide applications are carried out in accordance with label specifications and in compliance with National Pollutant Discharge Elimination System regulations.

Table E-1. Acres of vegetation treated with herbicides during WY2013.

Cell	Acres	Diquat (gallons)	Imazpyr (gallons)	Glyphosate (gallons)	2,4 D (gallons)	Triclopyr (gallons)	Flumioxazin (pounds)	Penoxsulam (gallons)	Imazamox (gallons)	Endothall (gallons)	Carfentrazone (gallons)
						STA 1E					
1	31.53	6.5	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0
3	127.01	24.88	2.5	3.75	1.25	0	0	0	0	0	0
4N	314.69	58.13	3	4.5	0	0	4.88	0	0	0	0
4S	0.77	0.5	0	0	0	0	0	0	0	0	0
5	306.38	19.75	2.75	8.63	3	27.5	38.01	3.26	0	0	7.67
6	188.18	23.25	2.5	18.76	0	0	10.51	0	0	0	0
7	231.01	18.13	0	0.5	2.12	25.25	48.02	4.95	0	0	0
						STA 1W					
1A	255.28	29	7.5	54.37	17.25	0	14.63	0	0	0	0
1B	20.77	20.25	0	0	0	0	0	0	0	0	0
2A	105.73	19.5	3.75	7.5	0	0	0	0	0	0	0
2B	37.36	1.25	12.5	18.76	0	0	0	0	0	0	0
3	180.39	2	4.75	156.09	0	0.71	0	0	0	0	0
4	93.58	0	15.22	93.13	0	0	0	0	0	0	0
5A	277.82	40.75	3.75	7.5	9	0	22.26	2.78	0	0	0
5B	463.27	61.66	4	30	8.25	0	0	0	0	0	0
						STA 2					
1	17.99	2.25	0	3.09	3.13	0	0	0	0	0	0
2	533.66	6	77.5	150.25	6.25	0	0	0	0	0	0
3	52.71	8	0	2.81	0.75	0	0	0	0	0	0
4	686	0	350	656.25	0	0	0	0	0	0	0
5	1468.36	0	269.94	573.34	0	1796	0	0	0	0	0
6	1896.01	0	200	360.69	0	1204	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0

Table E-1 (Continued).

Cell	Acres	Diquat (gallons)	Imazpyr (gallons)	Glyphosate (gallons)	2,4 D (gallons)	Triclopyr (gallons)	Flumioxazin (pounds)	Penoxsulam (gallons)	Imazamox (gallons)	Endothall (gallons)	Carfentrazone (gallons)
						STA 3/4					
1A	293.93	14.28	2.5	24.89	6.88	0	20.06	6.38	0	0	0
1B	877.6	1.5	170.18	769.19	0	0.5	1.69	0	0	0	0
2A	214.25	6.25	2.5	8.72	0	0	93.75	7.8	0	0	0
2B	58.1	1.5	25	46.75	0	0	0	0	0	0	0
3A	16.93	14.5	0	18.88	0	0	0	0	0	0	0
3B	433.59	0	51.5	325.32	0	0	0	0	0	0	0
PSTA	55.04	0	12.25	53.44	0	0	0	0	0	0	0
						STA 5/6					
5-1A	405.53	7.69	0	0.94	0	177.5	9.38	5.30	0	0	0
5-1B	246.36	51.75	0	0	0	0	9.13	9.25	0	0	0
5-2A	684.15	28.59	2.25	8.44	0	175	0	0	0	0	0
5-2B	872.55	181.59	0.5	1.88	0	0	51.5	13.5	0	0	0
5-3A	50.77	18.69	0	3.28	7.63	0	0	0	0	0	0
5-3B	507.89	0	162.75	376.88	0	52.5	0	0	0	0	0
5-4A	932.16	0	290	543.75	0	95.63	0	0	0	0	0
5-4B	105.89	0	32.75	131.16	0	0	0	0	3.25	3.5	0
5-5A	567.44	0.5	240	450	1.0	46.21	0	0	0	0	0
5-5B	0	0	0	0	0	0	0	0	0	0	0
6-3	0	0	0	0	0	0	0	0	0	0	0
6-5	0	0	0	0	0	0	0	0	0	0	0
6-2	0	0	0	0	0	0	0	0	0	0	0
6-4	0	0	0	0	0	0	0	0	0	0	0

Attachment F: Annual Permit Compliance Monitoring Report for Other Toxicants in the STAs

Richard Pfeuffer

EXECUTIVE SUMMARY

The Everglades Forever Act Permit Number 0311207 (Specific Condition 23 and Table 2) for the Everglades Construction Project, issued to South Florida Water Management District (District and SFWMD) in September 2012 requires the SFWMD "to monitor mercury in accordance with the Department [Florida Department of Environmental Protection] approved mercury monitoring plan." The Florida Department of Environmental Protection (FDEP) approved the plan on September 18, 2012. This document, *STA-1W, STA-1E, STA-2, STA-3/4 and STA-5/6 Mercury and Other Toxicants Monitoring Program*, referred to as the Monitoring Plan, contains sampling locations, frequency and types of monitoring for mercury and other toxicants required by the permit (SFWMD, 2012). This document is referred to as the Monitoring Plan throughout the rest of this document.

Specific Condition 23 also requires that the Monitoring Plan be developed in accordance with the publication *A Protocol for Monitoring Mercury and Other Toxicants* (FDEP and SFWMD, 2011). This document, referred to as the Protocol throughout the rest of this document, is a guide for design of monitoring and assessment plans for mercury, pesticides, and other toxicants for SFWMD projects.

INTRODUCTION

The SFWMD constructed two new flow-ways in Stormwater Treatment Area (STA)-2 known as the Everglades Agricultural Area (EAA) Compartment B Buildout Project. Compartment B (**Figure F-1**) includes Cells 4, 5, and 6, referred to as the North Buildout (NBO), and cells 7 and 8, referred to as the South Buildout (SBO). The Monitoring Plan (page 9) states that based on the prevailing status of Compartment B and guidance contained in the Protocol, the SFWMD would conduct Phase 2 – Tier 1 Routine Monitoring during Stabilization Period for all cells (4-8) of Compartment B. **Figure F2** shows the cells and flow-ways within STA-2.

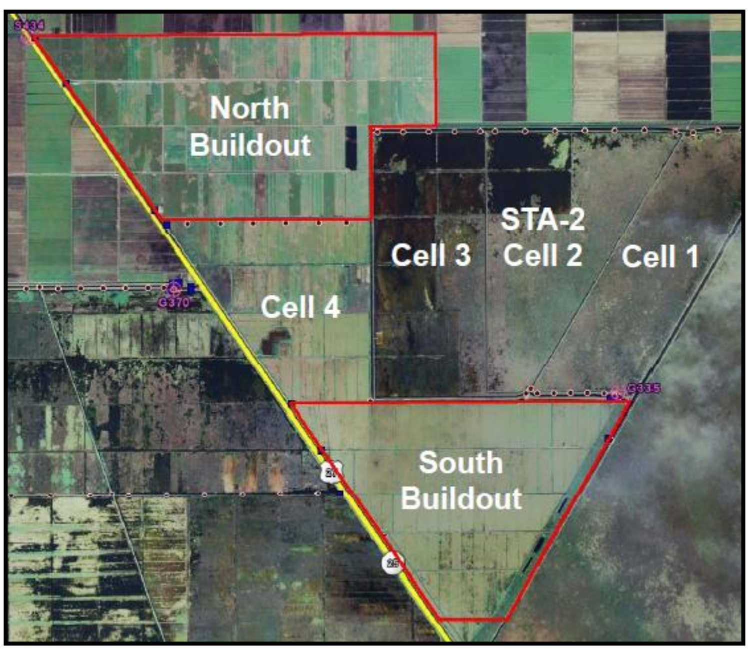

Figure F-1. Map showing Compartment B including the location of the NBO and SBO in relation to STA-2.

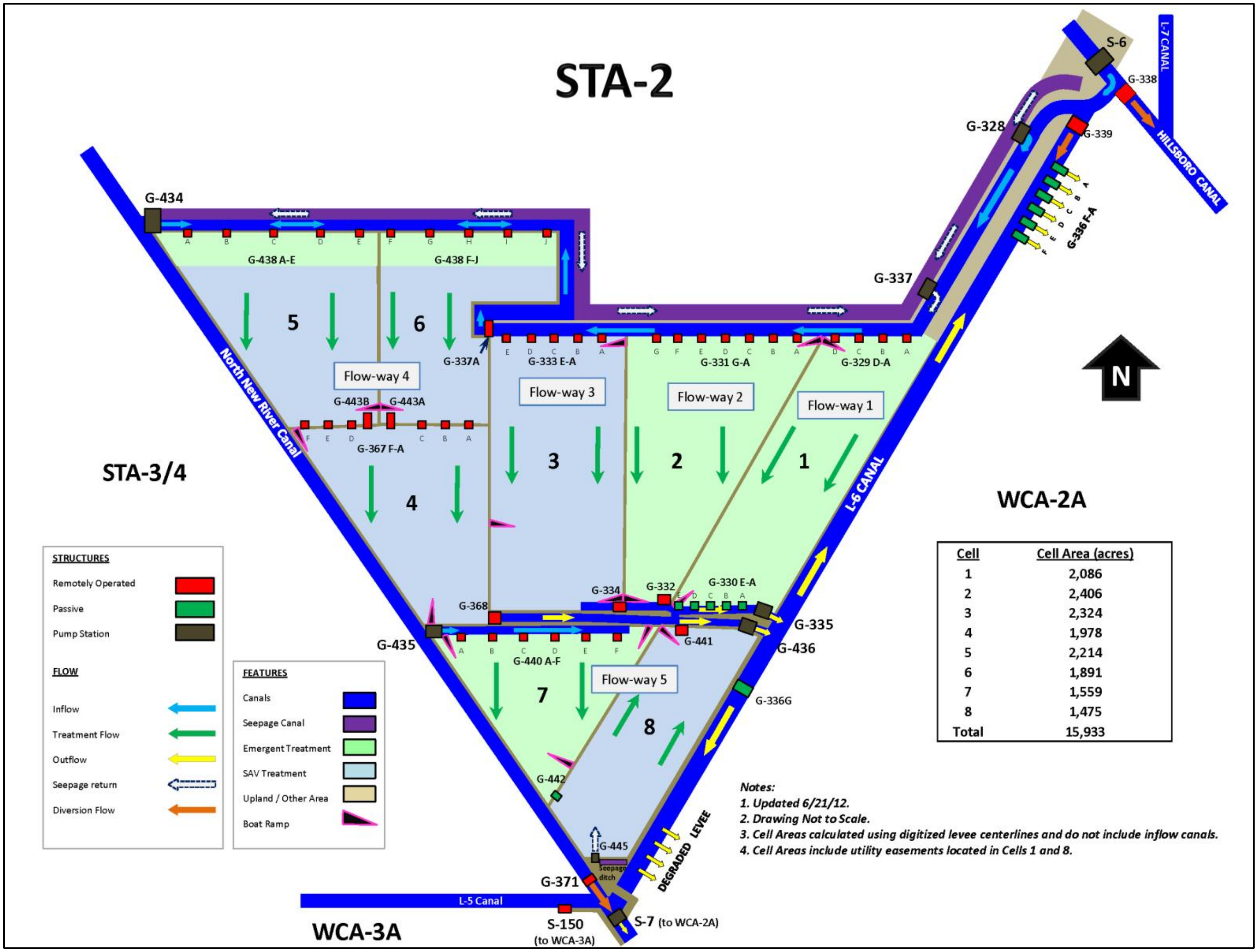

Figure F-2. Map of STA-2 showing cells and flow-ways.

OTHER TOXICANT MONITORING REQUIREMENTS

The Monitoring Plan lists the Phase 2 – Tier 1 collection matrix (surface water and fish tissue), along with locations, method, frequency and parameters for Compartments B. **Table F-1** summarizes these monitoring requirements. Analysis of other toxicants from surface water or fish tissue samples in Compartment C was deemed not necessary based on results of an environmental site assessment. Initially, the operation plan for STA-2 and Compartment B only allowed STA-2 Cells 1–3 to discharge through the G-335 structure and Compartment B NBO and SBO to discharge through G-436. After start-up monitoring was completed, however, a plug was removed from the levee that segregated original STA-2 discharge from Compartment B discharge and the operation plan was changed to reflect this. Structure G-335 was subsequently added to the Compartment B monitoring plan.

Table F-1. Compartment B Phase 2 – Tier 1: Routine Monitoring during Stabilization Period.

Matrix	Location	Collection Method	Frequency	Parameter[a]
Mosquitofish (*Gambusia* spp.)	within each flow-way of NBO and SBO	net or trap	quarterly	cis-chlordane, trans-chlordane, o,p'-DDD, p,p'-DDD, o,p'-DDE, p,p'-DDE, o,p'-DDT, p,p'-DDT, cis-nonachlor, trans-nonachlor, and toxaphene
Bass and Sunfish	within each flow-way of NBO and SBO	electrofishing	annually	cis-chlordane, trans-chlordane, o,p'-DDD, p,p'-DDD, o,p'-DDE, p,p'-DDE, o,p'-DDT, p,p'-DDT, cis-nonachlor, trans-nonachlor, and toxaphene
Surface water	G-328, S-6, G-434 G-435, G-335, G-436	grab	quarterly	chlordane, p,p'-DDD, p,p'-DDE, p,p'-DDT, and toxaphene

a. Key to parameters: o,p'-DDD – ortho para dichlorodiphenyldichloroethane; o,p'-DDE – ortho para dichlorodiphenyldichloroethylene; o,p'-DDT – ortho para dichlorodipheyltrichloroethane; p,p'-DDD – para para dichlorodiphenyldichloroethane; p,p'-DDE – para para dichlorodiphenyldichloroethylene; p,p'-DDT – para para dichlorodipheyltrichloroethane.

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OTHER TOXICANT MONITORING EVALUATION

Surface water and fish sampling events were performed under project codes ST2G and ST2F, respectively. Surface water sampling occurred in November 2012 and March 2013. Mosquitofish sampling events occurred in November 2012, February and April 2013, while the bass and sunfish sampling occurred November 2012. Samples were analyzed for pesticide compounds listed in **Table F-1**. Evaluations were performed based on the following criteria listed in the Protocol to determine if the Phase 2 – Tier 1 Routine Monitoring during Stabilization Period criteria were met:

- If water column concentrations do not exceed state water quality standards in Chapter 62-302, Florida Administrative Code (F.A.C.).
- If ambient mosquitofish do not demonstrate excessive bioaccumulation that exceeds a critical tissue benchmark used to establish sediment quality assessment guidelines or in site-specific risk assessments.

Surface water samples were collected from six different sites (**Figure F-3**). All of the compounds were below detection level.

The only compound detected during the mosquitofish sampling was trans-nonachlor, one of the major constituents of the insecticide chlordane and the most bioaccumulative (**Table F-2**). However, the detected concentrations were below any levels of concern.

No pesticides were detected in the annual large-bodied fish collection (bass and sunfish), which occurred on November 7, 2012.

The fourth quarterly surface water and mosquitofish sampling events are scheduled for August 2013. These events will conclude the minimum required one year or four quarters of sampling. This last data set will be utilized in conjunction with the previous data sets in determining if the evaluation criteria have been met and justify the elimination of the other toxicant monitoring.

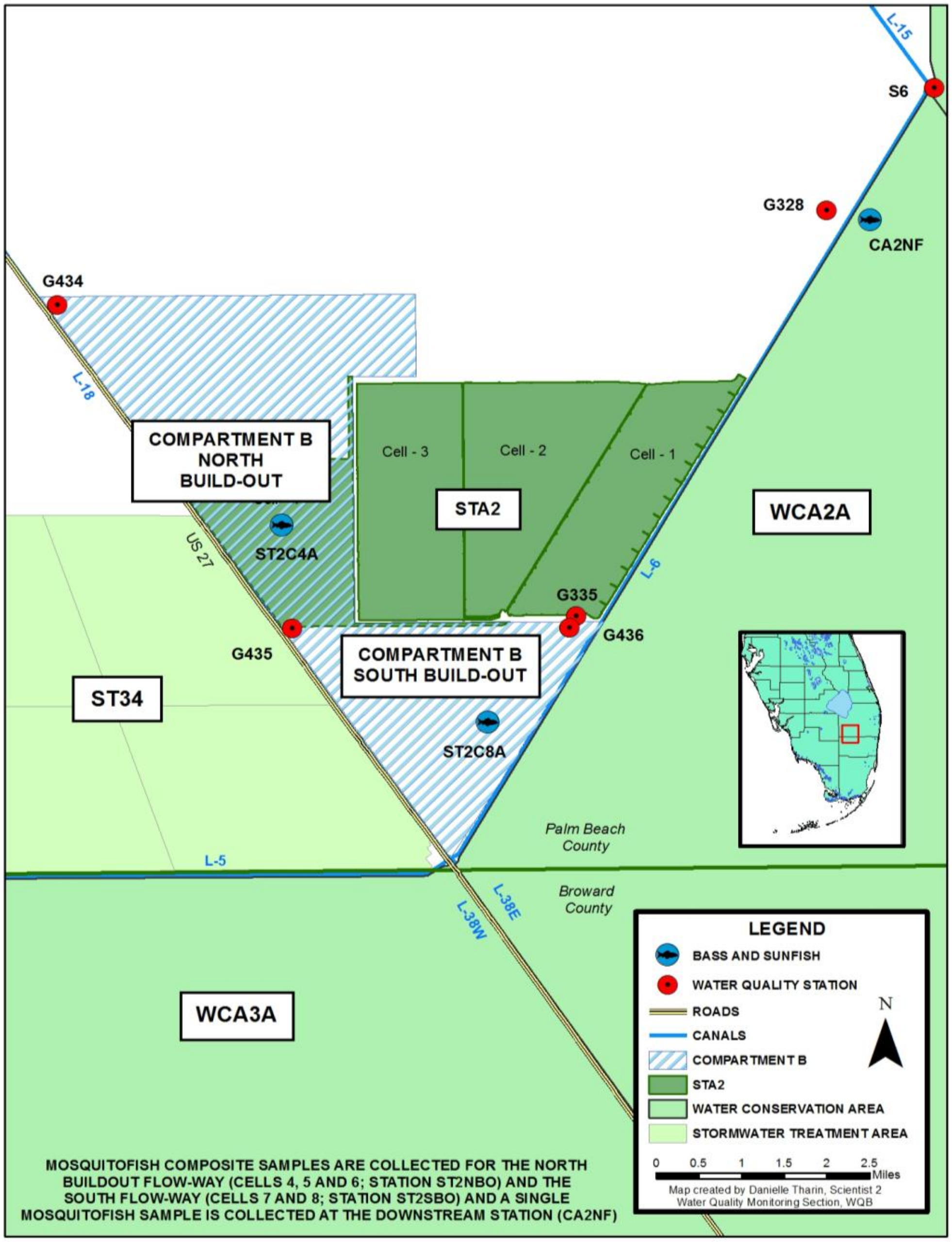

Figure F-3. Compartment B surface water quality sample locations.

Table F-2. Summary of fish pesticide analysis.

Sampling Date	Station Fish	Total chlordane (µg/kg wet weight) (includes sum of cis- and trans- chlordane and nonachlor, and oxychlordane)	Criteria					
			Total chlordane (includes sum of cis- and trans- chlordane and nonachlor, and oxychlordane) (µg/kg wet weight) (Newfields 2006)					Recreational Fishers Screening Value (USEPA 2000)
			Bald Eagle	Great Blue Heron	Little Blue Heron	White Pelican	Wood Stork	Total chlordane (µg/kg dry weight)
11/19/2012	STA2NBO mosquitofish	1.7 I	40,000	27,200	14,100	33,300	27,600	114
2/25/2013	STA2NBO mosquitofish	1.6 I	40,000	27,200	14,100	33,300	27,600	114
4/2/2013	STA2NBO mosquitofish	1.1 I	40,000	27,200	14,100	33,300	27,600	114

a. µg/kg – micrograms per kilograms.
b. Screening levels correspond to exposure equal to no-observed-adverse-effects levels, wet weight basis, for overall receptor diet.
c. I – value reported is less than the practical quantification limit, and greater than or equal to the method detection limit.

REFERENCES

FDEP and SFWMD. 2011. A Protocol for Monitoring Mercury and Other Toxicants. Florida Department of Environmental Protection, Tallahasee, FL, and South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2012. STA-1W, STA-1E, STA-2, STA-3/4 and STA-5/6 Mercury and Other Toxicants Monitoring Program. South Florida Water Management District, West Palm Beach, FL. September 18, 2012.

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USEPA. 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories – Volume 1, Fish Sampling and Analysis, Third Edition. EPA 823-B-00-007, U.S. Environmental Protection Agency, Office of Water, Washington, DC.