Chapter 4A: STA Performance and Compliance

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Working in conjunction with the best management practices of the Everglades Agricultural Area (EAA) discussed in the previous chapter, the Stormwater Treatment Areas (STAs) represent the second stage of a phosphorus (P) control program for the northern Everglades. Four of the six STAs are fully operational and are removing P that otherwise would have gone into the Everglades Protection Area (EPA). During Water Year 2002 (WY02), STA-1W, STA-2, STA-5 and STA-6, section 1 treated more than 826 cubic hectometers (670,244 ac-ft) of water, and removed more than 83 metric tons of P, for an overall 71-percent removal rate. Flows and P inflows to the STAs increased considerably from the previous water year's drier conditions. A summary is provided in **Table 4A-1**. To date, the four operational STAs have reduced P concentrations to less than 35 parts per billion (ppb), well below the long-term design target of 50 ppb. Since the initiation of STA operation in 1994, the STAs have reduced P loads by approximately 198 tons through April 2002.

Table 4A-1. Summary of STA phosphorus removal for WY02

	STA-1W	STA-2	STA-5	STA-6
Inflow volume (acre feet)	236,731	212,807	164,737	53,437
Inflow P concentration (ppb)	148	77	244	69
Inflow P load (metric tons)	43.3	20.3	49.6	4.5
Outflow volume (acre feet)	267,624	240,685	166,692	27,945
Outflow P concentration (ppb)	38	16	78	16
Outflow P load (metric tons)	12.4	4.9	16.1	0.6
P retained (metric tons)	30.9	15.4	33.6	4.0
Load reduction (%)	71%	76%	68%	88%
To date P retained (metric tons)	123	15.4	41.8	17.3

An overview of the STA operations, vegetation, phosphorus performance, water quality monitoring, and permit compliance is presented in this section for each of the STAs. Water quality parameters that are addressed include nutrients, dissolved oxygen (DO), pesticides and mercury. This information is provided to document compliance with appropriate conditions of the Everglades Forever Act (EFA) and United States Environmental Protection Agency (USEPA) National Pollution Discharge Elimination System (NPDES) permits. Water quality monitoring within and downstream of the STAs demonstrated that the four STAs in operation are in full compliance with state operating permits. A summary of STA operations and P removal is presented in **Table 4A-2**. Appendices provide additional details of the monitoring program required by state operating permits.

Table 4A-2. Summary of STA operations

STA	Operational Status	Other Issues
STA-1 East	Under construction by U.S. Army Corps of Engineers; scheduled for completion in 2004	None identified
STA-1 West	Fully operational; in stabilization phase	None identified
STA-2	Fully operational and in stabilization phase	Monitoring elevated mercury in cell 1
STA-3/4	Under construction; scheduled for completion in October 2003	Three large contracts were taken over by a new company; reviewing recovery schedule
STA-5	Fully operational; in stabilization phase; as a result of above-average runoff during WY02, there was a diversion of 29 cubic hm (23,349 ac-ft) and 9.2 metric tons of P through G-406	None identified
STA-6	Fully operational; in post-stabilization phase	None identified

STA-1 EAST UPDATE

The construction of STA-1 East is being managed by the U.S. Army Corps of Engineers (USACE). Construction on the inflow and outflow pump stations for STA-1 East commenced in May 2000 and September 2000, respectively, and is scheduled for completion in January 2003 and February 2003, respectively, according to the August 2002 status report to Judge Hoeveler. Construction of the interior works was initiated in January 2002 and is scheduled to be completed in phases. The eastern distribution cell and cells 1 and 2 could be completed as early as March 2003; another flow path may be ready for internal startup by October 2003; all the flow paths are scheduled to be complete by January 2004. To accelerate the startup period, the South Florida Water Management District (District) and the USACE are currently discussing early hydration of treatment cells for vegetative establishment. A schematic of STA-1 East is presented in **Figure 4A-1**. Based on the 1979 through 1988 period of flow and P data used during design, the STA should receive approximately 94,000 ac-ft from the C-51 west basin and approximately 31,000 ac-ft from the S-5A basin though the G-311 structure. Actual deliveries will vary based on hydrologic conditions in the basins.

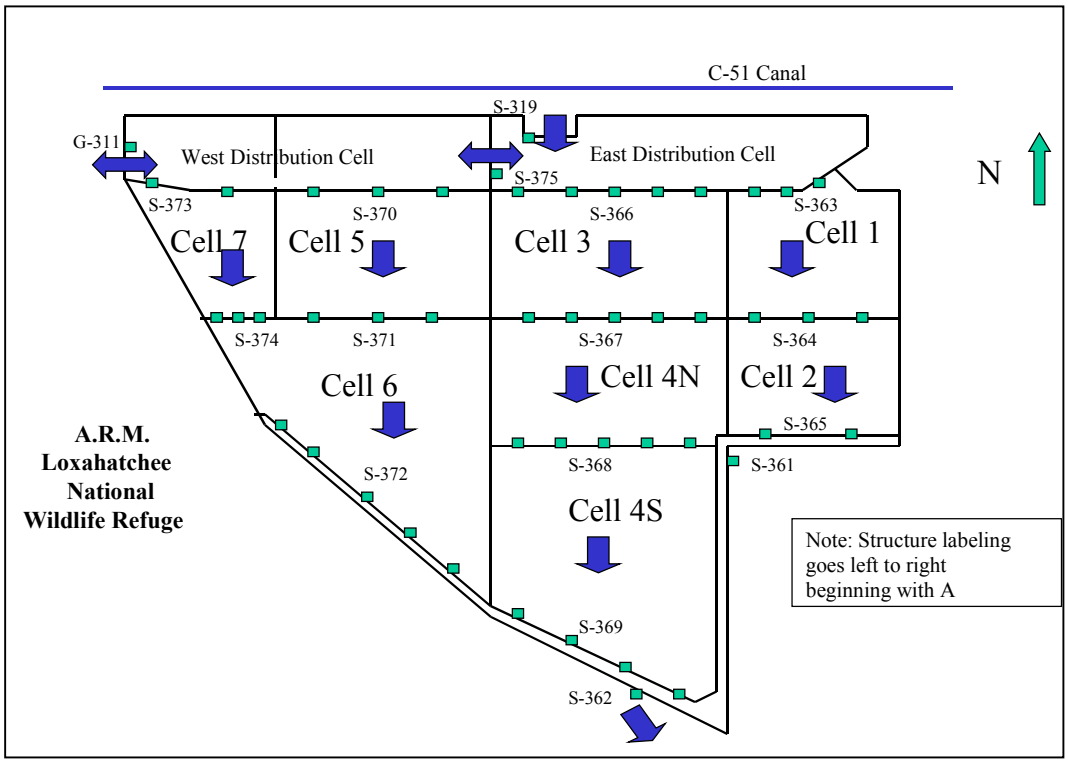


Figure 4A-1. Schematic of STA-1 east (not to scale)

STA-1 WEST

STA-1W contains approximately 6,670 acres of effective treatment area arranged in three flowways. The eastern flowway contains cells 1 and 3, with an effective treatment area of approximately 2,516 acres. The western flowway contains cells 2 and 4, with an effective treatment area of approximately 1,300 acres. The northern flowway (cell 5) consists of approximately 2,855 acres. In addition, STA-1W includes the STA-1 inflow basin, with inflow pump station S-5A and four gated spillways that allow tremendous operational flexibility. Based on the 1979 through 1988 period of flow, and on P data used during design, the STA should receive approximately 125,000 ac-ft from the S-5A basin, approximately 11,500 ac-ft from the C-51 west basin, approximately 4,300 ac-ft from the East Beach Water Control District, approximately 2,300 ac-ft of Lake Okeechobee regulatory releases, and BMP replacement water from the lake. Actual deliveries will vary based on hydrologic conditions in the basins.

Inflows into STA-1W from the S-5A pump station were directed into STA-1W (cells 1 through 4) via the G-302 and G-303 structures, and into the northern flowway (cell 5) via the G-302 and G-304-A through G-304-J structures (**Figure 4A-2**). Full flow-through operations in cells 1 through 4 have occurred since August 1994, when these cells were part of the old Everglades Nutrient Removal (ENR) Project. Full flow-through operations through cell 5 have occurred since July 2000. Treated water from STA-1W has been discharged into the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) via the G-251 and G-310 pump stations throughout WY02.

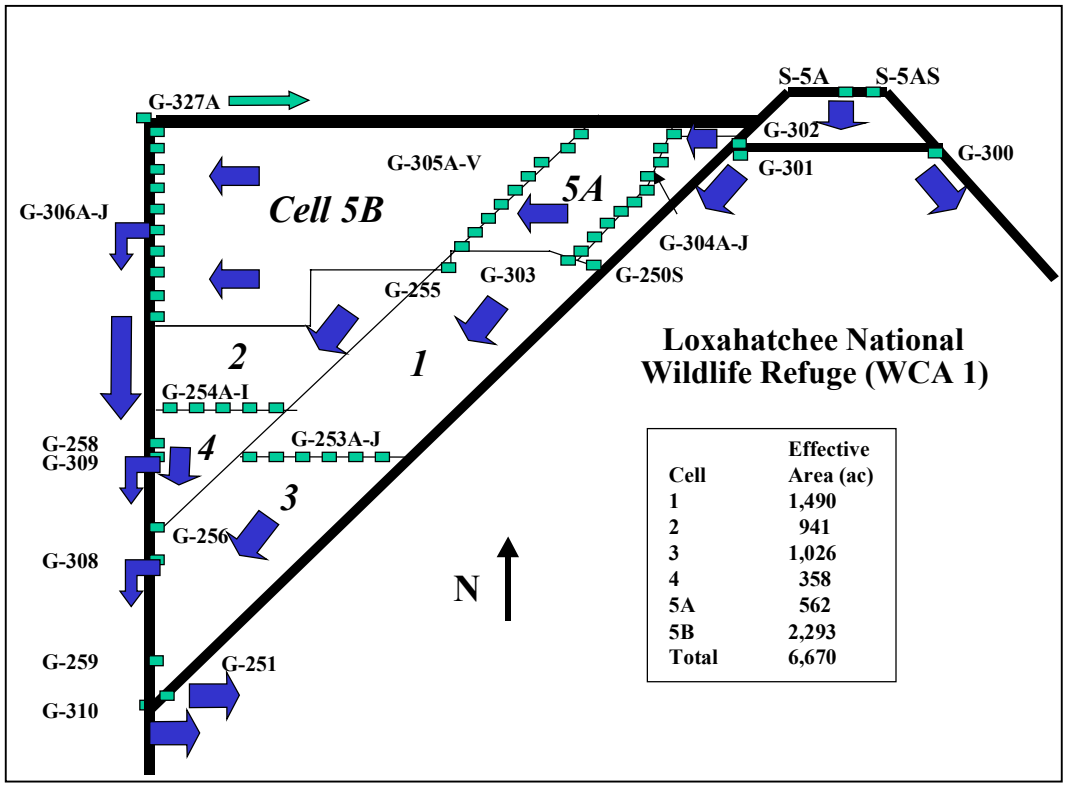
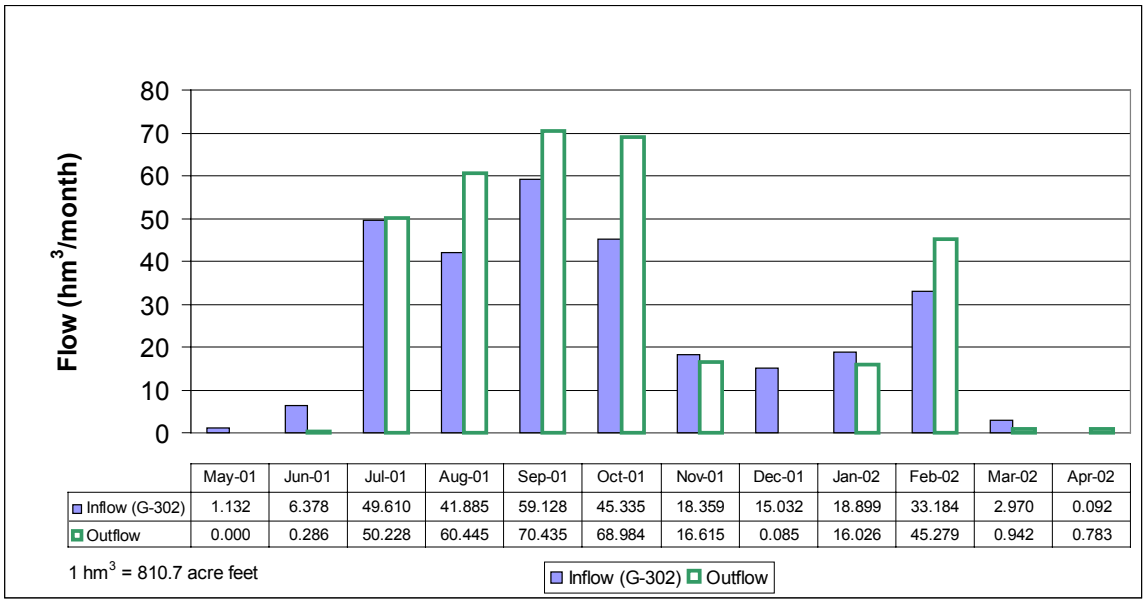


Figure 4A-2. Schematic of STA-1 west (not to scale)

STA-1W OPERATIONS

In early WY02, operations at STA-1W were influenced by the latter stages of a severe drought in South Florida. In June 2001 a typical rainfall cycle returned, and normal wet-season operation of most project structures resumed. Supplemental water was not required at any time during WY02 to protect plant communities within STA-1W, and no adverse impacts to plant communities were found. Discharge from STA-1W during the dry season closely followed significant rainfall events in the S-5A pump station basin of the EAA. Dry-season operations at STA-1W began in December 2001, when District water managers began operating the wetland in a water-conservation mode, as described in the STA-1W operation plan. In this mode, water in the wetland is conserved when it is deemed necessary to protect plant communities and to help maximize P-removal performance upon a return to flow-through conditions. Dry-season operations at STA-1W continued through the end of the reporting period.

During WY02, discharge to the STA-1W treatment cells via G-302 was approximately 292 cubic hm (236,731 ac-ft), equal to an average hydraulic loading rate of 3.0 cm/d over the effective treatment area of the STA. The annual volume of treated water discharged to the Refuge was 330 cubic hectometers (267,624 ac-ft), or about 150 percent of the anticipated long-term average annual flow for the treatment area. The difference between the inflow and outflow volumes reflects the net contributions of direct rainfall, evapotranspiration (ET), seepage from the Refuge, seepage losses to the adjacent lands, and deep percolation. A summary of monthly flows is presented in **Figure 4A-3**.



	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02
Inflow (G-302)	1.132	6.378	49.610	41.885	59.128	45.335	18.359	15.032	18.899	33.184	2.970	0.092
Outflow	0.000	0.286	50.228	60.445	70.435	68.984	16.615	0.085	16.026	45.279	0.942	0.783

Figure 4A-3. Summary of WY02 flows for STA-1W

Until STA-1E is fully operational, flows from the S-5A pump station that exceed the hydraulic capacity of STA-1W will be diverted into the Refuge through G-300 and G-301. During WY02, approximately 13,383 ac-ft (1.6 metric tons of P) were diverted in this manner.

STA-1W VEGETATION

The composition of the plant communities in STA-1W varies among the five treatment cells in the project, but is generally dominated by either cattail (*Typha* sp.) or submerged aquatic vegetation (SAV) and periphyton. Cell 1 is cattail-dominated but also contains significant amounts of SAV and periphyton; the vegetation communities appear to have stabilized. Other notable plant species in cell 1 include Carolina willow (*Salix caroliniana*) and leather fern (*Acrostichum* sp.). Cell 2 is dominated by cattail but also supports a large coverage of SAV and periphyton; the cattail clumps have floated free from the cell bottom and are blown around the cell by local winds. Cell 3 is dominated by cattail, but still contains a stable mosaic of native wetland plant species planted during the construction of the ENR Project. Cell 4 is an SAV and periphyton cell by design; any emergent plant species are controlled using appropriate herbicides. Cell 5A is managed as an emergent marsh and is dominated by cattail, while cell 5B is an SAV- and periphyton-dominated cell.

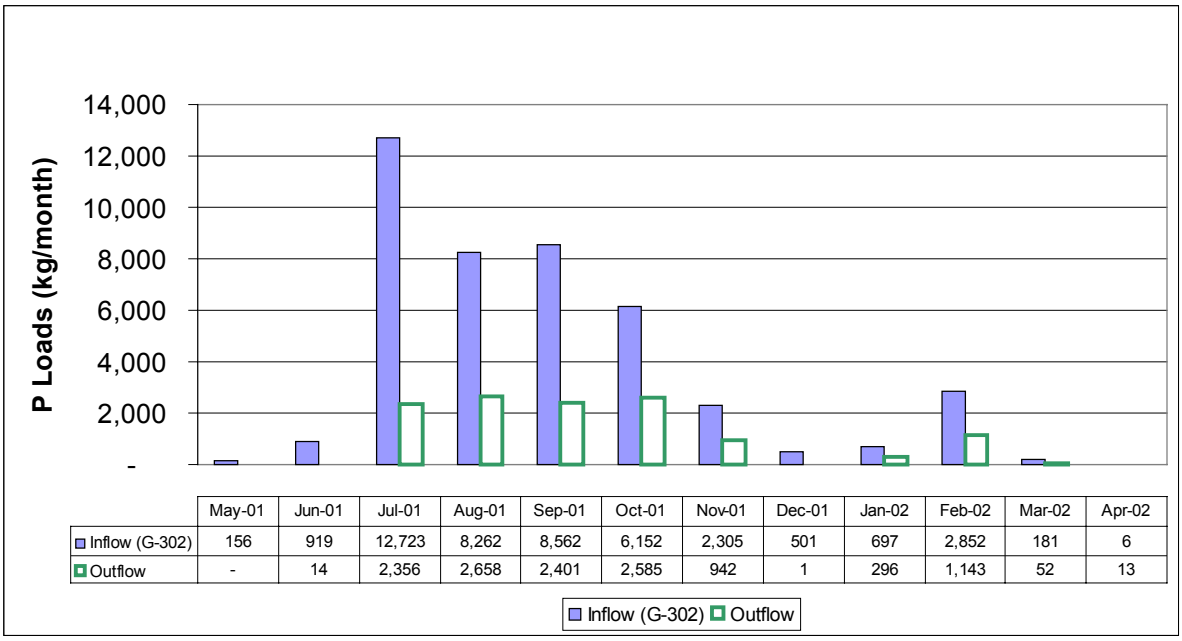
Specific condition 13(b) of the EFA permit requires that the annual Everglades Consolidated Report (ECR) include information regarding the application of herbicides to exclude and/or eliminate undesirable vegetation within the treatment cells. For this reporting period, the District applied a total of 633 gallons of the herbicide Rodeo, 28.5 gallons of Arsenal, and 79 gallons of various adjuvants (inert liquids used to help distribute the herbicide) to control nuisance vegetation. Both aerial and ground-based spray equipment were used to apply these herbicides.

STA-1 WEST WATER QUALITY MONITORING

The data presented in this section demonstrate that STA-1W was in compliance with the EFA and NPDES operating permits for this reporting period and that discharges do not pose any known danger to public health, safety or welfare. Specific Condition 14(C) of the EFA permit states that STA-1W will remain in the stabilization phase of operation until STA-1E and STA-2 begin flow-through operations. At this time, STA-2 has begun flow-through operations, but STA-1E is not expected to begin flow-through operations until 2003.

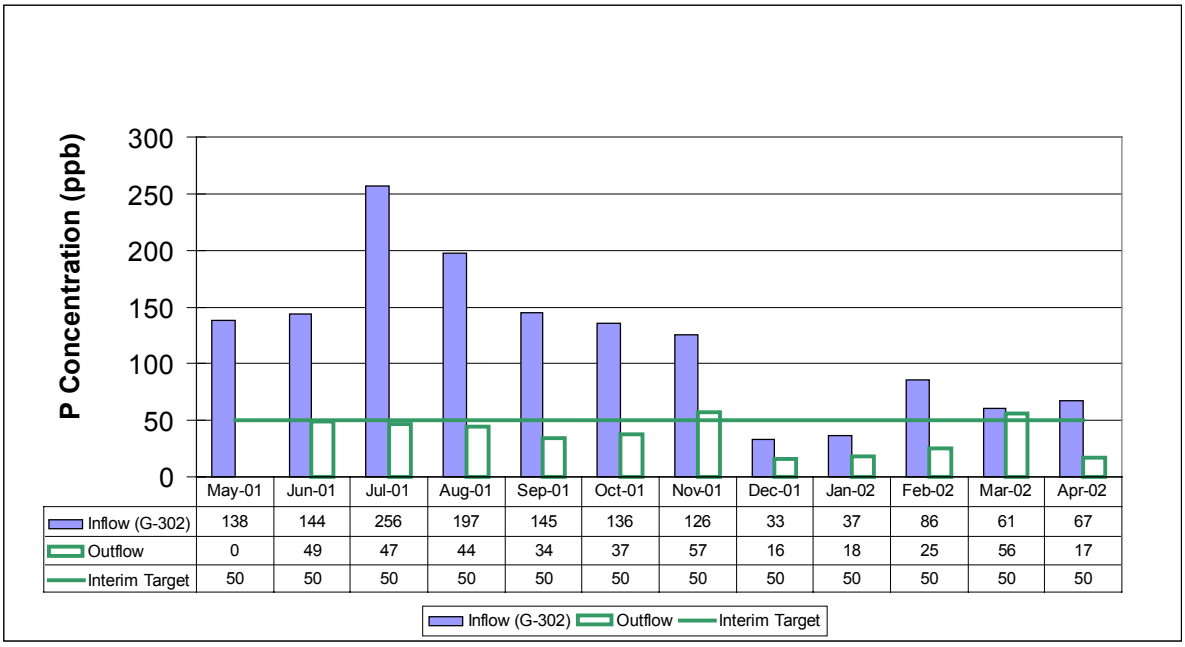
Total Phosphorus

Under the design objectives of the Everglades Forever Act (EFA), STA-1W continues to achieve its interim discharge goal of less than 50 parts per billion for total phosphorus (P). During WY02 the STA received 43.3 metric tons of P through the G-302 inflow structure, equal to a nutrient loading rate of 1.6 grams/square meter. Approximately 30.9 metric tons of P were removed by STA-1W during WY02. Monthly discharge concentrations were considerably lower than inflow concentrations. Between May 2001 and April 2002, STA-1W reduced P discharge loads by 71 percent compared to inflow loadings measured at G-302. A summary of monthly P loads and flow-weighted mean P concentrations is presented in **Figures 4A-4** and **4A-5**. The flow-weighted mean outflow concentration was 38 ppb, a 75-percent reduction from the inflow concentration of 148 ppb measured at G-302. For informational purposes, the geometric mean P concentration of the discharge was calculated as 26 ppb, using autosampler data from G-251 and G-310. Permit compliance requires that outflow P concentrations must also be reported as moving 12-month flow-weighted mean values. As shown in **Figure 4A-6**, P values have been in compliance with permit conditions at the outflow pump stations for this entire reporting period. The moving 12-month flow-weighted mean P outflow concentration for STA-1W ranged from 38 to 46 ppb.



	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02
Inflow (G-302)	156	919	12,723	8,262	8,562	6,152	2,305	501	697	2,852	181	6
Outflow	-	14	2,356	2,658	2,401	2,585	942	1	296	1,143	52	13

Figure 4A-4. Summary of WY02 phosphorus loads for STA-1W



	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02
Inflow (G-302)	138	144	256	197	145	136	126	33	37	86	61	67
Outflow	0	49	47	44	34	37	57	16	18	25	56	17
Interim Target	50	50	50	50	50	50	50	50	50	50	50	50

Figure 4A-5. Summary of WY02 phosphorus concentrations for STA-1W

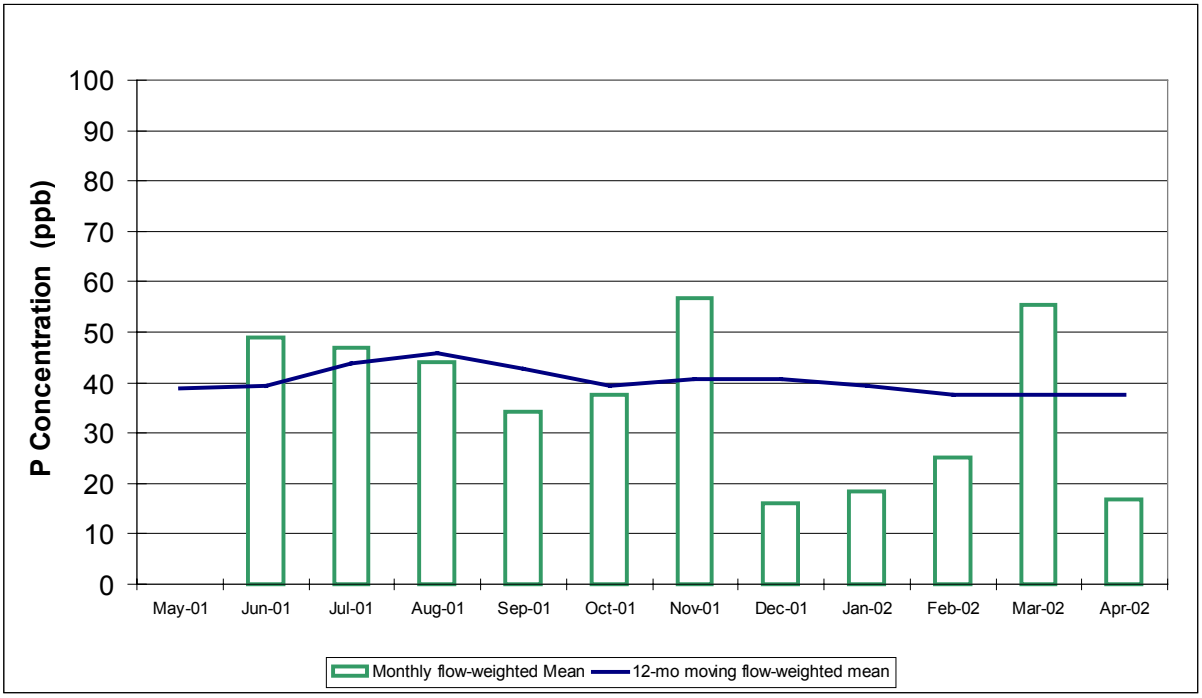


Figure 4A-6. Comparison of monthly to 12-month moving average phosphorus concentrations for WY02 for STA-1W

Other Water Quality Parameters

Water quality parameters with Class III standards are identified in **Table 4A-3**. The monitoring data for non-phosphorus parameters at STA-1W during this reporting period are presented in **Appendix 4A-1** and are summarized in **Table 4A-4**. Temperature, specific conductance, dissolved oxygen (DO) and pH values reported in this chapter are field measurements. While atrazine was detected in the outflow, this herbicide is not used within the STA. 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 STA-1W 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 STA-1W 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 STA-1W shall be deemed out of compliance.

Discharges from STA-1W were determined to be in compliance by satisfying the initial test.

Additional requirements for DO are listed in Administrative Order AO-002-EV and are discussed below. Mercury monitoring results are also discussed in a proceeding section.

Table 4A-3. Water quality parameters with Class III criteria specified in Section 62-302.530, Florida Administrative Code

Parameter	Units	Class III Criteria
Dissolved Oxygen	mg/L	Greater than or equal to 5.0 mg/L
Specific Conductivity	µmhos/cm	Not greater than 50% of background or greater than 1,275 µmhos/cm, whichever is greater
pH	standard units	Not less than 6.0 or greater than 8.5
Turbidity	NTU	Less than or equal to 29 NTU above background conditions
Unionized Ammonia	mg/L	Less than or equal to 0.02 mg/L
Alkalinity	mg/L	Not less than 20 mg/L
Total Iron	µg/L	Less than or equal to 1,000 µg/L

Table 4A-4. Summary of annual arithmetic averages and flow-weighted means for water quality parameters other than total phosphorus monitored in STA-1W

Parameter	Arithmetic Means			Flow-Weighted Means			
	Inflow	Outflow		Total Inflow		Total Outflow	
	S5A	G251	G310	n	Conc.	n	Conc.
Temperature (°C)	24.9	24.4	24.6	-NA-	-NA-	-NA-	-NA-
Dissolved Oxygen (mg/L)	3.8	2.1	3.4	-NA-	-NA-	-NA-	-NA-
Specific Conductivity (µmhos/cm)	1,162	1,116	1,117	-NA-	-NA-	-NA-	-NA-
pH	7.5	7.5	7.5	-NA-	-NA-	-NA-	-NA-
Turbidity (NTU)	6.5	1.9	5.2	-NA-	-NA-	-NA-	-NA-
Total Dissolved Solids (mg/L)	749	708	700	10 (26)	848	18 (52)	637
Unionized Ammonia (mg/L)	0.0058	0.0020	0.0040	10 (26)	0.0093	18 (52)	0.0017
Orthophosphate as P (mg/L)	0.069	0.008	0.010	10 (26)	0.127	18 (52)	0.012
Total Dissolved Phosphorus (mg/L)	0.076	0.013	0.015	10 (26)	0.135	18 (52)	0.018
Sulfate (mg/L)	77.2	58.4	62.3	10 (26)	88.8	18 (52)	61.3
Alkalinity (mg/L)	263	249	250	10 (26)	308	18 (52)	228
Dissolved Chloride (mg/L)	166	160	157	10 (26)	181	18 (52)	140
Total Nitrogen (mg/L)	3.03	2.46	2.51	10 (26)	4.30	18 (52)	2.53
Total Dissolved Nitrogen (mg/L)	2.85	2.35	2.36	10 (26)	3.98	18 (52)	2.31
Nitrate + Nitrite (mg/L)	0.587	0.012	0.052	10 (26)	1.110	18 (52)	0.026
Ametryn (µg/L)	0.072	0.044	0.056	1 (6)	0.069	2 (8)	0.056
Atrazine (µg/L)	0.625	0.471	0.513	1 (6)	0.120	2 (8)	0.134

-NA- : Not Applicable
n: number of samples with flow (total number of samples)

The District has included the following documentation to satisfy the remaining monitoring requirements of the EFA permit:

- The District has performed all sampling and analysis under the latest FDEP-approved CompQAP No. 870166G (June 1999).
- A signed copy of this statement is provided in **Appendix 4A-2**.

STA-1 WEST DISSOLVED OXYGEN MONITORING

Introduction

Dissolved oxygen (DO) concentrations fluctuate naturally in marsh environments, such as the Everglades, and routinely fall below the Class III water quality criterion of 5 mg/L. STAs also experience natural fluctuations in DO that routinely fall below 5 mg/L, as was observed in DO data collected in the ENR Project (ENR Monitoring Report Appendices, 1995 to 1998). The Florida Department of Environmental Protection (FDEP) recognized the phenomenon of fluctuating DO concentrations in the EFA permit issued to the District for STA-1W (Administrative Order No. AO-002-EV in Exhibit C of Permit No. 503074709, April 13, 1999). To address DO in STA discharges, section II of the Administrative Orders requires the District to provide the FDEP an annual report consisting of an analysis demonstrating that DO levels in STA discharges do not adversely change the downstream Everglades ecology or downstream water quality based on the following:

- Comparison of DO levels in STA discharges with background conditions in receiving waters
- Evaluation of DO levels at representative interior Everglades marsh stations, demonstrating that STA discharges fully maintain and protect the existing designated uses of the downstream waters and the level of water quality consistent with applicable anti-degradation requirements
- Evaluation of whether discharges are necessary or desirable and are otherwise in the public interest
- Depiction of the daily and seasonal diel cycles for STA DO discharges during the period covered by the STA annual report
- Comparison of STA effluent with other historic DO data from the Everglades Protection Area (EPA), including data from interior marsh stations within the A.R.M. Loxahatchee National Wildlife Refuge (STA-1W), the Rotenberger Tract (STA-5), and any other locations downstream of the STA discharges
- Consideration of the influences of temperature, seasonal weather conditions, aquatic community type, and hydropattern on the diel cycle of the STA discharges

Sampling Locations

The District developed the following plan to comply with the DO requirements of the Administrative Orders for STA-1W. Under the plan, DO concentrations are measured quarterly with Hydrolab™, DataSonde® or MiniSonde® probes at 30-minute intervals for four consecutive days at the following locations:

- On the south side of the C-51 canal upstream of S-5A (**Figure 4A-2**)
- Downstream of the G-251 and G-310 discharge structures (**Figure 4A-2**)
- At sites along the X, Y, and Z transects in the periphery of the interior Arthur R Marshall Loxahatchee National Wildlife Refuge marshes downstream of the combined discharges (**Figure 4A-7**)

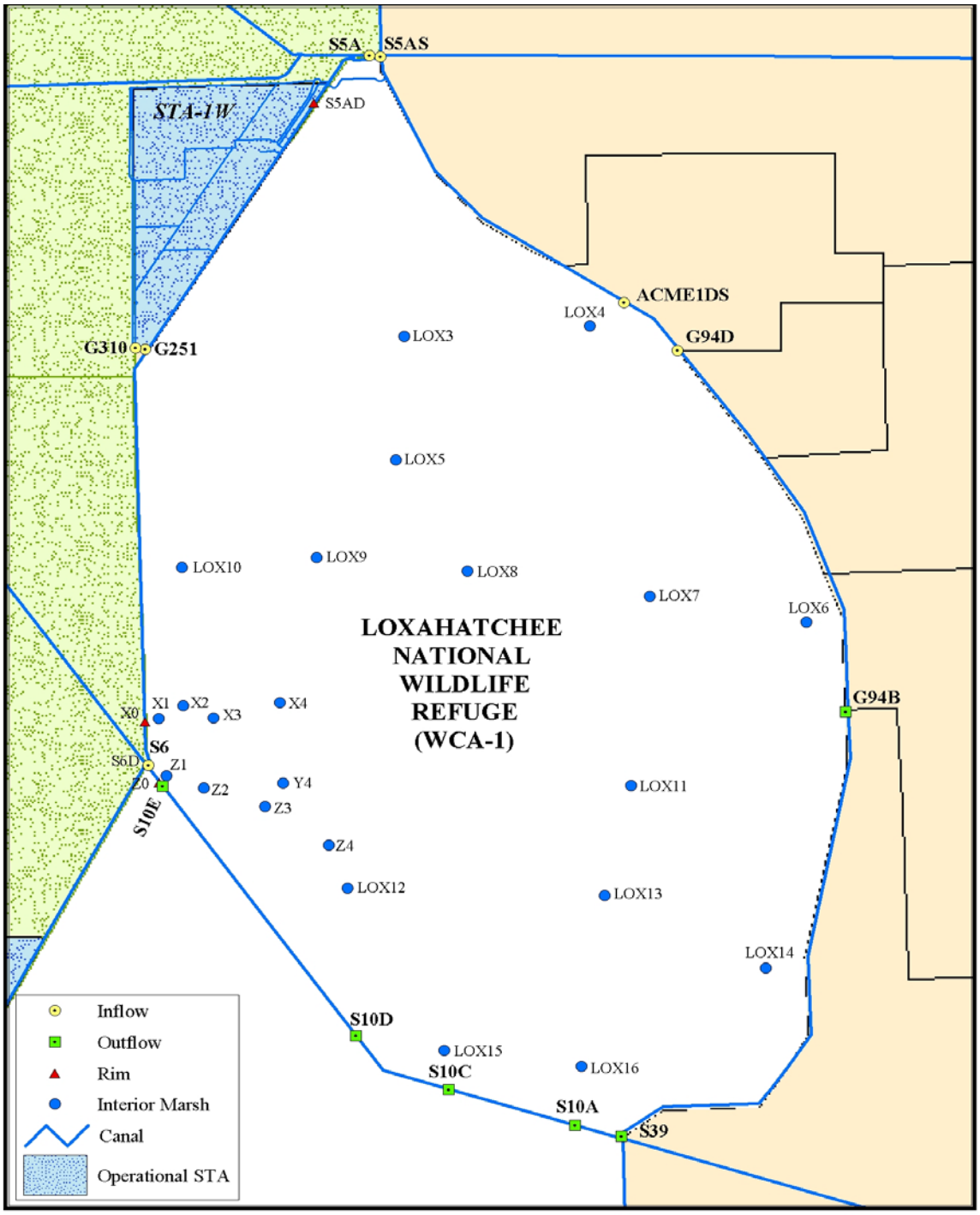


Figure 4A-7. Location and classification of water quality monitoring stations in the Arthur R. Marshall Loxahatchee National Wildlife Refuge. Note: the Refuge also includes the Snail Farm and Strazzulla properties

Sampling Dates

Diel oxygen measurement dates and sites for WY02 are provided in **Table 4A-5**.

Table 4A-5. Deployment dates for diel oxygen measurements at STA-1W structures and associated downstream marsh sites

Event Dates		Structures			Sites Monitored in Refuge
Start	End	Inflow	Outflow		
05/07/2001	05/14/2001	S5AU	G251D	G310	----------
07/11/2001	07/17/2001	S5AU	G251D	G310	X1, X2, X3, Z1, Z2, Z3, Z4
10/08/2001	10/12/2001	S5AU	G251D	G310	X1, X2, X3, X4, Y4, Z1, Z2, Z3, Z4, MESO01
12/12/2001	12/17/2001	S5AU	G251D	G310	----------
01/03/2002	01/09/2002	S5AU	G251D	G310	----------
01/23/2002	01/28/2002	------	------	------	X1, X2, X3, X4, Y4, Z1, Z2, Z3, Z4, MESO01
04/02/2002	04/09/2002	S5AU	G251D	G310	----------
04/22/2002	04/26/2002	------	------	------	X1, Y4, Z1, Z3, MESO01

Comparison of Dissolved Oxygen in STA-1W Discharges with Dissolved Oxygen at Downstream Marsh Sites

Comparisons of DO in STA-1W discharges with DO at downstream marsh sites in the Refuge provide an indication of whether the discharge is affecting the marsh DO concentration or the diel oxygen cycle. The summary statistics for STA-1W outflows and Refuge marsh transect sites are presented in **Table 4A-6**. The complete DO data sets collected at all sites during WY02 are presented in **Appendix 4A-3**. Examination of this table indicates that the median diel DO values of discharges from G-251 and G-310 were greater than transects sites X1, X3, X4, Y4, Z1, Z2 and Z4.

Table 4A-6. Statistical summary of diel dissolved oxygen at outflow stations (G-251D and G-310) and transect stations (X, Y, Z and mesocosm) in the Refuge during eight deployment periods

Location	Station	Number of Measurements	Mean	Minimum	Median	Maximum	Standard Deviation
Outflow	G251D	1,663	3.74	0.25	3.49	7.45	1.58
	G310	1,664	4.44	0.84	4.19	8.45	1.77
Transect X	X1	605	2.60	0.11	1.87	12.44	2.43
	X3	619	3.02	0.65	2.53	8.20	1.61
	X4	422	3.92	1.77	3.31	8.68	1.54
Transect Y	Y4	607	3.10	0.24	3.05	7.01	1.58
Transect Z	Z1	802	1.15	0.01	0.84	3.56	1.03
	Z2	619	3.83	0.29	3.44	14.43	2.82
	Z3	606	4.60	0.34	4.96	8.30	1.85
	Z4	620	3.71	0.9	3.52	7.06	1.41
Mesocosm	MESO01	500	5.44	1.31	5.55	8.94	1.32

See **Appendix 4-4**, **Table 2** for statistical summaries by event and diel parameter

Notched box and whisker plots were created from the data in **Table 4A-5** as another method for analyzing differences between monitoring sites. The median diel DO concentrations in the discharges from G-251 were significantly greater than the median diel DO concentrations at marsh sites Z1, X1, X3 and Y4. Diel DO concentrations in G-310 discharges were also significantly greater than those at marsh sites Z2, Z4, and X4, leaving only marsh sites Z3 and MESO01 with significantly higher concentrations than those in the discharges (**Figure 4A-8)**. The notched box plots also show that the diel DO concentrations in the Refuge significantly improve from the impacted sites near the L-7 rim canal (X1 and Z1) to the interior sites.

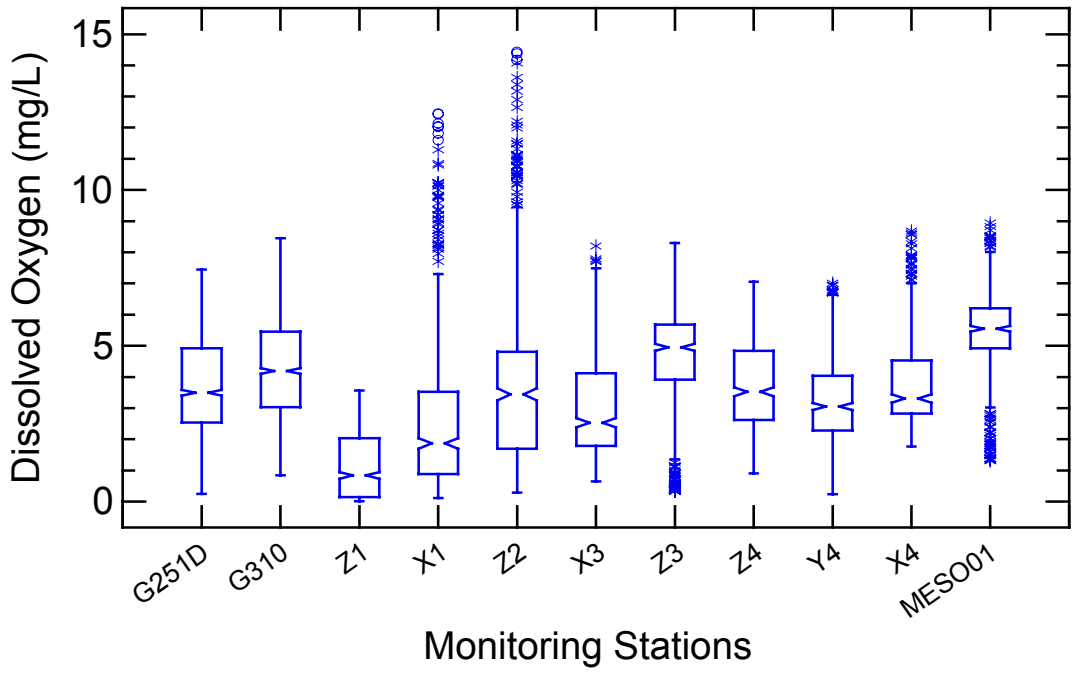


Figure 4A-8. Notched-box and whisker plots of diel dissolved oxygen measurements at STA-1W outflow stations (G-251D and G-310) and along transect sites in the Refuge during eight monitoring periods. The notch on a box plot represents the 95-percent confidence interval about the median, which is represented by the narrowest part of the notch. The top and bottom of the box represent the 75th and 25th percentiles, respectively. The whiskers represent the highest and lowest data values that are within two standard deviations of the median. Values above and below the whiskers are greater than two standard deviations from the median. Notches that do not overlap indicate that the data represented by the boxes being compared are significantly different at the 95-percent confidence level

Based on the data presented, it appears that the diel DO concentrations in the STA-1W discharges did not affect the low DO concentrations observed at marsh transect stations. The diel DO patterns observed at transect sites X1 and Z1 are largely due to the long-term effects of P loading to the rim canal. Patterns at the more interior transect sites are the result of water depth and habitat vegetation differences. Ultimately, P load reductions to the Refuge should improve DO conditions at the transect sites affected by rim canal water penetration into the marsh.

STA-1 West Mercury

The results of mercury compliance monitoring for routine operation are summarized in **Appendix 4A-4**. During WY02 there were no violations of the Florida Class III numerical water quality standard of 12 ng/L unfiltered total mercury (THg). As such, the Everglades Construction Project (ECP) has met one of the requirements of the operating permits.

Like the ENR Project it subsumed, STA-1W continued to have only low concentrations of methylmercury (MeHg) in surface water, consistently showed both Hg and MeHg reduction across the STA, and exhibited greatly reduced MeHg bioaccumulation in resident fish relative to other STAs and other Everglades areas.

STA-2

STA-2 contains approximately 6,430 acres of effective treatment area arranged in three parallel flowways. The eastern flowway (cell 1) consists of approximately 1,990 acres of effective treatment area. The center flowway (cell 2) consists of approximately 2,220 acres of effective treatment area. The western flowway (cell 3) consists of approximately 2,220 acres of effective treatment area. A schematic of STA-2 is presented in **Figure 4A-9**. Based on the 1979 through 1988 period of flow, and based on phosphorus (P) data used during design, the STA should receive approximately 163,000 ac-ft from the S-6 and S-5A basins, approximately 8,300 ac-ft from the East Shore Water Control District and Closter Farms, approximately 3,000 ac-ft of Lake Okeechobee regulatory releases, and BMP replacement water from the lake. Actual deliveries will vary based on hydrologic conditions in the basins.

Water enters the STA from the S-6 and G-328 pump stations, is distributed by the inflow canal across the north end of the treatment cells, and flows via gravity south through the three treatment cells. Treated water is collected and discharged to WCA-2A via the G-335 outflow pump station. Discharges are directed to areas within WCA-2A that are already impacted by elevated nutrient levels.

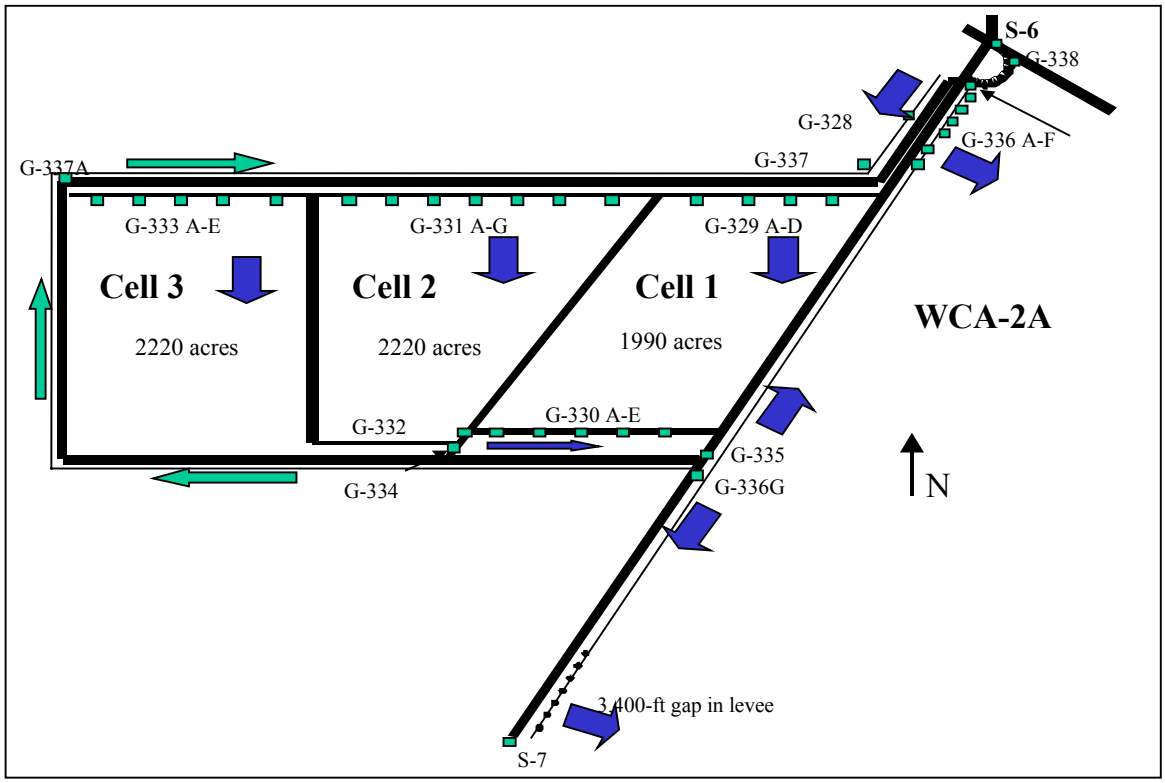
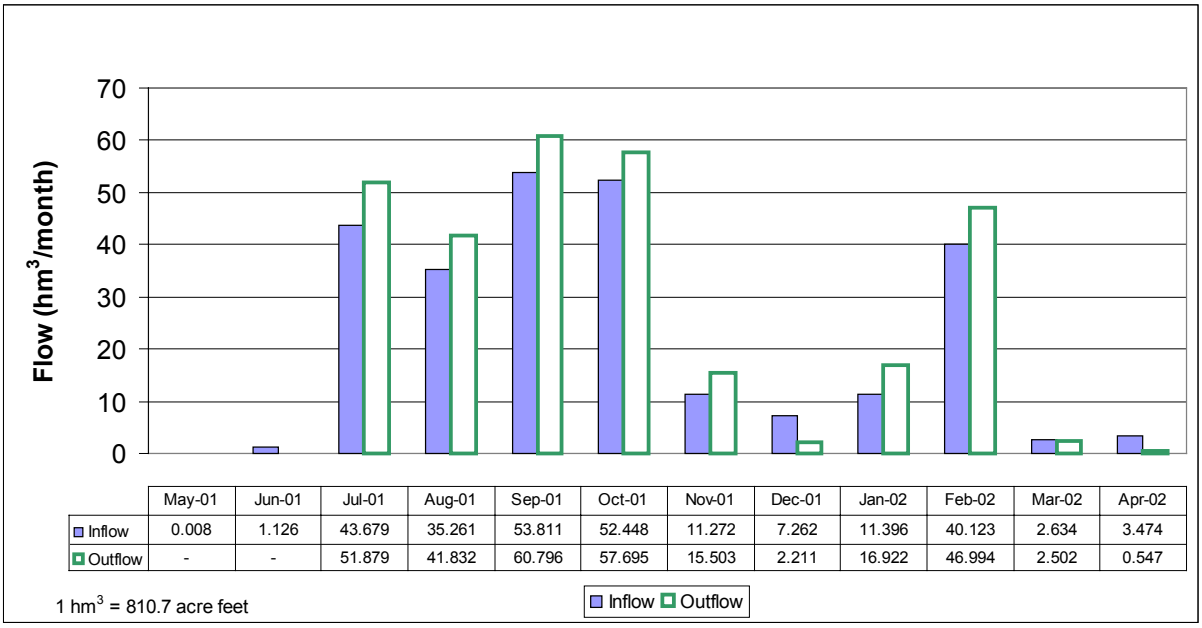


Figure 4A-9. Schematic of STA-2 (not to scale)

STA-2 OPERATIONS

Startup operations for STA-2 began upon the completion of the three treatment cells in 1999. Inflow to the STA commenced in June 1999 from the 450-cfs pump station G-328; water levels were maintained for optimal growth of desired vegetation. Construction of the 3,040-cfs outflow pump station (G-335) was completed in 2000, with final operational testing taking place in October 2000. The final construction component, connection of the S-6 pump station to the inflow canal, was completed during the dry season of 2001, a schedule that minimized the potential down time of pump station S-6. The outflow structures in cell 1 (G-330S) were recently fitted with weir plates to increase water depths in the cell, which should reduce the frequency and duration of drydowns within the cell.

During WY02, approximately 262 cubic hm (212,807 ac-ft) of water was captured and treated by STA-2, equal to an average hydraulic load of 2.8 cm/day over the treatment area. The annual volume of treated water discharged to WCA-2A was 297 cubic hectometers (240,685 ac-ft), or about 120 percent of the anticipated average annual flow for the treatment area. The difference between the inflow and outflow volumes reflects the net contributions of direct rainfall, ET, seepage losses to the adjacent lands, and deep percolation. A summary of monthly flows is presented in **Figure 4A-10**. Minimal flows (less than 100 ac-ft and less than 10 kg of P) were diverted around STA-2 in association with restricted operations in cell 1.



	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02
Inflow	0.008	1.126	43.679	35.261	53.811	52.448	11.272	7.262	11.396	40.123	2.634	3.474
Outflow	-	-	51.879	41.832	60.796	57.695	15.503	2.211	16.922	46.994	2.502	0.547

Figure 4A-10. Summary of WY02 flows for STA-2

STA-2 VEGETATION

STA-2 water levels are managed to protect the established wetland plant community within each treatment cell. Cells 1 and 2 in STA-2 are dominated by stable emergent vegetation, such as sawgrass (*Cladium jamaicense*), with some cattail (*Typha* sp.). Cell 3 is maintained to promote the growth of submerged aquatic vegetation (SAV) and is still in a grow-in phase.

Specific Condition 27 of the EFA permit also requires the District to report information regarding the application of herbicides and pesticides used to control undesirable vegetation and pests within the project. For this reporting period, 40 gallons of the herbicide Arsenal EUP, 80 gallons of the herbicide Glyphosate, and 85 gallons of various adjuvants (inert liquids used to help distribute the herbicide) were applied in STA-2 to control Old World climbing fern (*Lygodium microphyllum*), Brazilian pepper (*Schinus terebinthifolius*) and other nuisance vegetation. All herbicides were applied using aerial spray equipment.

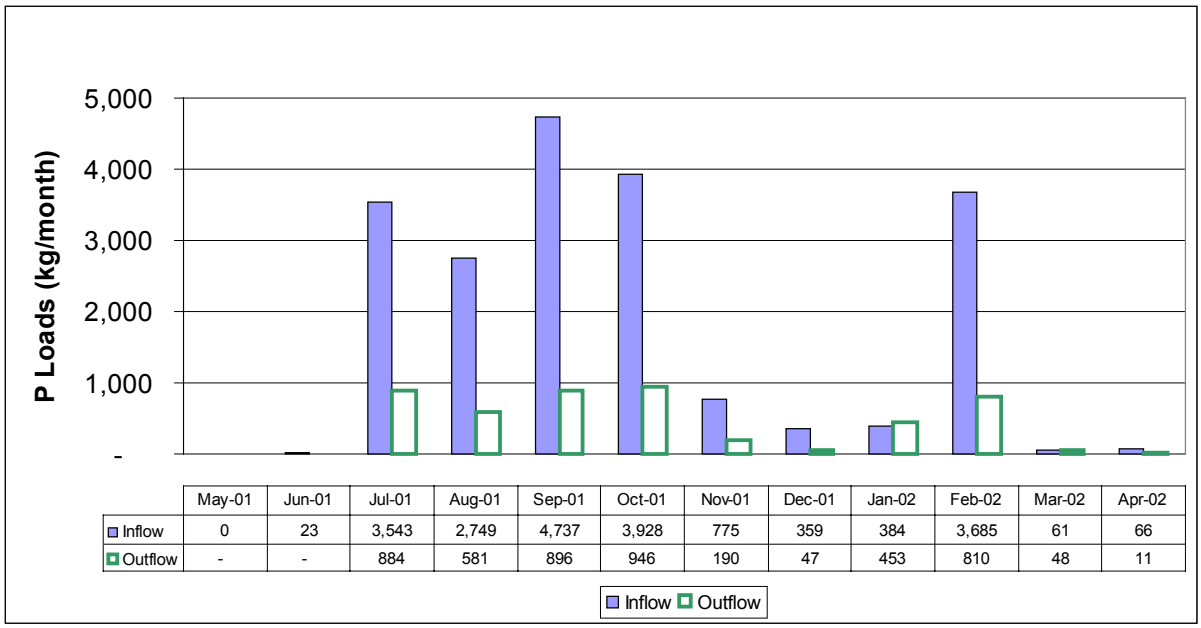
STA-2 PERMIT WATER QUALITY MONITORING

Monitoring data collected for STA-2 demonstrate that STA-2 was in compliance with the EFA and NPDES operating permits for WY02 and that discharges do not pose any known danger to public health, safety, or welfare. Cells 2 and 3 are in the stabilization phase, having demonstrated net improvement in P and mercury. However, though cell 1 has demonstrated a net improvement in P, it will remain in the startup phase until it demonstrates a net improvement in mercury, as discussed in greater detail below. In addition, Specific Condition 14(B) of the EFA permit states that STA-2 will remain in the stabilization phase of operation until STA-1E and STA-3/4 begin flow-through operations. At this time, STA-1E and STA-3/4 are still in the construction phase and are not expected to begin flow-through operations until late 2003 through early 2004, subject to vegetation grow-in and soil P stabilization.

Total Phosphorus

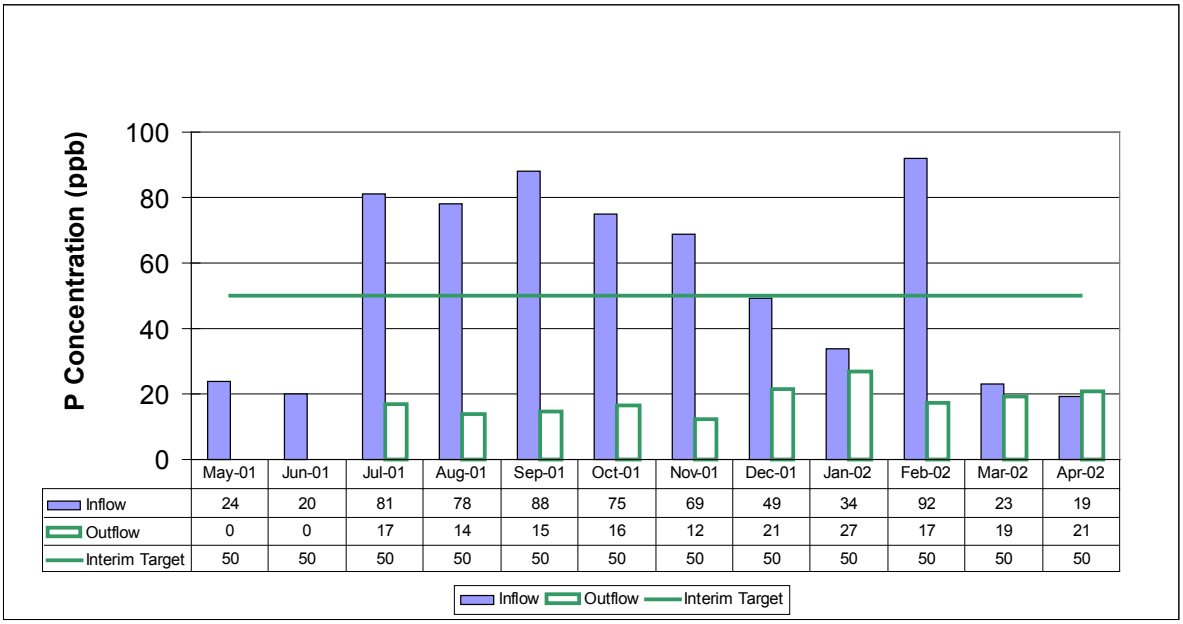
The EFA and NPDES operating permits were issued for this project on September 29, 2000. Each treatment cell in STA-2 operates independently, and the permit authorizes discharges when net improvement in P and mercury is demonstrated for each cell. STA-2 cells 2 and 3 passed the net improvement startup tests for P and mercury on September 13 and November 9, 2000, respectively. STA-2 cell 1 passed the startup test for P but did not pass the startup criteria for mercury. After review of the cell 1 mercury situation by the FDEP, the USEPA, and other agencies, it was determined that the most effective way to reduce mercury concentrations in cell 1 was to move as much water through the cell as possible to increase sulfur levels. On August 9, 2001 a draft permit modification was issued to initiate flow-through operations for cell 1.

Under the design objectives of the Everglades Forever Act, STA-2 is achieving its interim discharge goal of less than 50 ppb for total phosphorus (TP). During WY02 the STA received 20.3 metric tons of P, equal to a nutrient loading rate of 0.8 grams/sq m. STA-2 removed approximately 15.4 metric tons of P during WY02. Monthly discharge concentrations were considerably lower than inflow concentrations; between May 2001 and April 2002, STA-2 reduced discharge loads of P by 76 percent. A summary of monthly P loads and flow-weighted mean P concentrations is presented in **Figure 4A-11** and **Figure 4A-12**. The annual flow-weighted mean outflow concentration was 16 ppb, a 79-percent reduction from the inflow concentration of 77 ppb. During the dry season, there were occasional months of higher P levels in the outflow than in the inflow; however, the loads were minor compared to the annual totals. For informational purposes, the annual geometric mean discharge P concentration for STA-2 was 18 ppb for Water Year 2002. By virtue of achieving an outflow concentration of less than 50 ppb in accordance with the EFA permit for STA-2, cells 2 and 3 would have been deemed past the stabilization phase if not for the requirement that STA-2 should remain in the stabilization phase until STA-1E and STA-3/4 begin full flow-through operation. The initial 12-month moving average P concentration from STA-2 was 16 ppb.



	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02
Inflow	0	23	3,543	2,749	4,737	3,928	775	359	384	3,685	61	66
Outflow	-	-	884	581	896	946	190	47	453	810	48	11

Figure 4A-11. Summary of WY02 phosphorus loads for STA-2



	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02
Inflow	24	20	81	78	88	75	69	49	34	92	23	19
Outflow	0	0	17	14	15	16	12	21	27	17	19	21
Interim Target	50	50	50	50	50	50	50	50	50	50	50	50

Figure 4A-12. Summary of WY02 phosphorus concentrations for STA-2

Other Water Quality Parameters

The monitoring data for non-phosphorus parameters at STA-2 during this reporting period are presented in **Appendix 4A-5** and are summarized in **Table 4A-7**. 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 STA-2 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 STA-2 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 STA-2 shall be deemed out of compliance.

Discharges from STA-2 were determined to be in compliance by satisfying the initial test.

Additional requirements for dissolved oxygen are listed in Administrative Order AO-006-EV and are discussed below. Mercury monitoring results are also discussed in a proceeding section.

The District has included the following documentation to satisfy the remaining monitoring requirements of the EFA permit:

- The District has performed all sampling and analysis under the latest FDEP-approved CompQAP No. 870166G (June 1999).
- A signed copy of this statement is provided in **Appendix 4A-2**.

Table 4A-7. Summary of annual arithmetic averages and flow-weighted means for water quality parameters other than total phosphorus monitored in STA-2.

Parameter	Arithmetic Means			Flow-Weighted Means			
	Inflow		Outflow	Total Inflow		Total Outflow	
	S6	G328	G335	n	Conc.	n	Conc.
Temperature (°C)	24.8	25.0	25.3	-NA-	-NA-	-NA-	-NA-
Dissolved Oxygen (mg/L)	3.1	3.6	4.8	-NA-	-NA-	-NA-	-NA-
Specific Conductivity (µmhos/cm)	1,186	1,534	1,275	-NA-	-NA-	-NA-	-NA-
pH	7.4	7.5	7.7	-NA-	-NA-	-NA-	-NA-
Turbidity (NTU)	3.5	4.5	6.0	-NA-	-NA-	-NA-	-NA-
Total Dissolved Solids (mg/L)	780	972	791	15 (42)	809	15 (21)	744
Unionized Ammonia (mg/L)	0.0052	0.0075	0.0023	15 (42)	0.0069	14 (19)	0.0014
Orthophosphate as P (mg/L)	0.025	0.010	0.005	16 (44)	0.063	15 (21)	0.006
Total Dissolved Phosphorus (mg/L)	0.030	0.012	0.008	15 (42)	0.066	15 (21)	0.008
Sulfate (mg/L)	61.1	47.7	47.1	15 (42)	72.6	15 (21)	45.5
Alkalinity (mg/L)	315	380	306	16 (44)	338	15 (21)	285
Dissolved Chloride (mg/L)	161	259	187	16 (44)	161	15 (21)	181
Total Nitrogen (mg/L)	2.97	2.68	2.44	16 (43)	4.34	15 (21)	2.28
Total Dissolved Nitrogen (mg/L)	2.87	2.56	2.32	15 (41)	4.07	15 (21)	2.19
Nitrate + Nitrite (mg/L)	0.451	0.332	0.113	16 (43)	1.263	15 (21)	0.120

-NA- : Not Applicable
n: number of samples with flow (total number of samples)

Dissolved Oxygen Monitoring

Introduction

STA-2 Administrative Order No. AO-006-EV in Exhibit C of the EFA STA-2 permit (permit No. 0126704, September 29, 2000) specifies the same dissolved oxygen (DO) monitoring requirements as those for STA-1W. The District developed the following plan to comply with the DO requirements of the administrative orders for STA-2. Under the plan, DO concentrations are measured quarterly with Hydrolab™ DataSonde®, or MiniSonde® probes at 30-minute intervals for four consecutive days at the following locations:

- At the inflow side of the S-6 pump station
- At the inflow side of the G-328 pump station
- At sites along the N, C, S and Z transects in the northwest section of WCA-2A, located downstream of culverts distributing flow from discharge pump station G-335
- Diel oxygen measurement dates and sites for WY02 are provided in **Table 4A-8**

Table 4A-8. Deployment dates for diel oxygen measurement at STA-2 structures and associated downstream marsh sites

Event Dates		Structures			Sites Monitored in Water Conservation Area 2
Start	End	Inflow		Outflow	
09/05/2001	09/12/2001	S6	G328	G335	C.25, C1, N.25, N1, S4, Z.5, Z1, Z2, Z4
11/15/2001	11/21/2001	S6	G328	G335	C.25, C1, N.25, N1, S4, Z.5, Z1, Z2, Z4
03/06/2002	03/13/2002	S6	G328	G335	----------

Comparison Of Dissolved Oxygen in STA-2 Discharges with Dissolved Oxygen at Downstream WCA-2A Sites

Comparisons of DO in STA-2 discharges with DO at downstream marsh sites in WCA-2A provide an indication of whether the discharges are affecting the marsh DO concentration or the diel oxygen cycle. The summary statistics for STA-2 outflows and WCA-2A marsh transect sites are presented in **Table 4A-9**. The complete data sets collected at all sites during WY02 are in **Appendix 4A-6**. Examination of this table shows that the median diel DO concentration in the G-335 discharges was greater than any of the marsh site median concentrations on transects N, C, S and Z. In addition, the minimum diel DO concentration in the G-335 discharges was greater than all the marsh site minimum concentrations, with the exception of C-4.

Table 4A-9. Statistical summary of diel dissolved oxygen at the outflow pump stations from STA-2 and marsh stations in WCA-2 during WY02

Location	Station	Number of Measurements	Mean	Minimum	Median	Maximum	Standard Deviation
Outflow	G335	951	4.44	1.09	5.07	9.11	1.88
	N.25	471	1.83	0.19	1.51	7.49	1.65
Transect N	N1	471	1.02	0.05	0.78	4.16	0.79
	N4	187	1.59	0.83	1.63	2.07	0.29
	C.25	471	0.71	0.06	0.47	2.85	0.55
Transect C	C1	471	3.58	0.64	3.17	8.91	2.29
	C4	187	3.95	1.83	3.71	7.69	1.56
Transect S	S4	470	4.44	0.99	4.10	9.72	2.12
	Z.5	469	1.67	0.01	0.82	8.02	1.81
Transect Z	Z1	469	0.93	0.18	0.68	5.15	0.71
	Z2	470	0.53	0.03	0.52	3.50	0.50

See **Appendix 4-4**, **Table 3** for statistical summaries by event and diel parameter

Notched box and whisker plots were created from the data in **Table 4A-9** to compare the DO concentrations in the G-335 discharges with the marsh transect site concentrations. The median diel DO concentration for G-335 was significantly greater than the median diel DO concentrations at all the marsh transect sites (**Figure 4A-13**). The notched box plots also show that the DO concentrations at marsh transect sites C1, C4, S4 and Z4 are significantly greater than the DO concentrations at marsh sites N25, N1, N4, C25, Z5, Z1 and Z2. This indicates that the vegetative community in which diel DO concentrations are measured can affect the resulting diel curve characteristics, particularly if there is evidence that the site had been previously impacted by discharges containing high TP concentrations (**Figure 4A-14**).

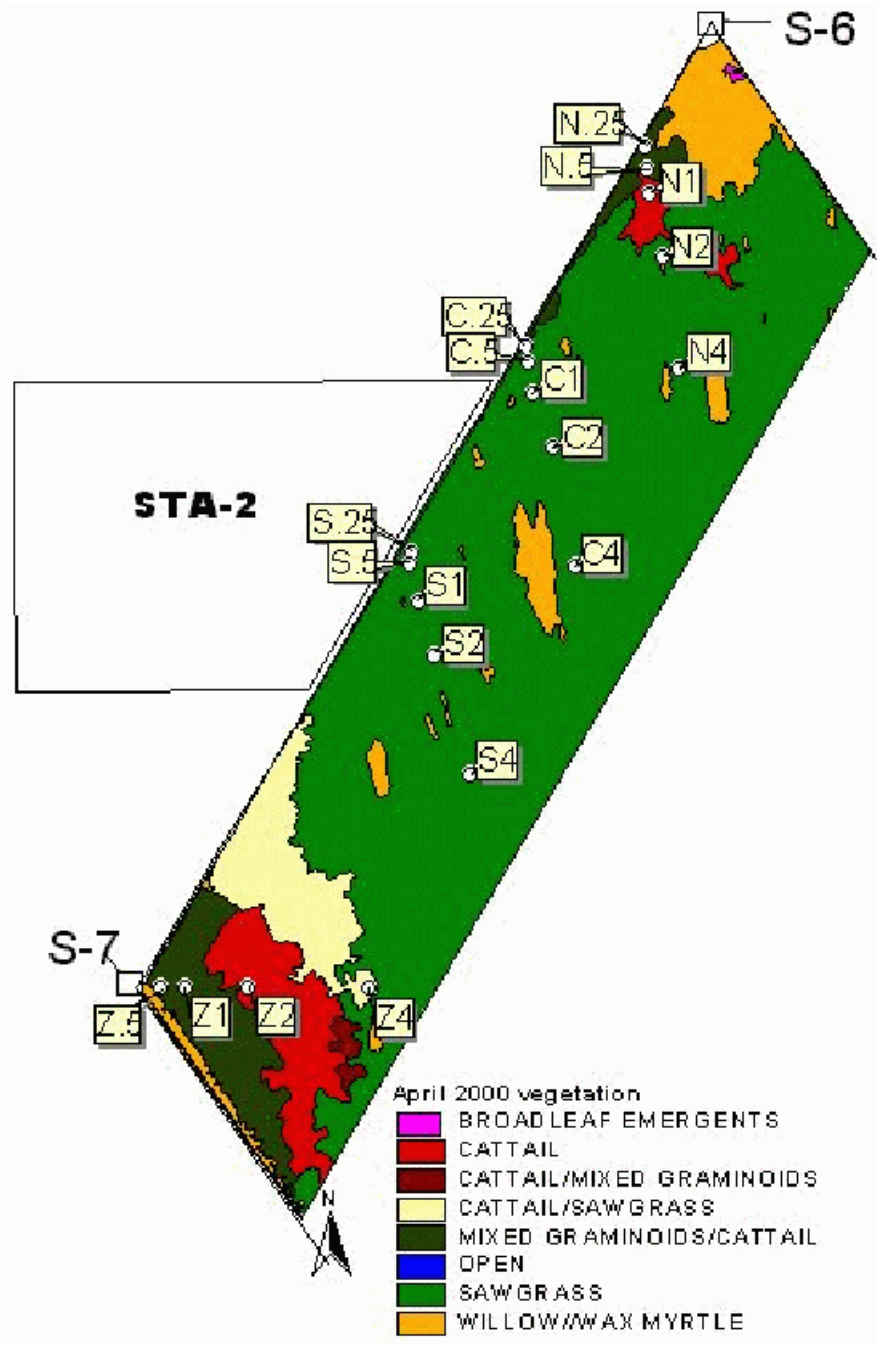


Figure 4A-13. Dissolved oxygen monitoring sites in WCA-2

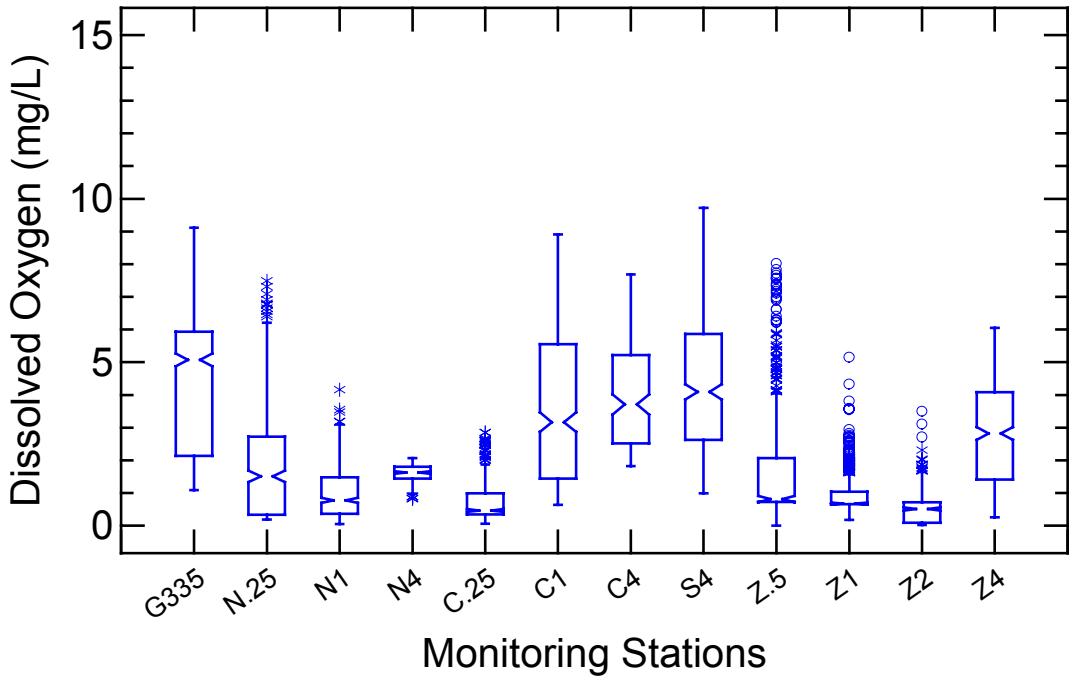


Figure 4A-14. Notched-box and whisker plots of diel dissolved oxygen measurements at the STA-2 outflow station (G-335) and along transect sites in Water Conservation Area 2 during three monitoring periods. The notch on a box plot represents the 95-percent confidence interval about the median, which is represented by the narrowest part of the notch. The top and bottom of the box represent the 75th and 25th percentiles, respectively. The whiskers represent the highest and lowest data values that are within two standard deviations of the median. Values above and below the whiskers are greater than two standard deviations from the median. Notches that do not overlap indicate that the data represented by the boxes being compared are significantly different at the 95-percent confidence level.

Based on the data presented, it appears that the diel DO concentrations in the STA-2 discharges did not affect the low DO concentrations observed at marsh transect stations X1, X2, Z1 and Z2. The diel DO patterns observed at these transect sites are probably due primarily to the long-term effects of P loading. It is anticipated that P load reductions in STA-2 should improve DO conditions at these transect sites.

Mercury

The results of mercury compliance monitoring for routine operation are summarized in **Appendix 4A-4**. During WY02, there were no violations of the Florida Class III numerical water quality standard of 12 ng/L unfiltered total mercury (THg). As such, the Everglades Construction Project has met one of the requirements of the operating permits. However, STA-2 cell 1 still did not meet its net improvement test during WY02.

The occurrence and reporting of an anomalous mercury event in STA-2 cell 1 are summarized in the next subsection. The outflow concentrations of unfiltered THg and methylmercury (MeHg) for WY02 in cells 2 and 3 were not statistically or environmentally significantly higher than the inflow concentrations. For total mercury, levels in the outflow of cells 2 and 3 are likely attributable to the contribution from wet and dry atmospheric deposition of mercury, which probably accounts for more than two-thirds of the annual THg load into cells 2 and 3. This is not the case for MeHg, which is probably being produced from the fresh supply of "new" inorganic mercury in atmospheric deposition. Nevertheless, the mosquitofish, sunfish and largemouth bass collected in these cells contain lower Hg concentrations than the Everglades-wide average, so there is, as yet, no cause for concern. This is not the case for STA-2 cell 1, however, which is the focus of discussion in the next subsection.

Cell 1 Anomalous Mercury Event

Condition (6)i of Exhibit D of the EFA permit for STA-2 requires the District to report anomalously high mercury concentrations. One such event occurred in WY02. In July 2001 the District petitioned the FDEP to allow initiation of flow-through operation of cell 1 prior to passing the net improvement start-up test. This was intended to accelerate stabilization of cell 1 MeHg by creating conditions designed to reduce production. In August 2001 the FDEP approved the District's request, with conditions for expanded monitoring of and reporting for STA-2 cell 1. The District detected an anomalous mercury event in STA-2 cell 1 in October 2001 and reported it to the FDEP immediately after the data underwent a quality assurance review. Because the dry season was just beginning, and there was no certainty that water levels could be held sufficiently high to discourage wading bird feeding in cell 1, the District concluded it was prudent at that time to drawdown and dryout cell 1 rather than to allow the excess MeHg in sediment and water to magnify up the aquatic food chain to levels that might present an unacceptable risk to fish-eating wildlife foraging in cell 1. Dryout began the first week in December 2001 and was essentially complete a month later, though some pools remained on the western side of cell 1 throughout most of the dry season due to the sloping topography; some discharge continued as water was drawn out of the soil below grade. Additional details of this anomalous event are presented in Chapter 2B of the 2003 ECR.

Results from the expanded monitoring of mercury in surface water and fish tissues strongly indicated that anomalous methylmercury production was restricted to cell 1. Details are provided in **Appendix 4A-7**. A positive gradient was observed in MeHg levels in surface water and fish tissues from the inflow in the north to the outflow in the southern portion of cell 1. Consequently, site C-1A was found not to be representative of conditions within STA-2 cell 1. Further, due to the configuration and design of cell outlets, a single grab sample upstream of the outflow pump at G-335 was found to be unrepresentative of discharge under steady-state flow. The dramatic fluctuations and concentrations of THg and MeHg in the discharge canal decreased following drawdown and reduction in discharge from cell 1. A gradient in cell-1 stage may have resulted in relatively shallow depths in the southern portion of the cell. In turn, this might have affected sediment biogeochemistry, particularly redox and mercury methylation. Mercury levels in STA-2 fish exhibited spatial patterns consistent with patterns observed in surface water concentrations. Average mercury concentrations in sunfish caught in a swale in cell 1 in April 2002, which otherwise was dry, were twice the basin-wide mean concentration for sunfish. Levels of mercury in largemouth bass were also elevated relative to other STAs and downstream sites, with the expected mean concentration in a three-year-old fish from the discharge canal at 1148 ng/g. Fortunately, the area of contact and the exposure potential were lowered substantially by draining cell 1.

The District and the FDEP have been working together to better understand the cause of this anomalous mercury event and identify short- and long-term measures to reduce the magnitude and duration of excessive MeHg production, exposure and export within cell 1 and the receiving waters. The primary management action taken was to raise the elevation of the outlet weir crests to minimize the frequency and magnitude of dryout events. These retrofits were completed at the end of July 2002.

To better understand the causes and identify short- and long-term measures to reduce the magnitude and duration of excessive MeHg production, exposure and export within STA-2 cell 1 and the receiving waters, three joint initiatives are now underway and several more are planned. The first initiative was to expand the biweekly mercury monitoring of the STA-2 inflow and cell 1 outflow to include the outflows from cells 2 and 3. This allowed the District to confirm that cell 1 was the source of the high MeHg concentrations detected in the STA-2 discharge canal at G-335. The expanded monitoring continues with in-kind analytical support from the FDEP's ultra-trace mercury laboratory in Tallahassee, Florida. With the onset of flow-through operation in the wet season, interior marsh monitoring of surface water, pore water, soils and mosquitofish will be added to the inflow and outflow monitoring. The District also secured grant funding from the FDEP for partial reimbursement for the cost of expanded mercury monitoring (about $500K in FY02 and FY03).

The second initiative used an existing modeling contract to model the production, bioaccumulation, export and potential downstream impacts of the first anomalous mercury event in STA-2 cell 1 that occurred in the fall of 2000. Those results were available at the end of May 2001.

The third initiative involved the issuance of a cooperative agreement with the U.S. Geological Survey (Dave Krabbenhoft, Ph.D., William Orem, Ph.D., and co-workers) and the Academy of Natural Sciences Environmental Research Laboratory (Cynthia Gilmour, Ph.D., and co-workers) to carry out a study of the effect of dryout duration on the MeHg production, with associated analyses of surface water, pore water and soil chemistries. A report on the preliminary results is due at the end of June 2002 and will be reported in next year's *2004 Everglades Consolidated Report*.

Though not yet underway, proposed initiatives for FY03 include the following: (1) more detailed modeling of the anomalous mercury event to evaluate operational alternatives that might reduce its magnitude, duration, and frequency of occurrence, and, if needed (2) an *in situ* mesocosm study of the effect of canal water chemistry and modifications thereto on MeHg production and bioaccumulation in STA-2 cell 1 soils.

STA-3/4

In November 2000, construction on STA-3/4 commenced with the award of the inflow pump station's equipment contract. STA-3/4 will use the existing S-7 and S-8 pump stations as the outflow facilities; refurbishment of those stations is underway. Management of all construction de-watering and rainfall is directed at developing vegetation in the interior cells such that start-up operations should begin several months before the October construction completion date. A schematic of STA-3/4 is presented in **Figure 4A-15**. Based on the 1979 through 1988 period of flow, and on P data used during design, the STA should receive approximately 324,000 ac-ft from the S-7 and S-8 basins, approximately 12,200 ac-ft from the Ch. 298 Districts along the lake,

approximately 252,000 ac-ft of Lake Okeechobee regulatory releases, and BMP replacement water from the lake. Actual deliveries will vary based on hydrologic conditions in the basins.

While all construction is currently scheduled to be completed by the October 1, 2003 date mandated by the Everglades Forever Act, during WY02 the contractor on three of the STA-3/4 construction components filed for bankruptcy. A new contractor purchased the firm and has submitted a recovery schedule that shows substantial completion by the original October 2003 date. District staff are reviewing the recovery schedule at this time.

No pre-operational soil samples were collected for mercury analysis during the reporting year, because STA-3/4 construction has not yet been completed. Samples will be collected during the upcoming year.

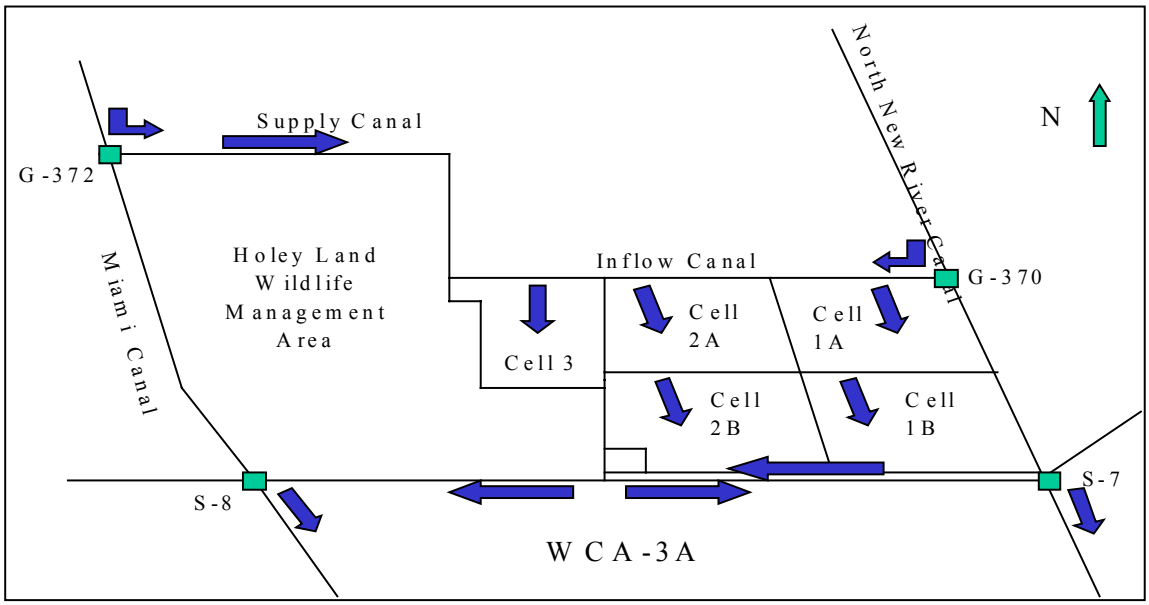


Figure 4A-15. Schematic of STA-3/4 (not to scale)

STA-5

STA-5 contains approximately 4,110 acres of effective treatment area arranged in two parallel flowways. The northern flowway (cells 1A and 1B) consists of approximately 2,055 acres of effective treatment area. The southern flowway (cells 2A and 2B) consists of approximately 2,055 acres of effective treatment area. A schematic of STA-5 is presented in **Figure 4A-16.** Based on the 1979 through 1988 period of flow, and on P data used during design, the STA should receive between 78,300 and 104,000 ac-ft per year from the C-139 basin. Runoff that exceeds the hydraulic capacity of STA-5 will be diverted through G-406. Actual deliveries will vary based on hydrologic conditions in the basins.

Water enters the STA from the west and flows by gravity through the treatment area to the east. Treated water is collected and discharged to the Miami Canal, where the majority of the water moves south to the northwest corner of WCA-3A. A complete description of STA-5 is contained in Chapter 6 of the *2000 Everglades Consolidated Report.*

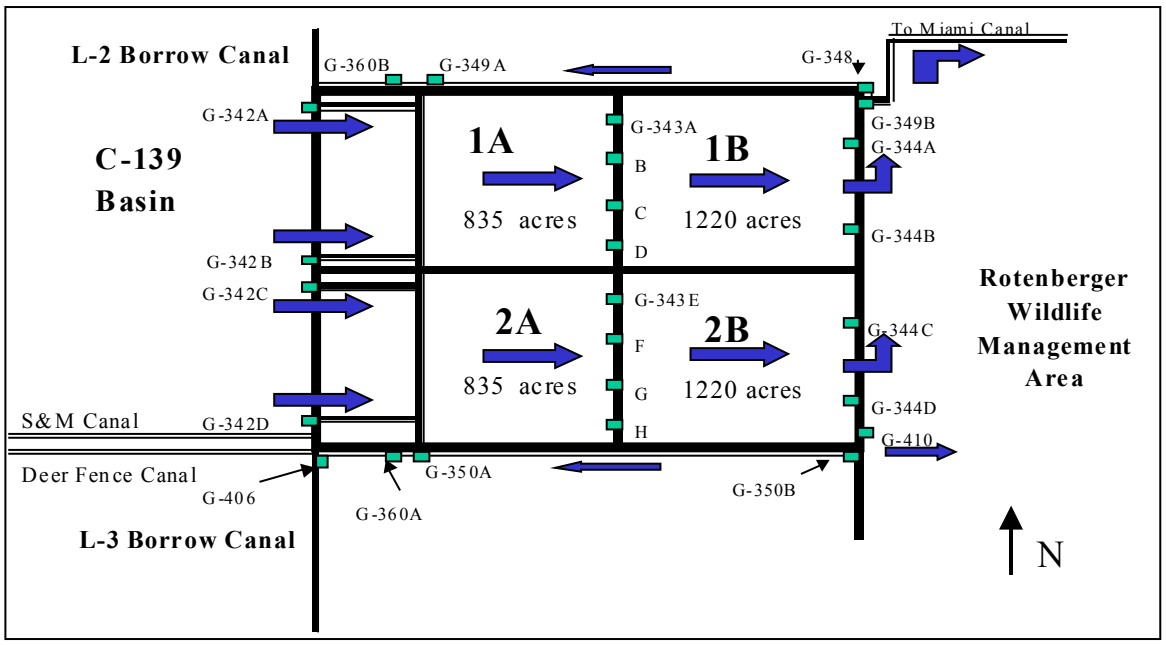


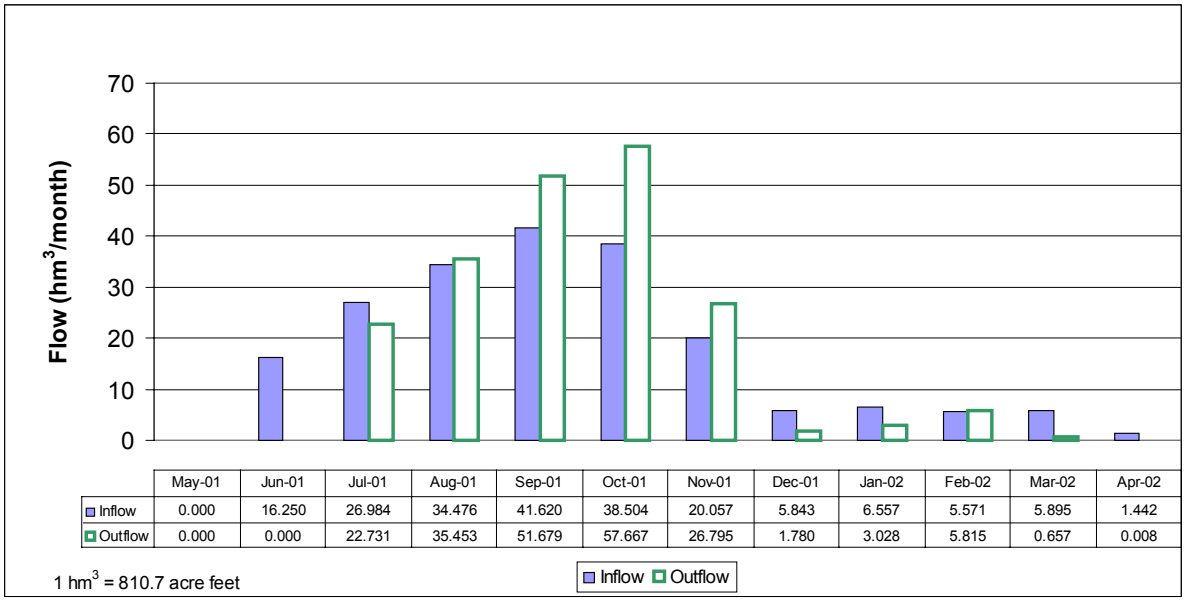
Figure 4A-16. Schematic of STA-5 (not to scale)

STA-5 OPERATIONS

Operations at STA-5 over the past year were influenced significantly by the latter stages of the most severe drought ever recorded in South Florida. Three of the four treatment cells experienced a dryout period during which water levels receded below the average ground surface elevation. One treatment cell, cell 1B, was kept at a minimum depth of six inches to protect a growing SAV community, but no supplemental water deliveries were needed to maintain that depth. When a normal wet-season rainfall pattern returned in June 2001, stormwater runoff from the C-139 basin resumed flow through STA-5. Structure operations followed normal wet-season guidelines, as prescribed in the District's STA-5 operation plan, until December 2001, when normal dry-season operations began. The STA remained in this water conservation mode for the remainder of the reporting period to protect vegetation in the treatment cells from drying out. Despite the lingering effects of the severe drought early in this reporting period, no serious impacts to any of the plant communities were discovered within STA-5.

During WY02, approximately 202 cubic hm (165,000 ac-ft) of water were captured and treated by STA-5, or about 160 percent of the anticipated average annual flow for the treatment area assumed during design. This surface inflow equates to an average hydraulic loading rate of 3.34 cm/d over the effective treatment area of the STA. As a result of the above-normal runoff

from the C-139 basin, approximately 23,300 ac-ft of stormwater carrying approximately 9 metric tons of P was diverted around STA-5 through the G-406 structure. In the future, flows and loads diverted around STA-5 will be captured and treated in STA-6 section 2, which is scheduled for completion in December 2006. A summary of monthly STA-5 flow is presented in **Figure 4A-17**.



	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02
Inflow	0.000	16.250	26.984	34.476	41.620	38.504	20.057	5.843	6.557	5.571	5.895	1.442
Outflow	0.000	0.000	22.731	35.453	51.679	57.667	26.795	1.780	3.028	5.815	0.657	0.008

Figure 4A-17. Summary of WY02 flows for STA-5

STA-5 VEGETATION

The composition of the plant communities within STA-5 is somewhat variable between the four treatment cells. Cell 1A is dominated by cattail (*Typha* sp.) but also contains significant amounts of primrose willow (*Ludwigia* sp.) and several panic grasses (*Panicum* sp.). The western quarter of cell 1A has a much higher average ground elevation than the remainder of the cell and supports some notable upland plant species, such as wax myrtle (*Myrica cerifera*) and elderberry (*Sambuca canadensis*). Cell 1B is managed as a submerged aquatic vegetation (SAV) and periphyton cell; any emergent plants are eliminated using appropriate herbicides. Cell 2A is dominated by cattail and primrose willow but contains a significant coverage of smartweed (*Polygonum* sp.) and mixed grasses. Cell 2B is also cattail-dominated, with isolated areas occasionally occupied by water lettuce (*Pistia stratiotes*).

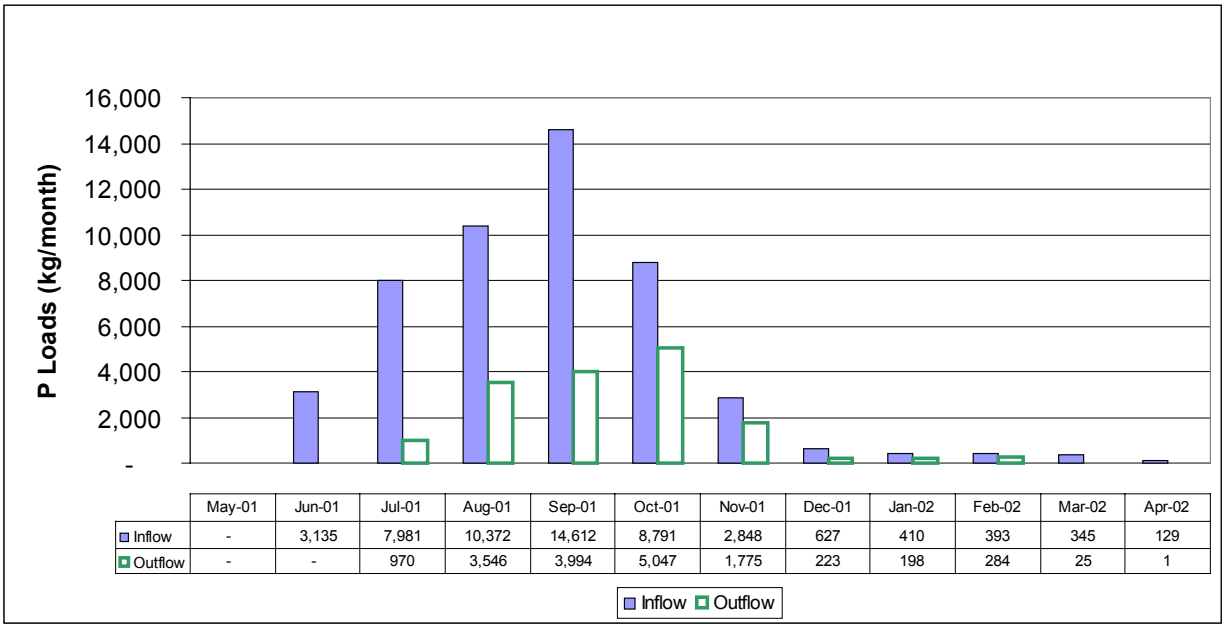
The EFA permit requires that the annual Everglades Consolidated Report include information regarding the application of herbicides to exclude and/or eliminate undesirable vegetation within the treatment cells. For this reporting period, the District applied 491 gallons of 2-4,D, 56.1 gallons of Garlon 3A (trichlopyr), 149.5 gallons of AquaNeat (glyphosate), 44.3 gallons of Gly Pro Plus (glyphosate), 37.4 gallons of Roundup (glyphosate), 13.68 gallons of Arsenal (imazapyr), 50 gallons of Reward (Diquat dibromide), and 138 gallons of various adjuvants (surfactants used to help distribute the herbicide) to control nuisance vegetation in STA-5. The District used both aerial and ground-based spray equipment for herbicide applications.

STA-5 WATER QUALITY MONITORING

The data presented in this section demonstrate that STA-5 was in compliance with the EFA and NPDES operating permits for WY02 and that discharges do not pose any known danger to public health, safety or welfare. The EFA permit states that STA-5 will remain in the stabilization phase of operation until STA-6 section 2 begins flow-through operations.

Total Phosphorus

During WY02, STA-5 received 49.6 metric tons of P, equal to a nutrient loading rate of 2.98 grams/sq m. This nutrient load was approximately 50 percent more than anticipated during the design of the treatment area. Despite the heavy loading, the treatment area performed well. STA-5 removed approximately 33.6 metric tons of P during WY02, equal to a removal rate of approximately 2.0 grams per square meter per year. This removal rate exceeded the design removal rate of approximately 1.5 grams per square meter per year. Monthly discharge P concentrations were considerably lower than inflow concentrations, and between May 2001 and April 2002 STA-5 reduced discharge loads of TP by 68 percent compared to inflow loadings. A summary of monthly P loads and flow-weighted mean P concentrations is presented in **Figures 4A-18** and **4A-19**. During December 2001 and January 2002, outflow P concentrations were slightly higher than in the inflow, however, due to reductions in flow volumes, the actual P loads were always lower in the outflow. The flow-weighted mean outflow P concentration was 78 ppb, a 68-percent reduction from the inflow concentration of 244 ppb. The flow-weighted mean outflow concentration for WY02 is significantly lower than the 105 ppb reported last year and indicates that the treatment area continues to improve. While the outflow concentration is above the 50-ppb interim target, the STA is still in the stabilization phase and improved P reduction is anticipated in the future. Permit compliance requires that outflow P concentrations be reported as moving 12-month flow-weighted mean values (see **Figure 4A-20)**. The moving 12-month flow-weighted mean P outflow concentration for STA-5 decreased from 96 to 78 µg L^{-1} over the course of WY02. For informational purposes, the geometric mean discharge P concentration for STA-5 was 66 ppb for WY02.



	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02
Inflow	-	3,135	7,981	10,372	14,612	8,791	2,848	627	410	393	345	129
Outflow	-	-	970	3,546	3,994	5,047	1,775	223	198	284	25	1

Figure 4A-18. Summary of WY02 phosphorus loads for STA-5

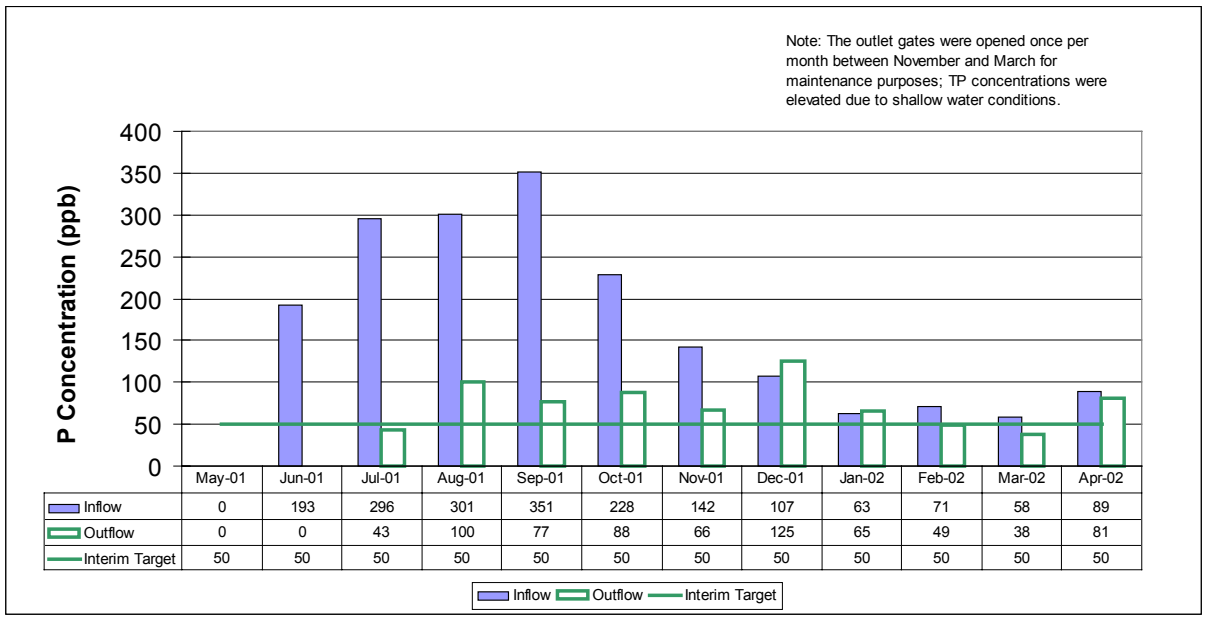


Figure 4A-19. Summary of WY02 phosphorus concentrations for STA-5

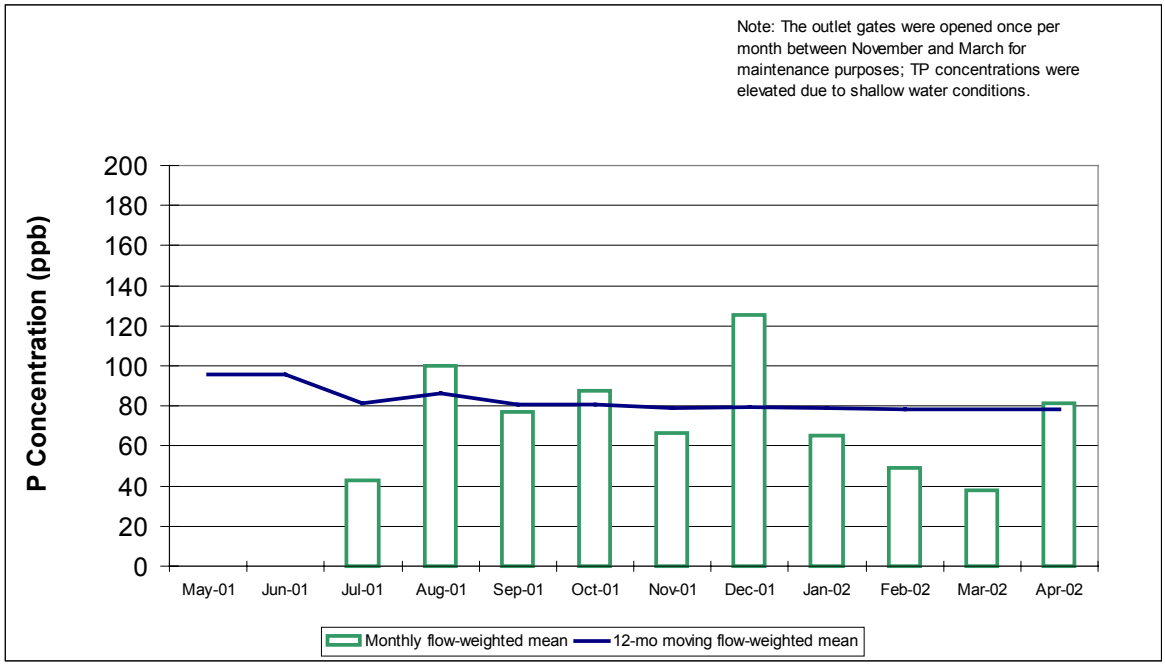


Figure 4A-20. Comparison of monthly to 12-month moving average phosphorus concentrations for WY02 for STA-5

Other Water Quality Parameters

The monitoring data for non-phosphorus parameters at STA-5 during this reporting period are presented in **Appendix 4A-8** and are summarized in **Table 4A-10**. While atrazine was detected in the outflow, this herbicide is not used within the STA. 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 STA-5 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 STA-5 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 STA-5 shall be deemed out of compliance.

Discharges from STA-5 were determined to be in compliance by satisfying the initial test.

Additional requirements for dissolved oxygen are listed in Administrative Order AO-004-EV and are discussed below. Mercury monitoring results are also discussed in a proceeding section.

The District has included the following documentation to satisfy the remaining monitoring requirements of the EFA permit:

- The District has performed all sampling and analysis under the latest FDEP-approved CompQAP No. 870166G (June 1999).
- A signed copy of this statement is provided in **Appendix 4A-2**.

Table 4A-10. Summary of annual arithmetic averages and flow-weighted means for water quality parameters other than total phosphorus monitored in STA-5

Parameter	Arithmetic Means								Flow-Weighted Means			
	Inflow				Outflow				Total Inflow		Total Outflow	
	G342A	G342B	G342C	G342D	G344A	G344B	G344C	G344D	n	Conc.	n	Conc.
Temperature (°C)	25.6	25.4	25.3	25.3	23.8	24.0	24.0	24.0	-NA-	-NA-	-NA-	-NA-
Dissolved Oxygen (mg/L)	4.8	4.7	4.7	4.9	4.0	3.6	2.5	2.8	-NA-	-NA-	-NA-	-NA-
Specific Conductivity (µmhos/cm)	548	558	578	578	600	599	689	671	-NA-	-NA-	-NA-	-NA-
pH	7.5	7.5	7.5	7.6	7.6	7.4	7.3	7.4	-NA-	-NA-	-NA-	-NA-
Turbidity (NTU)	3.4	3.3	3.0	4.4	1.8	1.7	2.0	2.2	-NA-	-NA-	-NA-	-NA-
Total Dissolved Solids (mg/L)	361	350	361	364	382	379	433	426	66 (104)	306	40 (104)	302
Unionized Ammonia (mg/L)	0.0010	0.0007	0.0008	0.0012	0.0023	0.0008	0.0005	0.0005	66 (104)	0.0013	40 (103)	0.0002
Orthophosphate as P (mg/L)	0.068	0.094	0.103	0.113	0.016	0.036	0.076	0.050	66 (104)	0.155	40 (104)	0.049
Total Dissolved Phosphorus (mg/L)	0.082	0.108	0.117	0.128	0.029	0.050	0.089	0.063	66 (104)	0.171	40 (104)	0.059
Sulfate (mg/L)	9.9	10.6	11.4	11.2	9.5	9.5	8.8	7.5	66 (104)	10.0	40 (104)	7.1
Alkalinity (mg/L)	184	191	197	207	160	168	232	228	66 (104)	158	40 (104)	155
Dissolved Chloride (mg/L)	56	53	53	49	86	79	72	68	66 (104)	41	40 (104)	45
Total Nitrogen (mg/L)	1.55	1.45	1.38	1.40	1.68	1.64	1.67	1.71	66 (104)	1.62	40 (104)	1.37
Total Dissolved Nitrogen (mg/L)	1.38	1.25	1.23	1.17	1.57	1.51	1.56	1.59	66 (104)	1.47	40 (104)	1.28
Nitrate + Nitrite (mg/L)	0.057	0.040	0.041	0.040	0.013	0.009	0.008	0.004	66 (104)	0.059	40 (104)	0.011
Ametryn (µg/L)	0.006	0.006	0.005	0.005	0.017	0.016	0.014	0.011	11 (16)	0.010	6 (16)	0.011
Atrazine (µg/L)	0.099	0.080	0.054	0.041	0.153	0.152	0.243	0.214	11 (16)	0.046	6 (13)	0.086

-NA- : Not Applicable
n: number of samples with flow (total number of samples)

Dissolved Oxygen Monitoring

INTRODUCTION

STA-5 Administrative Order No. AO-004-EV in Exhibit C of Permit No. 0131842, February 29, 2000 specifies the same DO monitoring requirements as STA-1W (see pages 4A-1 and 4A-2 of this chapter).

The District developed the following plan to comply with the DO requirements of the administrative orders for STA-5. Under the plan, DO concentrations are measured quarterly with Hydrolab™, DataSonde®, or MiniSonde® probes at 30-minute intervals for four consecutive days at the following locations:

- Upstream of the four inflow structures G-342A-D
- In the discharge canal near structures G-344A and G-344D, to provide representative data whether the discharge is to the Miami Canal, the Rotenberger Tract through pump station G-410, or to both sites simultaneously
- Background conditions in the Miami Canal are measured on the west bank about 100 meters upstream of the confluence of the Miami Canal and the STA-5 discharge canal
- Effects of STA-5 discharges to the Miami canal are measured on the west bank about 100 meters downstream of the confluence of the Miami canal and the STA-5 discharge canal
- Effects of STA-5 discharges to the Rotenberger Tract are measured at sites along the north and south transects within the Rotenberger Tract (**Figure 4A-21**).

Diel oxygen measurement dates and sites for WY02 are provided in **Table 4A-11**.

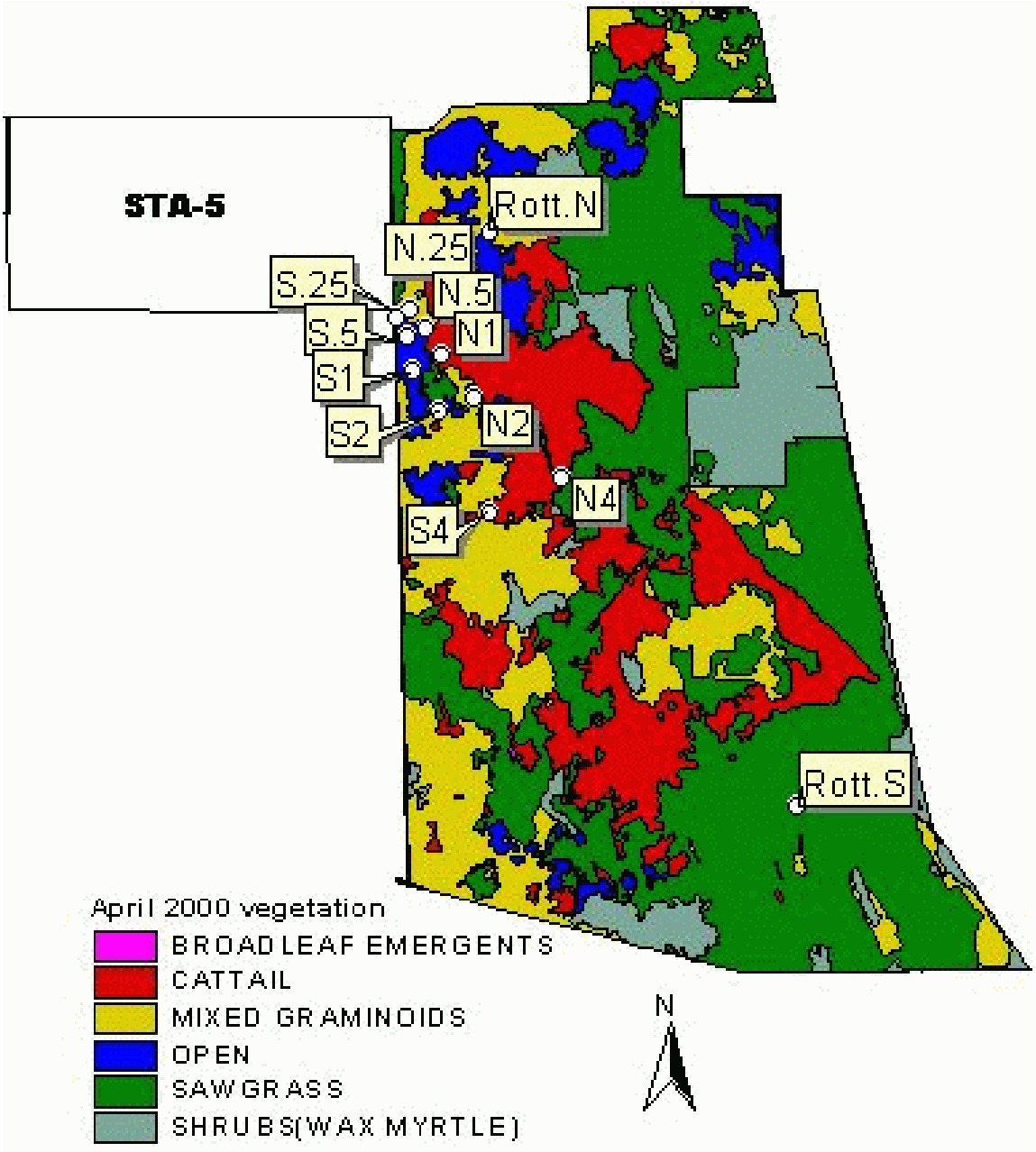


Figure 4A- 21. Dissolved oxygen monitoring sites in Rotenberger Tract

Table 4A-11. Deployment dates for diel oxygen measurement at STA-5 structures, sites in the Miami canal, and Rotenberger tract marsh sites

Event Dates		Structures		Miami Canal Sites		Sites Monitored in Rotenberger Tract
Start	End	Outflow				
05/21/2001	05/24/2001	G344A	G344D	NMC	SMC	----------
09/20/2001	09/26/2001	G344A	G344D	NMC	SMC	N.25, N1, N4, S.25, S1, S4
11/07/2001	11/13/2001	G344A	G344D	NMC	SMC	N.25, N1, N4, S.25, S1, S4
03/20/2002	03/27/2002	G344A	G344D	NMC	SMC	----------

Comparison of Dissolved Oxygen in STA-5 Discharges With Dissolved Oxygen at Miami Canal and Rotenberger Tract Marsh Sites

Comparisons of DO in STA-5 discharges with DO in the Miami canal and at Rotenberger tract marsh transect sites provide an indication of whether the discharge is affecting the canal and marsh DO concentrations or the diel oxygen cycle.

The summary statistics for STA-5 discharges and the downstream sites are presented in **Table 4A-12**. The complete data sets collected during WY02 are presented in **Appendix 4A-9**. Examination of this table shows that median, mean and maximum DO concentrations in discharges from G-344A are greater than those from G-344D. The notched box and whisker plots for these sites show that G-344A has a significantly higher median DO concentration (**Figure 4A-22**). The north Miami canal site median and mean DO concentrations are slightly higher than the south Miami canal values, but the notched box and whisker plots show they are not statistically different (**Figure 4A-22**). This indicates that the combined STA discharge entering the Miami canal did not have a measurable effect on Miami canal DO concentrations.

Table 4A-12. Statistical summary of diel dissolved oxygen at the outflow stations from STA-5, stations in the Miami canal and marsh stations in the Rotenberger tract during four deployment periods

Location	Station	Number of Measurements	Mean	Minimum	Median	Maximum	Standard Deviation
Outflow	G344A	1,062	3.57	0.37	3.78	8.64	1.99
	G344D	1,065	2.17	0.70	2.16	4.80	0.88
Miami Canal	NMC	1,067	3.80	0.73	3.48	8.56	1.96
	SMC	1,066	3.73	0.56	3.39	8.81	1.82
Transect N	N.25	510	1.76	0.24	1.64	4.84	1.03
	N1	512	1.52	0.16	1.39	4.53	0.90
	N4	512	2.30	0.40	1.90	6.70	1.34
Transect S	S.25	512	2.55	0.29	2.37	6.17	1.44
	S1	511	2.80	0.18	2.42	7.33	1.87
	S4	512	2.24	0.48	2.00	6.77	1.33

See **Appendix 4-4**, **Table 3** for statistical summaries by event and diel parameter

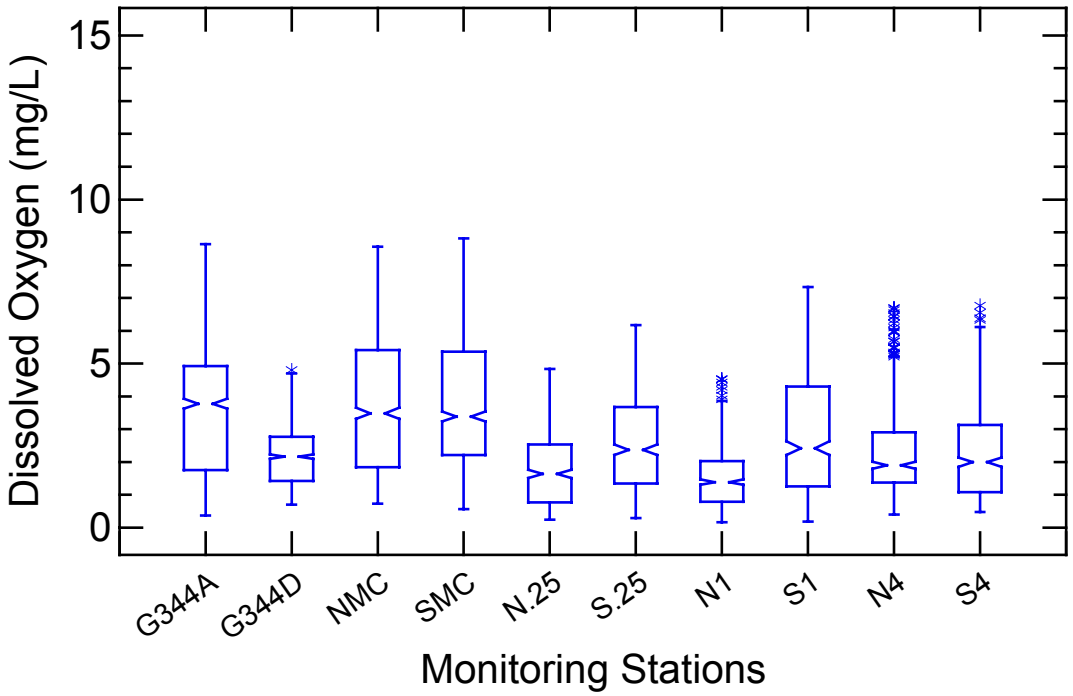


Figure 4A-22. Notched-box and whisker plots of diel dissolved oxygen measurements at the STA-5 outflow stations (G-344A and G-344D), at sites in the Miami Canal (NMC and SMC), and along transect sites in the Rotenberger Tract during four monitoring periods The notch on a box plot represents the 95-percent confidence interval about the median, which is represented by the narrowest part of the notch. The top and bottom of the box represent the 75th and 25th percentiles, respectively. The whiskers represent the highest and lowest data values that are within two standard deviations of the median. Values above and below the whiskers are greater than two standard deviations from the median. Notches that do not overlap indicate that the data represented by the boxes being compared are significantly different at the 95-percent confidence level.

Comparisons between the median DO concentrations in the discharges with marsh sites along the Rotenberger north and south transects show that N25, N1, N4, and S4 are lower. S25 and S1 are greater than G-344D, but less than G-344A. Comparison of median DO concentrations between the corresponding sites on the north and south transects shows that N25 and N1 are less than S25 and S1 values. The N4 and S4 data are essentially the same.

Comparison between the notched box and whisker plots for the median DO in the discharges with those of transect sites N.25 and N1 shows that the discharges are significantly greater than these transect sites. In contrast, the median DO concentrations at sites S.25, S1, S4, and N4 are not significantly different from the G-344D median concentration but are significantly less than the G-344A median concentration.

Based on the data presented, it does not appear that STA-5 discharges are having any negative effect on DO conditions in the Miami canal or along the Rotenberger tract transects.

Mercury

The results of mercury compliance monitoring for routine operation are summarized in **Appendix 4A-4**. During WY02, there were no violations of the Florida Class III numerical water quality standard of 12 ng/L unfiltered total mercury (THg). As such, the Everglades Construction Project has met one of the requirements of the operating permits.

Concentrations of THg and MeHg in sediment cores collected from STA-5 in 2001 remained at background levels observed in cores collected in 1998, they and continued to be within the expected range for Everglades soils. During the reporting year, THg and MeHg concentrations in surface water generally exhibited a reduction across STA-5. Further, levels of Hg in mosquitofish from the interior marshes of STA-5 declined from peak levels observed during the second semiannual collection in 2000 and contained roughly 50 percent less Hg than fish from either the inflows or outflows. Levels of Hg were generally similar in mosquitofish at inflow and outflows of STA-5. Alternatively, concerns were raised by the observation that Hg concentrations were greater in sunfish from the discharge canal and the interior compared to sunfish from the supply canal. Further, while concentrations of Hg declined over the last three years in sunfish inhabiting the supply canal, mercury levels increased in fish from the interior and the discharge canal in 2000 and remained elevated in WY02 relative to 1999. Likewise, there is some evidence to suggest that levels of Hg have increased slightly in largemouth bass in the discharge canal during the monitoring period. Finally, while temporal trends cannot be evaluated for bass inhabiting the interior marshes of STA 5 (due to age distribution of collected fishes), the expected mean concentration of Hg in three-year-old interior bass reached 801 ±147 ng/g in 2001. This exceeds the state's limited consumption advisory for human health of 500 ng/g wet weight muscle (0.5 mg/Kg or 0.5 ppm). For perspective, the Everglades continue to remain under a Department of Health advisory, which recommends limited or no consumption of select fish species due to high mercury levels in their flesh.

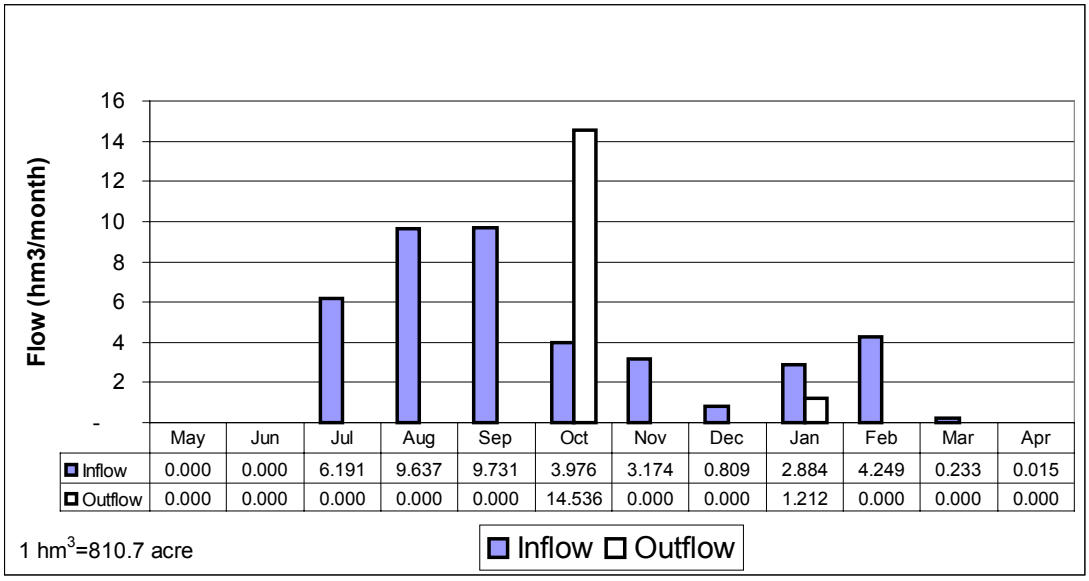
ROTENBERGER WILDLIFE MANAGEMENT AREA

The Rotenberger Hydropattern Restoration Project is a component of the Everglades Construction Project (ECP). The project's goal is to restore a more natural hydroperiod, thereby reversing ecosystem degradation within the Rotenberger Wildlife Management Area that is caused by drought and seasonal fires, soil oxidation and compaction, and the release of ambient nutrients from soils. Anticipated benefits include preservation of coverage of the remaining desired vegetative species, replacement of undesirable vegetation species with desirable wetland vegetation, and the initiation of the process of peat formation. The FDEP completed acquisition of all the remaining private lands within the Rotenberger tract, and the District completed construction in October 2000. Project features (see **Figures 4A-16** and **4A-21**) include a 240-cfs electric pump station (G-410) to withdraw treated water from the STA-5 discharge canal for establishing a more natural hydroperiod within Rotenberger. This pump station distributes water through a 3.5 mile-long spreader canal located parallel to the west perimeter levee of the Rotenberger tract. Discharges out of Rotenberger go into the Miami canal through four gated culverts (G-402D) along the eastern boundary of Rotenberger. There is also a quarter-mile-long collection canal upstream of each outlet structure.

The FDEP issued a modification to the STA-5 EFA permit for the project in October 2000. The permit establishes a phase approach to restoration and recognizes an interagency group, including representatives from the FDEP, the Florida Fish and Wildlife Conservation

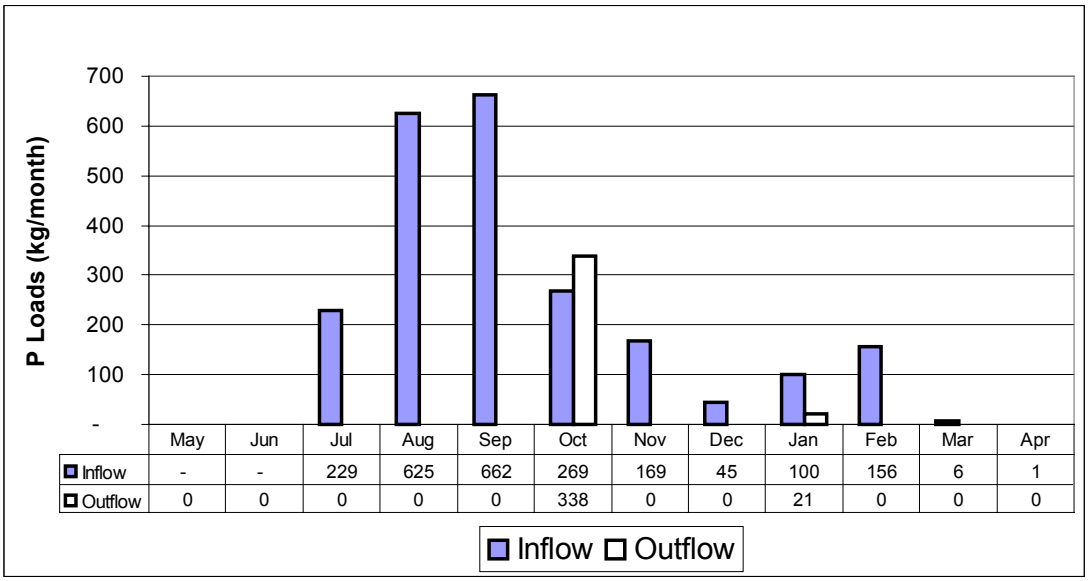
Commission (FWC), the U.S. Army Corps of Engineers (USACE), Friends of the Everglades, and the District. The permit requires the interagency group to periodically evaluate the progress the project is making towards achieving its restoration goals. The first part of this phased approach calls for an interim operational period that will last for two years from the first date of discharge from the G-410 pumping station (July 2001). Following this interim period, the interagency group will evaluate the benefits and progress toward the project's ultimate goals, and then decide whether to continue interim operations or modify those operations if necessary to achieve restoration goals. The interim phase of operations uses the G-410 pumps only when STA-5 is in a discharge mode and when water levels within the tract are below the daily regulation schedule. This schedule was based on the 31-year stages predicted by the Natural Systems Model (NSM). On July 18, 2002 the interagency group convened to discuss the first year's interim operation and the progress that was being made towards achieving the project's restoration goals. The interagency group's consensus was that favorable progress was being made towards restoration, since desirable vegetation species had replaced undesirable species, and water column P levels had decreased below pre-project levels.

For WY02, approximately 41 cubic hectometers (33,000 ac-ft) were directed into the Rotenberger tract through G-410, while approximately 16 cubic hectometers (13,000 ac-ft) were discharged to the Miami canal from the outlet structures (see **Figure 4A-23**). The flow-weighted mean inflow P concentration was 55 ppb, yielding a total P inflow load of approximately 2,300 kg (see **Figure 4A-24** and **Figure 4A-25**). As the treatment system in STA-5 stabilizes, P levels entering the Rotenberger tract are anticipated to decrease. P concentrations leaving Rotenberger averaged 23 ppb.



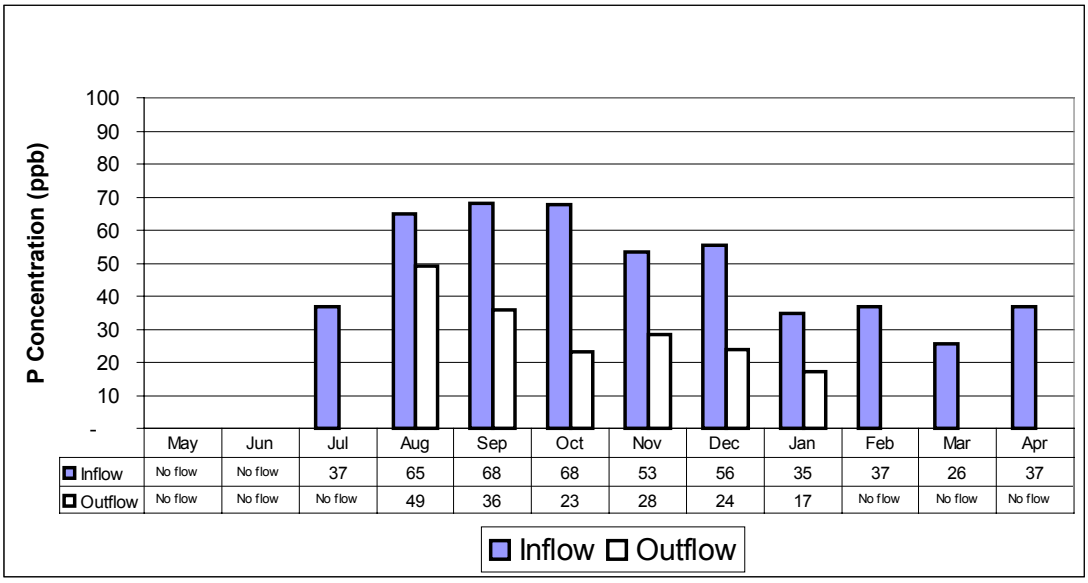
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Inflow	0.000	0.000	6.191	9.637	9.731	3.976	3.174	0.809	2.884	4.249	0.233	0.015
Outflow	0.000	0.000	0.000	0.000	0.000	14.536	0.000	0.000	1.212	0.000	0.000	0.000

Figure 4A-23. Summary of WY02 flows for the Rotenberger Wildlife Management Area



	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Inflow	-	-	229	625	662	269	169	45	100	156	6	1
Outflow	0	0	0	0	0	338	0	0	21	0	0	0

Figure 4A-24. Summary of WY02 phosphorus loads for the Rotenberger Wildlife Management Area



	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Inflow	No flow	No flow	37	65	68	68	53	56	35	37	26	37
Outflow	No flow	No flow	No flow	49	36	23	28	24	17	No flow	No flow	No flow

Figure 4A-25. Summary of WY02 phosphorus concentrations for the Rotenberger Wildlife Management Area

STA-6 SECTION 1

STA-6 section 1 contains approximately 870 acres of effective treatment area, arranged in two parallel flowways. The northern flowway (Cell 5) consists of approximately 625 acres of effective treatment area. The southern flowway (Cell 3) consists of approximately 245 acres of effective treatment area. A schematic of STA-6 is presented in **Figure 4A-26.** Based on the 1979 through 1988 period of flow, and on P data used during design, the STA should receive approximately 16,000 ac-ft from the EAA basin. Actual deliveries will vary based on hydrologic conditions in the basins.

Water enters the STA from the G-600 pumping station (operated by U.S. Sugar Corporation) and travels southeast in the supply canal. Water enters the treatment cells through three broad-crested weirs (G-601, G-602 and G-603) and flows by gravity east through the treatment cells. Treated water is collected in the discharge canal and is discharged to the L-4 borrow canal, where the majority of the water moves east to the northwest corner of WCA-3A.

STA-6 section 2 will add approximately 1,400 acres of additional treatment area to the STA-5/STA-6 system. This expansion will allow for the capture and treatment of any C-139 basin runoff that exceeds the hydraulic capacity of STA-5, as well as runoff from the C-139 annex located just west of the L-3 borrow canal. STA-6 section 2 is scheduled to be completed by December 31, 2006.

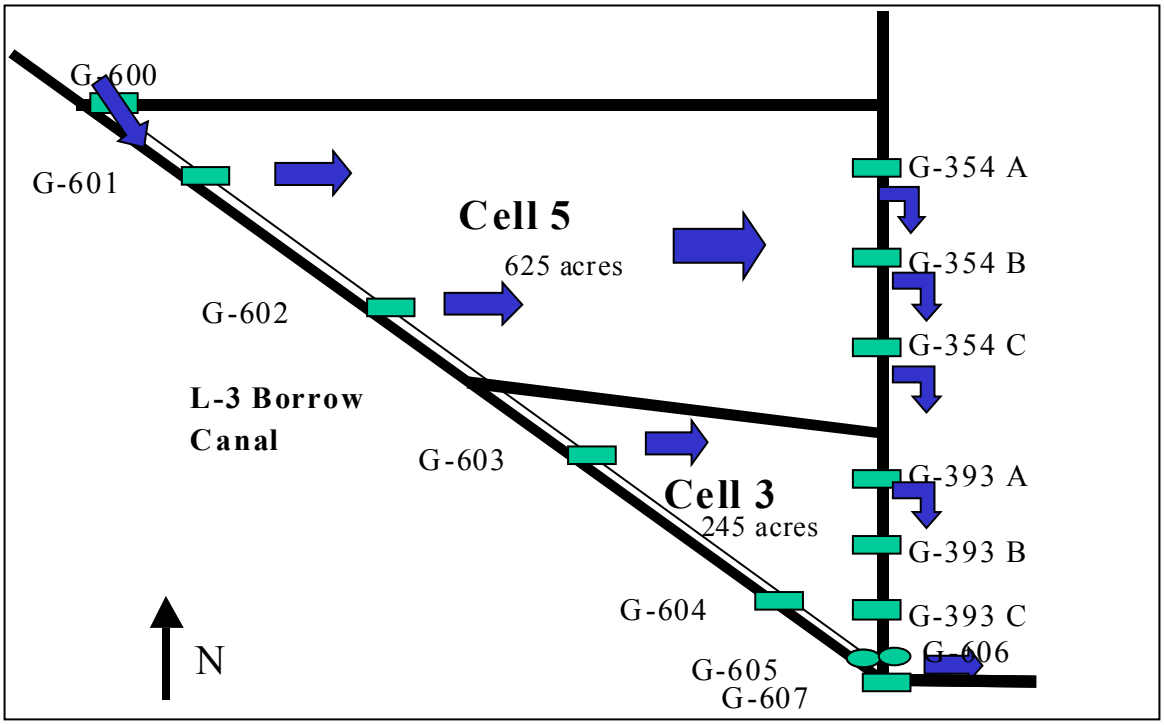
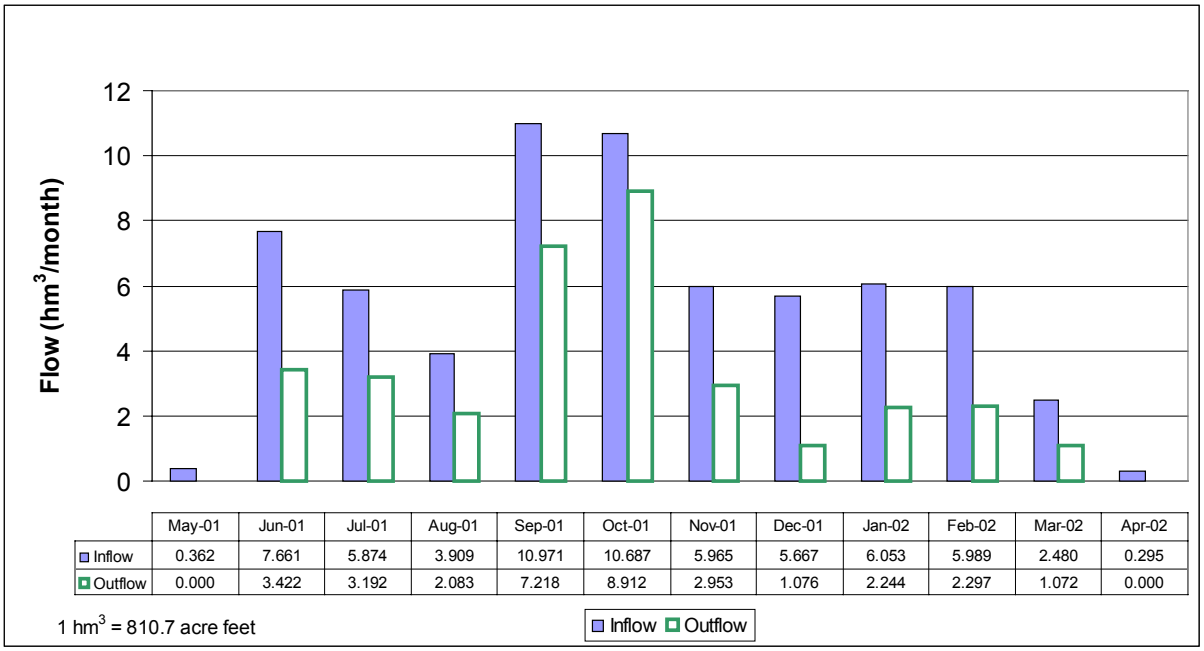


Figure 4A-26. Schematic of STA-6 (not to scale)

STA-6 OPERATIONS

Operations at STA-6 during this reporting period were significantly influenced by the latter stages of a severe drought in South Florida. During WY02, STA-6 experienced two separate dryout events. The first event, a result of the 2001 drought, occurred in May 2001, while the second dryout occurred as a result of normal dry-season conditions in April 2002. No emergency water deliveries were required at STA-6 because the plant communities there are somewhat drought resistant. Stormwater flow-through operations at STA-6 during the wet season followed normal patterns, as described in the operation plan, and were controlled mainly by U.S. Sugar Corporation's G-600 pumping station.

During WY02 approximately 65.9 cubic hm (53,437 ac-ft) of water were captured and treated in STA-6, equating to a hydraulic load of 5.1 cm/day. Due to seepage losses and evapotranspiration (ET), the net volume of treated water discharged from STA-6 during WY02 was 34.5 cubic hectometers (27,945 ac-ft). A summary of monthly flow is presented in **Figure 4A-27**.



	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02
Inflow	0.362	7.661	5.874	3.909	10.971	10.687	5.965	5.667	6.053	5.989	2.480	0.295
Outflow	0.000	3.422	3.192	2.083	7.218	8.912	2.953	1.076	2.244	2.297	1.072	0.000

Figure 4A-27. Summary of WY02 flows for STA-6

STA-6 VEGETATION

Because of its past and current hydroperiod, the plant community in STA-6 is composed predominantly of drought resistant and stable vegetation communities. The composition of the plant communities within STA-6 is somewhat variable between the two treatment cells. Cell 3 is dominated primarily by sawgrass (*Cladium jamaicense*), but it also contains significant amounts of primrose willow (*Ludwigia* sp.) and arrowhead (*Sagittaria* sp). Cell 5 is dominated by panic grasses (*Panicum* sp.), but the eastern portion of the cell contains some seasonal periphyton communities. Cell 5 also contains isolated areas of cattail (*Typha* sp.), smartweed (*Polygonum* sp.) and SAV.

Specific Condition 13(b) of the operating permit requires that the annual Everglades Consolidated Report include information regarding the application of herbicides to exclude and/or eliminate undesirable vegetation in the treatment cells. For this reporting period the District applied 26.5 gallons of Garlon 3A (trichlopyr), 13.33 gallons of AquaNeat, 11.25 gallons of Gly Pro Plus (glyphosate), 18.62 gallons of Roundup (glyphosate), 4.31 gallons of Arsenal (imazapyr), and 4 gallons of various adjuvants (surfactants used to help distribute the herbicide) to control Brazilian pepper growing on the project levees. The District used only ground-based spray equipment to apply the herbicide.

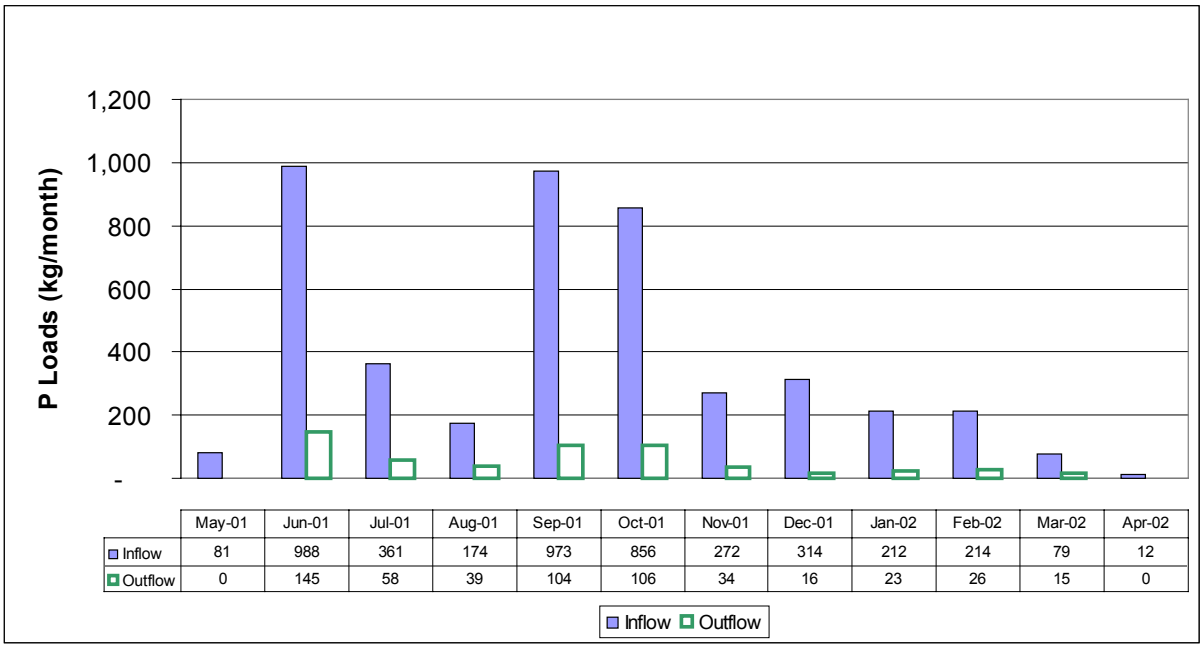
STA-6 SECTION 1 WATER QUALITY MONITORING

The District initiated a water quality monitoring program in STA-6 in December 1997 for the purpose of demonstrating compliance with the above-mentioned conditions of the operating permit. Presently, STA-6 is in a post-stabilization phase. STA-6 discharges do not pose any known danger to the public health, safety or welfare. Compliance with specific conditions 7(a)(i) and 7(a)(ii) was achieved.

Total Phosphorus

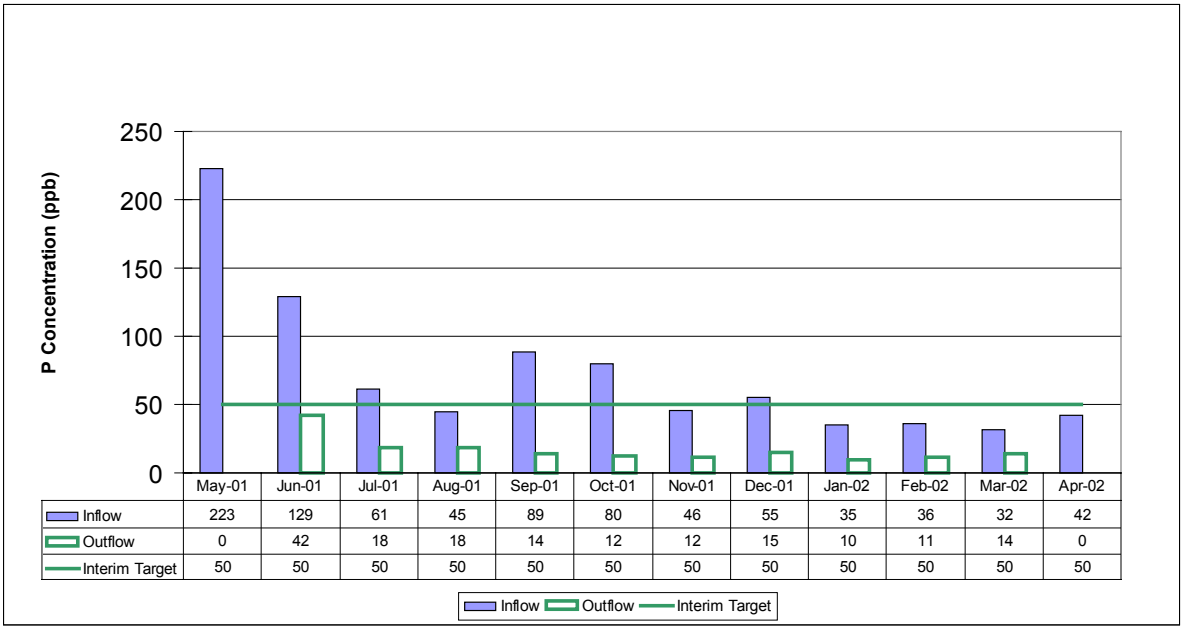
STA-6 continues to achieve its interim discharge goal of less than 50 ppb for P. During WY02, the STA received 4.5 metric tons of P, equating to a nutrient loading rate of 1.3 g/m^2. Approximately four metric tons of P were removed by STA-6 during WY02. Between May 2001 and April 2002, STA-6 experienced an 88-percent load reduction in TP (**Figure 4A-28**). Furthermore, monthly discharge concentrations were considerably lower than inflow concentrations (**Figure 4A-29**). The flow-weighted mean outflow concentration was 16 ppb, a 76-percent reduction from the inflow concentration of 69 ppb. For informational purposes, the geometric mean P concentration of the discharge was 18 ppb.

The EFA permit requires that the flow-weighted average annual outflow concentration must remain below 76 ppb. STA-6 exhibited an annual value of 16 ppb during WY02. The moving 12-month, flow-weighted average decreased from 30 ppb to 16 ppb during the course of WY02 (see **Figure 4A-30**).



	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02
Inflow	81	988	361	174	973	856	272	314	212	214	79	12
Outflow	0	145	58	39	104	106	34	16	23	26	15	0

Figure 4A-28. Summary of WY02 phosphorus loads for STA-6



	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01	Jan-02	Feb-02	Mar-02	Apr-02
Inflow	223	129	61	45	89	80	46	55	35	36	32	42
Outflow	0	42	18	18	14	12	12	15	10	11	14	0
Interim Target	50	50	50	50	50	50	50	50	50	50	50	50

Figure 4A-29. Summary of WY02 phosphorus concentrations for STA-6

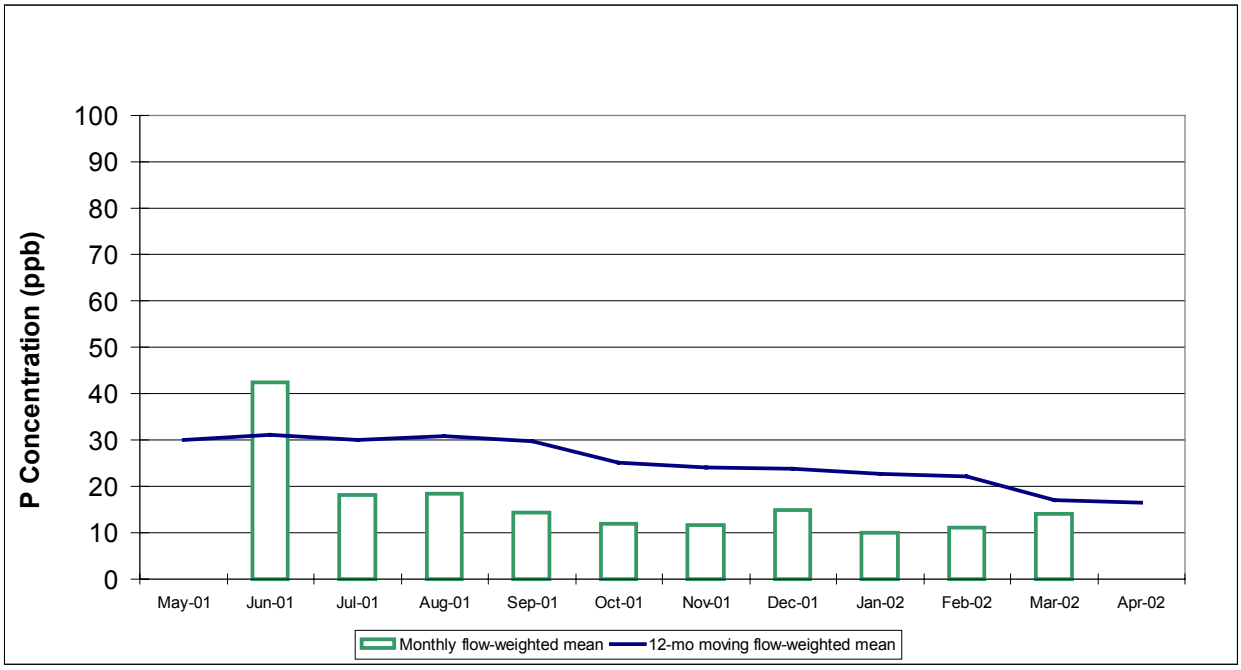


Figure 4A-30. Comparison of monthly to 12-month moving average phosphorus concentrations for WY02 for STA-6

Other Water Quality Parameters

The monitoring data for non-phosphorus parameters at STA-6 during this reporting period are presented in **Appendix 4A-10** and are summarized in **Table 4A-13**. While atrazine was detected in the outflow, this herbicide is not used within the STA. 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 STA-6 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 STA-6 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 STA-6 shall be deemed out of compliance.

Discharges from STA-6 were determined to be in compliance by satisfying the initial test (see **Table 4A-13**). Dissolved potassium and ametryn were slightly higher in the outflow than in the inflow concentrations; however, since these parameters have no applicable numeric state water quality standards, then STA-6 is deemed to be in full compliance with the permit.

Table 4A-13. Summary of annual arithmetic averages and flow-weighted means for water quality parameters other than total phosphorus monitored in STA-6

Parameter	Arithmetic Means			Flow-Weighted Means			
	Inflow	Outflow		Total Inflow		Total Outflow	
	G600	G354C	G393B	n	Conc.	n	Conc.
Temperature (°C)	25.3	24.4	22.5	-NA-	-NA-	-NA-	-NA-
Dissolved Oxygen (mg/L)	3.1	3.3	1.5	-NA-	-NA-	-NA-	-NA-
Specific Conductivity (µmhos/cm)	849	747	775	-NA-	-NA-	-NA-	-NA-
pH	7.3	7.5	7.2	-NA-	-NA-	-NA-	-NA-
Turbidity (NTU)	3.6	1.1	0.8	-NA-	-NA-	-NA-	-NA-
Color (PCU)	75	80	86	-NA-	-NA-	-NA-	-NA-
Total Suspended Solids (mg/L)	7.5	1.6	0.8	18 (27)	7.6	36 (52)	0.8
Unionized Ammonia (mg/L)	0.0014	0.0034	0.0002	18 (27)	0.0020	36 (52)	0.0004
Total Kjeldahl Nitrogen (mg/L)	1.76	1.77	1.47	18 (27)	1.77	36 (52)	1.44
Orthophosphate as P (mg/L)	0.012	0.004	0.008	18 (27)	0.017	34 (50)	0.005
Total Iron (µg/L)	227	119	102	2 (4)	313	6 (8)	106
Silica (mg/L)	7.95	9.58	7.83	2 (4)	9.38	6 (8)	9.20
Sulfate (mg/L)	27.4	21.6	27.9	2 (4)	29.4	6 (8)	25.7
Alkalinity (mg/L)	273.3	220.7	216.8	2 (4)	281.0	6 (8)	237.9
Dissolved Chloride (mg/L)	82.2	81.6	74.9	2 (4)	78.3	6 (8)	71.1
Dissolved Sodium (mg/L)	57.1	55.9	50.4	2 (4)	55.6	6 (8)	48.6
Dissolved Potassium (mg/L)	4.1	5.3	4.9	2 (4)	3.8	6 (8)	4.8
Dissolved Calcium (mg/L)	107.6	83.9	84.7	2 (4)	109.8	6 (8)	91.8
Dissolved Magnesium (mg/L)	8.8	8.2	7.4	2 (4)	9.3	6 (8)	7.8
Ametryn (µg/L)	0.051	0.061	0.062	4 (4)	0.050	6 (8)	0.055
Atrazine (µg/L)	0.815	0.413	0.415	4 (4)	0.994	6 (8)	0.627

-NA- : Not Applicable
n: number of samples with flow (total number of samples)

Table 4A-13 lists the herbicides that were analyzed in surface waters from STA-6. The four-quarter average outflow concentration for all compounds was lower than or equal to corresponding inflow concentrations. Although not a permit requirement, it is important to note that during each quarter, herbicide concentrations at the outflow were less than at the inflow. The herbicides detected are not used for vegetation management at STA-6, but are typical of areas with nearby intensive agricultural activity.

The District has included the following documentation to satisfy the remaining monitoring requirements of the EFA permit:

- The District has performed all sampling and analysis under the latest FDEP-approved CompQAP No. 870166G (June 1999).
- A signed copy of this statement is provided in **Appendix 4A-2**.

Mercury

The results of mercury compliance monitoring for routine operation are summarized in **Appendix 4A-4** of this chapter. During WY02, there were no violations of the Florida Class III numerical water quality standard of 12 ng/L unfiltered total mercury (THg). As such, the Everglades Construction Project has met one of the requirements of the operating permits.

After four years of operation, STA-6 continued to exhibit fluctuations in Hg species in water and Hg levels in resident fish. Following a drydown and re-wetting event during the second quarter of 2001, concentrations of THg and MeHg in the unfiltered surface water spiked at STA-6 outflows, reaching 7.0 ng THg /L and 3.4 ng MeHg/L. While a scoping-level assessment found THg loads out of STA-6 to be similar to or less than inflow loads (including atmospheric deposition), loads of MeHg out of the STA were found to exceed inflow loads by approximately 2 to 7 grams. A more intensive follow-up study is planned to more accurately quantify MeHg mass loading and export on an annual average basis. Resident fishes continued to exhibit a positive percent change in Hg across STA-6; however, there was no evidence that the spike in water column MeHg was followed by significant increases in mercury bioaccumulation over background. While levels of Hg in STA-6 fishes have fluctuated near background and are similar to or lower than levels found in other Everglades areas, based on USFWS and USEPA criteria there is some risk of adverse chronic effects from mercury exposure to fish-eating wildlife if feeding preferentially at STA-6. For perspective, the entire Everglades continues to remain under a Department of Health advisory that recommends limited or no consumption of select fish species due to high mercury levels in their flesh.

Another event of anomalously high mercury levels occurred in STA-6 in June 2002 during the initial rewetting following the extended seasonal dryout of the STA. This was reported to the FDEP in July 2002 following quality assurance confirmation. This event will be reported in detail in next year's *2004 Everglades Consolidated Report*.