Chapter 5: STA Performance, Compliance and Optimization

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SUMMARY

The ability of wetlands to assimilate phosphorus is a crucial component of the Everglades restoration program. For this purpose, approximately 40,000 acres of freshwater wetlands have been constructed in the Everglades area (STA-1E, STA-1W, STA-2, STA-3/4, STA-5, and STA-6) (**Figure 5-1** and **Table 5-1**) to remove excess total phosphorus (TP) from surface waters entering into the Everglades Protection Area (EPA). Since 1994, these constructed wetlands, referred to as Stormwater Treatment Areas (STAs), have reduced the TP load that would have gone into the Everglades by over 800 metric tons (mt).

An overview of the hydraulic and nutrient loadings, operations, vegetation management, phosphorus and nutrient removal performance, and permit compliance for each STA is presented in this chapter, along with an update of the progress of the STA enhancements projects that were identified in the Everglades Protection Area Tributary Basins Long-Term Plan for Achieving Water Quality Goals (Long-Term Plan) (Burns and McDonnell, 2003) and subsequent revisions (see Chapter 8 of this volume). This chapter documents compliance with appropriate conditions of the Everglades Forever Act (EFA) and the U.S. Environmental Protection Agency's National Pollution Discharge Elimination System (USEPA's NPDES) operating permits.

General information about the various activities that occurred in the STAs is found in this section of this chapter. Specific information about each STA is then presented in separate sections, beginning with a bulleted listing of the highlights over the water year. In the *Analysis and Interpretation* section of this chapter, a more detailed analysis of the performance of each treatment cell of each STA is presented. Finally, a synopsis of annual performance for all of the STAs is presented.

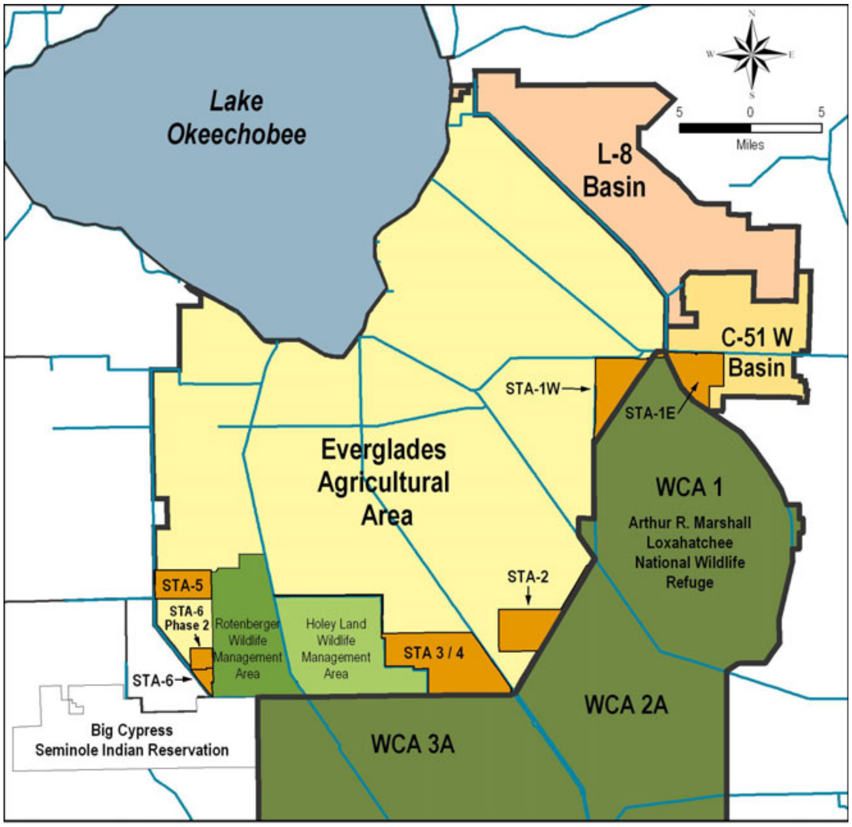


Figure 5-1. Location of the Everglades Stormwater Treatment Areas (STAs).

Table 5-1. Sequencing of STA operational dates.

	STA Operational Dates												
	Water Years (May - April)												
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
STA-1E											"	"	"
ENR Section of STA-1W	"	"	"	"	"	"							
STA-1W							"	"	"	"	"	"	"
STA-2							"	"	"	"	"	"	"
STA-3/4											"	"	"
STA-5						"	"	"	"	"	"	"	"
STA-6					"	"	"	"	"	"	"	"	"

Note: "ENR Section of STA-1W" refers to the Everglades Nutrient Removal Project which consisted of Cells 1 through 4; after Cell 5 was constructed, the project was then named STA-1W.

WY2006 STA HIGHLIGHTS

- The six STAs in operation (STA-1E, STA-1W, STA-2, STA-3/4, STA-5, and STA-6) are in full compliance with state and federal operating permits (**Table 5-2** and within each STA section).
- In Water Year 2006 (WY2006) (May 1, 2005–April 30, 2006), the STAs combined received over a million acre-feet (ac-ft) of inflow (1,446,316 ac-ft), equating to an average hydraulic loading rate of 3.99 centimeters per day (cm/day) and an average phosphorus loading rate of 2.23 grams per square meters per year ($g/m^2/yr$) (**Table 5-3**). Overall, the flow-weighted total phosphorus entering into the STAs was 144 parts per billion (ppb) and the TP load was 257 mt. The STAs retained 176 mt of TP, reducing the inflow TP load by 69 percent and the inflow TP concentration down to 44 ppb (**Table 5-3**).
- Hurricane Wilma impacted all the STAs, resulting in widespread loss of power and damage to the levees and plants (**Figure 5-2** and each STA section).
- Long-Term Plan enhancements construction and vegetation conversion (e.g., expansions, divide levees, water control structures, hydraulic improvements) occurred in all six STAs (**Table 5-4**). Some of the STAs experienced temporary reduction of effective treatment area due to Long-Term Plan enhancements construction and plant regeneration efforts.
- Some of the STAs experienced dry-out conditions, either due to low rainfall amounts or drawdown for plant reestablishment or Long-Term Plan enhancements construction.
- The biological systems in the STAs showed stress responses to major storm events, high loadings, and dryout.
- Major efforts by the District to rehabilitate STA-1W Cell 5 occurred during this water year. Plant re-growth was very slow after rehydration primarily due to turbidity and, consequently, poor light penetration.
- Issues pertaining to threatened, endangered, and migratory birds were addressed; STA operation was affected. The District is currently developing an Avian Protection Plan to be used in conjunction with STA operations.
- Vegetation management activities included submerged aquatic vegetation (SAV) rehabilitation, exotic plant eradication, and buffering emergent vegetation strips creation within the SAV treatment area, in addition to routine vegetation management activities.
- The WY2006 preferred outflow data for STA-3/4 was updated in October 2006. The flow data were first revised in July 2006 to reflect the calibrations made to the flow equations from streamgaging, and then further refined in October 2006 using mass balance analysis to correct the bias observed in the flows at small head differences due to the difficulty in measuring flows under such conditions.
- Recreational opportunities included duck and alligator hunting, bird watching, and tours.
- STA management continued through coordination with multidisciplinary teams at various, regularly scheduled communication meetings.

Over this past water year, numerous events impacted the performance of the STAs. For the second water year in a row, the STAs experienced the devastating effects of hurricane winds with accompanying increases in hydraulic and nutrient loads and water column turbidity (hurricanes Frances and Jeanne in WY2005, and Hurricane Wilma in WY2006). Another issue experienced in some of the STAs was the temporary reduction of effective treatment area due to rehabilitation of the treatment cells or implementation of physical and vegetative enhancement components. The presence of endangered or nesting migratory-protected birds also altered operations.

The South Florida Water Management District (SFWMD or District) has expended much effort in resolving the difficulties encountered in rehabilitating and restarting STA treatment cells following enhancements projects and hurricane damage. Operation of the STAs involves the participation of multidisciplinary teams and the use of integrative diagnostic tools. District staff discuss STA operational and management issues in various meetings, including regularly scheduled weekly, bi-weekly, and monthly communication meetings. Operational recommendations are made using real-time flow and TP loading data compared to target flows and TP loads. Efforts are also focused on achieving target water depths between storm events. Vegetation surveys are conducted routinely, which provide basis for management, including control of less desirable vegetation types. Two-dimensional hydrodynamic models are used to predict the effect of structural and operational modifications and the Dynamic Model for Stormwater Treatment Areas (DMSTA) is used to predict STA phosphorus removal performance. Research efforts are focused on characterizing the sediment and vegetation conditions in the various treatment cells, as well as the implementation of recovery and rehabilitation plans.

To fortify the STAs against hurricane impacts, emergency power sources such as installation of hook-ups for portable generators are being installed at key structures, emergent vegetation strips were added to some SAV treatment cells to reduce the impacts of waves and high winds, and loadings into impacted treatment cells, if possible, were reduced. To address vegetation issues and associated poor TP removal performance of STA-1W Cell 5, a recovery plan was written and a comprehensive sediment reconsolidation plan was implemented (Appendix 5-7). The recovery plan can be found on the District's website at www.sfwmd.gov under *Everglades, Long-Term Plan for Achieving Everglades Water Quality Goals* link. This multifaceted plan included planting rice in an effort to consolidate sediments and reduce overlying water turbidity, removing unconsolidated sediment at water control structures, surveying remnant farm roads, and planting emergent vegetation strips in the SAV cell. Measures aimed at minimizing impacts to protected birds included maintaining water stages to prevent the nests from flooding, conducting surveys through a cooperative effort with the U.S. Fish and Wildlife Service, and developing an Avian Protection Plan aligned with STA treatment objectives and operations.

In WY2006, groundbreakings were held for STA expansion and enhancements projects. The STA expansion projects involve the addition of large treatment cells to STA-2, STA-5, and STA-6, which will increase the total amount of effective treatment area by about 5,336 acres. STA enhancements, which include construction of interior levees and water control structures, improvements for water flow, and vegetation conversions, continued to be implemented. Design of the recreational facilities for three of the STAs was under way in FY2006, and construction of these facilities will occur in FY2007. Increased recreational use opportunities such as duck hunting, bird watching, and hiking were offered in the STAs.

Figure 5-2. Avid bird watchers flock to the STAs (left). Recreational opportunities in the STAs include bird watching, hunting, and hiking. The impacts of Hurricane Wilma included damage to the submerged aquatic vegetation (SAV) and damage to the high voltage electrical lines (center). Vegetation strips were planted in STA-1W Cell 5 to protect the SAV from wind and wave damage (right).

The District has performed all sampling and analysis under the latest Chemistry Laboratory Quality Manual and a Field Sampling Quality Manual (SFWMD, 2005). Certification statements regarding sampling and laboratory procedures are provided in Appendix 5-1 of this volume. The water quality parameters presented include nutrients, physical parameters, pesticides, major ions, and mercury. **Tables 5-1** and **5-2** present a summary of STA operations and issues. The appendices presented with this chapter provide additional details of the monitoring program, as required by state operating permits, as well as plots showing the annual flow, TP load, and TP concentrations for the inflow and outflow of each STA for each year of operation (see Appendix 5-2).

STA PERFORMANCE OVERVIEW

Since 1994, the STAs have been retaining TP that would have otherwise entered into the Everglades (**Figure 5-3**). The amount of phosphorus removed has increased as more STAs became operational (**Table 5-1**). A complete summary of the STA performance, beginning at start-up, is found in the *STA Performance Synopsis* section of this chapter (**Table 5-39**). The operational status of the STAs and issues faced during WY2006 are found in **Table 5-2**, along with the amount of Lake Okeechobee water received by the STAs and the amount of water diverted around the STAs.

During WY2006, the STAs received variable hydraulic and nutrient loadings (**Table 5-3**). Large storm events occurred in June and October 2005 and February 2006, but not all of the STAs were impacted (refer to each STA section of this chapter for monthly information). The TP concentrations from Lake Okeechobee were high following Hurricane Wilma (see Chapter 2 of this volume). Compared to WY2005, the amount of loading received by STA-1W was lower and the amount received by STA-2 was about the same. For STA-3/4, the hydraulic loading rate (HLR) was slightly lower than last water year and the phosphorus loading rate (PLR) was about the same. Both the HLR and PLR were higher for STA-5 and STA-6 compared to last water year. Additional details are found in each STA section and in the *STA Performance Synopsis* section of this chapter. The progress of the STA Long-Term Plan enhancements and expansion projects (**Table 5-4**) is also discussed in each STA section.

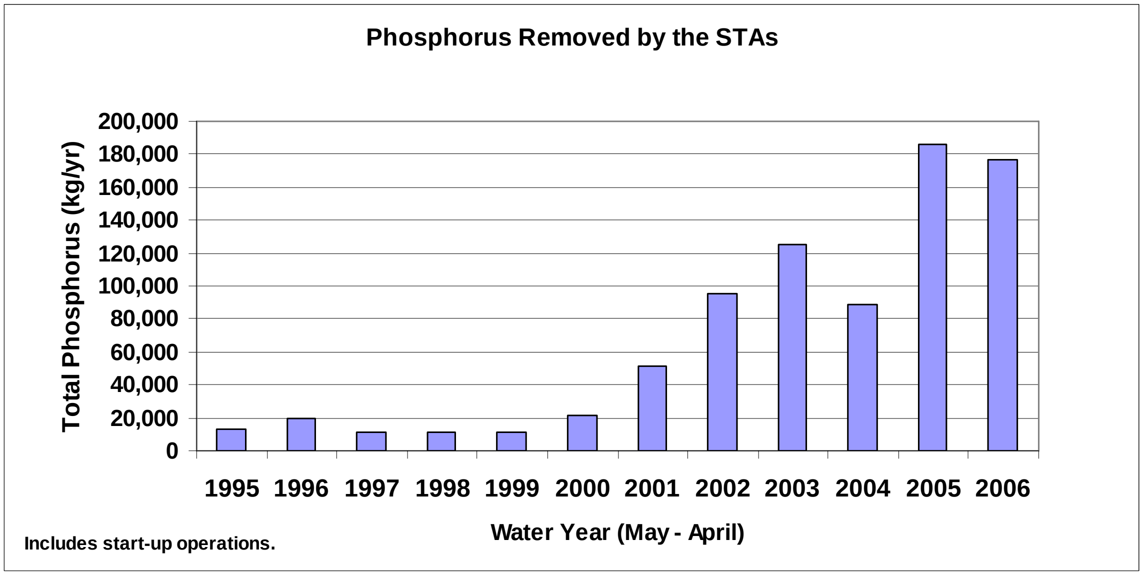


Figure 5-3. Annual phosphorus removal by the STAs. The STAs began operation at different times: the original section of STA-1W (ENR Project) began start-up in October 1993, expansion of the ENR to become STA-1W occurred in March 1999, STA-2 began start-up in June 1999; STA-3/4 began start-up in October 2003; STA-5 began start-up in October 1999; STA-6 began start-up in October 1997; and STA-1E began start-up in September 2004.

Table 5-2. Summary of STA operations and issues. Operational phases: (1) start-up: inundate for vegetation growth, no discharge, phase ends when cell demonstrates net improvement in phosphorus and mercury; (2) stabilization: flow-through including discharge, phase ends when 12-month outflow total phosphorus (TP) ≤ 50 parts per billion (ppb); and (3) post-stabilization: after stabilization phase. The terms "fully operational" and "partially operational" refer to the status of the treatment cells.

STA-1E	Operational Status	WY2006 Diversions and Lake Okeechobee Water Received	Operational Issues
	In Stabilization phase	Lake water received: 16,551 ac-ft, 3.89 mt TP Diversions through G-300 and G-301: 2,821 ac-ft, 0.9 mt TP	• Partially operational. • Cells 1 and 2 remain off-line due to construction of the periphyton-based STA (PSTA) demonstration project by the U.S. Army Corps of Engineers (USACE).
Permit timeline: • Construction completed June 2004 for Cells 3, 4N, 4S, 5, 6, 7 • Start-up operations began September 2004 • Emergency discharges in September and October 2004 due to hurricanes Frances and Jeanne • Permit issued August 30, 2005 • Net improvement for phosphorus and mercury in Central and Western Flow-ways demonstrated on September 20, 2005			
STA-1W	**Operational Status**	**WY2006 Diversions and Lake Okeechobee Water Received**	**Operational Issues**
	In Stabilization Phase	Lake water received: 12,769 ac-ft, 3.37 mt TP Diversions through G-300: 20,682 ac-ft, 6.04 mt TP Diversions through G-301: 26,126 ac-ft, 7.97 mt TP	• Partially operational. • Hurricane damaged Cell 5 • Long-Term Plan enhancements construction in Western Flow-way January 2005–August 2005. Flow-way remained off-line for plant re-growth through end of WY2006. • Long-Term Plan enhancements construction and vegetation rehabilitation in Northern Flow-way December 2005 through end of WY2006.
Permit timeline: Initial 3,742 acres (Eastern and Western Flow-ways): • Start-up operations: October 1993 • Flow-through operations: August 1994 Additional 3,018 acres (Northern Flow-way): • Construction completed March 18, 1999 • Start-up operations began March 18, 1999 • Net improvement demonstrated January 21, 2000 • Flow-through operations began July 7, 2000			

Table 5-2. Continued.

STA-2	Operational Status	WY2006 Diversions and Lake Okeechobee Water Received	Operational Issues
	In Post-Stabilization Phase	Lake water received: 6,977 ac-ft, 0.78 mt TP Diversion through G-339: 19 ac-ft, 0.002 mt TP	Hurricane damage to Cell 3
Permit timeline: • Start-up operations began June 1999 • Net improvement for TP and mercury for Cells 2 and 3 demonstrated in Fall 2000; Cell 1 demonstrated net improvement for mercury January 2003. • Flow-through operations began for Cells 2 and 3 October 2000 as part of pump station commissioning, although drought prevented flow-through operations until summer 2001			
STA-3/4	**Operational Status**	**WY2006 Diversions and Lake Okeechobee Water Received**	**Operational Issues**
	In Post-Stabilization Phase	Lake water received: 54,805 ac-ft, 12.26 mt TP Diversion through G-371, G-373, G-373BC: 75,050 ac-ft, 8.74 mt TP *(it is estimated that 80% of this diversion consisted of STA-5 discharge during the June 6–July 22, 2005, flood event)*	• Partially operational. • Long-Term Plan enhancements construction in Western Flow-way October 2004–June 2005
Permit timeline: • Cells 1A/1B and 2A/2B began start-up October 2003 • Cell 3 began start up November 2003 • Cells 1A/1B passed start-up January 15, 2004, Cells 2A/2B passed start-up August 30, 2004 • Cell 3 began flow-through June 2004 (FDEP permit modification March 25, 2004, for expanded mercury monitoring) • Cell 2A/2B began flow-through September 2004			
STA-5	**Operational Status**	**WY2006 Diversions**	**Operational Issues**
	In Stabilization Phase	Diversion through G-406: 86,124 ac-ft, 44.04 mt TP	• Partially operational: Long-Term Plan enhancements construction in Northern Flow-way January 2005–December 2005 • Long-Term Plan enhancements construction in Southern Flow-way January 2006–September 2006
Permit timeline: • Start-up began December 30, 1998 • DEP Emergency Order for flow-through issued October 15, 1999, net improvement for TP and mercury demonstrated			
STA-6	**Operational Status**	**WY2006 Diversions**	**Operational Issues**
	In Post-stabilization Phase	No diversions	
Permit timeline: • Start-up began October 1997 • Net improvement for TP and mercury December 9, 1997; Flow-through began December 1997			

Table 5-3. STA hydrology and TP removal for Water Year 2006 (WY2006). Refer to each STA section for details regarding the operation of each STA, such as treatment cell start-up information, flow-through status, and temporary loss of effective treatment area due to vegetation rehabilitation or implementation of the Long-Term Plan enhancements.

	STA-1E	STA-1W	STA-2	STA-3/4**	STA-5	STA-6	All STAs *WY2006*
Average Effective Treatment Area* (acres)	4,024	4,181	6,430	14,253	3,222	870	32,980
Inflow:							
Total Inflow Volume (ac-ft)	52,132	142,678	297,364	697,161	216,514	40,467	1,446,316
Hydraulic Loading Rate (HLR) (cm/day)	1.08	2.85	3.86	4.08	5.61	3.88	3.99
Flow-weighted Mean Inflow TP (ppb)	188	213	120	123	199	104	144
TP Loading Rate (PLR) ($g/m^2/yr$)	0.74	2.21	1.69	1.83	4.07	1.47	2.23
Total Inflow TP Load (mt)	12.1	37.4	44.0	105.4	53.0	5.2	257.2
Outflow:							
Total Outflow Volume (ac-ft)	40,572	137,890	322,303	749,092	201,102	26,312	1,477,271
Flow-weighted Mean Outflow TP (ppb)	146	113	21	23	96	26	44
Total Outflow TP Load (mt)	7.3	19.3	8.2	21.6	23.7	0.8	80.9
Hydraulic Residence Time (d)	41	13	15	14	6	13	18
TP Retained (mt)	4.8	18.2	35.8	83.8	29.3	4.3	176.2
TP Removal Rate ($g/m^2/yr$)	0.31	1.21	1.38	1.25	1.76	1.23	1.32
Load Reduction (%)	40%	49%	81%	80%	55%	84%	69%
Period of Record:							
Start date	Sep-04	Oct-93	Jun-99	Oct-03	Oct-99	Oct-97	***1994 – 2006***
TP Retained to Date (mt)	1.6	314.1	149.5	161.6	151.2	32.2	810.3
TP Outflow to Date (ppb)	214	52	18	18	100	19	43

Note: * Average effective treatment areas reflect treatment cells off-line for plant rehabilitation or Long-Term Plan enhancements.

** The STA-3/4 outflow data was revised in October 2006.

The inception-to-date Period of Record numbers presented for the STAs now include start-up flows and loads and, therefore, will reflect a revision to the TP removal information reported in previous SFERs.

Table 5-4. STA enhancements and expansion projects, as listed in the Long-Term Plan and subsequent revisions.

STA	Enhancements and Expansion Projects
STA-1E	• Convert emergent cells to SAV Cells 2, 4N, 4S, and 6 • PSTA demonstration project under construction by USACE (see *PSTA Investigations* section of this chapter)
STA-1W	• Replace existing Cell 2 inflow structure G-255 (seven culverts) with a fully operable control structure [three gated culverts, nominal capacity of approximately 850 cubic feet per second (cfs)] • Construct a new levee across Cell 2, together with a series of culverts for improved flow distribution (G-249 structures) • Convert Cell 2B to SAV • Construct a small seepage pump station (designated as G-327B) near the northwest corner of Cell 5B to permit withdrawal from the seepage canal to maintain stages in the SAV Cell 5B • Addition of a 150-cfs structure (G-307) to replace G-256 as the primary discharge for Cell 4 • Demolish Cell 4 original outflow G-256 structure and restore levee section • Remove vegetation tussock material from Cell 2 • Excavate cuts in berm along the C-7 Canal within Cell 4 • Excavate cuts in remnant farm road along north end of Cell 2A • Replace five existing galvanized culvert pipes along the G-254 levee • Earthwork for improved flow distribution, Cell 5 (G-304 and G-306 berms) • Automate Cell 5 G-304 structures • Construct a new levee across Cell 1, together with a series of culverts for improved flow distribution • Earthwork for improved flow distribution, Cell 3 (C-6 canal) • Improve G-308 collection canal • Convert Cells 1B and 3 to SAV
STA-2	• Construct interior levees and associated water control structures in the existing treatment cells • Convert emergent vegetation to SAV in the new downstream cells • Initial expansion of STA-2 includes the construction of an additional 2,015-acre treatment cell (new Cell 4) on Compartment B • Expand STA-2 on the remainder of Compartment B

Table 5-4. Continued.

STA	Enhancements and Expansion Projects
STA-3/4	• Construct about 3.3 miles of interior levee, subdividing Cell 3 into Cells 3A and 3B • Construct additional water control structures through the new levee subdividing Cell 3 into Cells 3A and 3B • Extend an overhead power distribution line from the intersection of Interior Levee 3 and Interior Levee 4, extending north along Interior Levee 4 to the new levee across Cell 3, and then west along the new levee across Cell 3 (total length of approximately 3.6 miles) • Construct small forward-pumping stations along the interior levees between cells in series to permit withdrawal from upstream emergent marsh cells to maintain stages in the downstream SAV cells. Supplemental flows can be transferred from Cell 2A to Cell 1A through structure G-382A, and between Cell 2A and Cell 3B through structure G-382B • Herbicide treatment of Cells 1B, 2B, and 3B for removal of emergent macrophyte vegetation to allow establishment of SAV • Inoculate SAV to accelerate vegetation recruitment • Construct the full-scale PSTA demonstration project (see *STA-3/4 PSTA Implementation Project* section of this chapter for additional details)
STA-5	• Modify the G-343 structures • Construct an additional seepage return pump station near the northwest corner of Cell 1B. This pump station will provide a nominal capacity of 45 cfs, similar to the capacity of existing pump stations G-349A and G-350A • Remove obstructions to flow • Construct an additional 2,560-acre treatment cell (new Flow-way 3) on Compartment C • Expand STA-5 on remainder of Compartment C
STA-6	• Construct additional 1,440-acre treatment cell (new STA-6 Section 2)

STA MANAGEMENT

A detailed breakdown of the sources of inflow water to the STAs, and the Everglades Protection Area (EPA) is found in Table 3C-3 of Chapter 3C of this volume. Information about the phosphorus source controls within the basins tributary to the Everglades Construction Project (ECP) is detailed in Chapter 4 of this volume.

The management of the STAs has been based on using an adaptive management approach and real-time data interpretation tools. The management of STAs continues through coordination with multidisciplinary teams, including regularly scheduled weekly, bi-weekly, and monthly communication meetings. The various communication meetings, which include the involvement of the site managers and construction engineers, and other technical working group meetings have contributed to the operation and management of the STAs. The real-time data evaluation tools consist of stage and water quality information presented by the site managers to the operations staff, as well as a graphical output that compares the actual flow and TP loads to the long-term average annual values that were anticipated for each STA (Goforth, 2004).

General operational principles that are currently performed in STA operations are to (1) ensure that inflow and TP loads are within the operational envelope, (2) avoid dryout and maintain a minimum of 15 cm depth of water, (3) avoid keeping the water stage too deep for extended periods of time by limiting depth to a maximum of 137 cm for 10 days, (4) maintain target depths between storm events (38 cm for emergent vegetation; 45 cm for SAV), and (5) have frequent field observations of site conditions. A complete set of references regarding STA operations can be found on the District's website at www.sfwmd.gov/org/ema/everglades/consolidated_00/ecr2000/intro.pdf.

As part of the adaptive implementation process envisioned in the Long-Term Plan, it is anticipated that further refinements to the recommended water quality improvement measures would be made at the earliest achievable dates as more scientific and engineering information is obtained. Investigations are under way in each STA and are summarized in later sections of this chapter. Examples of the adaptive implementation process are evident in the recovery plan developed for STA-1W, written to encompass both short- and long-term projects aimed at reestablishing the vegetation and improving phosphorus removal performance. For example, the STA-1W Cell 5 sediment consolidation effort, which entailed drying down the treatment cell, removing flow-obstruction areas, and planting rice in an effort to stabilize the sediments and encourage SAV re-growth. Another example is the reduction of nutrient loadings to STA-2 Cell 3 to encourage vegetation regrowth. Additional information on the recovery plan can be found on the District's website at www.sfwmd.gov under the *Everglades* section, *Long-Term Plan for Achieving Everglades Water Quality Goals* link.

STA RESEARCH

Applied research conducted in the STAs focuses on ways to stabilize the STAs for long-term sustainability. Research efforts are geared on characterizing the sediment and vegetation conditions in the various treatment cells, as well as the implementation of recovery and rehabilitation plans. Vegetation surveys are conducted routinely and serve as a basis for management decisions, such as the control of less desirable vegetation types. Annual vegetation maps are created. Small-scale seed bank studies and SAV re-establishment studies were conducted following Hurricane Wilma. Evaluation of the SAV inoculation program in STA-3/4 can be found under the *STA-3/4* section of this chapter.

HURRICANE WILMA IMPACTS

Hurricane Wilma affected levees, structures, power, vegetation, and water clarity in the STAs (**Figure 5-2**). Most structures lost power during the storm and experienced minor damage. Wooden and high voltage poles were broken, some telemetry to the structures was lost with the power outage, and auto-samplers and intakes were damaged by high winds and wave action. The hurricane also adversely affected the vegetation, especially the SAV communities, creating poor water clarity and high turbidity. All SAV and open water treatment cells experienced turbidity problems, whereas STA-1W Cell 5B and STA-2 Cell 3 experienced severe turbidity problems. Those treatment cells with damaged SAV communities had highly turbid water, unconsolidated sediments, increased water column TP concentrations, and little to no plant reestablishment. The effects of the hurricane impacts prompted efforts to fortify the marsh to increase plant survivability and the implementation of a "lost power" scheme for both pre- and post-storm operations. In STA-1W Cell 5B, emergent vegetation strips were established to help prevent vast SAV migration across the marsh and reduce the impact of wave action.

VEGETATION MANAGEMENT

Vegetation management activities in the STAs contain operational and research components. The various management activities conducted over the water year have included monitoring the success of a large-scale plant inoculation to accelerate SAV recruitment in STA-3/4, conducting research studies to evaluate the best methods to treat undesirable vegetation, estimating the percent coverage of plant communities, and conducting routine vegetation maintenance. In general, emergent vegetation is encouraged at the beginning of the treatment system where nutrient concentrations are higher, and SAV is encouraged further down the flow path in areas where phosphorus concentrations are expected to be lower.

Overall, vegetation management focuses on keeping floating aquatic vegetation at maintenance control levels. The floating aquatic vegetation "shades out" or impedes beneficial SAV and emergent vegetation, which is necessary for optimum STA performance. Additionally, emphasis was also placed on controlling emergent vegetation, mainly torpedograss (*Panicum repens*) and cattail (*Typha* spp.), which appears in SAV cells. The final report on the torpedograss control experiment conducted in STA-3/4 can be found on the District's website at www.sfwmd.gov under the *Everglades* section, *Long-Term Plan for Achieving Everglades Water Quality Goals* link. A summary of the monitoring phase of the vegetation management demonstration project in STA-3/4 Cell 2B is found in the *STA-3/4* section of this chapter. Research experiments were conducted in WY2006 using varying dosages of herbicide along with different water depths and fire regimes. Vegetation strips consisting of emergent plant species were established in STA-1W Cell 5B to help prevent vast SAV migration across the marsh and reduce the impact of wave action during large storm events. A summary of the herbicide applications used in the STAs during WY2006 is presented in **Table 5-5** as well as under each STA section in this chapter.

Floating vegetation consists of water hyacinths (*Eichhornia crassipes*) and water lettuce (*Pistia stratiotes*) and is controlled with diquat, a contact-type herbicide. Emergent vegetation consists of numerous species such as cattail, torpedograss, para grass (*Brachiaria mutica*), and many others. These plants are controlled using systematic herbicides such as glyphosate, imazapyr, and triclopyr-based products. To control hydrilla (*Hydrilla verticillata*), which colonized 167 acres within STA-2 Cell 3, an endothall-based herbicide was used.

Table 5-5. Summary of the amount of herbicides applied to the STAs during WY2006. The active ingredient in the herbicide is listed. Floating vegetation, such as water hyacinth and water lettuce, was controlled using herbicide containing diquat. Emergent vegetation, such as cattail, torpedograss, and para grass, was controlled using herbicides containing glyphosate or imazapyr. The submerged plant *hydrilla* was controlled using herbicide containing endothall.

STA	Acres	Herbicide containing Glyphosate (gallons)	Herbicide containing Imazapyr (gallons)	Acres	Herbicide containing Diquat (gallons)	Acres	Herbicide containing Endothall (pounds)
STA-1E	2,003	689	290.75	540	88.45	0	0
STA-1W	2,501	1,332	351.00	216	81.00	0	0
STA-2	52	108	14.25	219	87.00	167	3,950
STA-3/4	2,511	931	616.00	1,233	592.75	0	0
STA-5	3,448	3,192	828.00	414	96.40	0	0
STA-6	170	147	33.00	0	0	0	0

PSTA INVESTIGATIONS

A Periphyton-Based Stormwater Treatment Area (PSTA) is generally defined as a constructed wetland with a sparse emergent macrophyte community that provides structure to support a dominant periphyton assemblage. PSTA wetlands were studied extensively as part of the District's Advanced Treatment Technology (ATT) Program and are envisioned to be a post-STA technology that is operated at inflow TP concentrations of 50 ppb or less. The primary nutrient removal mechanisms in a PSTA wetland are direct phosphorus uptake by the periphyton and algal-mediated co-precipitation of phosphorus with calcium carbonate. The objective of the PSTA Investigations Project is to track the performance of ongoing PSTA research projects. The District has done previous research regarding the ability of PSTA as treatment wetlands and is currently demonstrating the feasibility of a large-scale PSTA Implementation project at STA-3/4 and the U.S. Army Corps of Engineers (USACE) is currently constructing a PSTA demonstration project in STA-1E. The PSTA Investigations Project will track the performance of these demonstration projects as data becomes available.

STA-1W South PSTA Test Cell Research

The District continued to conduct research in the STA-1W test cells (0.5 acre constructed wetlands) to evaluate the efficacy of the PSTA technology. An overview to the TP removal for the period of May 1, 2002, through April 30, 2006, is presented in the *STA-1W* section of this chapter.

PSTA Field-Scale Test Facility

The PSTA field-scale test facility was a 20-acre site located immediately west of STA-2 that consisted of four 5-acre constructed wetlands. Treatment performance in these wetlands was monitored from November 2001 through October 2003. Descriptions of the facility, its operation, and a summary of phosphorus treatment results can be found in Newman et al. (2003), Chimney et al. (2004), and Goforth et al. (2005). The site was decommissioned in October 2004 and is being incorporated into the footprint of the STA-2 Cell 4 expansion project.

STA-3/4 PSTA Implementation Project

The STA-3/4 PSTA Implementation Project is a 400-acre section of Cell 2B in STA-3/4 that consists of an upstream 200-acre cell and two adjacent downstream 100-acre [40 hectares (ha)] cells. Construction of the full-scale PSTA Implementation Project in Cell 2B of STA-3/4 was completed during WY2006, and the project was flooded in spring 2005 to begin establishing periphyton and SAV. The project is described further in the *STA-3/4* section of this chapter.

2006 STILT NESTING SUMMARY FOR THE STAs

The 2006 breeding season for black-necked stilts (*Himantopus mexicanus*) in the STAs was a very active season, with an overall total of 380 surveyed nests. This number includes all nests surveyed during the first and second sampling events, active (with eggs) and inactive (no eggs) nests, and non-inundated and inundated nests. Assuming that all inactive nests have fledged, overall success for the 2006 breeding season was approximately 94 percent (**Table 5-6**). Areas to be surveyed by boat for stilts were determined by observing the breeding/nesting behavior of *Himantopus* from the levee road in early to mid May 2006. A more intensive nesting survey was performed between May 3, 2006 and June 1, 2006 to document both active and inactive nests. A second survey during the last week of June 2006 encompassed all STAs that contained active nests previously identified during the initial survey and documented activity status of nests and any observations of new nests encountered. This second survey indicated that (1) numbers of active nests were much lower than during the original survey and (2) some inactive nests in STA-5 and STA-1E were flooded due to rainfall and not due to the District's operational activities. A final survey was performed to determine whether or not to resume normal operations of treatment cells that contained active nests. All nests identified during this survey were inactive.

In summary, results gathered during the 2006 breeding season in the STAs for *Himantopus* reveal that the height of the nesting season appears to be from late May through early June, which corresponds with published literature on this species. Furthermore, the increased nesting activity that was seen in the STAs appears to be the result of drought conditions (rainfall in the Everglades Agricultural Area was 8.73 inches below normal for the January to June period of record) experienced during this year's dry season, which decreased the availability of water resulting in low water levels in most treatment cells. In all but three cases, the District was able to maintain water levels so as to not inundate active nests in identified nesting areas; the offspring from those nests were assumed to have fledged. Most inundated inactive nests that were observed during the second survey were due to rain and not District operations. Those areas that were inundated by the District did not harm a large number of active nests (five active nests in Cell 5 of STA-1W, three active nests in Cell 3B of STA-3/4, and two active nests in Cell 6 of STA-1E) and were done to improve environmental conditions within treatment cells and/or for the betterment of downstream areas. The District is currently working on an Avian Protection Plan for the existing ECP STAs and their expansions to be used in conjunction with STA operations.

Table 5-6. 2006 stilt nesting summary for the STAs.

STA	Cell	First Survey				Second Survey			Check Out Survey	
		Date	Total #	Nests: Active	Nests: Inactive	Date	Active Nests: Old	Active Nests: New	Status	Comments
1E	4N	5/22, 5/24	80	51	29	6/27	1	0	FLDG	Assume All Nests Successful – on second survey some inactive nests were flooded
	4S	5/26, 5/30	60	44	16	6/28	6	2	FLDG	Assume All Nests Successful – on second survey some inactive nests were flooded
	6	5/18, 5/19, 5/25, 5/26	46	32	14	6/27	1	2	INUND District	Most Nests Successful – on second survey some inactive nests were flooded two nests inundated due to water in basin
1W	5	5/3, 5/9, 5/10	5	5	0	IN	IN	IN	INUND District	All Nests Inundated due to rehabilitation effort of Cell 5
	2A	5/19	2	2	0	6/21	0	0	FLDG	Assume All Nests Successful
	2B	5/19	2	2	0	6/21	0	0	FLDG	Assume All Nests Successful
	4	6/12	40	30	10	6/29	8	5	INUND Natural?	Final survey unable to be completed – assume remaining nests were inundated due to high rainfall (two new families were observed after rain)
3/4	3B	6/7	5	3	2	IN	IN	IN	INUND District	All Nests Inundated to comply with long-term plan goals
5	1B	5/31, 6/1, 6/6	122	87	35	6/26 6/30	1	0	FLDG	Assume All Nests Successful – on second survey some inactive nests were flooded

Number of Nests Fledged (Active and Inactive)	**352(O) + 3(N) = 355 94% Success**		**Number of Nests Inundated**	**12**		**Status Unknown**	**13**

FLDG	All nests fledged	IN	Inundated
INUND District	District inundated area	O	Old fledged nests
INUND Natural	Natural inundation from rain	N	new fledged nests
INUND Natural?	Unsure whether nests were inundated from rain but were assumed inundated		

RECREATIONAL ACTIVITIES

Recreational facilities are proposed to provide public access to all six of the ECP STAs (refer to each STA section for details). The proposed facilities will include components such as boardwalks, bird watching blinds, parking areas, canoe launching sites, boat ramps, composting toilets, information kiosks, landscaping, pedestrian gates, road improvements, signs, and fencing as needed to define public access areas and to protect sensitive equipment.

Design of the STA-3/4, STA-1E, and the STA-1W recreational facilities was under way in FY2006 and construction of these facilities will occur in FY2007. The recreational facilities associated with STA-2, STA-5, and STA-6 are scheduled to be constructed concurrently with the Compartment B and C Buildout projects. The District has developed public access rules as well as a standard design for the recreational facilities.

WATER QUALITY PERMIT REQUIREMENTS

Water quality parameters with Florida Class III standards are identified in **Table 5-7**. 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-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.

The District has performed all sampling and analysis in compliance with Chapter 62-160, Florida Administrative Code, and the District's Laboratory Quality Manual (SFWMD, 2005) and Field Sampling Assurance Manual (SFWMD, 2005). Certification statements as to the procedures used in collection and analysis are provided in Appendix 5-1 of this volume.

The STA flow volumes are based on surface water flow and the TP loads are calculated using flow or time-proportional auto-sampler data. If auto-sampler data is not available, then concentration data from grab samples collected during flow events are used instead. A Site-Specific Alternative Criterion (SSAC) for dissolved oxygen in the Everglades was adopted in June 2004. The SSAC recognizes natural background conditions in the Everglades, which shall be applied as compliance criterion in future permits to be issued for the STAs.

Table 5-7. Water quality parameters with Florida Class III criteria specified in Section 62-302.530, Florida Administrative Code.

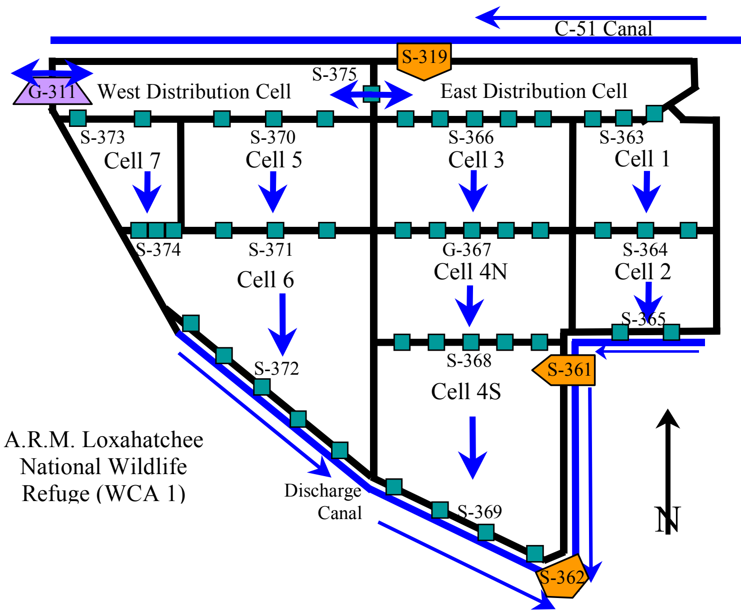
Parameter	Units	Class III Criteria
Dissolved Oxygen	mg/L	Greater than or equal to 5.0 mg/L
Specific Conductivity	µmhos/cm	Not greater than 50% of background or greater than 1,275 µmhos/cm, whichever is greater
pH	standard units	Not less than 6.0 or greater than 8.5
Turbidity	NTU	Less than or equal to 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

STA-1E

STA-1E CONFIGURATION

The construction of Stormwater Treatment Area 1 East (STA-1E) was managed by the U.S. Army Corps of Engineers (USACE). Construction of the STA was completed in June 2004. The Everglades Forever Act (EFA) and National Pollution Discharge Elimination System (NPDES) final permits were issued by the Florida Department of Environmental Protection (FDEP) on August 30, 2005. On September 20, 2005, the FDEP officially concurred with the District's submittal which documented that the start-up compliance tests for phosphorus and mercury, as outlined in the EFA and NPDES permits, was achieved for the Western (Treatment Cells 5, 6, and 7) and Central Flow-ways (Treatment Cells 3, 4N, and 4S) of STA-1E. The USACE is currently constructing a Periphyton-Based Stormwater Treatment Area (PSTA) demonstration project in Cell 2, and Treatment Cells 1 and 2 will remain off-line until the demonstration project is finished. The PSTA demonstration project consists of three cells (45.5 acres each) proceeded by a 556-acre cell, consisting of emergent vegetation and a 55-acre SAV cell. A schematic of STA-1E is presented in **Figure 5-4**.

STA-1E receives inflow from the C-51 West basin through the S-319 pump station and from the S-5A basin through the G-311 structure. While it is hydrologically possible for STA-1E to receive runoff from the L-8 basin, Lake Okeechobee regulatory releases, and the East Beach Water Control District, it is not expected to regularly accept water from these sources after the Comprehensive Everglades Restoration Plan (CERP) diversion projects are completed. It is also important to note that the STA was not sized to treat L-8 basin runoff. Chapter 7A of this volume provides an update on the CERP diversion projects. Actual deliveries vary based on hydrologic conditions in the basins. An updated water quality analysis for the C-51 West basin (Pietro and Goforth, 2004) can be found on the District's website for the Long-Term Plan at www.sfwmd.gov under the *Everglades* section, *Long-Term Plan for Achieving Everglades Water Quality Goals* link. Construction is under way to divert stormwater flows from ACME Basin B that currently enter the Water Conservation Area 1 (WCA-1) to the C-51 West Canal for treatment in STA-1E. During initial operation of STA-1E and in WY2006, there was no ACME Basin B runoff contributing to STA-1E.



Cell	Effective Area (ac)
1	556
2	552
3	589
4N	645
4S	752
5	571
6	1,049
7	418
Total	5,132 ac

Figure 5-4. Schematic of STA-1E (not to scale). The orange boxes denote pump stations, and the green boxes represent culverts.

STA-1E WY2006 HIGHLIGHTS

- Operational permit issued August 30, 2005. STA-1E is being operated on an interim basis in an adaptive manner that balances the water quality, flood control, and water supply purposes and adapts to major regional activities planned and under way that will affect STA-1E operations over the next several years.
- Treatment Cells 3, 4N, 4S, 5, 6, and 7 were online.
- Treatment Cells 1 and 2 continued to be off-line for construction of the USACE PSTA demonstration project.
- Hurricane Wilma caused power outages and minor damage to the levees and plant communities.
- Wildlife issues included presence of burrowing owls (*Athene cunicularia floridana*) in Cell 2 and black-necked stilts in Cells 4N, 4S, and 6.
- Vegetation management included transplanting duck potato (*Sagittaria* spp.) from Cell 6 to Cell 4N, creating vegetation strips in Cells 4N, 4S, and 6, and vegetation transplant experiments in Cell 6.
- A fuel tanker over-turned along the eastern levee of Cell 2 on May 30, 2006; the USACE is responsible for the spill cleanup.
- A large flow and TP loading event occurred in the Western Flow-way in February 2006.
- Discussions about distributing flow and loads to the Central and Western flow-ways continued.

STA-1E HURRICANE IMPACTS

Hurricane Wilma caused minor levee damage to the southern levee in Cell 4N and eastern levee in Cell 4S, and minor damage to the SAV and emergent plants, particularly in Cell 4N. Power outage varied depending on the structures, resulting in the manual operation of gates. The power was out for about two weeks and was restored November 4 - 9, 2005.

STA-1E PERMIT STATUS

The data presented in this section demonstrates that STA-1E 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. On June 16, 2004, FDEP issued a modification to dewatering permit number GL0178018 authorizing the operation of S-362 to provide seepage control during STA-1E construction related activities for 240 days, from June 16, 2004, through February 2005. An Emergency Order was issued in September 2004 that authorized flow-through operations as needed in response to Hurricane Frances. On May 6, 2005, an additional modification to dewatering permit number GL0178018 was issued, authorizing the continued operation of S-362 as needed for hurricane repair work within the STA. The EFA and NPDES final permits were issued by the FDEP on August 30, 2005. On September 20, 2005, the FDEP officially concurred with the District's submittal which documented that the start-up compliance tests for phosphorus and mercury, as outlined in the EFA and NPDES permits, was achieved for the Western (Treatment Cells 5, 6, and 7) and Central (Treatment Cells 3, 4N, and 4S) Flow-ways of STA-1E. Treatment Cells 1 and 2 remain off-line for construction of the USACE's PSTA demonstration project. Construction of PSTA demonstration project is expected to be completed around March 2007.

STA-1E OPERATIONS

Table 5-8. Operational status of the treatment cells in STA-1E.

STA-1E Operational Treatment Cells

2004					2005					2006		
Jan - Mar	Apr - Jun	Jul - Aug	Sep *Hurricanes Frances and Jeanne*	Oct - Dec	Jan - Mar	Apr - Jul	Aug - Sep	Oct *Hurricane Wilma*	Nov - Dec	Jan - Mar	Apr - Jun	Jul - Sep
			Emergency Operations, cell hydration					Central and Western Flow-ways Operational				
								Eastern Flow-way off-line for construction of PSTA project				

STA-1E Hydrology

During WY2006, 52,132 acre-feet (ac-ft) of water was captured and treated by STA-1E through structures S-319, G-311, and S-361 (**Table 5-3**). This amount was approximately 61 percent lower than the 31-year long-term average annual simulated inflow for this STA. This inflow loading was equal to an average hydraulic load of 1.08 centimeters per day (cm/day) over the effective treatment area. The volume of water that passed through S-319 and then immediately discharged through G-311 for delivery to STA-1W was subtracted out of the inflow loading calculations. The annual volume of treated water discharged to Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) was 40,572 ac-ft. The difference between the inflow and outflow volumes reflects the net contributions of direct rainfall, evapotranspiration (ET), seepage losses to adjacent lands, deep percolation, and flow measurement error. A summary of monthly flows is presented in **Figure 5-5**. During WY2006, STA-1E received 16,551 ac-ft of flow from Lake Okeechobee through S-319 and G-311. There was a total of 2,821 ac-ft of water diverted around STA-1E through G-300 and G-301 during WY2006.

STA-1E Total Phosphorus

During WY2006, STA-1E received 12.1 mt of TP, equal to a phosphorus loading rate of 0.74 grams per square meter (g/m^2) (**Table 5-3**). The TP loading to the system was about 44 percent lower than the 31-year long-term average annual simulated inflow TP for this STA. During WY2006, STA-1E received about 3.9 metric tons (mt) of TP with a flow-weighted mean (FWM) TP concentration of 191 parts per billion (ppb) from Lake Okeechobee. About 4.8 mt of TP were removed by STA-1E during WY2006. STA-1E reduced TP discharge loads by 40 percent, compared to inflow loadings measured at S-319, G-311, and S-361. A total of 0.914 mt of TP was diverted around STA-1E through G-300 and G-301 in WY2006. Summaries of monthly TP loads and FWM TP concentrations are presented in **Figures 5-5** through **5-7**. The FWM TP outflow concentration was 146 ppb, a 23 percent reduction from the inflow concentration of 188 ppb. For informational purposes, the geometric mean TP concentration of the outflow for WY2006 was 91 ppb, using auto-sampler data from S-362.

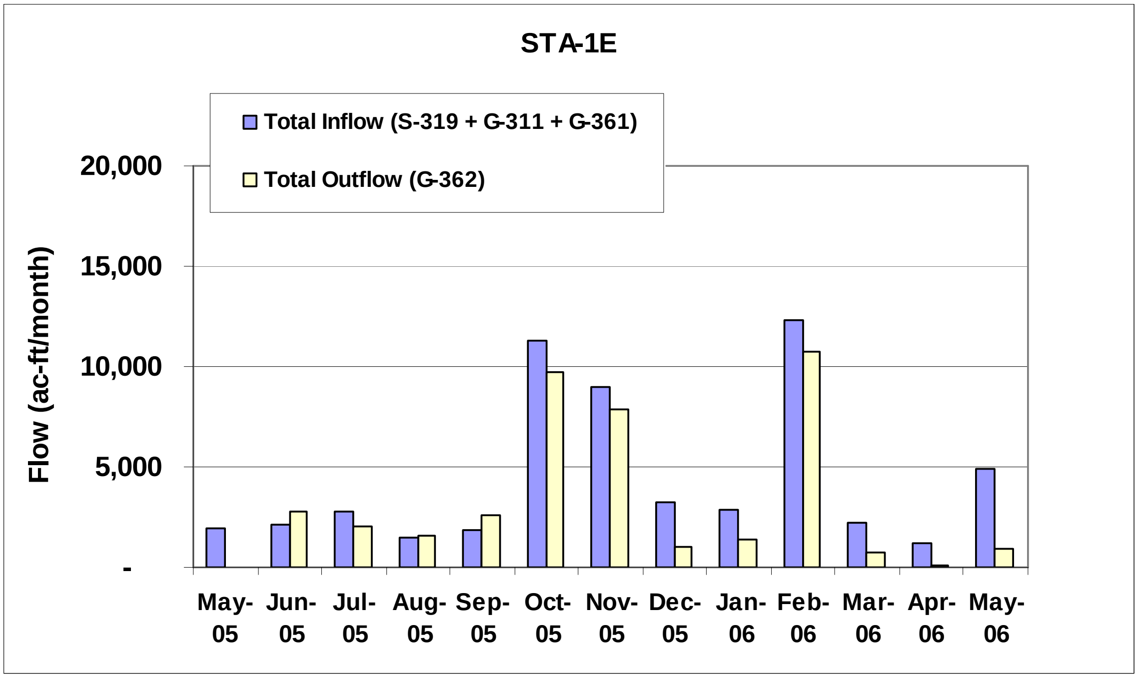


Figure 5-5. Summary of WY2006 flow for STA-1E. The Central and Northern Flow-ways (Cells 3, 4N, 4S, 5, 6, 7) were operational for part of the water year; Cells 1 and 2 are off-line for construction of the PSTA demonstration project.

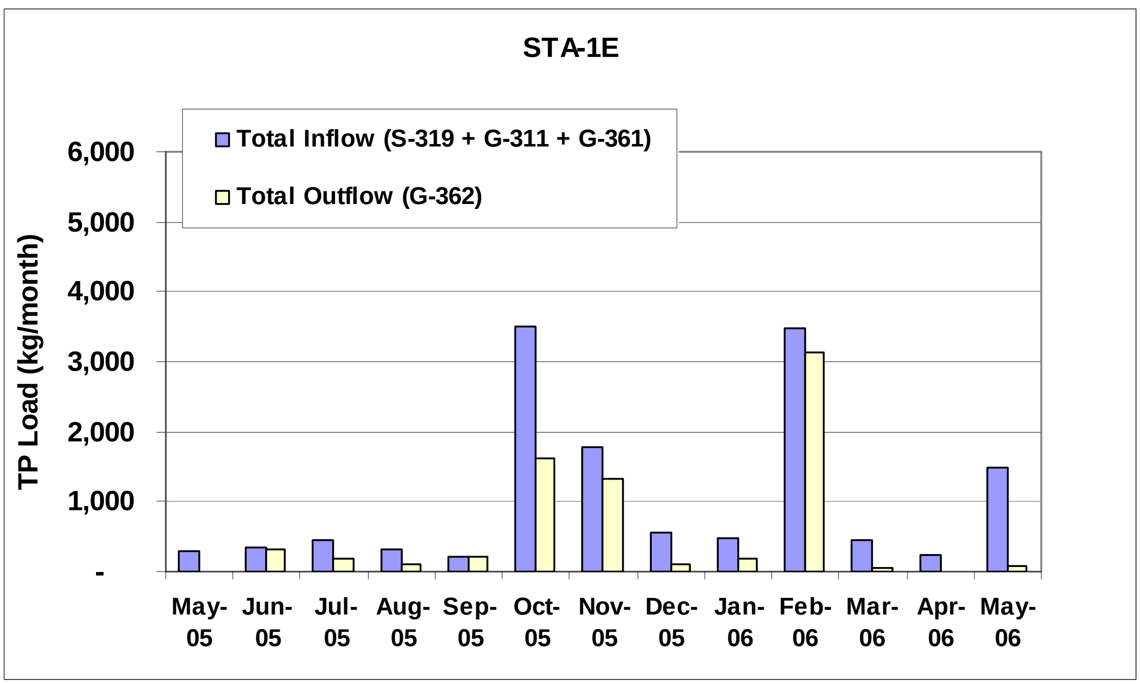


Figure 5-6. Summary of WY2006 TP load for STA-1E. The Central and Northern Flow-ways (Cells 3, 4N, 4S, 5, 6, 7) were operational for part of the water year; Cells 1 and 2 are off-line for construction of the PSTA demonstration project.

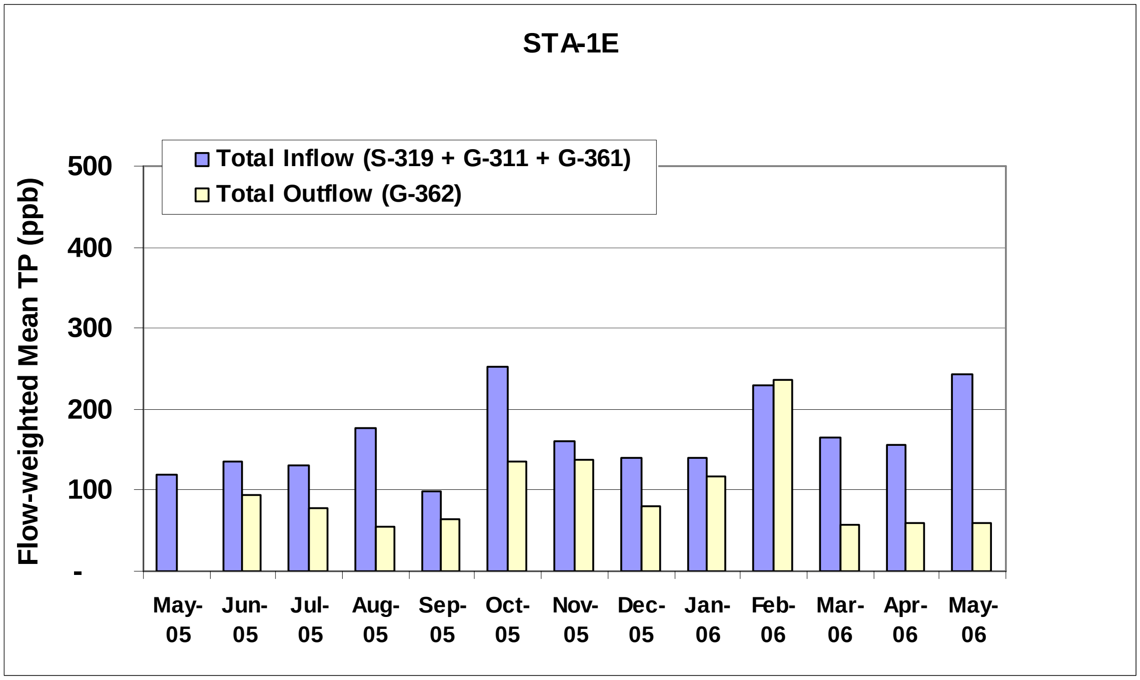


Figure 5-7. Summary of WY2006 flow-weighted mean (FWM) TP for STA-1E. The Central and Northern Flow-ways (Cells 3, 4N, 4S, 5, 6, 7) were operational for part of the water year; Cells 1 and 2 are off-line for construction of the PSTA demonstration project.

Other STA-1E Water Quality Parameters

Water quality parameters with Florida Class III standards are identified in **Table 5-7**. Compliance with the EFA permit is determined based on the three-part assessment presented in the *Water Quality Permit Requirements* section of this chapter. The monitoring data over the partial water year for non-phosphorus parameters at STA-1E during this reporting period are presented in Appendix 5-3 of this volume, and are summarized in **Table 5-9**. Temperature, specific conductance, dissolved oxygen (DO), and pH values reported in this chapter are field measurements.

Discharges from STA-1E were determined to be in compliance with the permit by satisfying criterion number 1 for all non-phosphorus and non-DO parameters with applicable numeric state water quality standards. Only one inflow site (S-361) had DO concentrations lower than the Class III numeric standard. Annual average concentrations of total nitrogen and sulfate were slightly higher at the outflow compared to the inflow. However, because these parameters have no applicable numeric state water quality standards, STA-1E is deemed to be in full compliance with the permit.

Table 5-9. Summary of annual arithmetic averages and FWM for all parameters other than TP monitored in STA-1E. Parameters that were measured higher at the outflow compared to the inflow are shaded in gray.

Parameter	Arithmetic Means: Inflow G311	Inflow S319	Inflow S361	Outflow S362	Flow-Weighted Means: Total Inflow* n	Total Inflow* Conc.	Total Outflow n	Total Outflow Conc.
Temperature (°C)	25.0	25.4	25.6	25.4	-NA-	-NA-	-NA-	-NA-
Dissolved Oxygen (mg/L)	5.1	5.7	4.6	6.9	-NA-	-NA-	-NA-	-NA-
Specific Conductivity (µmhos/cm)	896	517	929	956	-NA-	-NA-	-NA-	-NA-
pH	7.7	7.6	7.4	7.9	-NA-	-NA-	-NA-	-NA-
Sulfate (mg/L)	55.1	32.9	26.8	40.8	20 (42)	**39.0**	5 (13)	***48.1***
Alkalinity (mg/L)	197	128	285	208	20 (42)	140	5 (13)	207
Total Nitrogen (mg/L)	2.9	1.7	2.0	2.7	20 (43)	**1.8**	5 (12)	***3.0***

-NA- : Not Applicable
n: number of samples with flow (total number of samples)
* S-361 has 2.5 months of missing flows due to sensor failure.

STA-1E Dissolved Oxygen Monitoring

The existing STA-1E permits require dissolved oxygen (DO) monitoring only at the inflow and outflow and redirection (G-311) structures. There is no diel cycle or downstream marsh DO monitoring requirements. The permits require the SSAC to be used for compliance analysis purposes.

STA-1E VEGETATION MANAGEMENT

A small-scale transplant experiment, transplanting duck potato (*Sagittaria*, spp.) from Cell 6 to Cell 4N, was conducted to determine if the plant species would establish in the northern section of Cell 4N in the higher ground areas. Another small-scale vegetation transplant experiment was conducted in Cell 6, where three small corrals were set up and the plant growth was monitored. Vegetation strips, consisting of emergent vegetation, were allowed to establish in Cells 4N, 4S, and 6.

Specific Condition 13(b) of the EFA permit requires that the annual Everglades Consolidated Report (currently known as the *South Florida Environmental Report*) include information regarding the application of herbicides used to exclude and/or eliminate undesirable vegetation within the treatment cells. In WY2006, the District treated a total of 2,543 acres to control vegetation in the STA-1E marsh using diquat to treat the floating vegetation, and glyphosate and imazapyr to control emergent vegetation (**Table 5-4**). The District used both aerial- and ground-based spray equipment to apply these herbicides.

STA-1E WILDLIFE AND RECREATION

Wildlife issues include the presence of burrowing owls in Cell 2 and black-necked stilts in Cells 4N, 4S, and 6. A summary of the activities regarding the black-necked stilts can be found in the *Summary* section of this chapter. The USACE is responsible for mitigation activities involving the burrowing owls.

Recreational facilities are proposed to provide public access to STA-1E. The proposed recreational facilities include an asphalt parking area, road improvements, a composting toilet, landscaping, and an information kiosk. Pedestrian gates, signage, and fencing as needed to define public access areas and to protect sensitive equipment are also proposed. The current recreational activity available in STA-1E is bird watching.

STA-1E ENHANCEMENTS

The STA-1E Enhancements Project listed in the Long-Term Plan was for herbicide treatment of Cells 2, 4N, 4S, and 6 and for the conversion from emergent (cattail dominant) to SAV vegetation communities (**Table 5-4**). In the revised Part 2 of the Long-Term Plan dated November 2004, it was also recommended that the SFWMD coordinate with the USACE regarding its proposed PSTA demonstration project in Cell 2.

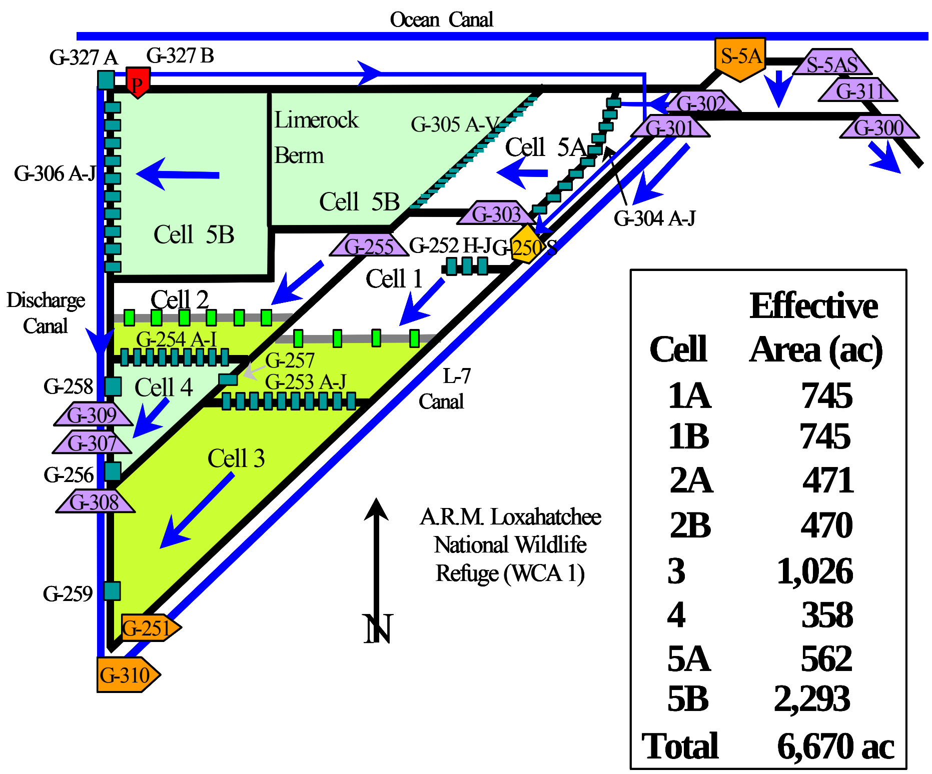
The start-up plan for STA-1E included efforts to establish Cells 6, 4N, and 4S as SAV cells from the beginning. Activities in these three cells during FY2006 included vegetation management activities such as herbicide application of emergent vegetation and less desirable vegetation. Cells 1 and 2 remain off-line for construction of the PSTA demonstration project.

STA-1W

STA-1W CONFIGURATION

Stormwater Treatment Area 1 West (STA-1W) contains approximately 6,670 acres of effective treatment area arranged in three flow-ways (**Figure 5-8**). The Eastern Flow-way contains Cells 1 and 3, with a combined effective treatment area of approximately 2,516 acres. The Western Flow-way contains Cells 2 and 4, with a combined effective treatment area of approximately 1,300 acres. The Northern Flow-way (Cell 5) consists of approximately 2,855 acres. In addition, STA-1W includes the STA-1 inflow basin consisting of inflow pump station S-5A and four gated spillways (S-5AS, G-311, G-300, and G-301), which allow for operational flexibility.

Inflows to STA-1W from the STA-1 inflow basin are directed into STA-1W via the G-302 structure. Flow then moves into the Northern Flow-way (Cell 5) via the G-304A through J structures and into Cells 1 through 4 via the G-303 structure (Figure 5-8). Full flow-through operations in Cells 1 through 4 have occurred since August 1994, when these cells were part of the original Everglades Nutrient Removal (ENR) Project. Full flow-through operations through Cell 5 have occurred since July 2000. A Limerock Berm was constructed in Cell 5 during WY2004 to improve the distribution of flow, thereby enhancing phosphorus removal. The berm was subsequently degraded by approximately 2 ft to reduce the amount of exposed surface under low stages and to discourage stilt nesting activity.



Cell	Effective Area (ac)
1A	745
1B	745
2A	471
2B	470
3	1,026
4	358
5A	562
5B	2,293
Total	6,670 ac

Figure 5-8. Schematic of STA-1W (not to scale). Note that the G-253 levee located in Cell 3 is not yet in place; construction is currently scheduled to be completed in 2007. Green shading indicates SAV dominated treatment areas.

STA-1W WY2006 HIGHLIGHTS

- The Eastern Flow-way (Cells 1 and 3) was operational during the entire water year, the Northern Flow-way (Cell 5) was operational part of the water year, and the Western Flow-way (Cells 2 and 4) was off-line to allow for plant reestablishment following completion of Long-Term Plan enhancements projects (see the *STA-1W Enhancements* section of this chapter).
- Hurricane Wilma directly affected STA-1W, damaging parts of the infrastructure and the SAV communities (details found in the *STA-1W Hurricane Wilma Impacts* section of this chapter).
- Major rehabilitation efforts were under way in Cell 5 throughout the water year.
  - Implementation of the STA-1W recovery plan (District's website at www.sfwmd.gov under the *Everglades* section, *Long-Term Plan for Achieving Everglades Water Quality Goals* link).
  - Implementation of the Cell 5 Sediment Reconsolidation Plan, which includes drawdown of Cell 5B for sediment consolidation efforts, rice planting, removal of high berm areas upstream of G-306 and downstream of G-304, clean out of G-306 distribution canal, vegetation strips planting, and scrape down of the marl in the north side of Cell 5 (Appendix 5-7).

  - Cell 5 was in restricted flow in November and December 2005, and was off-line from January through June 2006 for rehabilitation and Long-Term Plan enhancements construction.
  - Management of terrestrial plants to reduce invasion of pigweed (*Amaranthus* spp.) and other terrestrial plants growing in Cell 5 during drydown. The pigweed was treated with herbicide and the resulting dead biomass was harvested out of the treatment cell.
- Elevated turbidity levels in Cells 5, 2B, and 4.
- Because the emergent plant growth in Cell 5A was poor, cattail was harvested from Cells 2A and 5B for planting in Cell 5A. The planting was unsuccessful due to damage from Hurricane Wilma.
- Enhancements completed in Western Flow-way: clean out G-254 distribution canal, degrade mid canal (C-7), remove G-256 outflow structure and replace with gated box culvert structure G-307, and install four new G-254 culverts. The treatment cell was rehydrated July 2005.
- Unsuccessful re-establishment of vegetation in Cells 2 and 4. Minimal water depths were maintained in Cells 2 and 4 to encourage SAV re-growth. Rice planting and inoculating with SAV planned for Cells 2B and 4.
- Stilts nested in Cells 2, 4, and 5.
- Recreational opportunities, such as bird watching, continued. There was no duck hunting this last water year due to the enhancements construction projects and rehabilitation efforts in Cell 5.
- Flow-proportional auto-samplers were installed at diversion structures G-300 and G-301; STA-1W inflow structure G-302 auto-sampler was switched from time to flow-proportional on June 8, 2006.
- Vegetation management activities implemented to expedite vegetation establishment in Cells 2, 4, and 5.
- Construction of the S-5A trash rack completed.

STA-1W HURRICANE WILMA IMPACTS

STA-1W was directly impacted by Hurricane Wilma. The Florida Power and Light (FPL) high-voltage power lines located throughout the STA suffered severe damage. Hurricane impacts to the STA included moderate damage to the Cell 5 northern levee, minor damage to the western Cell 5 levee, damage to G-255 and G-306 water control structure buildings, damage to culvert G-254C, severe damage to the FPL high-voltage power lines, moderate damage to SAV in Cell 5, minor damage to emergent vegetation, and damage to the water quality auto-sampler intakes at the outflows G-251 and G-310.

STA-1W PERMIT STATUS

The data presented in this section demonstrates that STA-1W was in compliance with the EFA and the USEPA's NPDES operating permits for this reporting period and that discharges do not pose any known danger to public health, safety, or welfare. The EFA permits for the STAs acknowledge that until all the STAs are fully operational, certain STAs may receive higher than normal inflows. Specifically, Specific Condition 14(c) of the STA-1W 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 full capacity flow-through operations until the PSTA demonstration project is completed. The STA-1E PSTA Demonstration Project is expected to become operational in March 2007 and will be conducted for a 24-month period. Therefore, STA-1W currently remains in the stabilization phase.

STA-1W OPERATIONS

During WY2006, Cells 1 and 3 were operational for the entire water year; Cell 5 was operational in July 2005 through December 2005 (although under restricted flow due to hurricane damage in November and December) before being taken temporarily off-line for Long-Term Plan enhancements and to allow for the vegetation to recover; and Cells 2 and 4 were off-line the entire year for Long-Term Plan enhancements construction and vegetation re-growth (**Table 5-10**).

Table 5-10. Operational status of the treatment cells in STA-1W from January 2004 through September 2006.

STA-5 Operational Status of Treatment Cells

<table>
<tr><th colspan="5">2004</th><th colspan="5">2005</th><th colspan="3">2006</th></tr>
<tr><th>Jan - Mar</th><th>Apr - Jun</th><th>Jul - Aug</th><th>Sep Hurricanes Frances and Jeanne</th><th>Oct - Dec</th><th>Jan - Mar</th><th>Apr - Jun</th><th>Jul - Sep</th><th>Oct Hurricane Wilma</th><th>Nov - Dec</th><th>Jan - Mar</th><th>Apr - Jun</th><th>Jul - Sep</th></tr>
<tr><td colspan="5">All Flow-ways Operational</td><td colspan="2">Southern Flow-way and Cell 1A (restricted capacity) Operational</td><td colspan="3">All Flow-ways Operational (Cell 1B restricted capacity to allow for plant establishment)</td><td colspan="2">Northern Flow-way Operational</td><td>All Flow-ways Operational</td></tr>
<tr><td colspan="5"></td><td colspan="2">LTP Enhancements construction in Northern Flow-way, Cell 1B off-line</td><td colspan="3"></td><td colspan="2">LTP Enhancements construction in Southern Flow-way, both Cells 2A and 2B off-line</td><td></td></tr>
</table>

STA-1W Hydrology

During WY2006, the inflow to the STA-1W treatment cells via G-302 was 142,678 ac-ft, equal to an average hydraulic loading rate of 2.85 cm/day over the effective treatment area of the STA (**Table 5-3**). Although these inflows were about 11 percent lower than the 31-year long-term average annual simulated inflow for this STA, the hydraulic loading rate was 42 percent greater due to the temporary reduction of effective treatment area from Hurricane Wilma and Long-Term Plan enhancements construction (**Tables 5-3** and **5-10**). The volume of treated water discharged from STA-1W to the Refuge was 137,890 ac-ft. The difference between the inflow and outflow volumes reflects the net contributions of direct rainfall, ET, seepage from the Refuge, seepage losses to adjacent lands, deep percolation, and flow measurement error. A summary of monthly flows during WY2006 is presented in **Figure 5-9**. In WY2006, STA-1W received 12,769 ac-ft from Lake Okeechobee.

Until STA-1E is fully operational, the STA-1W enhancements are complete, and all flow-ways are in flow-through mode, flows from the S-5A pump station that exceed the hydraulic capacity of STA-1W will be diverted to STA-1E if capacity exists, or through the G-300 and G-301 structures into the Refuge. During WY2006, about 46,808 ac-ft (20,682 ac-ft via G-300, and 26,126 ac-ft via G-301) was diverted in this manner (**Figure 5-10**).

STA-1W Total Phosphorus

During WY2006, STA-1W received 37.4 mt of TP, equal to a phosphorus loading rate of 2.21 g/m^2 (**Table 5-3**). The TP loading to the system was approximately 2.2 times the 31-year long-term average annual simulated inflow TP load for this STA. During WY2006, STA-1W received approximately 3.365 mt of TP with a FWM TP concentration of 214 ppb from Lake Okeechobee. About 18.2 mt of TP were removed by STA-1W during WY2006. From May 2005 through April 2006, STA-1W reduced TP discharge loads by 49 percent, compared to inflow loadings measured at G-302 (**Figure 5-11**). The FWM outflow concentration was 113 ppb, a 47 percent reduction from the inflow concentration of 213 ppb measured at G-302 (**Figure 5-12**). The moving 12-month FWM TP outflow concentration for STA-1W ranged from 99 to 123 ppb (**Figure 5-13**). For informational purposes, the geometric mean TP concentration of the outflow was calculated as 96 ppb, using auto-sampler data from G-251 and G-310. About 14.01 mt of TP (6.04 mt via G-300, and 7.97 mt via G-301) with a FWM TP of 243 ppb was diverted into the Refuge **(Figures 5-14** and **5-15**).

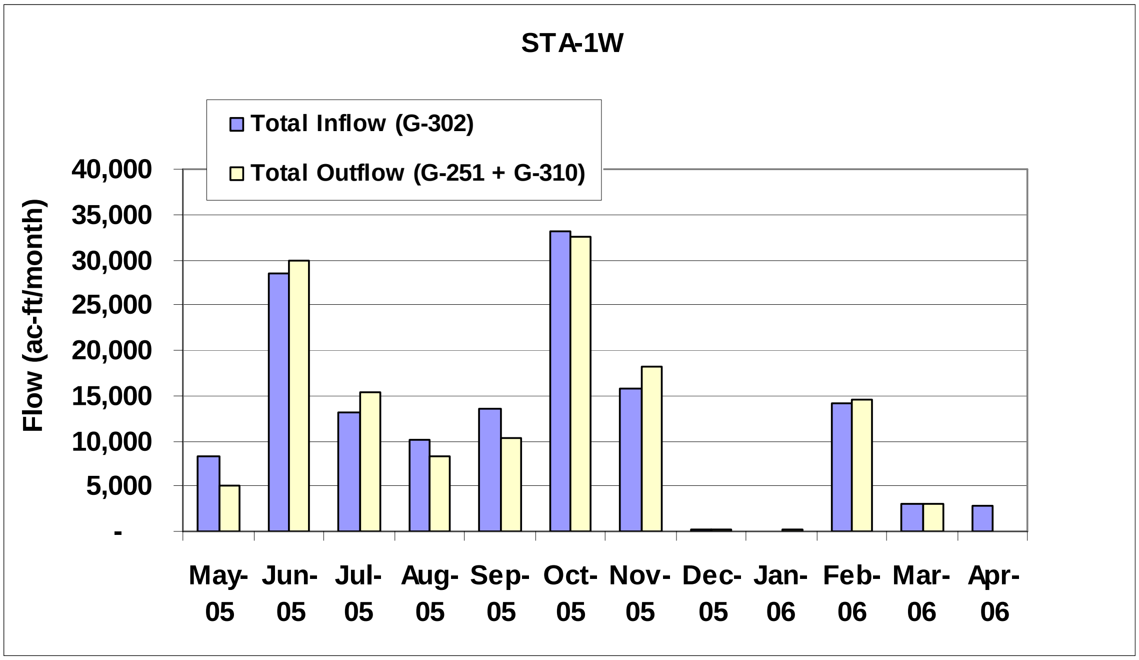


Figure 5-9. Summary of WY2006 flow for STA-1W. Cells 1 and 3 were operational for the entire water year; Cell 5 was off-line beginning in January 2006 for Long-Term Plan enhancements and treatment cell rehabilitation; Cells 2 and 4 were off-line the entire water year for plant reestablishment following completion of the Long-Term Plan enhancements construction.

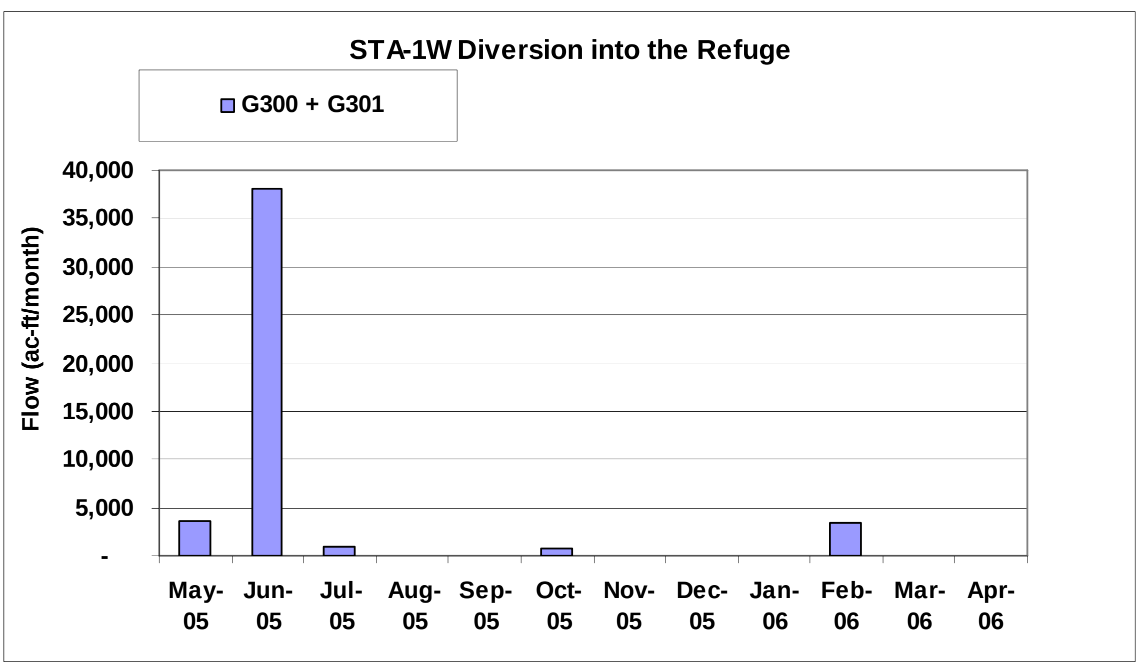


Figure 5-10. Diversion flow through G-300 and G-301 into the Refuge during WY2006.

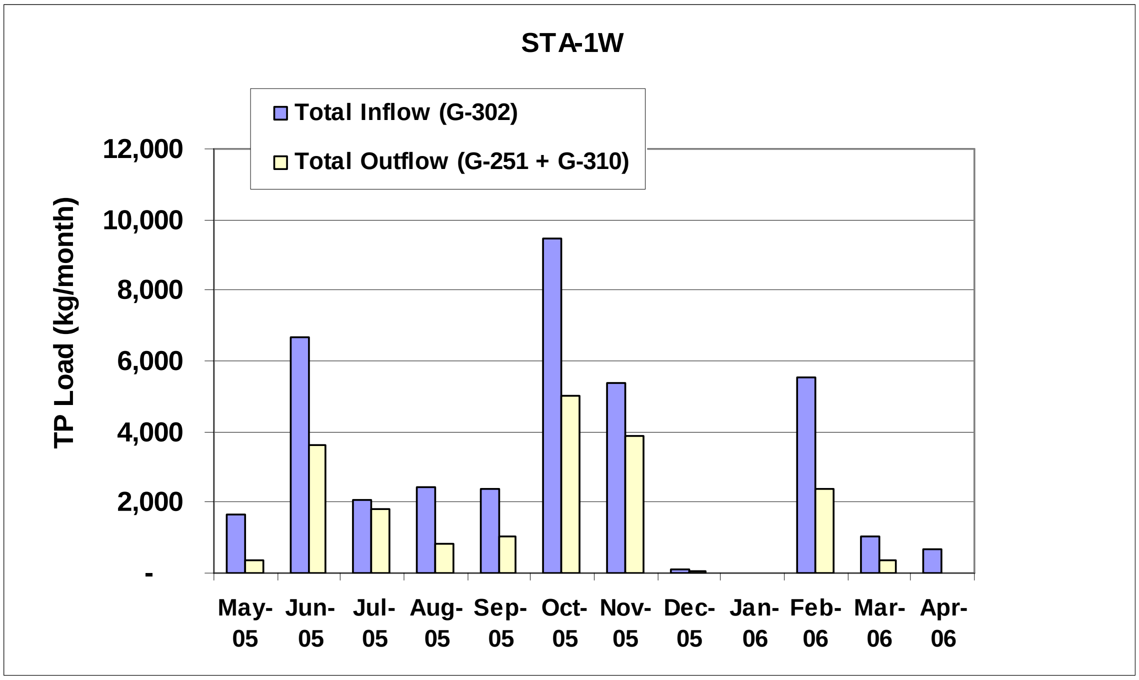


Figure 5-11. Summary of WY2006 TP loads for STA-1W. Cells 1 and 3 were operational for the entire water year; Cell 5 was off-line beginning in January 2006 for Long-Term Plan enhancements and treatment cell rehabilitation; Cells 2 and 4 were off-line the entire water year for plant reestablishment following completion of the Long-Term Plan enhancements construction.

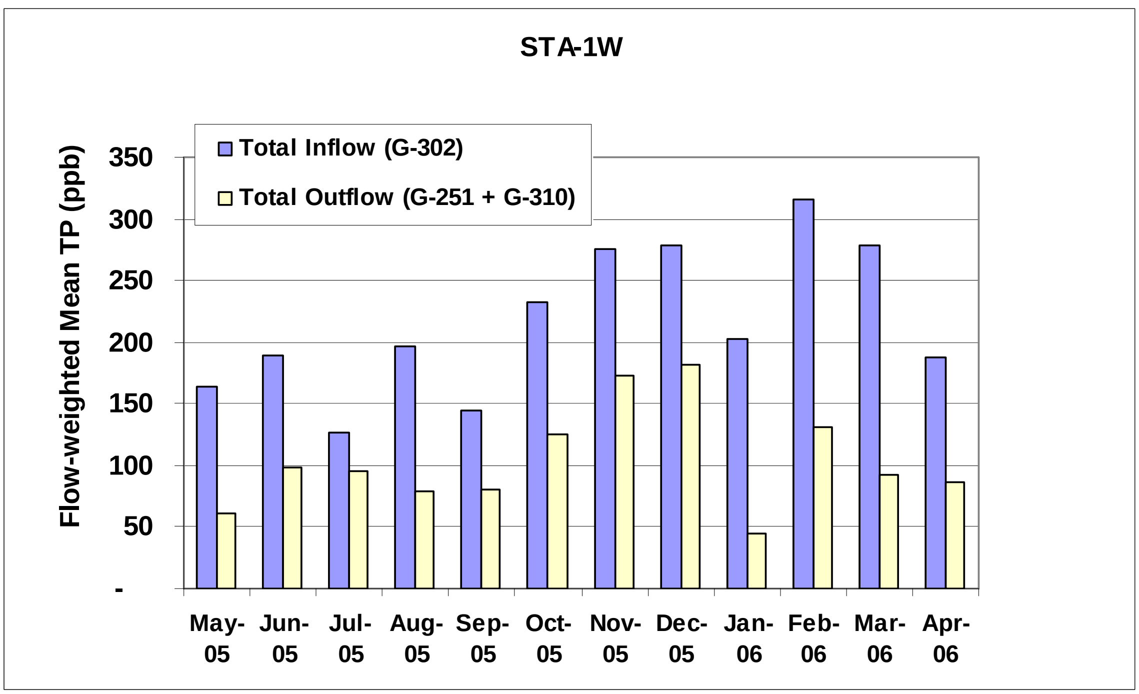


Figure 5-12. Summary of WY2006 FWM TP for STA-1W. Cells 1 and 3 were operational for the entire water year; Cell 5 was off-line beginning in January 2006 for Long-Term Plan enhancements and treatment cell rehabilitation; Cells 2 and 4 were off-line the entire water year for plant reestablishment following completion of the Long-Term Plan enhancements construction.

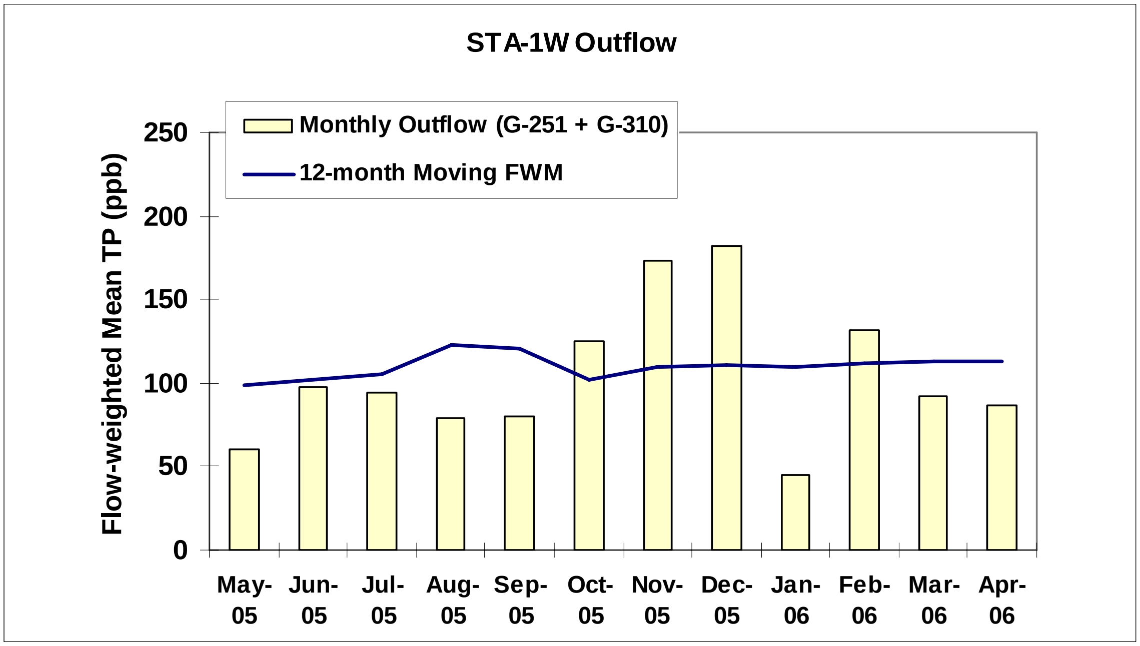


Figure 5-13. Comparison of monthly to 12-month moving average TP concentrations for WY2006 for STA-1W outflow. Cells 1 and 3 were operational for the entire water year; Cell 5 was off-line beginning in January 2006 for Long-Term Plan enhancements and treatment cell rehabilitation; Cells 2 and 4 were off-line the entire water year for plant reestablishment following completion of the Long-Term Plan enhancements construction.

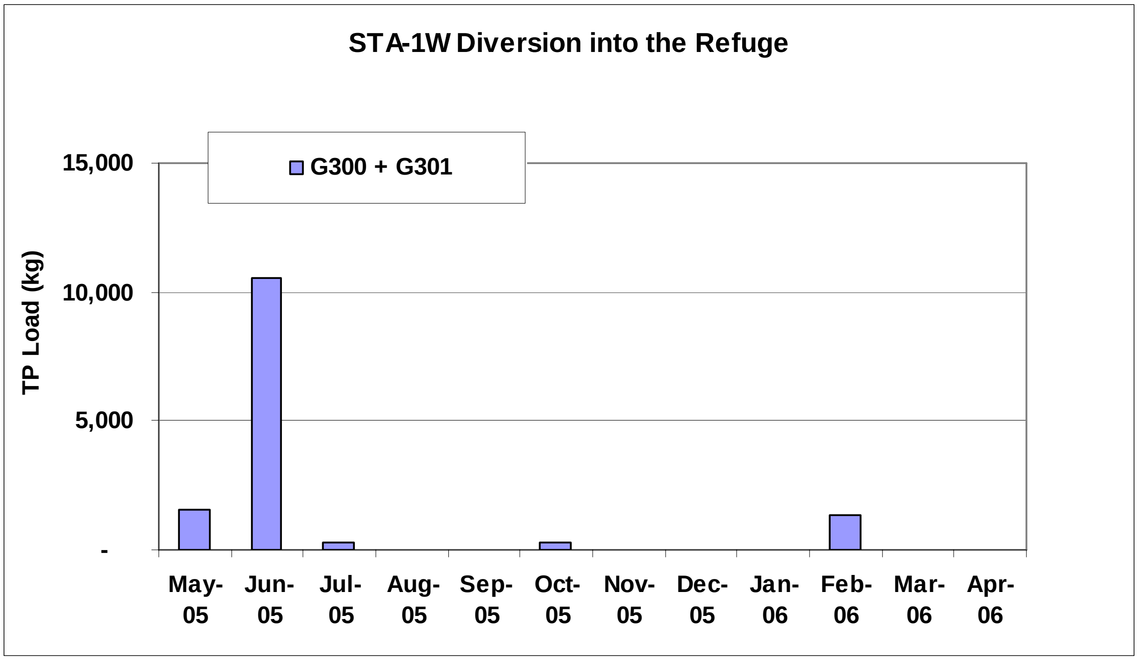


Figure 5-14. TP load from diversion flow through G-300 and G-301 into the Refuge during WY2006.

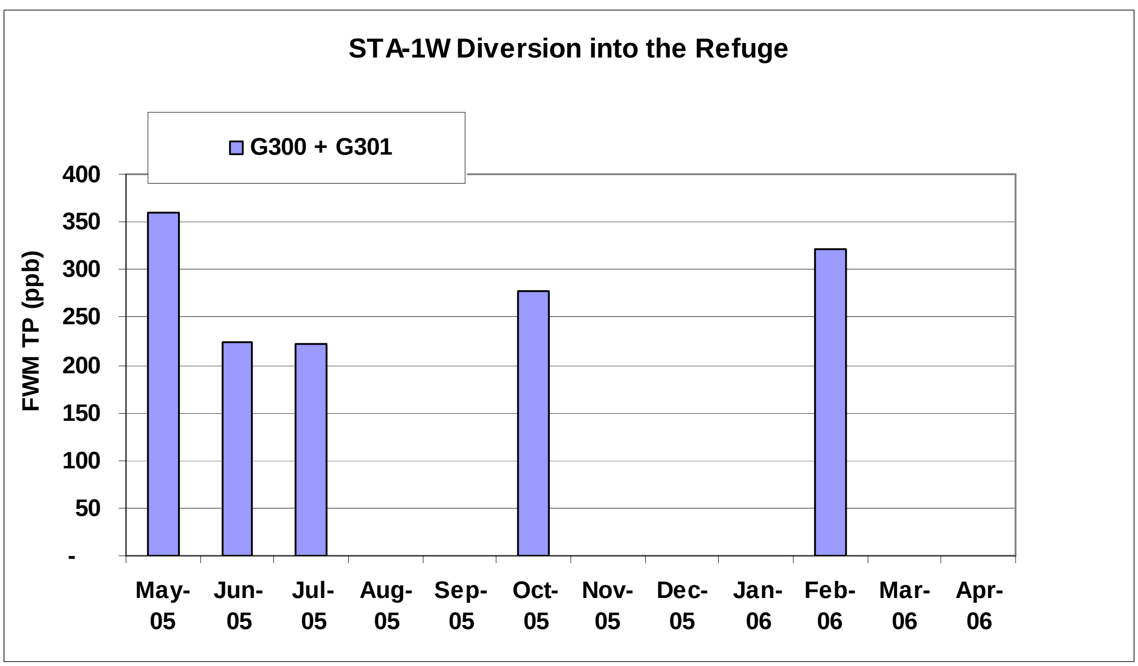


Figure 5-15. FWM TP from diversion flow through G-300 and G-301 into the Refuge during WY2006.

Other STA-1W Water Quality Parameters

Water quality parameters with Florida Class III standards are identified in **Table 5-7**. Compliance with the EFA permit is determined based on the three-part assessment presented in the *Water Quality Permit Requirements* section of this chapter. The monitoring data over the water year for non-phosphorus parameters at STA-1W during this reporting period are presented in Appendix 5-4 of this volume, and are summarized in **Table 5-11**. Temperature, specific conductance, DO, and pH values reported in this chapter are field measurements.

Discharges from STA-1W were determined to be in compliance with the permit by satisfying the criterion assessment for all non-phosphorus and non-DO parameters with applicable numeric state water quality standards. Both inflow and outflow DO concentrations were lower than the Class III numeric standard. Annual average concentrations of total dissolved solids and dissolved chloride were slightly higher at the outflow compared to the inflow. However, because these parameters have no applicable numeric state water quality standards, STA-1W is deemed to be in full compliance with the permit. Additional requirements for DO are listed in Administrative Order No. AO-002-EV and are discussed in the following section. Mercury monitoring results are discussed in Chapter 3B, and the annual permit compliance monitoring report for mercury in the STAs is in Appendix 5-5 of this volume.

Table 5-11. Summary of annual arithmetic averages and FWM for all parameters other than TP monitored in STA-1W. Parameters that were measured higher at the outflow compared to the inflow are shaded in gray.

Parameter	Arithmetic Means – Inflow	Arithmetic Means – Outflow		Flow-Weighted Means – Total Inflow		Flow-Weighted Means – Total Outflow	
	S5A	G251	G310	n	Conc.	n	Conc.
Temperature (°C)	25.0	23.9	24.8	-NA-	-NA-	-NA-	-NA-
Dissolved Oxygen (mg/L)	3.9	1.5	3.8	-NA-	-NA-	-NA-	-NA-
Specific Conductivity (μmhos/cm)	1,171	1,179	1,186	-NA-	-NA-	-NA-	-NA-
pH	7.6	7.4	7.7	-NA-	-NA-	-NA-	-NA-
Turbidity (NTU)	16.2	2.8	5.5	-NA-	-NA-	-NA-	-NA-
Total Dissolved Solids (mg/L)	760	794	780	12 (25)	**670**	24 (50)	***703***
Unionized Ammonia (mg/L)	0.007	0.002	0.006	21 (47)	0.010	22 (48)	0.004
Orthophosphate as P (mg/L)	0.119	0.038	0.041	24 (51)	0.127	49 (102)	0.062
Total Dissolved Phosphorus (mg/L)	0.130	0.052	0.057	24 (51)	0.136	49 (102)	0.077
Sulfate (mg/L)	86.4	72.8	80.3	12 (25)	72.6	24 (50)	69.2
Alkalinity (mg/L)	264	293	270	12 (25)	249	24 (50)	238
Dissolved Chloride (mg/L)	154	159	162	12 (25)	**130**	24 (50)	***142***
Total Nitrogen (mg/L)	3.52	2.50	3.00	22 (48)	3.88	24 (50)	2.96
Total Dissolved Nitrogen (mg/L)	3.34	2.33	2.77	12 (25)	3.19	24 (50)	2.74
Nitrate + Nitrite (mg/L)	0.871	0.117	0.355	22 (48)	0.770	24 (50)	0.552
Ametryn (μg/L)	0.025	-NA-	-NA-	1 (4)	0.010	-NA-	-NA-
Atrazine (μg/L)	0.318	-NA-	-NA-	1 (4)	0.210	-NA-	-NA-

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

STA-1W DISSOLVED OXYGEN MONITORING

Dissolved oxygen (DO) concentrations fluctuate naturally in marsh environments, such as the Everglades, routinely falling below the Class III water quality criterion of 5 milligrams per liter (mg/L). STAs also experience natural fluctuations in DO that routinely fall below 5 mg/L, as observed in DO data collected in the Everglades Nutrient Removal Project (ENR Project Monitoring Report Appendices, 1995–1998), and as reported in the 1999 Everglades Interim Report, and in the 2000 through 2004 Everglades Consolidated Reports. The 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 that the District provide the FDEP with an annual report consisting of an analysis demonstrating that DO levels in STA discharges do not adversely change the downstream Everglades ecology or the downstream water quality. The analysis is 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 that the level of water quality is 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 historical DO data from the Everglades Protection Area (EPA), including data from interior marsh stations within the Refuge (WCA-1) (receiving effluent from STA-1W), the Rotenberger Wildlife Management Area (RWMA) tract (receiving effluent from 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.

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 at 30-minute intervals for four consecutive days at the following locations:

- South side of the C-51 canal upstream of S-5A
- Downstream of the G-251 and G-310 discharge structures (**Figure 5-16**)
- Sites along the X, Y, and Z transects in the periphery of the interior Refuge marshes downstream of the combined discharges (**Figure 5-16**)

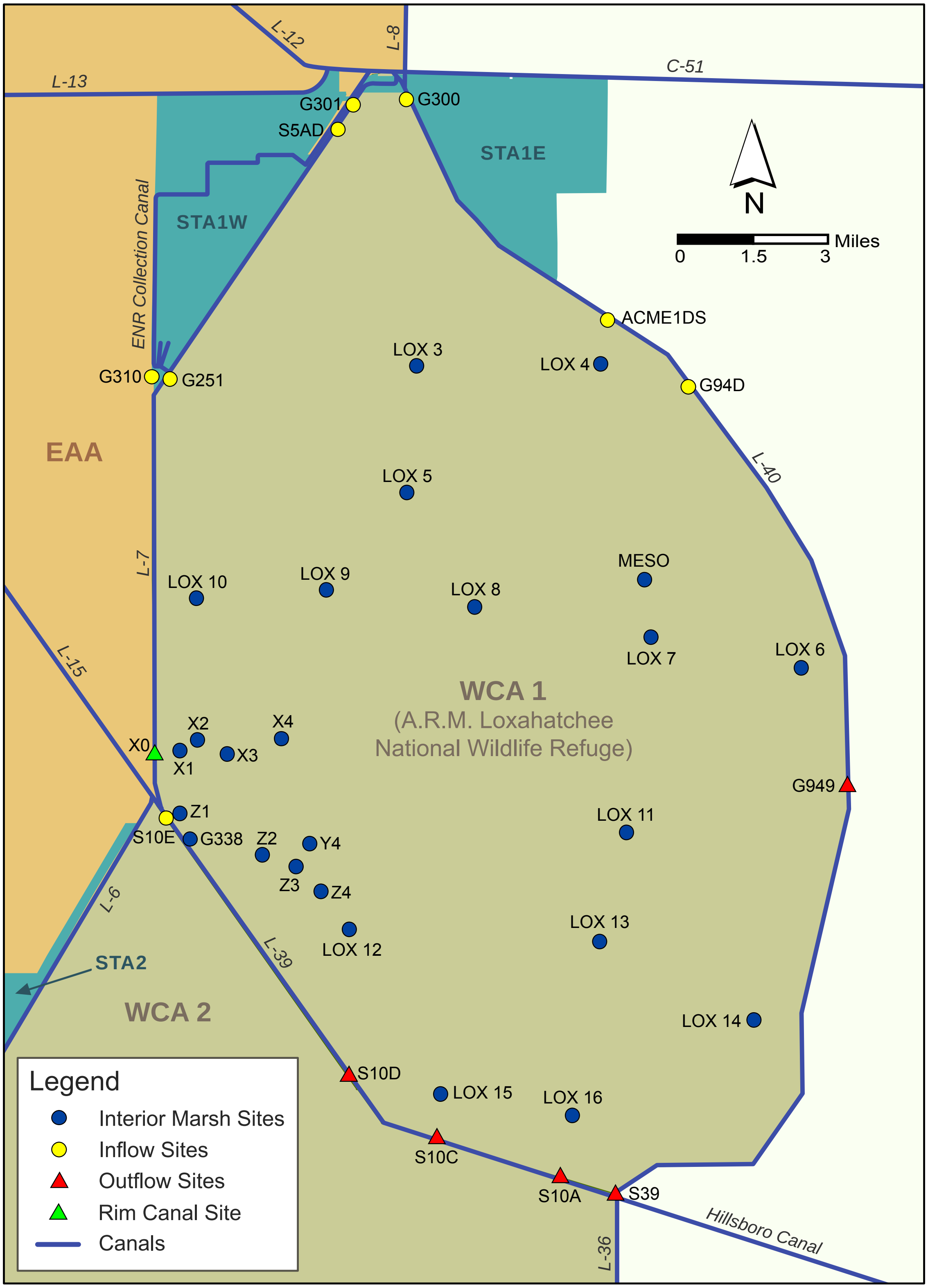


Figure 5-16. Location and classification of water quality monitoring stations in the Refuge.

Sampling Dates

Diel oxygen measurement dates and sites associated with STA-1W for WY2006 are provided in **Table 5-12**.

Table 5-12. 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		
06/06/2005	06/09/2005	S5AU	G251D	G310	---------------------------------
07/11/2005	07/15/2005	----	----	----	X1, X2, X3, X4, Y4, Z1, Z2, Z3, Z4
09/12/2005	09/16/2005	S5AU	G251D	G310	X1, X2, X3, X4, Y4, Z1, Z2, Z3, Z4
12/05/2005	12/08/2005	S5AU	G251D	G310	---------------------------------
01/09/2006	01/13/2006	----	----	----	X1, X2, X3, X4, Y4, Z2, Z3, Z4
03/06/2006	03/10/2006	S5AU	G251D	G310	X1, X2, X3, X4, Y4, Z1, Z2, Z3, Z4

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

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. However, direct comparisons of DO in STA-1W discharges with DO at downstream marsh sites in WCA-1 (**Figure 5-16**) cannot be made for all monitoring events in WY2006 because field meter deployment dates differed. Summary statistics for STA-1W discharges and WCA-1 marsh transect sites are presented in **Table 5-12**. Discharges from STA-1W structures G-251 and G-310 constitute the flow in the L-7 rim canal unless diversions are made through G-301, or there are outflows from the interior Refuge marsh. The DO concentration and concentrations of other constituents in the discharges affect water quality and vegetation along the fringe of the interior marsh. At times when rim canal stage is higher than interior marsh stage, rim canal water has the potential to flow into the interior marsh. The extent of this penetration is dependent on stage differential. Consequently, STA-1W discharges can affect the quality of water in the interior marsh up to several kilometers from the rim canal.

Examination of the data in **Table 5-13** and the notched box and whisker plots in **Figure 5-17** indicates that the median diel DO values in discharges from G-251 and G-310 were significantly greater than the values at transect sites Z1, X1, Z2, and X2. This significance is illustrated on **Figure 5-17** because the notches for the G-251 and G-310 plots, which represent the approximate 95 percent confidence interval (95% C.I.) for the medians, do not overlap the notches for Z1, X1, Z2, and X2. Non-overlapping notches indicate that data sets being compared are significantly different.

Further comparisons of medians and notches indicates G-310 and G-251 had significantly lower DO concentrations than concentrations measured at sites Z3, Z4, Y4, and X4. Site X3 did not have significantly different DO concentrations from G-251 and G-310. DO concentrations in G-310 and G-251 discharges were significantly greater than concentrations measured at transect sites X1, Z1, X2, and Z2. Sites Z3 and X4 were significantly different from both G-251 and G-310, as well as greater than the other marsh sites.

The STA-1W discharges must travel several kilometers down the L-7 canal before reaching the transect locations. Analysis of the data indicates that diel DO concentrations in the STA-1W discharges do not negatively affect the low DO concentrations observed at marsh transect stations Z1, X1, Z2, the closest to the canal, or the more interior marsh sites X2, X3, Z3, Z4, Y4, and X4. The diel DO patterns observed at Z1, X1, Z2, and X2 may be largely due to the long-term effects of TP loading to the rim canal. Diel oxygen patterns at the more interior marsh transect sites, which are rainfall dominated, are the result of water depth and habitat vegetation differences. Ultimately, TP load reductions to the rim canal of the Refuge should improve DO conditions in the marsh fringe areas affected by canal water penetration. The complete DO data sets collected during WY2006 are presented in Appendix 5-6 of this volume.

Table 5-13. Statistical summary of diel DO at outflow stations (G-251D and G-310) and transect stations (X, Y, and Z) in the Refuge during six deployment periods.

Location	Station	Number of Measurements	Mean	Minimum	Median	Maximum	Standard Deviation
Outflow	G251D	575	4.21	0.72	3.71	11.20	2.41
	G310	574	4.54	1.47	4.39	10.24	2.17
Transect X	X1	500	0.70	0.01	0.44	9.63	0.90
	X2	540	2.05	0.10	1.77	8.70	1.51
	X3	540	3.55	0.13	3.66	9.54	2.19
	X4	359	5.72	3.06	5.46	9.67	1.52
Transect Y	Y4	361	5.83	3.25	5.65	9.45	1.36
Transect Z	Z1	181	1.08	0.06	0.98	9.41	1.07
	Z2	361	2.10	0.08	1.90	6.11	1.23
	Z3	181	5.67	4.07	5.79	6.73	0.64
	Z4	179	7.45	5.23	7.46	9.57	1.18

Note: See Appendix 5-4, Table 2 for statistical summaries by event and diel parameter.

Diel DO monitoring at the marsh stations of WCA-1 was also intended to provide data for the development of a SSAC for DO in the Everglades. The SSAC was adapted by the FDEP in June 2004 and shall be applied to future permits. Diel cycle monitoring shall also not be required in future permits. Instead compliance will be determined using the SSAC.

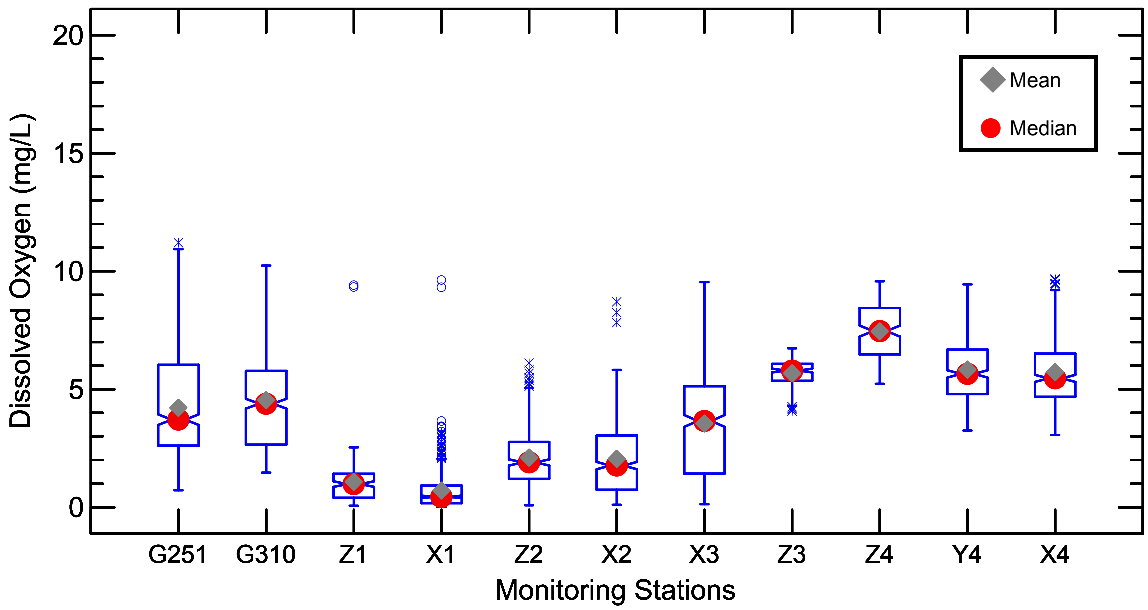


Figure 5-17. Notched box and whisker plots of diel DO measurements at STA-1W outflow stations (G-251D and G-310) and along transect sites in the Refuge during eight monitoring periods. The notch on a box plot represents the 95% confidence interval (C.I.) about the median, which is represented by the 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 form the median. Notches that do not overlap indicate that the data represented by the boxes being compared are significantly different at the 95% C.I.

Note: See Appendix 5-6 for statistical summaries by event and diel parameter.

STA-1W CELL 5 LIMEROCK BERM [FDEP GRANT AGREEMENT]

In February 2005, Cell 5 was closed to inflows in order lower the water depths to degrade the Limerock Berm, and in April 2005, the top of the Limerock Berm was scraped down to the approximate elevation of 10 feet National Geodetic Vertical Datum 1929 (NGVD29). The monitoring of the Limerock Berm was completed in FY2005 (October 1, 2004–September 30, 2005). A report summarizing the STA-1W Cell 5 Limerock Berm project is currently being developed and will be discussed in the 2008 SFER.

STA-1W VEGETATION MANAGEMENT

Specific Condition 13(b) of the EFA permit requires that the annual Everglades Consolidated Report (currently known as the *South Florida Environmental Report*) include information regarding the application of herbicides used to exclude and/or eliminate undesirable vegetation within the treatment cells. In WY2006, the District treated a total of 2,717 acres to control vegetation in the STA-1W marsh, using 81 gallons of diquat to treat the floating vegetation, and 1,332 gallons of glyphosate and 351 gallons of imazapyr to control emergent vegetation (**Table 5-4**). The District used both aerial and ground-based spray equipment to apply these herbicides.

Vegetation management activities also included controlling the emergent vegetation that grew during dry-down conditions in Cells 2, 4, and 5. Additionally, four vegetation strips consisting of a variety of emergent plant species (*Thalia geniculata, Pontederia cordata, Sagittaria lancifolia, Eleocharis interstincta, Scirpus californicus*) were planted in Cell 5 to reduce the impacts on the SAV from wind and wave damage (**Figures 5-2** and **5-18**). These vegetation strips run the entire length of the treatment cell from north to south and are situated perpendicular to flow. Over 200,000 plants were planted in July 2006.

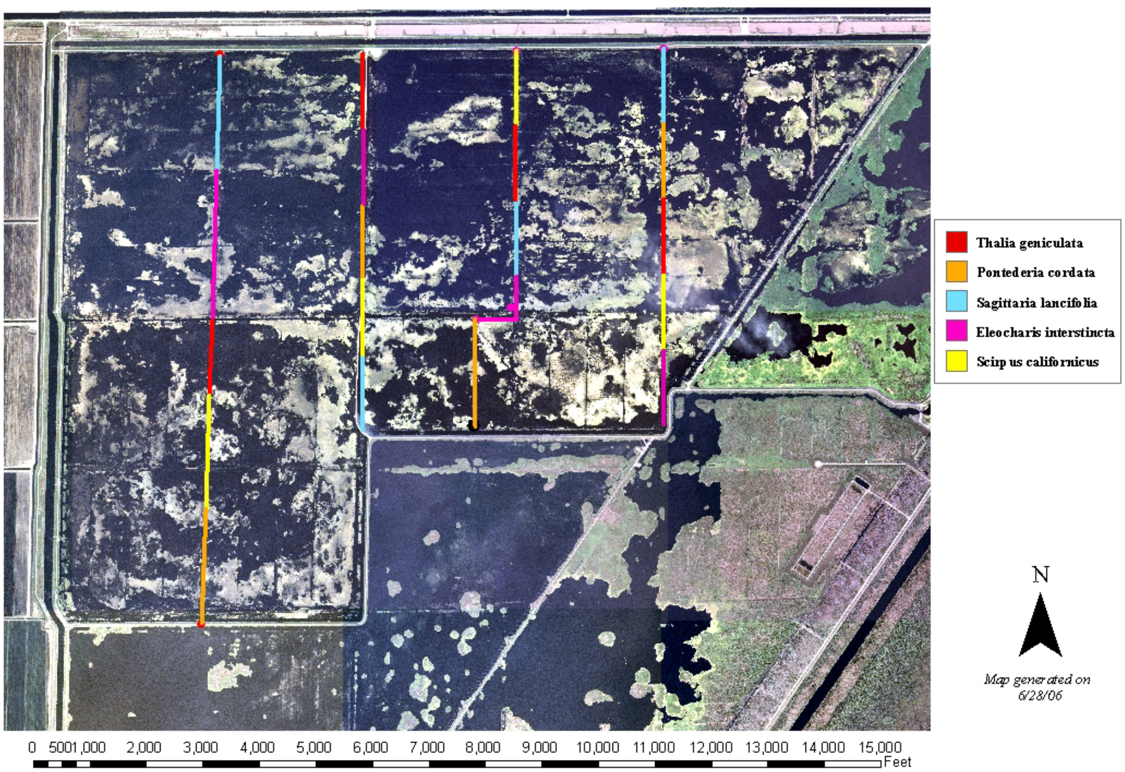


Figure 5-18. Map showing the location of the vegetation strips created in Cell 5.

STA-1W South PSTA Test Cells

The EFA required the District to optimize the treatment performance of the STAs. To comply with this mandate, the District initiated research projects in the STA-1W test cells to evaluate the efficacy of several different treatment technologies, one of which was the PSTA. The STA-1W test cells are 30 0.5-acre constructed wetlands designed to be hydrologically isolated from each other. One set of 15 test cells is located in STA-1W, Cell 1 (north test cells), and the other is in STA-1W, Cell 3 (south test cells). The test cells and the ATT Program research projects conducted in these cells are described in Chimney et al. (2000). All work associated with the ATT Program concluded in January 2002. Results from the ATT projects have been summarized in previous consolidated reports and in final project reports that can be found on the District's web site at www.sfwmd.gov/org/erd/ecp/etweb/main_template/report.html or through the District's home page at www.sfwmd.gov under the *What We Do, Environmental Monitoring* section, *Ecological Technologies* link.

After the ATT Program ended, the District continued monitoring the three south PSTA test cells on a reduced basis to document long-term trends in TP removal in these systems. Two of the south PSTA cells were constructed with 30 cm of shellrock placed over 30 cm of peat (shellrock cells), while the remaining cell only had a peat substrate (peat cell). This section provides an overview of TP removal in the south PSTA test cells for the period from May 1, 2002, through April 30, 2006, which is referred to as the period of extended monitoring.

The south PSTA test cells were operated at a constant hydraulic loading rate of 2.6 cm/day throughout the period of extended monitoring, except for the period following the 2005 hurricane season when power to the system was disrupted for several months. Water depth averaged 30 cm in all cells in WY2003, 60 cm in WY2004, and 30 cm in subsequent water years. Grab samples were collected biweekly at the common inflow to the south test cells and at the outflow from each individual PSTA test cell and were analyzed for TP. As reported in the 2006 SFER, the shellrock cells had substantially better treatment performance than the peat cell; sampling of the peat cell was discontinued in October 2004. Therefore, this report focuses only on the performance of the shellrock systems. Mean values discussed in this section are geometric means. Differences in inflow and outflow TP concentrations were compared using analysis of variance analysis (ANOVA) of $\log_{10}$-transformed data pooled over all sampling dates followed by post hoc mean comparison tests (Tukey-Kramer HSD) using SAS JMP®, version 6.

Overall mean outflow TP concentrations from the shellrock cells [15 micrograms per liter (µg/L) and 14 µg/L for Cells 3 and 8, respectively] were significantly lower ($p < 0.0001$) than the mean inflow TP concentration of 66 µg/L (**Table 5-12**). Mean inflow TP concentrations to the south test cells had an increasing trend in concentrations over all water years but with substantial increases beginning with the two hurricanes in September 2004. Yearly mean TP concentrations of 0.031 mg/L, 0.057 mg/L, 0.107 mg/L, and 0.118 mg/L for WY2003, WY2004, WY2005, and WY2006, respectively, were observed (**Figure 5-19)**. Mean total dissolved phosphorus (TDP) and soluble reactive phosphate (SRP) concentration values were also substantially elevated in the later water years relative to the first two years. The annual mean outflow TP concentrations from both PSTA cells remained relatively constant for the first three water years with annual means not significantly different from each other; Cell 3 outflow ranged from 0.013 mg/L to 0.015 mg/L, and Cell 8 outflows ranged from 0.011 mg/L to 0.016 mg/L. However, mean TP outflow concentrations for WY2006 were significantly elevated relative to prior years with means of 0.020 mg/L for Cell 3 and 0.021 mg/L for Cell 8, indicating that phosphorus removal performance was negatively affected by the increased phosphorus load to the system. Mean TDP outflow concentrations from the cells exhibited a similar trend with elevated outflow concentrations in WY2006. Interestingly, annual mean SRP outflow concentrations did not exhibit the same trend, indicating the system was able to absorb the increased SRP coming into the system and the elevated TDP concentrations were reflective of exported dissolved organic phosphorus rather than the soluble phosphorus species. These results may indicate that tracking TDP concentrations and not SRP concentrations may provide a better early warning of system decline. While none of the south PSTA test cells achieved a long-term mean outflow TP concentration of 10 µg/L, individual biweekly values were occasionally at or below this threshold level.

Table 5-14. Summary of the geometric mean TP concentrations values for the PSTA test cells (Cells 3 and 8) located at the STA-1W South Test Cell facility. Inflow and outflow concentrations presented for the period extending from May 1, 2002, through April 30, 2006. TP, soluble reactive phosphate (SRP), and total dissolved phosphorus (TDP) overall mean outflow concentrations were significantly lower ($p < 0.0001$) than the overall mean inflow concentrations for this period.

Parameter	Inflow (mg/L)	Outflow Cell 3 (mg/L)	Outflow Cell 8 (mg/L)
TP	0.066	0.015	0.014
TDP	0.040	0.008	0.008
SRP	0.025	0.005	0.005

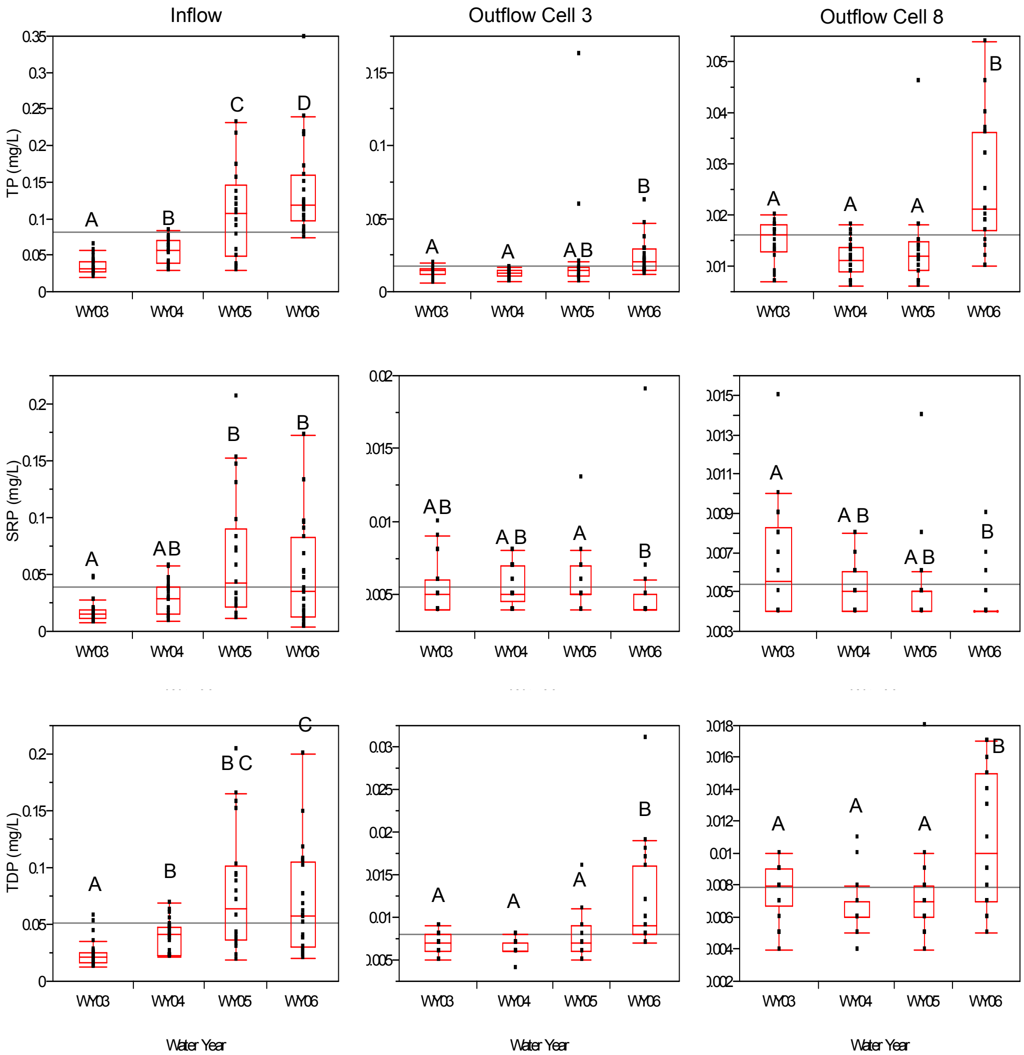


Figure 5-19. Summary of the yearly mean TP, SRP, and TDP removal in the two STA-1W south PSTA test cells for the period extending from May 1, 2002, through April 30, 2006. The solid line represents the grand mean. Top and bottom of the boxes = the 75th and 25th percentile of the data distribution, respectively; mid-line = 50th percentile; ends of whiskers = 10th and 90th percentiles, respectively. Means with different letters are significantly different from each other at a probability level (α) < 0.05.

STA-1W WILDLIFE AND RECREATION

STA-1W was opened for water fowl hunting in 2004. Bird watching tours were also conducted. Black-necked stilts were found nesting in Cells 2, 4, and 5B (refer to the *2006 Stilt Nesting Summary for the STAs* section in this chapter). District staff has worked with the USFWS initiating several improvements to minimize nesting within the footprint of the treatment area and, more importantly, to minimize impacts to active nests. The improvements include (1) degrading the Limerock Berm in Cell 5 to eliminate exposed surface areas, (2) conducting migratory bird surveys (USFWS), and (3) posting signs around the areas of concern to increase awareness of the birds' presence.

Recreational opportunities, such as bird watching, continued in WY2006. Duck hunting was not permitted this year due to Long-Term Plan enhancements construction and rehabilitation efforts in Cell 5. Recreational facilities are proposed to provide public access to STA-1W. The proposed recreational facilities include an asphalt parking area on the south side of County Road 880 and associated road improvements such as an acceleration and deceleration lane in the vicinity of the entrance to the parking lot. The proposed facilities include a canoe launching site and a boardwalk for access to the seepage canal north of the STA. A footbridge is also proposed across the seepage canal to provide pedestrian access to the existing leveled area adjacent to the north end of the Limerock Berm in Cell 5B. An information kiosk, a composting toilet, a boardwalk, and landscaping are proposed at this location. Pedestrian gates, signage, and fencing as needed to define public access areas and to protect sensitive equipment are also proposed.

STA-1W ENHANCEMENTS

Long-Term Plan enhancements for STA-1W are listed in **Table 5-4** and on **Figure 5-7**. Following is an update on current status.

Completed in FY2005

- Replacement of existing structure G-255 with a fully operable control structure (nominal capacity of approximately 850 cubic feet per second, or cfs) [Status: G-255 is flow capable]
- Construction of a new levee across Cell 2 together with a series of culverts for improved flow distribution (G-249 structures) [Status: G-249 structures are flow capable]
- Demolition of G-256 structure and levee restoration
- Removal of tussock material from Cell 2
- Excavation of flow-way cuts along the C-7 canal, within Cell 4
- Excavation of flow-way cuts along north end of Cell 2A (submerged remnant farm road)
- Excavation of G-254 distribution and collection canals
- Installation of overhead power line, beginning at northeast corner of Cell 5A and continuing along the G-304 levee, providing power to G-255 structure (and power to G-304 structures)

The STA Long-Term Plan enhancements construction projects completed in FY2006 consist of the following component elements:

- Earthwork for improved flow distribution of Cell 5 (G-304 and G-306 berms)
- G-304 automation work
- Construction of a small seepage pumping station (designated as G-327B) near the northwest corner of Cell 5B to permit withdrawal from the seepage canal to maintain stages in the SAV Cell 5B
- Addition of a 150-cfs structure (G-307) to replace G-256 as the primary discharge for Cell 4
- Replacement of five existing galvanized culvert pipes along the G-254 levee

The following projects are scheduled to occur in FY2007:

- Construct internal levee and culverts in Cell 1 over the 2006-2007 dry season. Approval was obtained from the FDEP to postpone the enhancements in Cells 1 and 3 by one year from the original schedule to allow vegetation grow-in in Cells 2, 4, and 5.
- Convert Cells 1B and 3 to SAV
- Conveyance capacity improvements to C-6 Canal in Cell 3
- Enhancements construction completion expected to be around June 2007 with vegetation grow-in to occur over the following year.

STA-2

STA-2 CONFIGURATION

Stormwater Treatment Area 2 (STA-2) contains approximately 6,430 acres of effective treatment area arranged in three parallel flow-ways. The Eastern Flow-way (Cell 1) consists of approximately 1,990 acres of effective treatment area. Both the Center Flow-way (Cell 2) and the Western Flow-way (Cell 3) each consists of about 2,220 acres of effective treatment area. A schematic of STA-2 is presented in **Figure 5-20**. Based on the simulated 1965–1995 period of flow, the STA should receive a long-term average of approximately 232,759 ac-ft. Actual deliveries will vary based on hydrologic conditions in the basins.

Water enters STA-2 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.

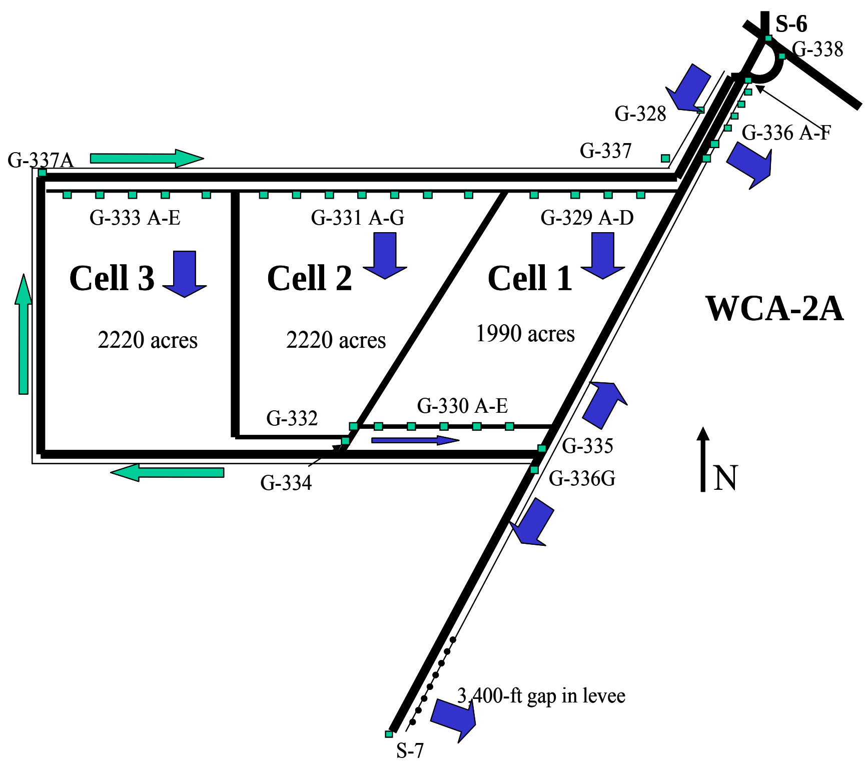


Figure 5-20. Schematic of STA-2 (not to scale).

STA-2 WY2006 HIGHLIGHTS

- Hurricane Wilma caused power outage, moderate damage to some of the levees, and severe damage to Cell 3 SAV (details found in the *STA-2 Hurricane Wilma Impacts* section of this chapter)
- All treatment cells were operational during the water year
- Vegetation in Cell 3 was managed in order to optimize SAV performance:
    - Hydrilla eradication studies: biocontrol flies (*Hydrellia*) were released in August 12, 2005 in the middle of the eastern side of the STA. The flies disappeared in the fall and may have been impacted by Hurricane Wilma.
    - Herbicide Aquathol Super K applied on April 11, 2006
    - SAV test inoculation completed on April 19, 2006
- Construction of the new treatment cell (Cell 4) began in January 2006 (Acceler8)
- Flow into Cell 2 was reduced to improve outflow TP concentrations and hydraulic loading (began August 30, 2005). During low-flow events, one culvert closed in an attempt to equalize flow. Operations directed water to Cell 1, Cell 3, then into Cell 2.
- Flow into Cell 3 was restricted beginning in December 2005 to allow plant establishment, SAV recovery, and hydrilla research; Cell 2 flows were then no longer restricted as described above; data analysis was done in order to modify flow and loading to treatment cells
- An active bald eagle (*Haliaeetus leucocephalus*) nest was found in Cell 2
- No recreational opportunities in STA-2 at this time

STA-2 HURRICANE WILMA IMPACTS

Hurricane Wilma caused moderate damage to the northwest Cell 3 levee and northwest Cell 2 levee. Damage was also done to the G-328 auto-sampler intake. The SAV in Cell 3 suffered severe damage, especially in the northern section of the cell, and the water was very turbid. Moderate damage was done to the emergent vegetation. The power outage lasted until December 20, 2005.

STA-2 PERMIT STATUS

Monitoring data collected for STA-2 demonstrates that this treatment area was in compliance with the EFA and NPDES operating permits for WY2006 and that discharges do not pose any known danger to public health, safety, or welfare. 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 permits authorize discharges when net improvement in TP and mercury is demonstrated for each cell.

Currently STA-2 is in the post-stabilization phase (**Table 5-2**), having demonstrated net improvement in TP and mercury. 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 full capacity flow-through operations. STA-3/4 is in flow-through operations, although Cell 3 was operated under a restricted flow and stage to allow for completion of Long-Term Plan enhancements projects and to allow for plant establishment. STA-1E received authorization to discharge from all treatment cells except for Cells 1 and 2. These cells will remain off-line until construction of the PSTA demonstration project is completed. The STA-1E PSTA Demonstration Project is expected to become operational in March 2007 and will be conducted for a 24-month period. Until STA-1E is in full capacity flow-through operations, STA-2 will remain in the stabilization phase of operation.

STA-2 OPERATIONS

STA-2 Hydrology

All treatment cells were operational during WY2006. During WY2006, 297,364 ac-ft of water was captured and treated by STA-2 (**Table 5-3**). This amount was approximately 28 percent greater than the 31-year long-term average annual simulated inflow for this STA, although annual variability was anticipated. Inflows were calculated by subtracting the volume of water that passed through S-6 for irrigation water (through G-328I). This inflow loading was equal to an average hydraulic load of 3.86 cm/d over the treatment area. The annual volume of treated water discharged to WCA-2A was 322,303 ac-ft. The difference between the inflow and outflow volumes reflects the net contributions of direct rainfall, ET, seepage losses to adjacent lands, deep percolation, and flow measurement error. A summary of monthly flows is presented in **Figure 5-21**. During WY2006, STA-2 received 6,977 ac-ft from Lake Okeechobee. There was a very small amount of flow (19 ac-ft) diverted around STA-2 via G-339 during WY2006.

STA-2 TOTAL PHOSPHORUS

During WY2006, the STA received 44 mt of TP, equal to a phosphorus loading rate of 1.69 g/m^2 (**Table 5-3**). The TP loading to the system was approximately 1.53 times the 31-year long-term average annual simulated inflow TP for this STA. During WY2006, STA-2 received approximately 0.78 mt of TP from Lake Okeechobee. STA-2 removed approximately 35.8 mt of TP during WY2006. Monthly discharge concentrations were considerably lower than inflow concentrations. Summaries of monthly TP loads and FWM TP concentrations are presented in **Figures 5-22** and **5-23**, respectively. The annual FWM outflow concentration was 21 ppb, an 83 percent reduction from the inflow concentration of 120 ppb. For informational purposes, the annual geometric mean discharge TP concentration for STA-2 was 22 ppb for WY2006. The

12-month moving average TP concentration from STA-2 ranged from 19 to 21 ppb during the course of WY2006 (**Figure 5-24**).

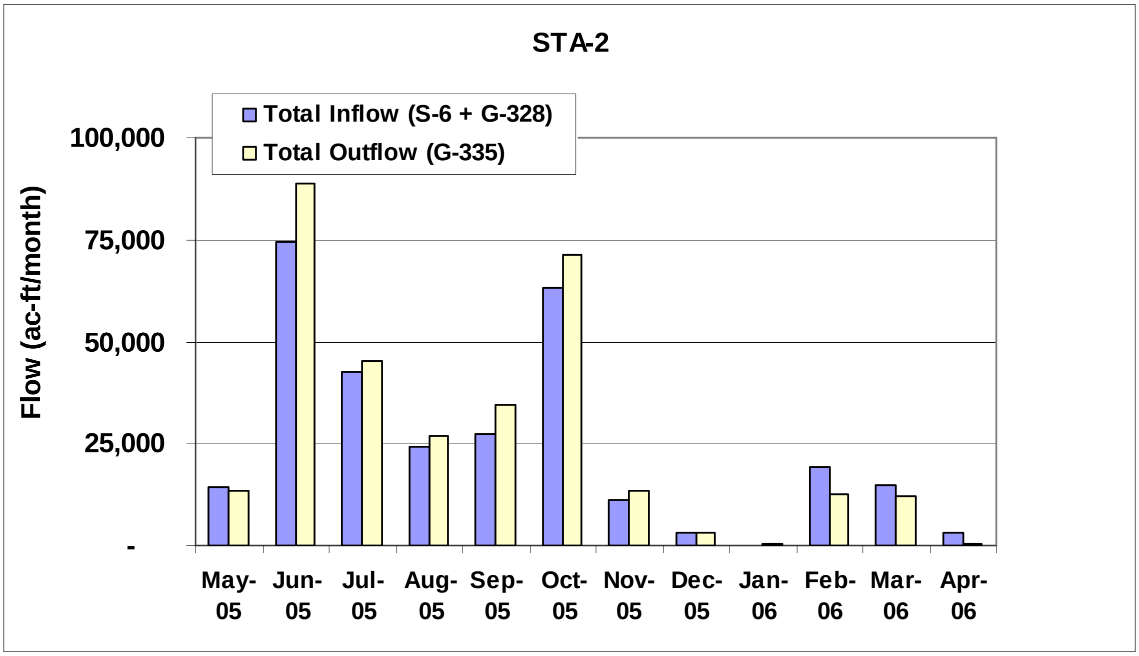


Figure 5-21. Summary of WY2006 flows for STA-2. All treatment cells were operational during WY2006.

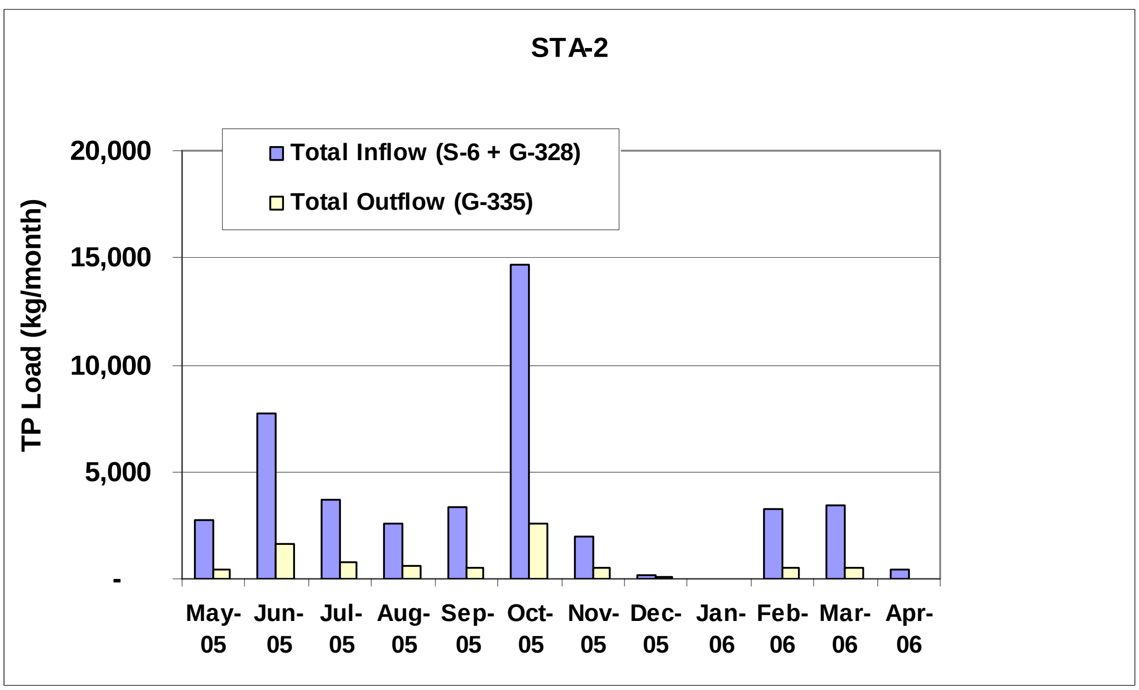


Figure 5-22. Summary of WY2006 TP loads for STA-2. All treatment cells were operational during WY2006.

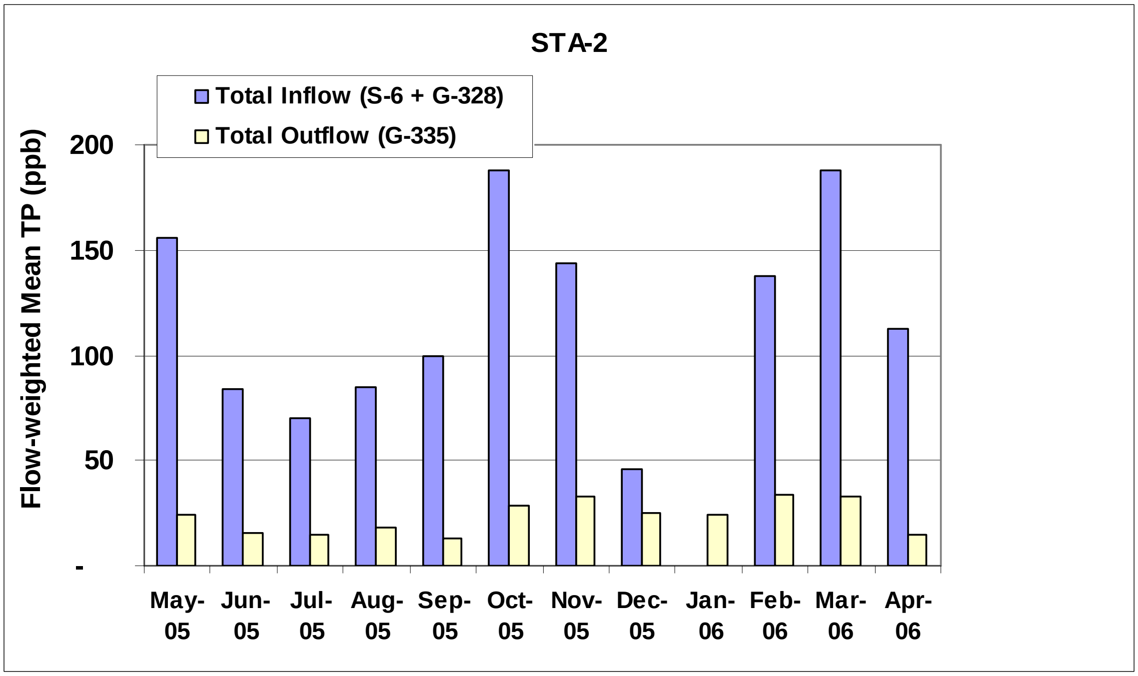


Figure 5-23. Summary of WY2006 TP concentrations for STA-2. All treatment cells were operational during WY2006.

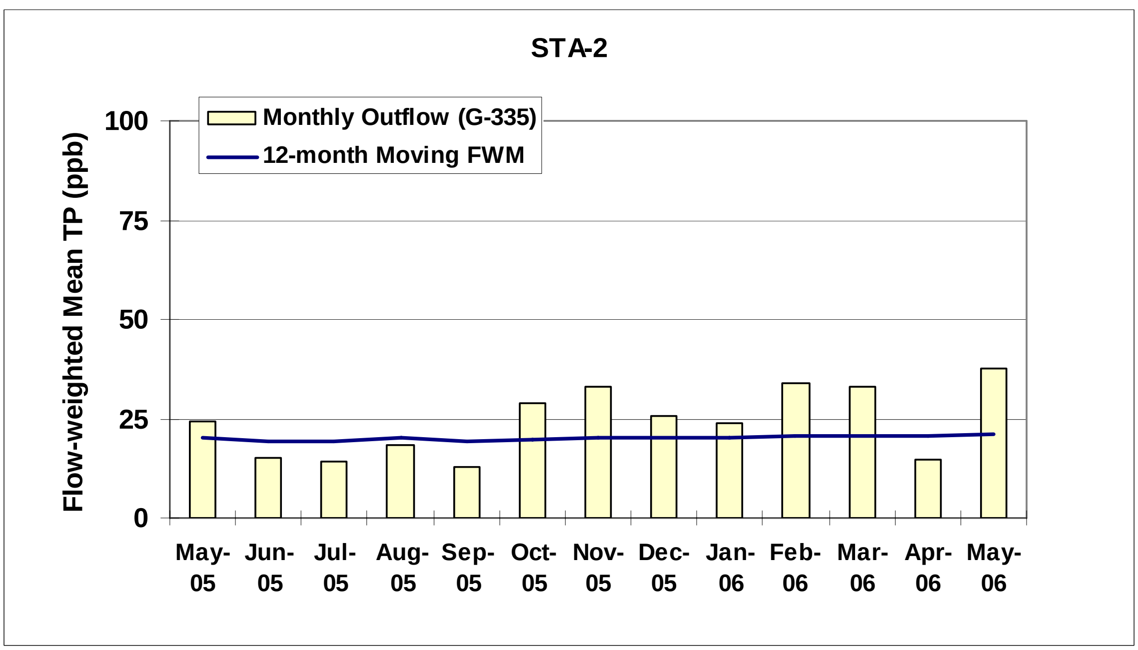


Figure 5-24. Comparison of monthly to 12-month moving average TP concentrations for WY2006 for STA-2 outflow. All treatment cells were operational during WY2006.

OTHER STA-2 WATER QUALITY PARAMETERS

The WY2006 monitoring data for non-phosphorus parameters at STA-2 during this reporting period are presented in Appendix 5-8 and are summarized in **Table 5-15**. Discharges from STA-2 were determined to be in compliance with the permit by satisfying criterion one above for all non-phosphorus and non-DO parameters with applicable numeric state water standards. Additional requirements for DO are listed in Administrative Order No. AO-006-EV and are discussed in the following section. Mercury monitoring results are discussed in Chapter 3B and Appendix 5-5 of this volume.

Table 5-15. Summary of annual arithmetic averages and FWM for all parameters other than TP 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)	25.2	25.5	24.6	-NA-	-NA-	-NA-	-NA-
Dissolved Oxygen (mg/L)	3.6	4.1	4.6	-NA-	-NA-	-NA-	-NA-
Specific Conductivity (µmhos/cm)	1,226	1,507	1,266	-NA-	-NA-	-NA-	-NA-
pH	7.5	7.6	7.6	-NA-	-NA-	-NA-	-NA-
Turbidity (NTU)	5.6	4.4	1.2	-NA-	-NA-	-NA-	-NA-
Total Dissolved Solids (mg/L)	823	940	812	16 (52)	906	26 (26)	767
Unionized Ammonia (mg/L)	0.006	0.012	0.002	16 (52)	0.010	26 (26)	0.001
Orthophosphate as P (mg/L)	0.049	0.013	0.004	36 (99)	0.075	49 (49)	0.006
Total Dissolved Phosphorus (mg/L)	0.057	0.018	0.011	37 (101)	0.085	48 (48)	0.012
Sulfate (mg/L)	80.3	52.4	69.9	16 (50)	103.2	25 (25)	76.4
Alkalinity (mg/L)	326	374	317	16 (52)	354	26 (26)	301
Dissolved Chloride (mg/L)	157	225	171	16 (52)	165	26 (26)	157
Total Nitrogen (mg/L)	3.22	2.87	2.45	15 (51)	4.04	25 (25)	2.48
Total Dissolved Nitrogen (mg/L)	3.06	2.75	2.42	15 (51)	3.77	25 (25)	2.46
Nitrate + Nitrite (mg/L)	0.630	0.437	0.172	15 (51)	0.809	25 (25)	0.269

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

STA-2 DISSOLVED OXYGEN MONITORING

Introduction

The 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 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 (**Figure 5-25**):

- 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

Sampling Dates

Diel oxygen measurement dates and sites associated with STA-2 for WY2006 are provided in **Table 5-16** and Appendix 5-9.

Table 5-16. 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	
06/06/2005	06/09/2005	S6	G328	G335	----------------------------------
08/15/2005	08/19/2005	----	----	----	C.25, C1, C4,N.25, N1, N4, S.25, S1, S4
09/12/2005	09/15/2005	S6	G328	G335	----------------------------------
09/19/2005	09/23/2005	----	----	----	C.25, C1, C4,N.25, N1, N4, S.25, S1, S4
10/17/2005	10/21/2005	----	----	----	C.25, C1, C4,N.25, N1, N4, S.25, S1, S4
12/06/2005	12/08/2005	S6	G328	G335	----------------------------------
03/24/2006	03/27/2006	S6	G328	G335	----------------------------------

Note: See Appendix 5-10 for statistical summaries by event and diel parameter.

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

Direct comparisons of DO in STA-2 discharges with DO at downstream marsh sites in WCA-2A (**Figure 5-25**) cannot be made for all monitoring events in WY2006 because Hydrolab™ deployment dates differed. However, to satisfy permit requirements, summary statistics for STA-2 discharges and WCA-2A marsh transect sites are presented in **Table 5-17**. Notched box and whisker plots for the sites are presented in **Figure 5-26**. The complete data sets collected at all sites during WY2006 are found in the appendices associated with this chapter of this volume.

The data indicate that diel DO concentrations in G-335 discharges were statistically greater than DO concentrations at all of the marsh transect sites. DO at marsh sites C-4 and S-4 was significantly greater than at the other marsh sites.

Diel DO monitoring at the marsh stations of WCA-2A was also intended to develop a SSAC for DO in the Everglades.

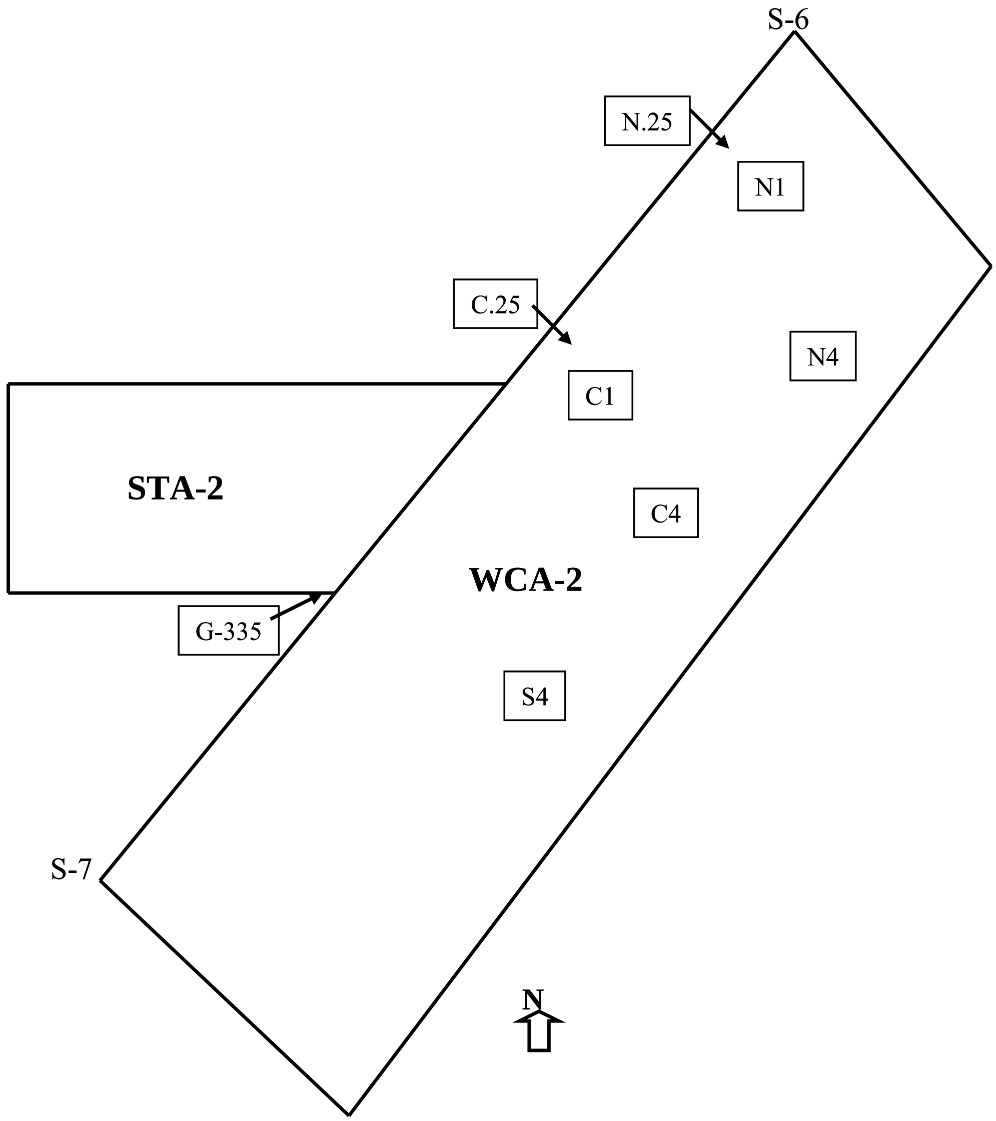


Figure 5-25. DO monitoring sites in WCA-2 (not to scale).

Table 5-17. Statistical summary of diel DO at the outflow pump station from STA-2 and marsh stations in WCA-2 during WY2006.

Location	Station	Number of Measurements	Mean	Minimum	Median	Maximum	Standard Deviation
Outflow	G335	532	5.12	3.15	5.07	10.35	1.28
	C.25	543	0.39	0.05	0.35	1.10	0.17
Transect C	C1	364	1.33	0.28	1.32	2.48	0.50
	C4	185	3.77	1.38	3.56	7.03	1.49
	N.25	364	2.34	0.43	1.96	6.04	1.40
Transect N	N1	363	0.85	0.06	0.56	4.27	0.77
	N4	363	0.90	0.09	0.85	1.80	0.37
Transect S	S4	364	4.06	0.91	3.44	9.68	2.39

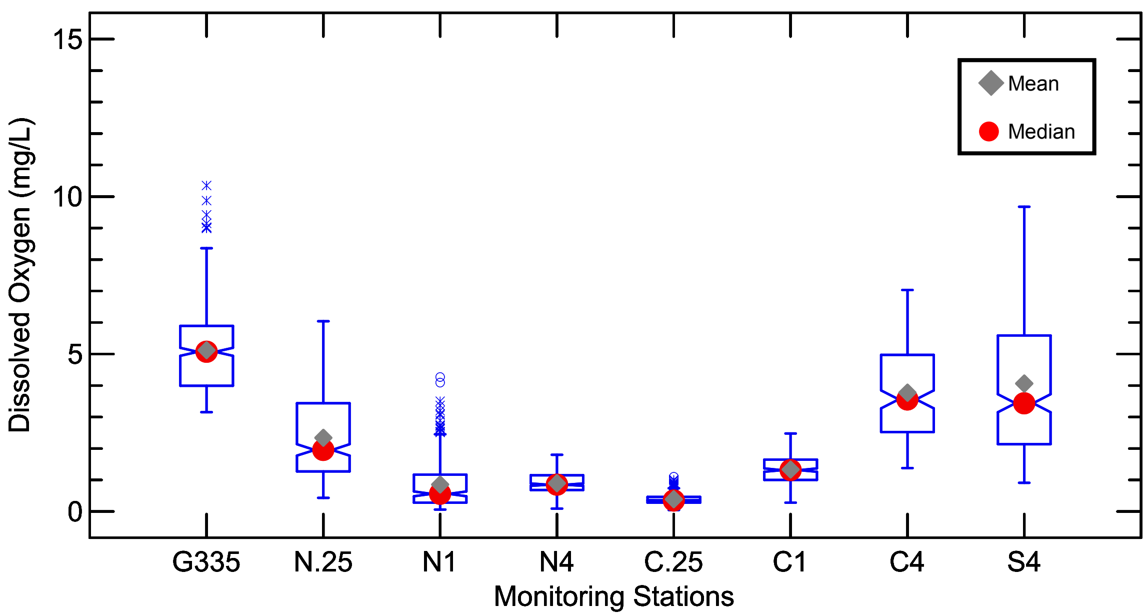


Figure 5-26. Notched-box and whisker plots of diel DO measurements at the STA-2 outflow station (G-335) and along transect sites in WCA-2 during three monitoring periods. The notch on a box plot represents the confidence interval (C.I.) about the median, which is represented by the narrowest part of 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 95% C.I.

STA-2 VEGETATION MANAGEMENT

Specific Condition 13(b) of the EFA permit requires that the annual Everglades Consolidated Report (currently known as the *South Florida Environmental Report*) include information regarding the application of herbicides used to exclude and/or eliminate undesirable vegetation within the treatment cells. In WY2006, the District treated a total of 438 acres to control vegetation in the STA-2 marsh, using 87 gallons of diquat to treat the floating vegetation, and 108 gallons of glyphosate and 14.25 gallons of imazapyr to control emergent vegetation (**Table 5-4**). There was one submerged treatment targeting hydrilla within Cell 3 of STA-2 where 3,950 pounds of the product Aquathol K Granular (active ingredient being endothall) was used to treat 167 acres of hydrilla. The District used both aerial and ground-based spray equipment to apply these herbicides.

A vegetation management project, as stated on page 5-27 of the 2003 Long-Term Plan, was conducted. The objective of this project is to control invasion by emergents or other "less desirable" species in order to optimize SAV performance of STA-2 Cell 3. In early FY2006, the SAV in the northern portion of Cell 3 was lost due to damage by Hurricane Wilma and an unexplained crash of hydrilla beds. In April 2006, the District transplanted small quantities of SAV from the south area of the cell to the north area to evaluate the potential for SAV reestablishment.

STA-2 WILDLIFE AND RECREATION

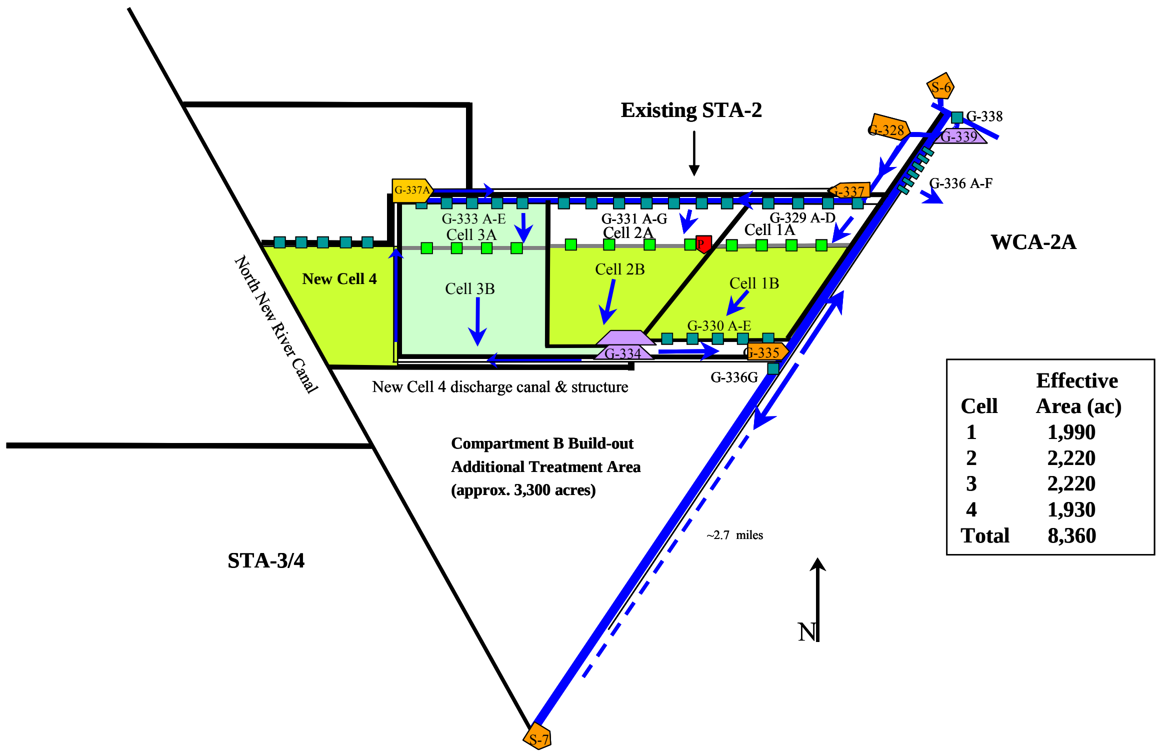
An active bald eagle nest was found in Cell 2. To protect the nest, the District worked with USFWS to perform weekly monitoring of site after nesting and establish a "no disturb" perimeter, which prevented aerial fly-overs and airboats from getting within 1,500 feet of the nest.

There were no recreational opportunities in STA-2 in WY2006, but recreational facilities are proposed to provide public access to STA-2**.** The proposed recreational facilities include a parking area along the east side of U.S. Highway 27, an information kiosk, a composting toilet, landscaping, and a canoe launching site for access to canals and deepwater areas outside the treatment footprint of the STA. Pedestrian gates, vehicle gates, signage, and fencing as needed to define public access areas and to protect sensitive equipment are also proposed. The proposed recreational facilities will be located just east of the Okeelanta property bridge that will provide access from U.S. Highway 27.

STA-2 EXPANSION AND ENHANCEMENTS

Expansion of STA-2 includes the construction of an additional 2,015-acre treatment cell (i.e., a new Cell 4) that will operate in parallel with existing Cells 1, 2, and 3 (**Figure 5-27**). The effective treatment area of the new Cell 4 will be approximately 1,930 acres. Construction of the new Cell 4 is under way and will be completed in July 2007, with the cell being flow capable by December 31, 2006. The design and construction of Cell 4 is being implemented under the District's Acceler8 program as part of the Everglades Agricultural Area (EAA) STA Expansion Project. For additional information on the status of the Acceler8 program, see Chapter 7A of this volume.

Enhancements to STA-2 include construction of interior levees and associated water control structures in the existing treatment cells as well as conversion of emergent vegetation to SAV in the new downstream cells (Figure 5-27). The new interior levees, water control structures, and vegetation conversion in existing cells are scheduled to occur in a phased approach following commencement of flow-through operation in Cell 4. The 2006 approved revision to the Long-Term Plan included the elimination of the proposed Cell 3 internal levee. For more information on this revision, refer to Chapter 8 of this volume. It is anticipated that the status of these additional enhancement projects will be included in future consolidated reports.



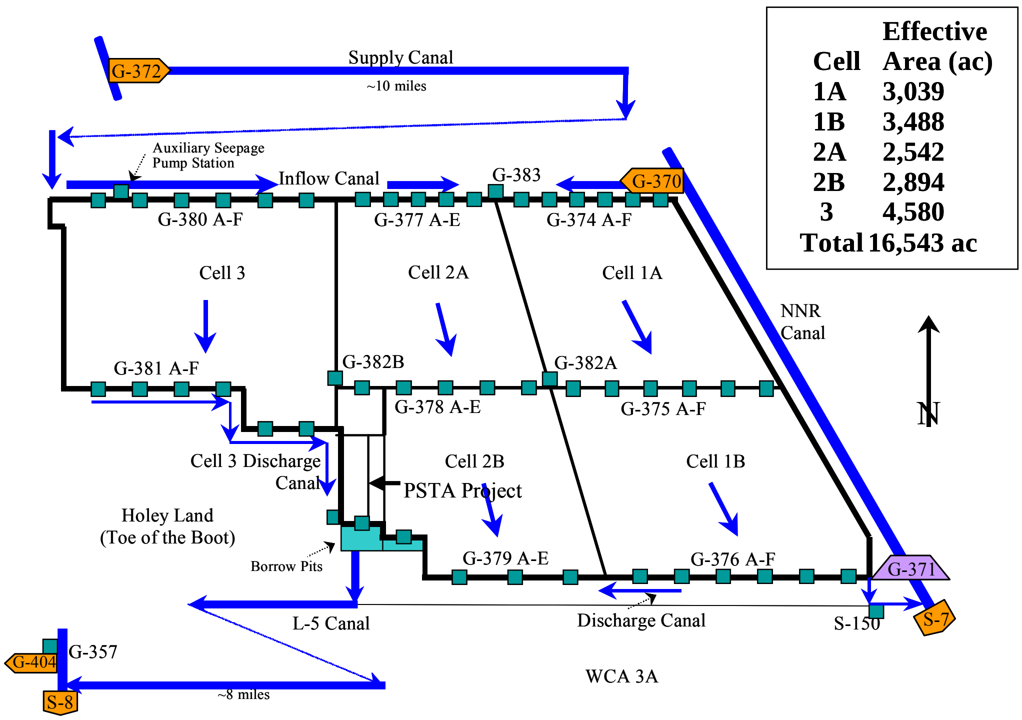
Cell	Effective Area (ac)
1	1,990
2	2,220
3	2,220
4	1,930
Total	8,360

Figure 5-27. STA-2 enhancements (not to scale).

STA-3/4

STA-3/4 CONFIGURATION

Stormwater Treatment Area 3/4 (STA-3/4) is the largest of the STAs, with approximately 16,543 acres of effective treatment area. A schematic of STA-3/4 is presented in **Figure 5-28**. STA-3/4 uses the existing S-7 and S-8 pump stations as the outflow facilities; these pump stations also continue to serve as components of the regional flood protection and water supply system. Refurbishment of those stations was under way in WY2006. STA-3/4 achieved full flow-through operation on September 16, 2004. STA-3/4 consists of three flow-ways; the Eastern Flow-way contains Cells 1A and 1B, the Central Flow-way contains treatment Cells 2A and 2B, and the Western Flow-way contains treatment Cells 3A and 3B. Inflows are through the G-370 and G-372 structures and outflows are through the G-376, G-379, and G-381 structures.



Cell	Effective Area (ac)
1A	3,039
1B	3,488
2A	2,542
2B	2,894
3	4,580
Total	16,543 ac

Figure 5-28. Schematic of STA-3/4 (not to scale).

STA-3/4 WY2006 HIGHLIGHTS

- The Eastern and Central flow-ways were operational in WY2006; the Western Flow-way (Cell 3) was off-line from May and June 2005, operated under restricted flow conditions from July 2005 through December 2005, then off-line from January 2006 through May 2006 to allow for Long-Term Plan enhancements construction and vegetation establishment.
- Hurricane Wilma caused minor damage to the levees and vegetation (details found in the *STA-3/4 Hurricane Wilma Impacts* section of this chapter).
- The full-scale PSTA implementation project located in Cell 2B is in the grow-in phase, and water quality sampling at the project has begun.
- Long-Term Plan enhancements construction in Cell 3 (that is, creation of divide levee and water control structures) was completed. During construction, a 200-foot cut was made in the divide levee to allow stormwater to move through and to reduce the amount of diversion through S-8 from July 2005 through December 2005.
- Small forward-pumping stations were constructed at the mid-levee in all three treatment cells. The purpose of these pumps is to hydrate downstream SAV communities in drought situations.
- Vegetation management activities included converting Cells 1B and 3B to SAV. Vegetation strips, consisting of emergent vegetation, were allowed to establish in Cell 3B (north/south orientation).
- Black-necked stilt nests were found in Cell 3B.
- STA-3/4 received Lake Okeechobee discharges in January 2006. The lake water had high TP concentrations and turbidity. The actual field conditions at the STA were closely monitored during this period.
- Completed construction of the divide structures G-371 and G-373 from July 2004 through August 2005. A large storm event required the canal plugs to be temporarily removed on June 14, 2005.
- The WY2006 preferred outflow data for STA-3/4 was updated in October 2006. The flow data were revised due to difficulty in measuring flow under conditions of very small head differences. Refinements were made to the calibrated flow rating for these small head differences using mass balance analysis.

STA-3/4 HURRICANE WILMA IMPACTS

Hurricane Wilma caused minor damage to the levees, moderate damage to SAV in Cell 2B, and moderate damage to the emergent vegetation. The flow-proportional auto-sampler samples were not operational due to power outage to the data logging units.

STA-3/4 PERMIT STATUS

The data presented in this section demonstrates that STA-34 was in compliance with the EFA and the USEPA's NPDES operating permits for this reporting period and that discharges do not pose any known danger to public health, safety, or welfare. Compliance with Specific Conditions 7(a)(i) and 7(a)(ii) was achieved. STA-3/4 is in the post-stabilization phase (**Table 5-2**).

STA-3/4 OPERATIONS

The Eastern and Central flow-ways were operational in WY2006; the Western Flow-way (Cell 3) was off-line from May and June 2005, operated under restricted flow conditions from July 2005 through December 2005, then off-line from January 2006 through May 2006 to allow for Long-Term Plan enhancements construction and vegetation establishment.

STA-3/4 Hydrology

The WY2006 preferred outflow flow data for STA-3/4 was updated in October 2006. The flow data were first revised in July 2006 to reflect the calibrations made to the flow equations from streamgaging, then further refined in October 2006 using mass balance analysis to correct the bias observed in the flows at small head differences due to the difficulty in measuring flows under such conditions. A detailed description of the flow rating and mass balance analyses is contained in the Improvement of Flow Ratings at STA 3/4 Structures report that can be found on the District's website at www.sfwmd.gov under *Everglades, Long-Term Plan for Achieving Everglades Water Quality Goals* link.

The District is exploring options to better estimate the flow for small head difference conditions at the STA-3/4 outflow culverts, such as installing flow meters at some of the culverts and trying to maintain greater head differences when operationally feasible.

During WY2006, inflow to STA-3/4 through G-370 and G-372 was 697,161 ac-ft, equal to an average hydraulic loading rate of 4.08 cm/day over the effective treatment area of the STA 3/4 (**Table 5-3**). These inflows were slightly higher (6 percent) than the 31-year long-term average annual simulated inflow for this STA, although annual variability was anticipated. Inflows were calculated by subtracting the volume of water that passed through G-372 to supply water to the Holey Land (through G-372HL). The volume of treated water discharged from STA-3/4 was 749,092 ac-ft. A summary of monthly flows during WY2006 is presented in **Figure 5-29**. STA-3/4 received 54,805 ac-ft from Lake Okeechobee (23,627 ac-ft through G-370, and 31,178 ac-ft through G-372). There was diversion around STA-3/4 through structures G-371, G-373, and G-373BC of 75,050 ac-ft in WY2006. It is estimated that about 80 percent of this diversion consisted of STA-5 discharge during flood events from June 6, 2005 through July 22, 2005.

Table 5- 18. Operational status of the treatment cells in STA-3/4 from January 2004 through September 2006.

STA-3/4 Operational Treatment Cells

2004					2005					2006		
Jan - Mar	Apr - Jun	Jul - Aug	Sep *Hurricanes Frances and Jeanne*	Oct - Dec	Jan - Feb	Mar - Jun	Jul - Sep	Oct *Hurricane Wilma*	Nov - Dec	Jan - Mar	Apr - May	Jun - Sep
Eastern and Western Flow-way Operational			All Flow-ways Operational	Eastern and Central Flow-way Operational			All Flow-ways Operational (Cell 3 restricted flow/stage)			Eastern and Central Flow-way Operational		All Flow-ways Operational
Central Flow-way off-line for vegetation conversion				Western Flow-way off-line for LTP enhancemenets construction			Western Flow-way re-hydrated, partial operation for plant re-establishment			Western Flow-way off-line for LTP enhancemenets construction		

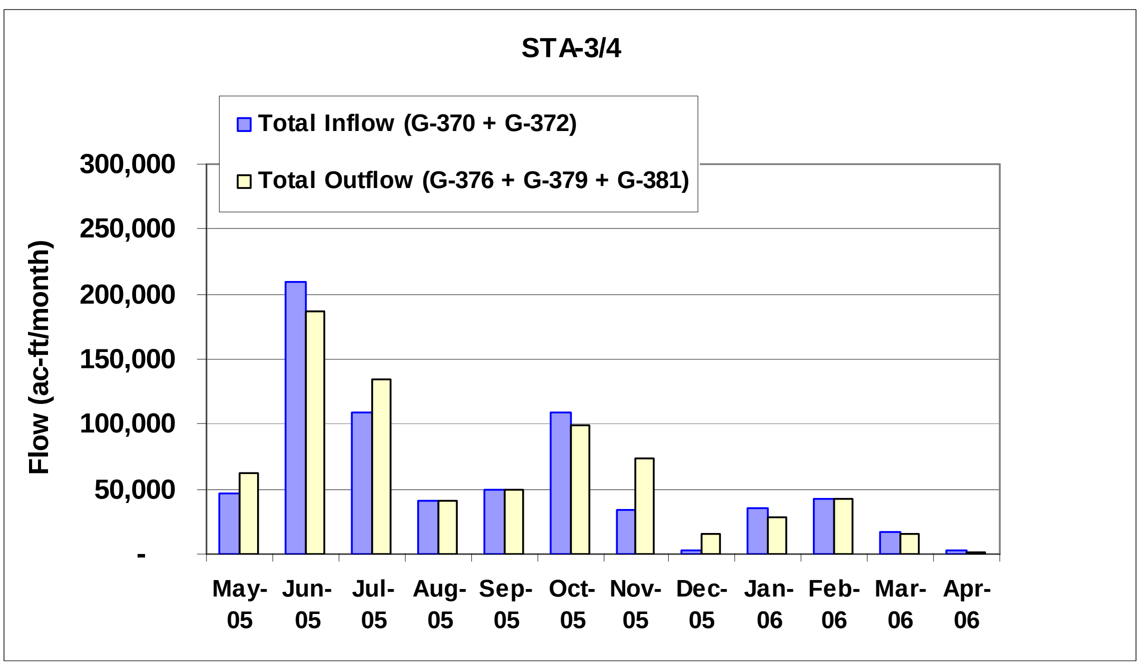


Figure 5-29. Summary of WY2006 flow for STA-3/4.

STA-3/4 Total Phosphorus

STA-3/4 has demonstrated better than anticipated phosphorus removal performance. In WY2006, STA-3/4 received a TP load of 105.4 mt with an average inflow of 123 ppb (**Table 5-3**). This TP load is 1.47 times the 31-year long-term average annual simulated inflow TP load for this STA, although annual variability was anticipated. During this period, the STA discharged a TP load of 21.6 mt, with an average concentration of 23 ppb (**Figure 5-30**). STA-3/4 received 12.26 mt of phosphorus from Lake Okeechobee (5.67 mt through G-370, and 6.59 mt through G-372) with a FWM TP concentration of 181 ppb. Approximately 83.8 mt of phosphorus was removed. The average inflow TP was reduced from 123 ppb to 23 ppb, resulting in an 80 percent load reduction (**Figure 5-31**). The moving 12-month FWM TP outflow concentration for STA-3/4 ranged from 13 to 23 ppb (**Figure 5-32**). For informational purposes, the geometric mean TP concentration of the outflow was calculated as 24 ppb.

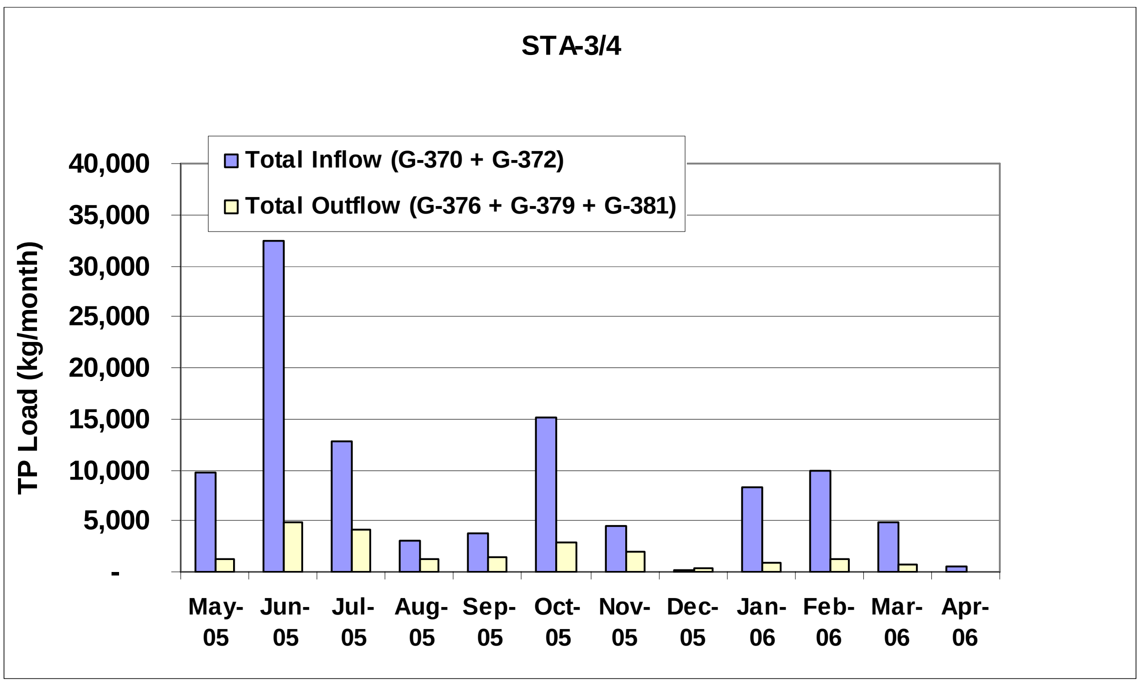


Figure 5-30. Summary of WY2006 TP load for STA-3/4.

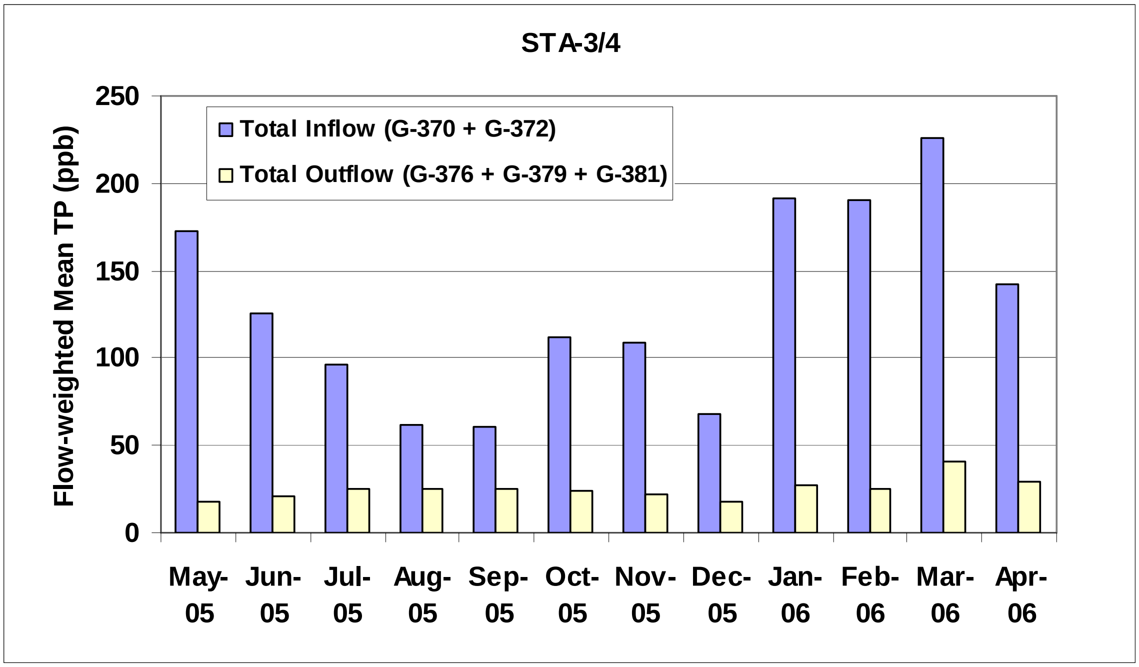


Figure 5-31. Summary of WY2006 FWM TP concentrations for STA-3/4.

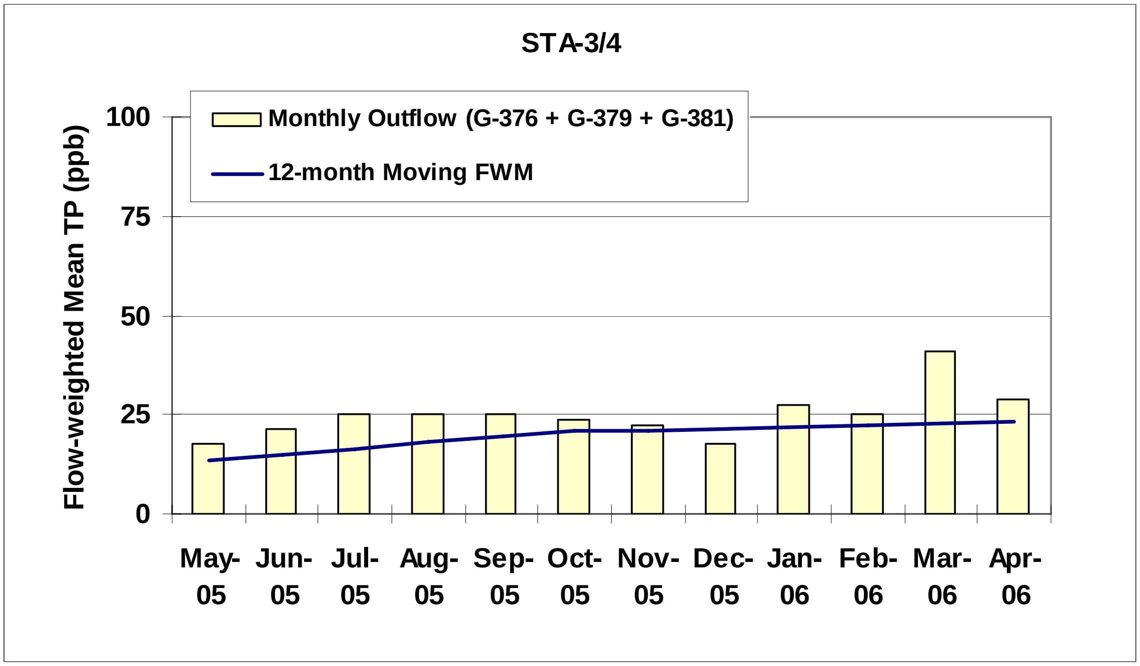


Figure 5-32. Comparison of monthly to 12-month moving average TP concentrations for WY2006 for STA-3/4 outflow.

STA-3/4 OTHER WATER QUALITY PARAMETERS

Compliance with the EFA permit is determined based on the three-part assessment presented in the *Water Quality Permit Requirements* section of this chapter. Water quality parameters with Florida Class III standards are identified in **Table 5-7**. The monitoring data for non-phosphorus parameters at STA-3/4 for the water year are presented in Appendix 5-10 and are summarized in **Table 5-19**. Additional requirements for DO are listed in Administrative Order No. AO-002-EV and are discussed in the next section. STA-3/4 is deemed to be in full compliance with the permit.

Table 5-19. Summary of annual arithmetic averages and flow-weighted means for all parameters other than TP monitored in STA-3/4.

Parameter	Arithmetic Means								Flow-Weighted Means			
	Inflow		Outflow						Total Inflow		Total Outflow	
	G370	G372	G376B	G376E	G379B	G379D	G381B	G381E	n	Conc.	n	Conc.
Temperature (°C)	24.7	25.3	24.2	24.3	24.5	24.6	26.5	26.7	-NA-	-NA-	-NA-	-NA-
Dissolved Oxygen (mg/L)	5.6	5.5	2.5	2.8	4.4	4.6	4.1	4.3	-NA-	-NA-	-NA-	-NA-
Specific Conductivity (μmhos/cm)	1,052	837	866	838	748	753	713	683	-NA-	-NA-	-NA-	-NA-
pH	7.6	7.6	7.4	7.5	7.7	7.7	7.6	7.6	-NA-	-NA-	-NA-	-NA-
Turbidity (NTU)	8.6	12.6	1.2	1.2	1.7	1.8	1.8	1.6	-NA-	-NA-	-NA-	-NA-
Total Dissolved Solids (mg/L)	658	534	539	522	472	482	444	410	25 (50)	532	93 (132)	472
Unionized Ammonia (mg/L)	0.002	0.002	<0.001	<0.001	0.004	0.003	0.003	0.002	22 (47)	0.002	81 (120)	<0.001
Orthophosphate as P (mg/L)	0.040	0.046	0.003	0.006	0.003	0.004	0.003	0.002	49 (102)	0.067	190 (277)	0.006
Total Dissolved Phosphorus (mg/L)	0.050	0.057	0.011	0.016	0.012	0.014	0.011	0.009	47 (100)	0.078	184 (271)	0.012
Sulfate (mg/L)	54.1	52.5	50.4	46.1	41.4	41.0	28.8	26.9	25 (50)	53.1	92 (131)	43.2
Alkalinity (mg/L)	306	229	252	241	196	202	207	207	25 (50)	243	93 (132)	218
Dissolved Chloride (mg/L)	110	86	84	81	82	80	69	65	25 (50)	74	92 (131)	73
Total Nitrogen (mg/L)	2.68	3.09	1.85	1.85	2.17	2.09	1.81	1.68	25 (50)	3.78	88 (125)	1.91
Total Dissolved Nitrogen (mg/L)	2.46	2.73	1.79	1.80	2.06	1.94	1.70	1.57	25 (49)	3.47	88 (125)	1.85
Nitrate + Nitrite (mg/L)	0.595	1.028	0.034	0.052	0.132	0.110	0.031	0.025	25 (50)	1.470	88 (125)	0.144
Total Arsenic (μg/L)	-NA-	-NA-	3.30	-NA-	3.50	-NA-	2.50	-NA-	-NA-	-NA-	1 (3)	3.30
Total Copper (μg/L)	-NA-	-NA-	1.700	-NA-	2.900	-NA-	0.600	-NA-	-NA-	-NA-	1 (3)	1.700
Total Lead (μg/L)	-NA-	-NA-	0.400	-NA-	0.400	-NA-	0.400	-NA-	-NA-	-NA-	1 (3)	0.400
Total Zinc (μg/L)	-NA-	-NA-	2.000	-NA-	2.000	-NA-	2.000	-NA-	-NA-	-NA-	1 (3)	2.000
Atrazine (μg/L)	-NA-	-NA-	0.066	-NA-	0.071	-NA-	0.066	-NA-	-NA-	-NA-	1 (3)	0.066
Chlordane (μg/L)	-NA-	-NA-	0.010	-NA-	0.010	-NA-	0.010	-NA-	-NA-	-NA-	1 (3)	0.020
DDD (μg/L)	-NA-	-NA-	0.002	-NA-	0.002	-NA-	0.002	-NA-	-NA-	-NA-	1 (3)	0.005
DDE (μg/L)	-NA-	-NA-	0.002	-NA-	0.002	-NA-	0.002	-NA-	-NA-	-NA-	1 (3)	0.004
DDT (μg/L)	-NA-	-NA-	0.003	-NA-	0.003	-NA-	0.003	-NA-	-NA-	-NA-	1 (3)	0.006
Simazine (μg/L)	-NA-	-NA-	0.005	-NA-	0.005	-NA-	0.005	-NA-	-NA-	-NA-	1 (3)	0.010
Toxaphene (μg/L)	-NA-	-NA-	0.050	-NA-	0.048	-NA-	0.048	-NA-	-NA-	-NA-	1 (3)	0.100

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

Parameters where outflow concentrations are greater than inflow concentrations are highlighted in gray. Pursuant to EFA Permit Number 0192895, an excursion occurs if outflow flow-weighted mean concentrations exceed applicable Class III criteria and are higher than inflow flow-weighted mean concentrations.

STA-3/4 DISSOLVED OXYGEN MONITORING

Introduction

STA-3/4 Administrative Order No. AO-007-EV in Exhibit D of Permit No. 0192895, January 9, 2004, specifies the DO monitoring requirements as STA-3/4.

The District developed the following plan to comply with the DO requirements of the Administrative Orders for STA-3/4. Under the plan, DO concentrations are measured quarterly at 30-minute intervals for four consecutive days at the following locations (**Figure 5-33**):

- At inflow monitoring stations to STA-3/4: G-370 and G-372
- At outflow stations in the two discharge canals: ST34EDC and ST34WDC

Additional diel DO monitoring at locations downstream of the discharge points was intended for development of the SSAC. The SSAC for DO has already been developed for the Everglades. Under new permits for the STAs, compliance for DO will be determined using the SSAC and diel monitoring will not be required.

Sampling Dates

Diel oxygen measurement dates and sites associated with STA-3/4 for WY2006 are provided in **Table 5-20** and Appendix 5-11.

Table 5-20. Deployment dates for diel oxygen measurement at STA-3/4 structures and sites in the discharge canal.

Event Dates		Structures		Structures	
Start	End	Inflow		Outflow	
09/23/2005	09/26/2005	G370	G372	ST34EDC	ST34WDC
12/12/2005	12/16/2005	G370	G372	ST34EDC	ST34WDC
03/24/2006	03/27/2006	G370	G372	ST34EDC	ST34WDC

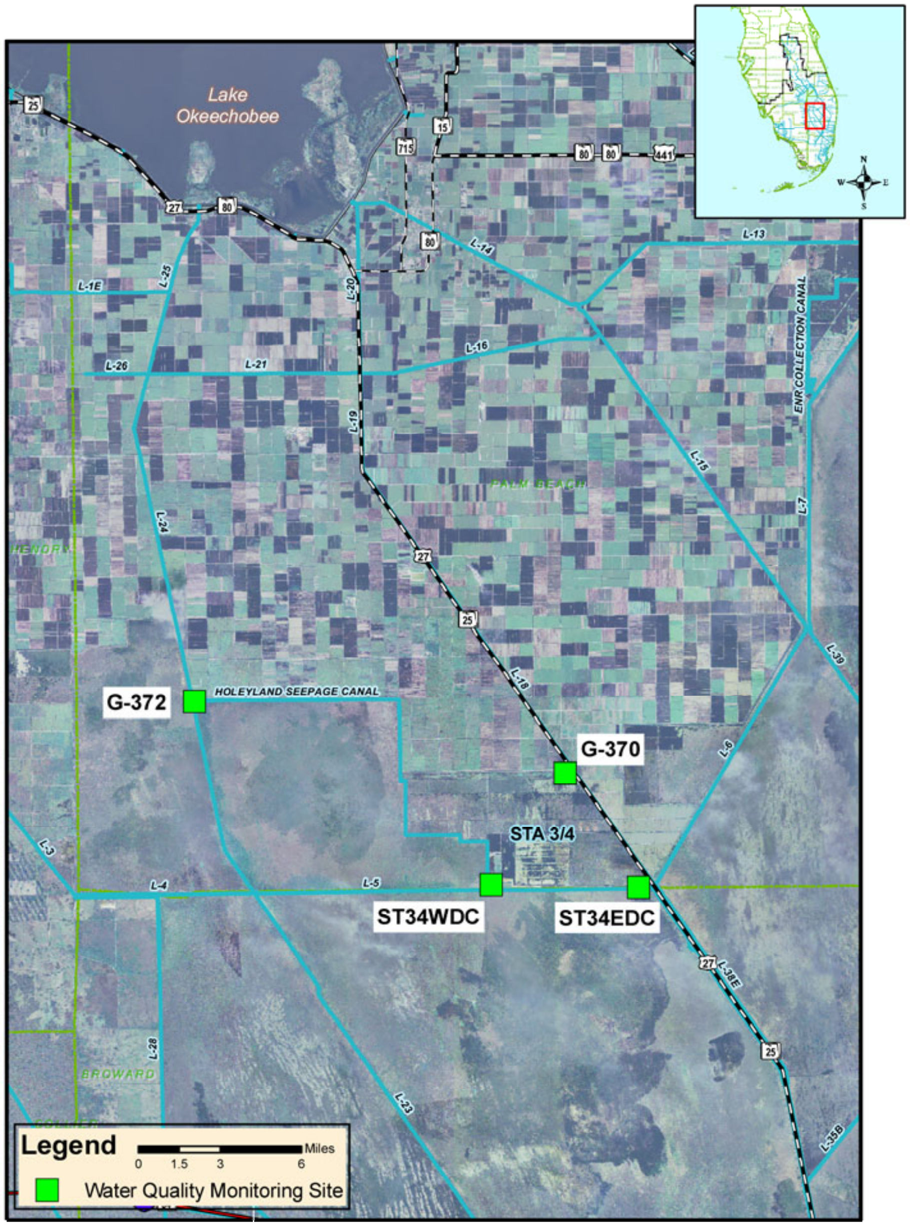


Figure 5-33. Diel DO monitoring sites for STA-3/4.

Dissolved Oxygen at STA-3/4 Discharges

DO levels at the STA-3/4 during the three diel deployment periods averaged greater than 5.0 mg/L (**Table 5-21**). Additionally, median DO levels were also greater than 5.0 mg/L. Further, ST34EDC exhibited DO levels that did not fall below 5.0 mg/L. In contrast, DO levels at ST34WDC were below the 5.0 mg/L 30 percent of the time during the three deployment periods. A graphical presentation of DO levels measured at STA-3/4 monitoring sites during WY2006 is provided in **Figure 5-52**. No significant difference was observed for DO concentrations measured at the outflows (ST34EDC and ST34WDC). However, both outflows had significantly higher DO levels than the inflow levels to STA-3/4 (**Figure 5-34**). The average of the DO concentrations in the discharge canal ranged from 6.21 to 6.86 mg/L compared with inflow levels, which ranged from 5.21 to 5.93 mg/L. The highest DO levels were observed at ST34EDC (**Table 5-21**). The complete data sets collected during WY2006 are presented in the appendices associated with this chapter of this volume.

Table 5-21. Statistical summary of diel DO at the outflow stations from STA-3/4 during three deployment periods.

Location	Station	Number of Measurements	Mean	Minimum	Median	Maximum	Standard Deviation
Outflow	ST34EDC	144	6.86	5.20	6.78	9.83	1.04
	ST34WDC	284	6.21	4.34	7.12	7.80	1.29

Note: Statistical summaries by event and diel parameter can be found in Appendix 5-5, Table 3.

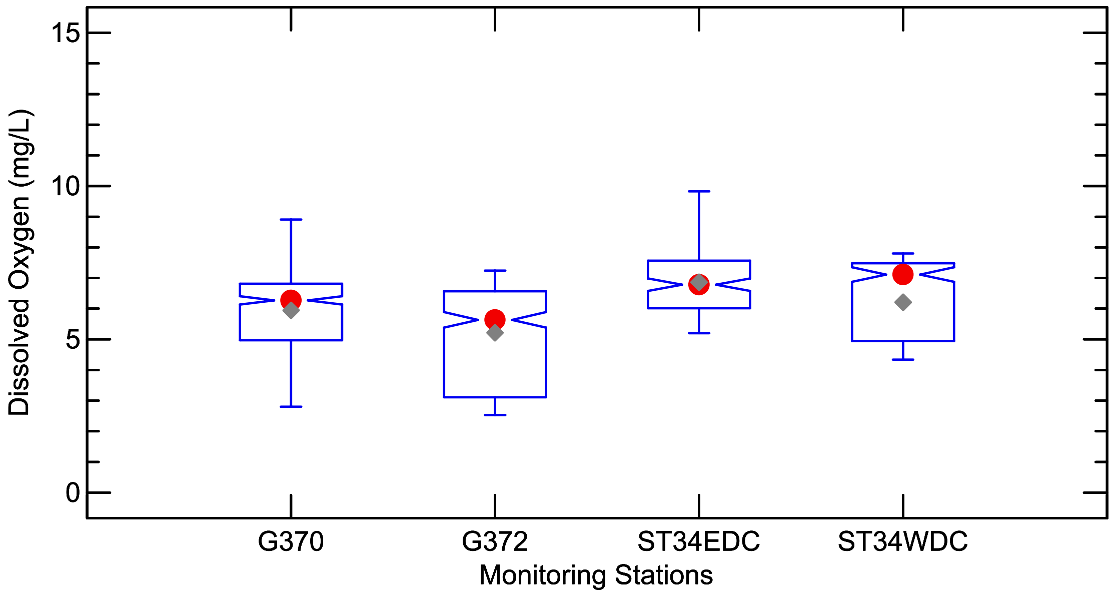


Figure 5-35. Notched box and whisker plots of diel DO measurements at STA-3/4 inflow stations (G370 and G372) and outflow stations (ST34EDC and ST34WDC). The notch on a box plot represents the approximate (95%) confidence interval (C.I.) about the median, which is represented by the narrowest part of 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% C.I.

STA-3/4 VEGETATION MANAGEMENT

Specific Condition 13(b) of the EFA permit requires that the annual Everglades Consolidated Report (currently known as the *South Florida Environmental Report*) include information regarding the application of herbicides used to exclude and/or eliminate undesirable vegetation within the treatment cells. In WY2006, the District treated a total of 3,744 acres to control vegetation in the marsh, using diquat to treat the floating vegetation, and glyphosate and imazapyr to control emergent vegetation (**Table 5-5**). The District used both aerial and ground-based spray equipment to apply these herbicides.

Other vegetation management activities occurred in STA-3/4 during WY2006 with the objective to convert Cells 1B, 2B, and 3B to SAV. The bottom 20 percent of Cell 1B (650 acres) was sprayed on November 15–16, 2005 to convert emergent to SAV. From February 27 through March 5, 2006, 1,400 acres were sprayed as part of Long-Term Plan conversion to SAV in Cell 3B. Vegetation strips, consisting of emergent vegetation, were allowed to grow in Cell 3B (north/south orientation) to protect the SAV communities from wind and wave damage (**Figure 5-36**).

Figure 5-36. Vegetation strips, consisting of emergent plants, serve as wind and wave barriers to fortify the SAV communities against large storm events.

Vegetation Management Demonstration Project in STA-3/4 Cell 2B [FDEP Grant Agreement]

In FY2004, with funding assistance from the same FDEP grant associated with the Limerock Berm in STA-1W Cell 5B, a vegetation management demonstration project was initiated in STA-3/4 Cell 2B. The purpose of the vegetation management demonstration project was to evaluate methods for eliminating undesirable emergent vegetation and establishing SAV in the STAs. The main focus of this effort was to determine the most effective method for eliminating torpedograss and other emergent vegetation from STA treatment cells and to evaluate large scale inoculation of SAV in the same treatment cells. The torpedograss and emergent removal portion of the project was conducted in a 313-acre area in the southwest portion of Cell 2B, and involved applications and evaluation of combinations of two types of herbicides, fire, and flooding. Results indicate that torpedograss is controlled most effectively by burning prior to herbicide applications and that elimination of torpedograss accommodated rapid colonization by SAV. A final report on the torpedograss control component of this project was completed in May 2005 and is available on the District's website at www.sfwmd.gov under the *Everglades* section, *Long-Term Plan for Achieving Everglades Water Quality Goals* link.

The SAV inoculation effort, completed in summer 2004, involved harvesting SAV from a donor site in STA-2 and transporting the harvested plants via helicopter to STA-3/4 Cell 2B. Initial monitoring of the success of these inoculations was conducted in spring 2005. Forty-nine point samples were taken at 5-meter (m) centers within a 30 m by 30 m grid at each of the 50 inoculation sites. Presence of submerged aquatic plants [southern naiad (*Najas guadalupensis*), *Chara*, pondweed] was documented within a 1-m radius of each point sample location by visible observation and bottom grab samples using a hand cultivator. Natural colonization of SAV was evaluated using this sampling methodology (grab samples within a 900 m^2 grid) at 50 randomly selected locations in the cell. Site selection was determined by a random compass direction and distance from each of the inoculation sites.

The monitoring phase of this component of the vegetation management demonstration project was completed in late spring 2006. The information gleaned from this research project is intended to be applied to other large-scale vegetation conversions from emergent vegetation to SAV. Results demonstrate that aerial inoculation of harvested SAV is an effective method for initial establishment of SAV cells in the STAs. Field observations indicate that all three transplanted species [southern naiad, musk grass (*Chara* spp.), and Illinois pondweed (*Potamogeton illinoensis*)] sustained minimal mortality during harvesting, aerial transport, and a post-inoculation establishment period that included two hurricane events in September 2004. However, inoculated SAV did not appear to begin rooting in the soil until water levels could be lowered to less than 50 cm in late October–November 2004. Anecdotal observations of rapid and full recovery of SAV beds at the donor site in Cell 3 of STA-2 further validate the potential applicability of this novel and unprecedented large-scale method for transplanted SAV.

Initial establishment of SAV beds occurred by rooting of plant fragments and/or germination of seed that was present on harvested plants. Subsequent vegetative growth contributed to local expansion of beds at inoculation sites and provided a source of both vegetative (plant fragments) and generative (seed) diaspores for colonization of the rest of the cell (i.e., random sites), particularly within the sugar cane fields. Although equivalent amounts of naiad and *chara* were inoculated, transplanted naiad established more successfully than inoculations of *chara* and Illinois pondweed.

The dispersal of inoculated SAV in the former sugar cane fields was slower than in the portion of the cell that was previously a sod farm/tree nursery. Although dead torpedograss covered much of the former sod production area, the overlying water column provided for unobstructed transport of SAV plant fragments and seed from the inoculations, which were likely the source of diaspores for the rapid colonization of this area. An absence of colonizing naiad and pondweed in the adjacent PSTA project indicates that remnant propagules of these species were not present in the drained soils of the former sod farm/tree nursery.

Similarly, the initial (i.e., during the spring 2005 sampling period) scarcity of SAV at random sites within the former sugar cane fields provides evidence of an absence of remnant SAV propagules in these soils. Poor initial colonization of SAV at random cane sites also was attributable to the dense sugar cane litter that occupied much of the water column and likely prevented the transport of SAV diaspores from inoculation sites. As cane litter decomposed, hydrochoric transport of SAV diaspores from established beds at inoculation sites provided for dispersal and colonization of surrounding areas.

The report which includes recommendations such as pre-treatment (herbicide and/or fire) and preferred SAV species for successful implementation of future SAV inoculation efforts can be found on the District's website at www.sfwmd.gov under the *Everglades* section*, Long-Term Plan for Achieving Everglades Water Quality Goals* link.

STA-3/4 PSTA Implementation Project

The STA-3/4 PSTA Implementation Project is a 400-acre (162 ha) section of Cell 2B in STA-3/4 that was isolated by constructing new levees to form an upstream 200-acre cell and two adjacent downstream 100-acre (40 ha) cells (**Figure 5-37**). The upstream cell (Upper SAV Cell) has been managed for SAV. An assumption during design was that SAV would become established in one of the downstream cells (Lower SAV Cell) and a periphyton community in the other cell (PSTA Cell). The chief difference between the downstream cells is that the peat substrate in the PSTA cell was scraped down to caprock level and removed, while the sediment in the Lower SAV cell was not disturbed. Peat is scraped off in PSTA cells primarily to remove a planting medium for emergents that will shade out the periphyton. The peat is also removed because it is a source of phosphorus that can flux back into the water column and reduce treatment efficiency. Consequently, the floor elevation of the PSTA cell is 60 cm lower than the adjacent SAV cells. The project is described further in Chimney et al. (2004).

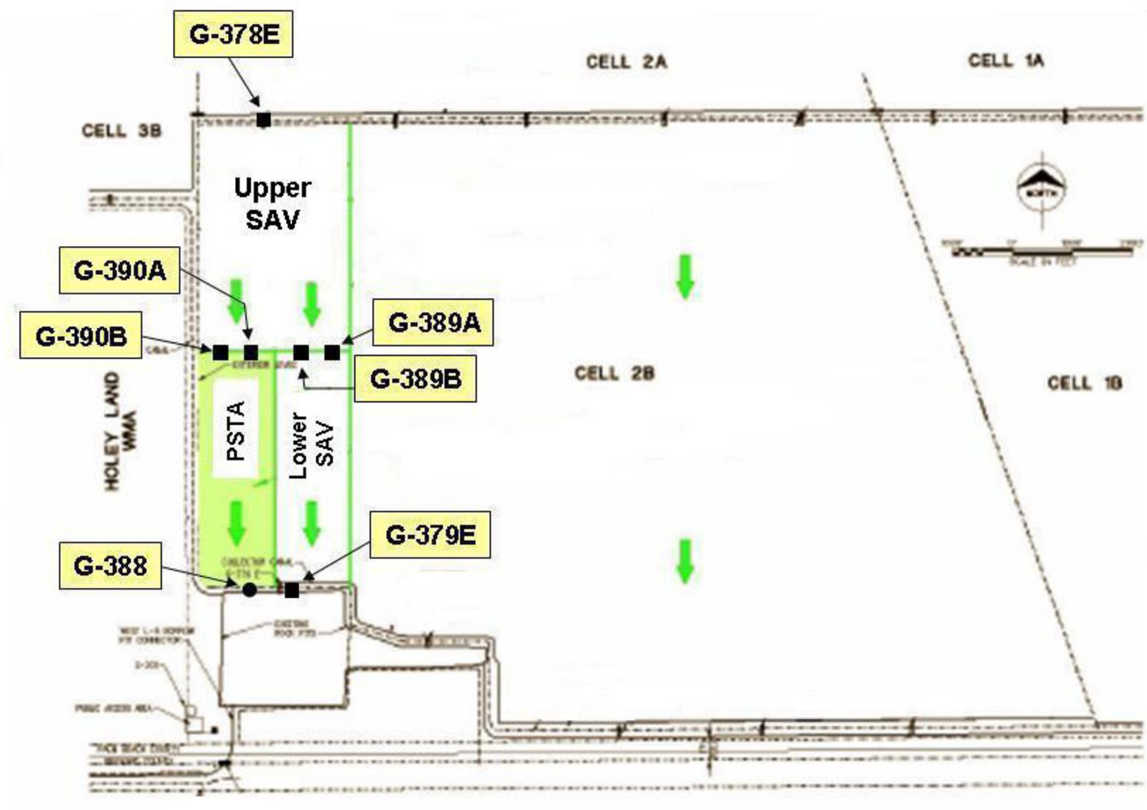


Figure 5-37. Map of the STA-3/4 PSTA Implementation Project showing the location of water control structures, the Upper SAV Cell, the Lower SAV Cell and the PSTA Cell. Arrows indicate the direction of flow.

Construction of all infrastructure (levees, culverts, gates, and the outflow pump station) has been completed, and the project was flooded in spring 2005 to begin establishing periphyton and SAV. The telemetry system needed to operate the project did not become functional until July 2006. As a consequence, the project inflow and outflow gates (G-378E and G-379E, respectively) remained closed during WY2006, and the only inflows to the project were rainfall and seepage from adjacent treatment cells in STA-3/4. The project outflow pump station (G-388) was operated to remove excess seepage into the PSTA cell and maintain a depth of approximately 46 ± 8 cm.

A water quality sampling program (grab samples only) was initiated at G-388 in August 2005 shortly after the pump station began operation. Water temperature, DO, specific conductance, and pH were measured *in situ* in conjunction with the collection of water samples. Soluble reactive phosphorus (SRP), total phosphorus (TP), and total dissolved phosphorus (TDP) were monitored weekly; nitrite+nitrate-nitrogen (NO_x), ammonia-nitrogen (NH_4), total Kjeldahl-nitrogen (TKN), calcium (Ca), chloride (Cl), and total suspended solids (TSS) were monitored monthly; and sodium (Na), potassium (K), magnesium (Mg), sulfate (SO_4), hardness, and alkalinity were monitored quarterly.

The vegetation community throughout the project was surveyed in May 2006. A geo-referenced grid of regularly spaced sampling stations was established for each cell (48 locations in the Lower SAV and PSTA cells; 104 locations in the Upper SAV Cell). The SAV species at each site were identified and the coverage of each species categorized as “low” (up to ⅓ coverage), “medium” (⅓ to ⅔ coverage), or “high” (greater than ⅔ coverage).

Summary statistics for the 19 water quality parameters monitored at G-388 are presented in **Table 5-22**. The median TP concentration was 0.015 mg/L and all SRP concentrations were at or below the method detection limit of 0.004 mg/L. However, because the project did not operate in WY2006, there are no corresponding inflow data and a treatment efficiency for this cell cannot be computed.

The most abundant SAV species observed throughout the project in May 2006 were *Chara* sp., *Ludwigia repens*, and *Najas guadalupensis* (**Figure 5-38**). *Ceratophyllum demersum*, *Potamogeton* sp., and *Hydrilla* had much lower coverages on this date. Other SAV species with low coverages noted on previous dates (limited vegetation surveys were conducted in September and November 2005 and January 2006) included *Utricularia* sp., *Hydrocotyle* sp., and *Ludwigia palustris*. These data and field observations indicate that (1) the SAV community is still developing throughout the project; (2) SAV is becoming established in the PSTA Cell; and (3) although present, hydrilla had a very limited distribution.

Table 5-22. Summary statistics for water quality parameters monitored weekly, monthly and quarterly in grab samples collected at the STA-3/4 PSTA Project outflow pump station (G-388) from August 2005 through April 2006.

	Temp (°C)	DO (mg/L)	Cond (µS/cm)	pH (s.u.)	SRP (mg/L)	TP (mg/L)	TDP (mg/L)
Min	14.4	3.6	619	7.4	0.004	0.011	0.006
Max	29.9	9.0	956	8.3	0.004	0.023	0.014
Mean	23.7	6.1	822	7.9	0.004	0.015	0.008
Median	24.2	6.4	881	7.9	0.004	0.015	0.008
CV	15%	24%	13%	3%	0%	20%	19%
N	36	34	36	36	36	36	35

	NO_X (mg/L)	NH_4 (mg/L)	TKN (mg/L)	Ca (mg/L)	Cl (mg/L)	TSS (mg/L)	Na (mg/L)
Min	0.007	0.026	1.70	75.7	64.5	3	38.6
Max	0.203	0.236	2.34	107.0	122.0	6	72.4
Mean	0.075	0.104	2.08	89.5	93.0	4	50.7
Median	0.033	0.112	2.07	89.0	95.8	3	41.0
CV	96%	63%	10%	11%	21%	27%	30%
N	11	11	11	11	11	11	3

	K (mg/L)	Mg (mg/L)	SO4 (mg/L)	Hardness (mg $CaCO_3$/L)	Alkalinity (mg $CaCO_3$/L)
Min	3.5	13.2	15.3	243	209
Max	5.7	22.9	32.1	327	268
Mean	4.6	16.8	22.1	276	232
Median	4.5	14.2	18.9	258	219
CV	20%	26%	33%	13%	11%
N	3	3	3	3	3

Temp: temperature; DO: dissolved oxygen; Cond: specific conductance; SRP: soluble reactive phosphorus; TP: total phosphorus; TDP: total dissolved phosphorus; NO_x: nitrite+nitrate-nitrogen; NH4: ammonia-nitrogen; TKN: total Kjeldahl-nitrogen; Ca: calcium; Cl: chloride; TSS: total suspended solids Na: sodium; K: potassium; Mg: magnesium; SO_4: sulfate

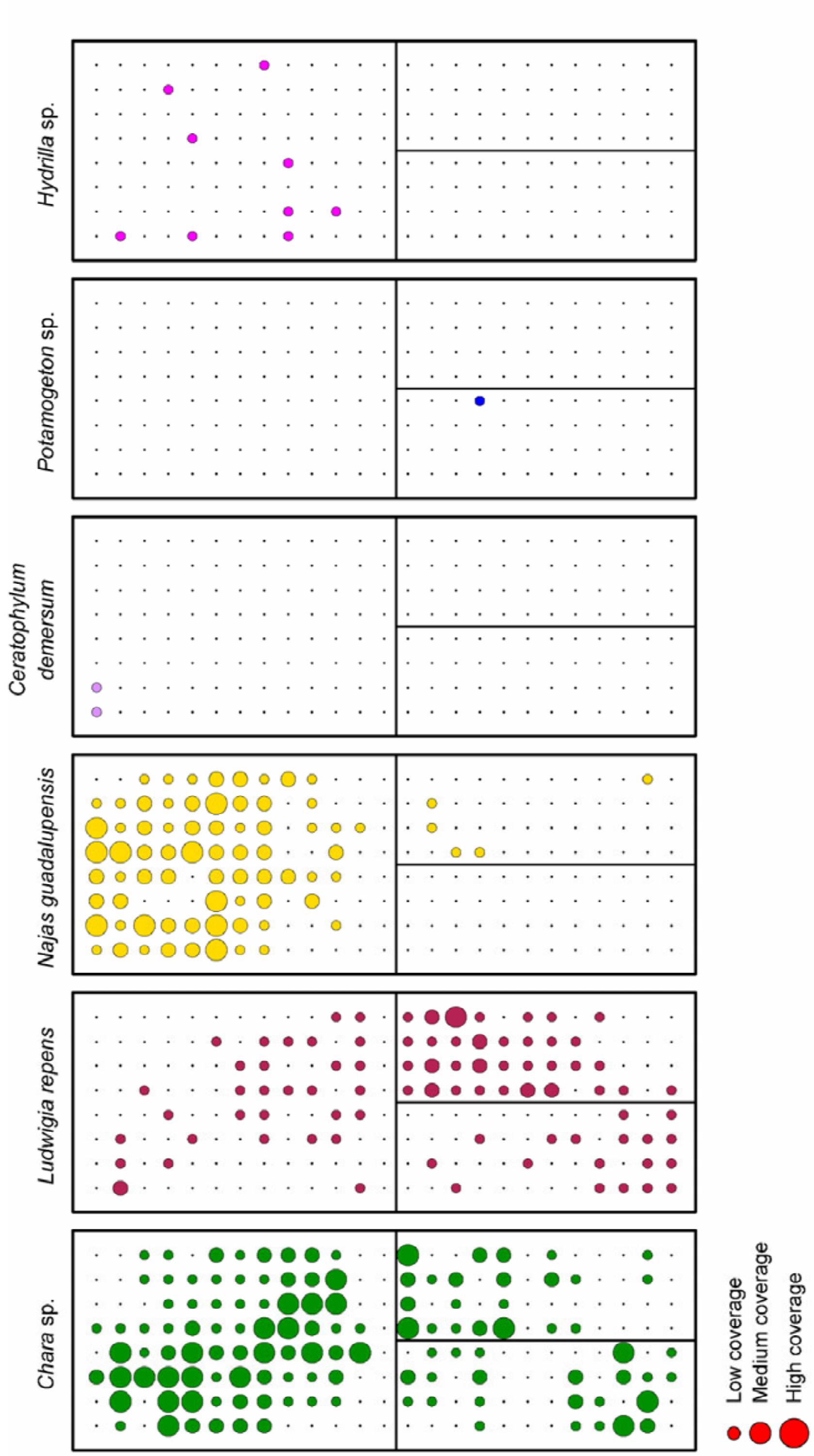


Figure 5-38. Diagrammatic maps of the distribution of submersed aquatic vegetation (SAV) in the STA-3/4 PSTA Implementation Project based on a vegetation survey conducted in May 2006. Dots indicate survey sites without that particular plant species; closed circles indicate level of vegetation coverage.

STA-3/4 WILDLIFE AND RECREATION

STA 3/4 has public roads along the east and south borders that allow development of multiple public access sites. Using more than one site allows the public to visit different portions of the STA and will minimize public access past the water control structures and data equipment. The proposed recreational facilities near the Griffin Pits include road improvements, an asphalt parking area, an information kiosk, landscaping, a multipurpose bridge, and a composting toilet. This site, named the Harold A. Campbell Public Use Area, also proposes two boat ramps (one in the rock pits located south and downstream of treatment Cell 2B, and one in the stub end of the L-5 canal). A second proposed site will be at the southeast corner and will include a small asphalt parking area, an information kiosk, landscaping, and a composting toilet. A third proposed site along U.S. Highway 27 may be located where guard rails and turning lanes exist that would allow protected parking if allowable by Florida Department of Transportation. This site would have a small asphalt parking area and landscaping. At each site pedestrian gates, vehicle gates, signage, and fencing as needed to define public access areas and to protect sensitive equipment are also proposed. Currently, duck hunting is allowed at STA-3/4.

STA-3/4 ENHANCEMENTS

Enhancements to STA-3/4 (**Table 5-4** and **Figure 5-39**) include the following features:

- Completion of the Long-Term Plan enhancements construction in Cell 3 (creation of an interior divide levee with water control structures, subdividing Cell 3 into Cells 3A and 3B). During construction, a 200-foot cut in divide levee was made to allow stormwater to move through and reduce the amount of diversion through S-8. Flow through this cell was restricted at that time to maintain low stages for construction.
- Construction of small forward-pumping stations at the mid-levee in all three treatment cells in order to hydrate downstream SAV in drought situations. Supplemental flows can be transferred from Cell 2A to Cell 1A through structure G-382A, and between Cell 2A and Cell 3B through structure G-382B.
- Convert Cells 1B, 2B, and 3B to SAV (see the *STA-3/4 Vegetation Management* section of this chapter)
- Extension of an overhead power distribution line from the intersection of Interior Levee 3 and Interior Levee 4, extending north along Interior Levee 4 to the new levee across Cell 3, and then west along the new levee across Cell 3 (total length of approximately 3.6 miles)
- Herbicide treatment of Cells 1B, 2B, and 3B for removal of emergent macrophyte vegetation to permit development of SAV (see the *STA-3/4 Vegetation Management* section of this chapter)

- Inoculation of SAV from STA-2 into STA-3/4 by helicopter to accelerate vegetation recruitment (see the *Vegetation Management Demonstration Project* section of this chapter)
- Construction of the full-scale PSTA demonstration project (see *PSTA Implementation Project* sections for additional details)

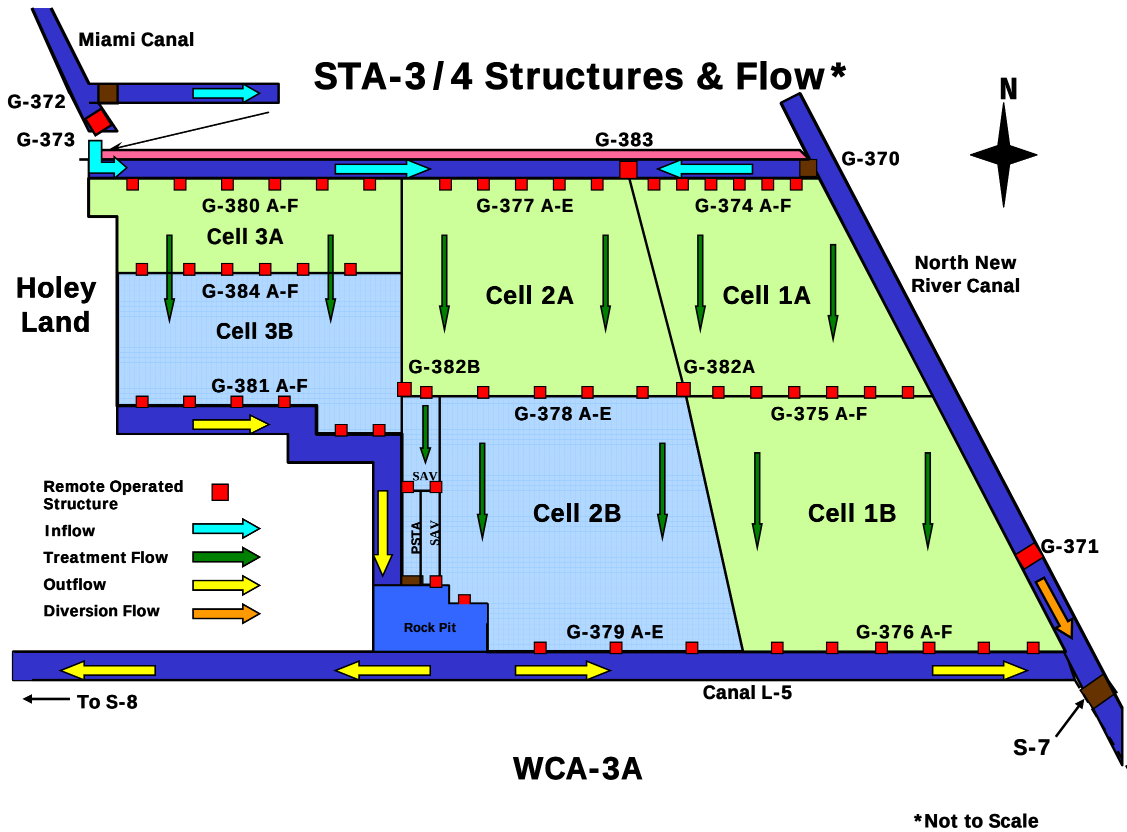


Figure 5-39. STA-3/4 enhancements (not to scale).

STA-5

STA-5 CONFIGURATION

Stormwater Treatment Area 5 (STA-5) contains approximately 4,110 acres of effective treatment area arranged in two parallel flow-ways. The Northern Flow-way (Cells 1A and 1B) consists of approximately 2,055 acres of effective treatment area. The Southern Flow-way (Cells 2A and 2B) consists of approximately 2,055 acres of effective treatment area. A schematic of STA-5 is presented in **Figure 5-40**. Runoff that exceeds the hydraulic capacity of STA-5 will be diverted through G-406.

Water enters STA-5 from the west and flows by gravity through the treatment area to the east. Treated water is collected and discharged to either the Rotenberger Wildlife Management Area (RWMA) or 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.

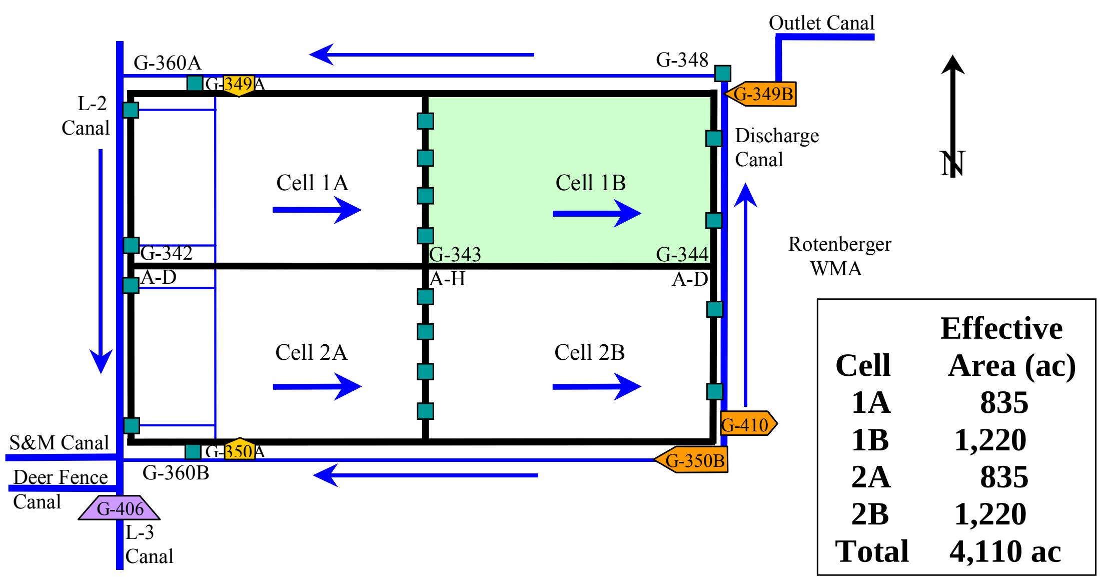


Figure 5-40. Schematic of STA-5 (not to scale). Not shown is the water supply pump G-507, located on the northeast corner of Cell 1B, and the two barrel culverts (G-345), located at the midpoint between the north and south flow-ways that were installed in the levee in order to transfer water from Cell 1B to Cell 2B.

STA-5 WY2006 HIGHLIGHTS

- Long-Term Plan construction to improve the mid-levee water control structures (G-343A through G-343D) in the Northern Flow-way started in January 2005. During this period, Cell 1A was operational under restricted capacity, and Cell 1B was off-line until July 9, 2005, before being operated under restricted capacity. A moderate amount of shrubby vegetation [primrose willow (*Ludwigia peruviana*)] was removed from Cell 2A. The plants were treated with herbicide then burned within the treatment cell.
- The Southern Flow-way was taken off-line for Long-Term Plan enhancements construction in January 2006. In addition to improving the mid-levee water control structures (G-343E through G-343H), high areas in Cell 2A were scraped down, and the berm in front of the outflow structures (G-344C through G-344D) was degraded in April 2006. The treatment cell was rehydrated in June 2006.
- Hurricane Wilma caused power outages and minor damage to the SAV and moderate damage to the emergent vegetation.
- Vegetation conversion from emergent to SAV in Cell 2B (herbicide) was under way, along with the establishment of emergent vegetation strips in this cell.
- Recreational opportunities in STA-5 include duck hunting and bird watching.
- The irrigation pump G-507 was used to keep Cell 1B hydrated during construction of the Long-Term Plan enhancements mid-levees.
- Adaptive management, such as discharging Cells 2A and 2B drawdown water into the seepage canal, pumping seepage canal water to the discharge canal, and avoiding over-loading the recovering Cell 1B, was used during construction.
- Vegetation strips consisting of emergent vegetation (cattails) were created in Cells 1B and 2B. These vegetation strips were established to protect the SAV against high wind and hydraulic loading events.
- Dredging of the S & M Canal occurred from October 2004 through May 2005.

STA-5 HURRICANE WILMA IMPACTS

Hurricane Wilma caused minor damage to the SAV and moderate damage to the emergent vegetation. Power to the STA was lost for approximately two months.

STA-5 PERMIT STATUS

STA-5 was in compliance with the EFA and NPDES operating permits for WY2006, and discharges do not pose any known danger to public health, safety, or welfare (**Table 5-2**). The EFA permit states that STA-5 will remain in the stabilization phase of operation until STA-6 Section 2 begins flow-through operations.

STA-5 OPERATIONS

STA-5 Hydrology

From January 2005 through January 2006, Long-Term Plan enhancements construction occurred in the Northern Flow-way in order to improve the water control structures (G-343A–D) and degrade a berm located near the outflow culverts (**Table 5-23**). During this period, Cell 1A was operational under restricted capacity, and Cell 1B was off-line until July 9, 2005, before being operated under restricted capacity. Starting in January 2006, similar Long-Term Plan enhancements construction occurred in the Southern Flow-way and both Cells 2A and 2B were taken off-line. The culvert G-345, located on the eastern side of the divide levee between the flow-ways between Cells 1B and 2B was opened to hydrate the cells during construction. A temporary gap was made in the divide levee between Cells 1A and 2A to allow Cell 1A to be operational while the Long-Term Plan enhancements construction occurred.

Table 5-23. Operational status of the treatment cells in STA-5 from January 2004 through September 2006.

STA-5 Operational Status of Treatment Cells

2004					2005					2006		
Jan - Mar	Apr - Jun	Jul - Aug	Sep *Hurricanes Frances and Jeanne*	Oct - Dec	Jan - Mar	Apr - Jun	Jul - Sep	Oct *Hurricane Wilma*	Nov - Dec	Jan - Mar	Apr - Jun	Jul - Sep
All Flow-ways Operational					Southern Flow-way and Cell 1A (restricted capacity) Operational		All Flow-ways Operational (Cell 1B restricted capacity to allow for plant establishment)			Northern Flow-way Operational		All Flow-ways Operational
					LTP Enhancements construction in Northern Flow-way, Cell 1B off-line					LTP Enhancements construction in Southern Flow-way, both Cells 2A and 2B off-line		

In WY2006, 216,514 ac-ft of water was captured and treated by STA-5 (**Table 5-3**). This is about 68 percent more than the 31-year long-term average annual simulated inflow for this STA, although annual variability was anticipated. This surface inflow equates to an average hydraulic loading rate of 5.61 cm/day over the effective treatment area of the STA. The volume of treated water discharged from STA-5 was 201,102 ac-ft. During WY2006, approximately 86,124 ac-ft of C-139 basin runoff was diverted around STA-5 through G-406 (**Table 5-2**). In the future, flows and loads that are diverted around STA-5 will be captured and treated in STA-6 Section 2, which is currently scheduled to be flow capable by December 2006. The water supply pump G-507 was used for only during the month of April in WY2006, and 2,354 ac-ft was pumped during this period. A summary of monthly STA-5 flow is presented in **Figure 5-41**.

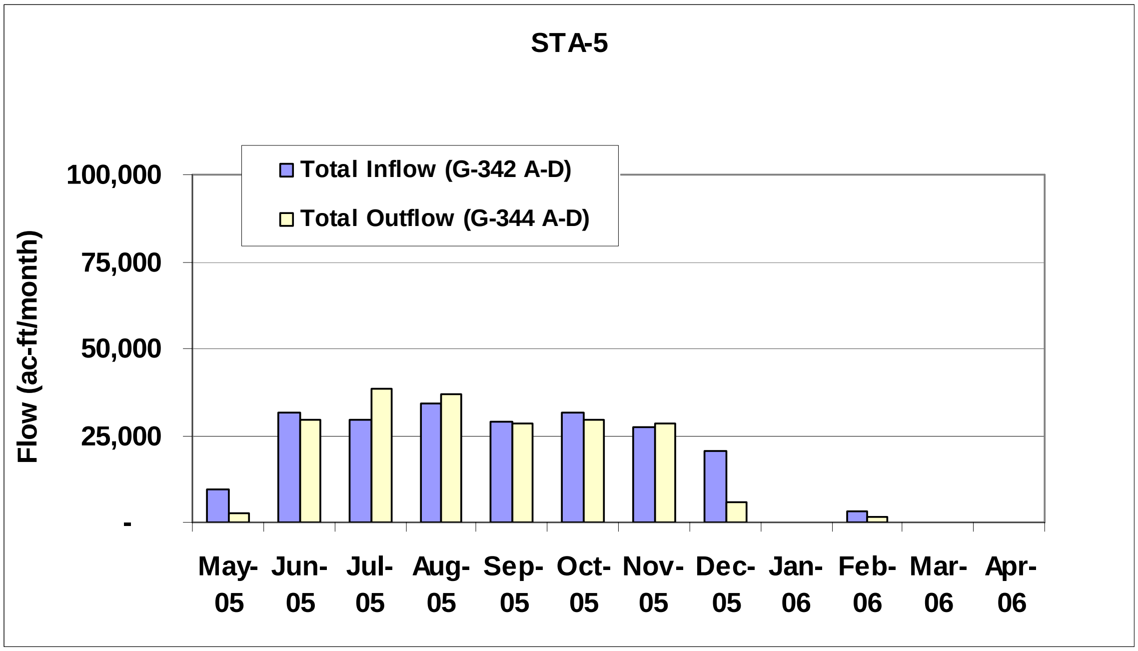


Figure 5-41. Summary of WY2006 flow for STA-5. Long-Term Plan enhancements occurred in the Northern Flow-way from January 2005 through July 2005, and then in the Southern Flow-way beginning in January 2006 through the end of the water year.

STA-5 Total Phosphorus

During WY2006, STA-5 received 53 mt of TP. This amount is approximately 88 percent more than the 31-year long-term average annual simulated inflow TP load for this STA, although annual variability was anticipated. STA-5 removed about 29.3 mt of TP during WY2006, equal to a removal rate of approximately 1.76 g/m^2/yr (**Table 5-3**). About 44.04 mt of TP with a FWM TP concentration of 415 ppb was diverted around STA-5 through G-406 (**Table 5-2**). Summaries of monthly TP loads and FWM TP concentrations are presented in **Figures 5-42** and **5-43**. The FWM outflow TP concentration was 96 ppb, a 52 percent reduction from the inflow concentration of 199 ppb. While the outflow concentration was above the 50-ppb interim target, this does not create a violation of the operating permits, as the STA is still in the stabilization phase. Improved TP reduction is anticipated in the future as BMP measures are implemented for the C-139 basin and as the benefits of vegetation management within the STA are realized. The moving 12-month FWM TP outflow concentration for STA-5 ranged from 80 to 96 ppb over the course of WY2006 (see **Figure 5-44**). For informational purposes, the geometric mean discharge TP concentration for STA-5 using auto-sampler data was 106 ppb for WY2006.

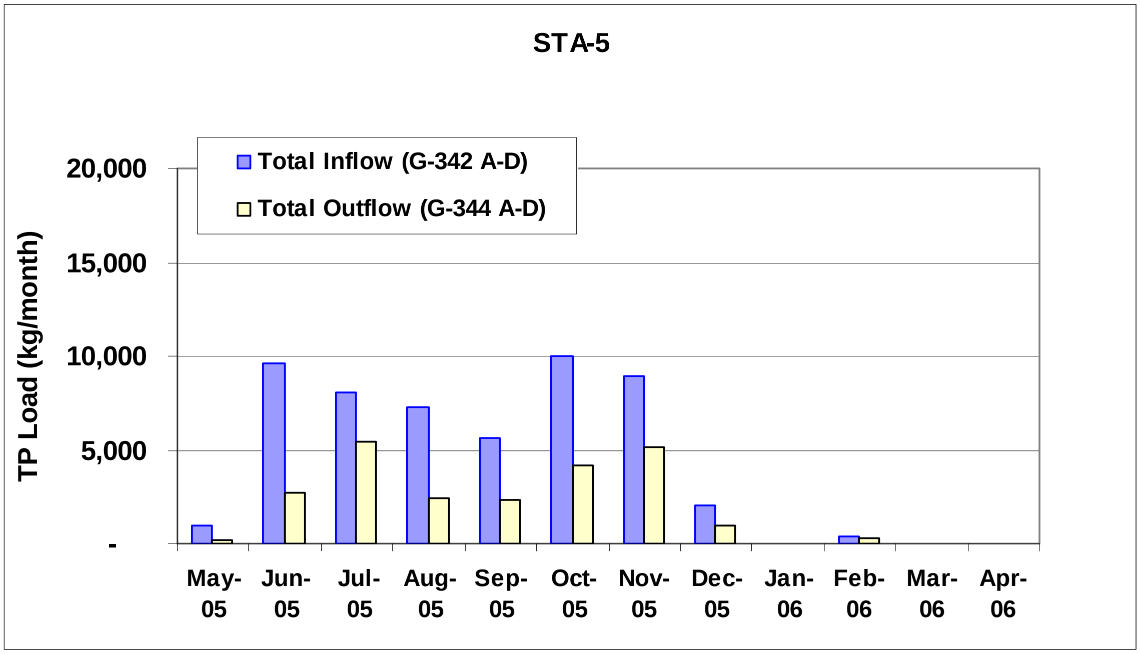


Figure 5-42. Summary of WY2006 TP load for STA-5. Long-Term Plan enhancements occurred in the Northern Flow-way from January 2005 through July 2005, and then in the Southern Flow-way beginning in January 2006 through the end of the water year.

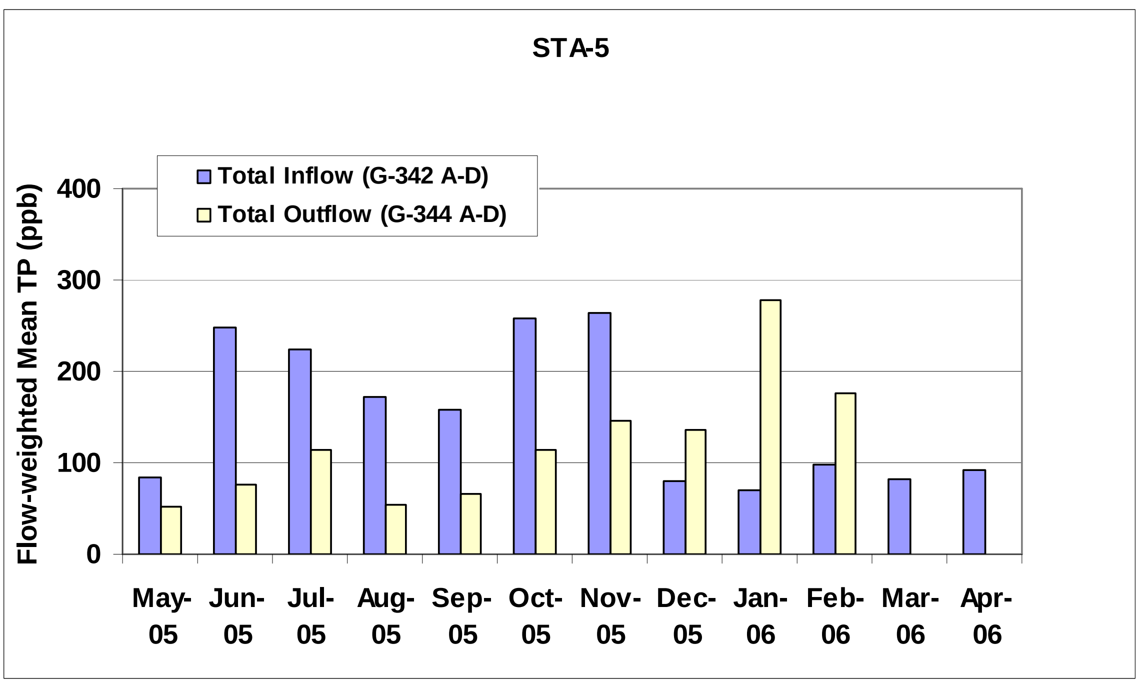


Figure 5-43. Summary of WY2006 FWM TP concentrations for STA-5. Long-Term Plan enhancements occurred in the Northern Flow-way from January 2005 through July 2005, and then in the Southern Flow-way beginning in January 2006 through the end of the water year.

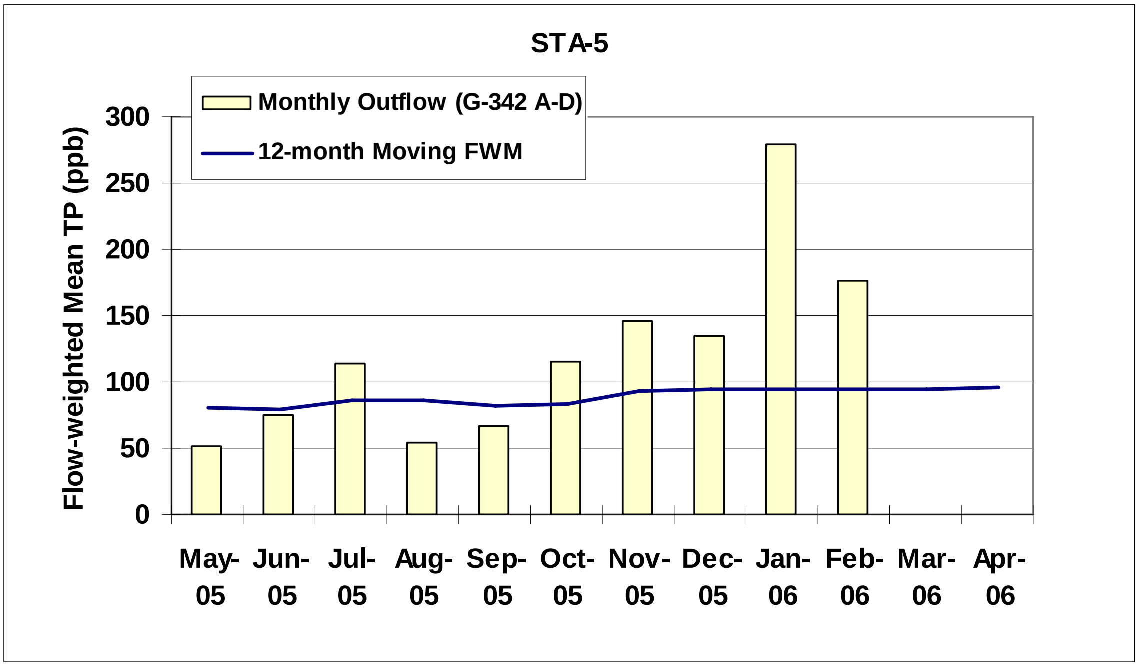


Figure 5-44. Comparison of monthly to 12-month moving average TP concentrations for WY2006 for STA-5 outflow. Long-Term Plan enhancements occurred in the Northern Flow-way from January 2005 through July 2005, and then in the Southern Flow-way beginning in January 2006 through the end of the water year.

OTHER STA-5 WATER QUALITY PARAMETERS

Compliance with the EFA permit is determined based on the three-part assessment presented in the *Water Quality Permit Requirements* section of this chapter. Water quality parameters with Florida Class III standards are identified in **Table 5-7**. The monitoring data for non-phosphorus parameters at STA-5 for the water year are presented in Appendix 5-12 and summarized in **Table 5-24**. Discharges from STA-5 were determined to be in compliance with the permit by satisfying criterion one above for all non-phosphorus and non-DO parameters with applicable numeric state water standards. Additional requirements for DO are listed in Administrative Order No. AO-004-EV and are discussed in the next section. Mercury monitoring results are discussed in Chapter 3B of this volume, and the annual permit compliance monitoring report for mercury in the STAs is in Appendix 5-5 of this volume.

Table 5-24. Summary of annual arithmetic averages and FWM for all parameters other than TP monitored in STA-5.

Parameter	Arithmetic Means – Inflow				Arithmetic Means – Outflow				Flow-Weighted Means – Total Inflow		Flow-Weighted Means – Total Outflow	
	G342A	G342B	G342C	G342D	G344A	G344B	G344C	G344D	n	Conc.	n	Conc.
Temperature (°C)	25.5	25.2	26.0	25.9	23.0	23.4	24.4	24.4	-NA-	-NA-	-NA-	-NA-
Dissolved Oxygen (mg/L)	4.3	4.3	3.6	4.3	2.7	3.0	1.1	1.5	-NA-	-NA-	-NA-	-NA-
Specific Conductivity (µmhos/cm)	474	484	462	479	468	494	470	486	-NA-	-NA-	-NA-	-NA-
pH	7.5	7.5	7.3	7.4	7.4	7.5	7.1	7.2	-NA-	-NA-	-NA-	-NA-
Turbidity (NTU)	3.2	3.5	2.9	2.7	2.0	1.8	0.9	0.9	-NA-	-NA-	-NA-	-NA-
Total Dissolved Solids (mg/L)	306	302	289	312	304	307	304	300	59 (92)	259	47 (84)	256
Unionized Ammonia (mg/L)	0.001	0.001	0.001	0.001	0.001	<0.001	0.001	<0.001	59 (92)	0.001	47 (84)	<0.001
Orthophosphate as P (mg/L)	0.043	0.068	0.109	0.083	0.068	0.096	0.107	0.097	120 (179)	0.091	92 (166)	0.090
Total Dissolved Phosphorus (mg/L)	0.060	0.082	0.121	0.102	0.092	0.115	0.120	0.109	115 (174)	0.107	88 (162)	0.097
Sulfate (mg/L)	6.6	7.5	8.4	8.1	9.6	6.0	3.0	2.1	59 (92)	7.1	47 (84)	3.6
Alkalinity (mg/L)	165	173	171	184	150	161	167	178	59 (92)	140	47 (84)	142
Dissolved Chloride (mg/L)	43	42	36	37	49	49	39	40	59 (92)	34	47 (84)	33
Total Nitrogen (mg/L)	1.53	1.50	1.57	1.51	1.57	1.61	1.38	1.35	59 (92)	1.58	47 (84)	1.28
Total Dissolved Nitrogen (mg/L)	1.23	1.19	1.24	1.19	1.40	1.40	1.28	1.22	59 (92)	1.30	47 (84)	1.13
Nitrate + Nitrite (mg/L)	0.068	0.059	0.062	0.044	0.030	0.040	0.018	0.013	59 (92)	0.074	47 (84)	0.019

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

STA-5 DISSOLVED OXYGEN MONITORING

Introduction

The STA-5 Administrative Order No. AO-004-EV in Exhibit C of Permit No. 0131842, February 29, 2000, specifies the DO monitoring requirements as for STA-1W.

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 at 30-minute intervals for four consecutive days at the following locations:

- In the discharge canal near structures G-344 and G-344D to provide representative data whether the discharge is to the Miami Canal, to the RWMA through pump station G-410, or to both sites simultaneously
- On the west bank of the Miami Canal about 100 m upstream of the confluence of the canal and the STA-5 discharge canal, to measure background conditions in the Miami Canal

- On the west bank of the Miami Canal, about 100 m downstream of the confluence of the canal and the STA-5 discharge canal, to measure effects of STA-5 discharges to the Miami Canal
- Sites along the north and south transects within the RWMA (**Figure 5-45**) to measure effects of STA-5 discharges to the RWMA

Sampling Dates

Diel oxygen measurement dates and sites associated with STA-5 for WY2006 are provided in **Table 5-25** and Appendix 5-13.

Table 5-25. Deployment dates for diel oxygen measurement at STA-5 structures and sites in the Miami Canal and discharge canal.

Event Dates		Structures		Miami Canal Sites[a] and Discharge Canal Sites[b]		Sites Monitored in Rotenberger Tract
Start	End	Outflow				
06/16/2005	06/20/2005	STA5DC	G344D	NMC[a]	SMC[a]	----------------------------------
09/26/2005	09/29/2005	STA5DC	G344D	G373[a]	G402DS[b]	----------------------------------
12/19/2005	12/22/2005	STA5DC	G344D	G373[a]	G402DS[b]	----------------------------------
03/20/2006	03/23/2006	STA5DC	G344D	G373[a]	G402DS[b]	----------------------------------

During July 2005, the discharge canal outflow point to the Miami Canal between the North Miami Canal (NMC) and South Miami Canal (SMC) monitoring sites was filled in. The discharge canal was extended southward and connected with the Miami Canal below structure G-373 (**Figure 5-46**).

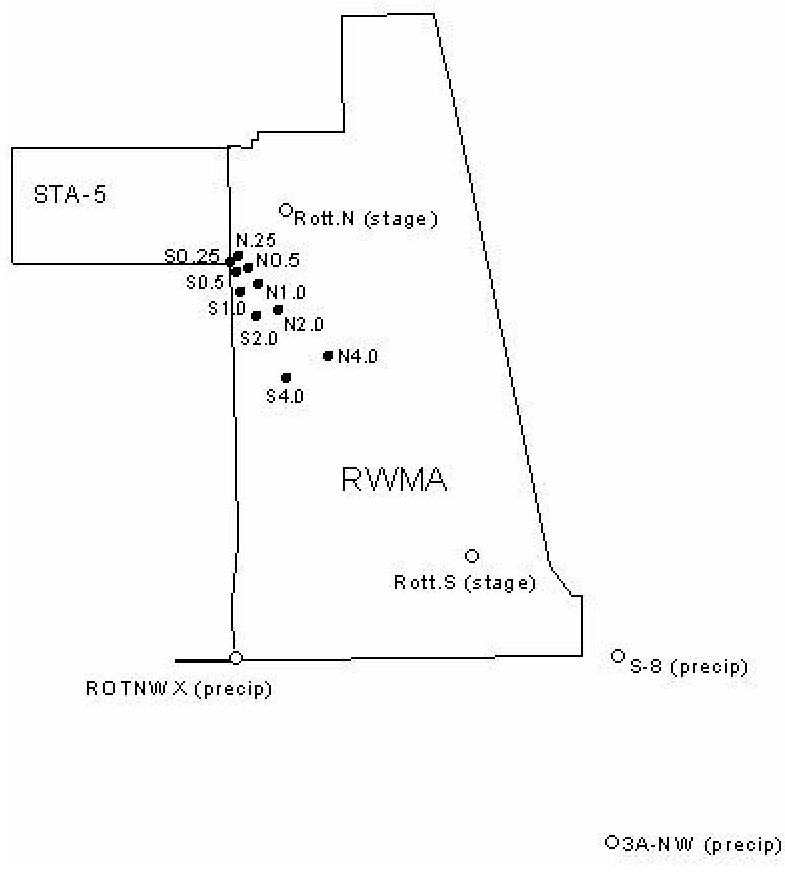


Figure 5-45. DO monitoring sites in the (RWMA).

Figure 5-46. Location where extended discharge canal from STA-5 connects to Miami Canal, south of structure G-373.

Comparison of Dissolved Oxygen in STA-5 Discharges with Dissolved Oxygen at Miami Canal Sites

Comparisons of DO in STA-5 discharges with DO in the Miami Canal provide an indication of whether the discharge is affecting the canal DO concentrations or the diel cycle. However, due to the alterations made to the discharge canal from STA-5, meaningful comparisons cannot be made. The summary statistics for STA-5 discharges and the downstream sites are presented in **Table 5-26**. A graphical presentation of DO levels measured at STA-5 monitoring sites during WY2006 is provided in **Figure 5-47**. No significant difference was observed for DO concentrations measured at the outflows (STA5DC and G-344D). DO concentrations at the NMC site were not significantly different from the outflow sites. Meanwhile, G-402DS had significantly lower DO levels than G-344D, while exhibiting no significant difference in DO levels when compared with STA5DC. The average of the DO concentrations in the discharge canal ranged from 2.64 to 3.36 mg/L. The highest DO levels were observed at G-373 (**Table 5-26**). The complete data sets collected during WY2006 are presented in Appendix 5-13 in this volume.

No sampling data were available for the RWMA; therefore, comparisons of DO concentrations cannot be made with marsh stations. Diel DO monitoring at the marsh stations of RWMA was intended to develop a SSAC for DO in the Everglades. Since the SSAC has been developed, future permits will not require diel monitoring. Instead, compliance will be determined using the SSAC.

Table 5-26. Statistical summary of diel DO at the outflow stations from STA-5 and stations in the Miami Canal[a] and discharge canal[b] during three deployment periods. No monitoring was done in the RWMA.

Location	Station	Number of Measurements	Mean	Minimum	Median	Maximum	Standard Deviation
Outflow	STA5DC	514	2.64	0.06	2.30	9.51	1.98
	G344D	415	3.18	0.17	2.93	7.73	2.39
Canal	NMC[a]	191	2.43	1.62	2.42	3.23	0.38
	G373[a]	413	5.93	2.73	6.91	8.61	1.85
	G402DS[b]	418	3.36	0.28	2.71	9.59	2.01

Note: Statistical summaries by event and diel parameter can be found in Appendix 5-4, Table 3.

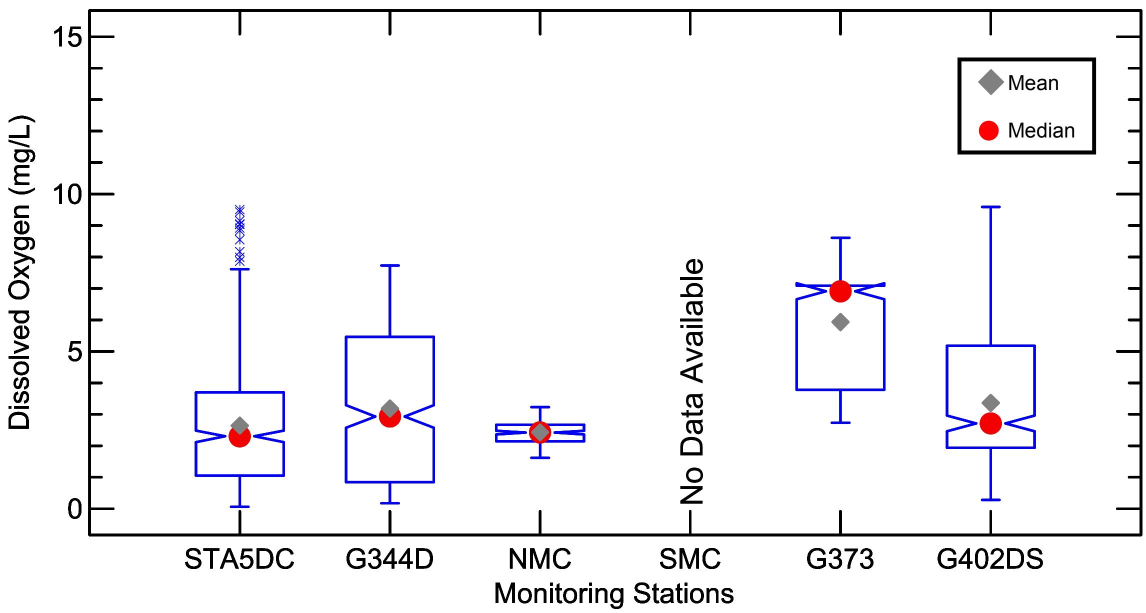


Figure 5-47. Notched box and whisker plots of diel DO measurements at STA-5 outflow stations (STA5DC, formally G-344A, and G-344D), at sites in the Miami Canal (NMC, SMC, and G-373) and in the discharge canal (G-402DS) during four monitoring periods. The notch on a box plot represents the approximate (95%) confidence interval (C.I.) 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% C.I.

STA-5 VEGETATION MANAGEMENT

Specific Condition 13(b) of the EFA permit requires that the annual Everglades Consolidated Report (currently known as the *South Florida Environmental Report*) include information regarding the application of herbicides used to exclude and/or eliminate undesirable vegetation within the treatment cells. In WY2006, the District treated a total of 3,862 acres to control vegetation in the STA-5 marsh using diquat to treat the floating vegetation, and glyphosate and imazapyr to control emergent vegetation (**Table 5-5**). The District used both aerial and ground-based spray equipment to apply these herbicides.

A moderate amount of shrubby vegetation (primrose willow) was also removed from Cell 2A. The plants were treated with herbicide then burned within the treatment cell. Vegetation conversion from emergent to SAV in Cell 2B, using herbicides and burning, is under way, along with the establishment of vegetation strips in this cell. Vegetation strips consisting of emergent vegetation (cattails) were created in Cells 1B and 2B. These vegetation strips were allowed to grow to minimize impacts of high wind and hydraulic loading events on SAV community.

STA-5 WILDLIFE AND RECREATION

Black-necked stilt nests were found on the levee roads and in Cell 1B (refer to the *2006 Stilt Nesting Summary for the STAs* section of this chapter).

STA-5 was opened for the fourth year for water fowl hunts and for the first year for alligator hunting. Recreational facilities are proposed to provide public access to STA-5. The proposed recreational facilities include an asphalt parking area, a composting toilet, landscaping, and an information kiosk. Pedestrian gates, signage, and fencing as needed to define public access areas and to protect sensitive equipment are also proposed.

STA-5 ENHANCEMENTS

The Long-Term Plan recommended enhancements to STA-5 include the conversion of Cell 2B from emergent macrophyte vegetation to SAV, modification of existing structures, and expanded treatment area (**Table 5-4**). The improvements are discussed below.

Modification of G-343 Structures

The G-343 structures are situated in the north/south interior levee, subdividing Cells 1A and 2A from Cells 1B and 2B. Those structures originally consisted of reinforced concrete box culverts controlled by simple weir crests set at the design static water surface elevation in Cells 1A and 2A. The nature of those structures inhibited the District's ability to control proper flow distribution across the STA. The limited flexibility in operation of the G-343 structures has also contributed to a higher than intended frequency and volume of diversion. To address these limitations and afford the District increased flexibility in the operation of STA-5, the existing G-343 structures were modified through the addition of gate structures and the removal of the upstream weir controls. This modification also required the addition of telemetric control to the structures, coupled with the addition of stilling wells for water level data acquisition in the upper ends of Cells 1B and 2B. Stilling wells presently exist in Cells 1A and 2A upstream of the G-343 structures. It was also necessary to extend an overhead power transmission line along the interior levee to service the modified water control structures.

In FY2005, the structural modifications to the G-343A through G-343D structures were substantially completed. Telemetry and power distribution for these four structures was also completed. In FY2006, the G-343E through G-343H structural modifications were completed. Power and telemetry for the final four structures was also completed.

Additional Seepage Control Facilities

In order to minimize the induced loading on STA-5, it was recommended that an additional seepage return pumping station be constructed near the northwest corner of Cell 1B. This pump station (G-349C) will provide a nominal capacity of 45 cfs, similar to the capacity of existing pumping stations G-349A and G-350A. Construction of the seepage pump station was completed and telemetry is expected to be completed in spring 2007.

Removal of Obstructions to Flow

Field observations indicated obstructions to flow existed in Cells 1B and 2B. These were likely a result of relatively high ground elevations or possibly an old road bed in the case of Cell 2B. These flow obstructions were removed as part of the STA-5 enhancements. Cell 1B flow obstructions were removed in FY2005. The Cell 2B flow obstructions were completed in FY2006.

STA-5 EXPANSION

Expansion of STA-5 includes the construction of an additional 2,560-acre treatment cell (i.e., a new Flow-way 3) that will operate in parallel with existing Flow-ways 1 and 2 with an effective treatment area of approximately 2,050 acres. The design of the new Flow-way 3 was completed in October 2005. Construction began in January 2006 and is scheduled to be completed by April 2007, with the new flow-way being flow capable by December 31, 2006. The design and construction of Flow-way 3 is being implemented under the District's Acceler8 program as part of the EAA STA Expansion Project. Additional information on the status of the Acceler8 program is presented in Chapter 7A of this volume.

ROTENBERGER WILDLIFE MANAGEMENT AREA

ROTENBERGER CONFIGURATION

The Rotenberger Hydropattern Restoration Project is a component of the larger Everglades Construction Project (ECP). The goal of the project is to restore a more natural hydroperiod to slow, alter, and eventually reverse the ecosystem degradation within the Rotenberger Wildlife Management Area (RWMA) caused by drought and seasonal fires, soil oxidation and compaction, and the release of ambient nutrients from soils. Anticipated benefits include the preservation of coverage of the remaining desired vegetative species, the encouragement of desirable wetland vegetation, and the initiation of the process of peat formation. Project features 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 the RWMA. This pump station distributes water through a 3.5-mile-long spreader canal located parallel to the west perimeter levee of the RWMA. Discharges out of the RWMA go into the Miami Canal through four gated culverts (G-402A through G-402D) along the eastern boundary of the RWMA. There is a quarter-mile-long collection canal upstream of each outlet structure.

The FDEP issued a modification to the STA-5 EFA permit to include construction and operational authorization for the project in October 2000. This permit established a phased approach to restoration, and recognizes an interagency group including representatives from the District, FDEP, Florida Fish and Wildlife Conservation Commission (FWC), USACE, and the Friends of the Everglades. The permit requires the interagency group to periodically evaluate the progress the project is making toward achieving its restoration goals.

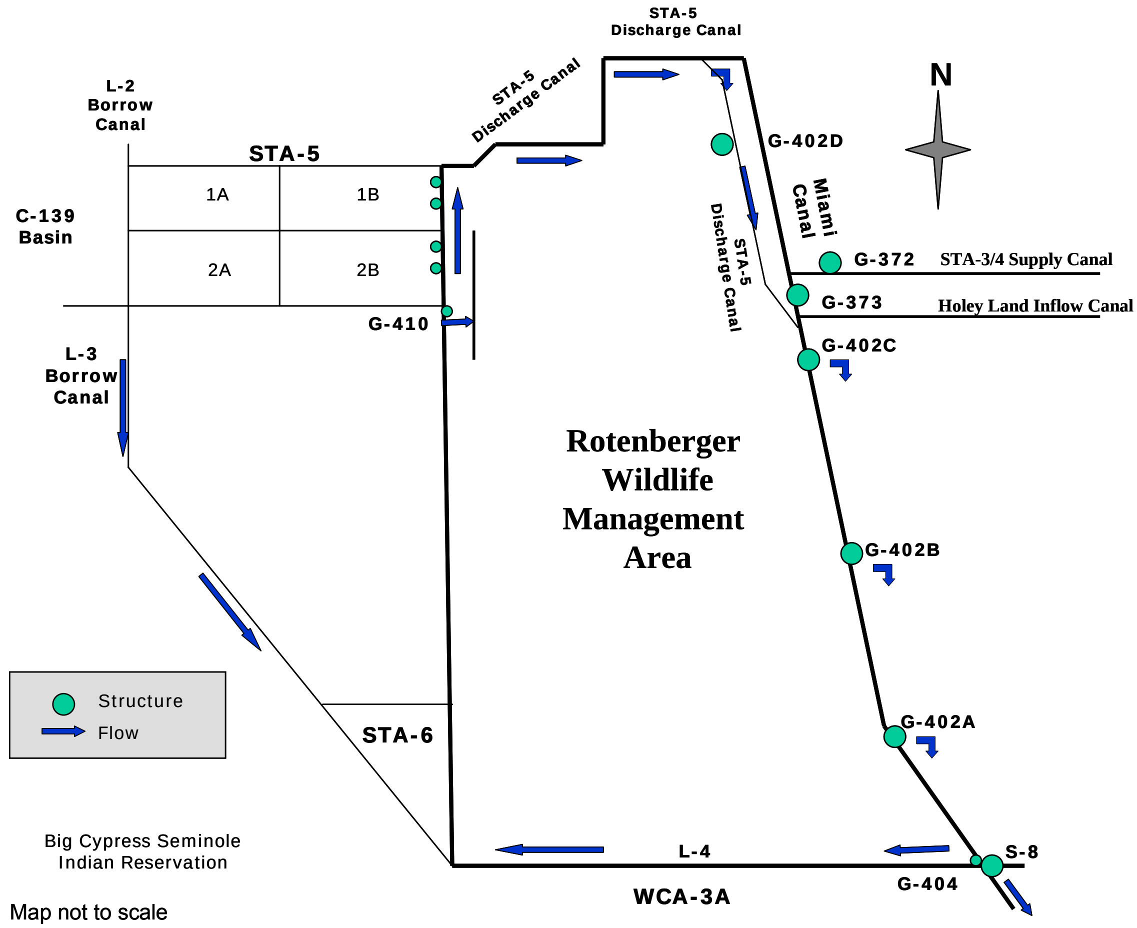


Figure 5-48. Schematic of the RWMA (not to scale).

ROTENBERGER OPERATIONS

For WY2006, about 29,886 ac-ft were directed into the RWMA through G-410, while approximately 54,648 ac-ft were discharged to the Miami Canal from the outlet structures (**Figure 5-49**). The FWM inflow TP concentration was 100 ppb, yielding a total TP inflow load of about 3,690 kilograms (kg) (**Figure 5-50**). As the treatment system in STA-5 stabilizes, TP levels entering the RWMA are anticipated to decrease. TP concentrations leaving the RWMA averaged 14 ppb, although the total load was only 977 kg (**Figure 5-51**). Additional information about the RWMA is presented in Chapter 6 of this volume.

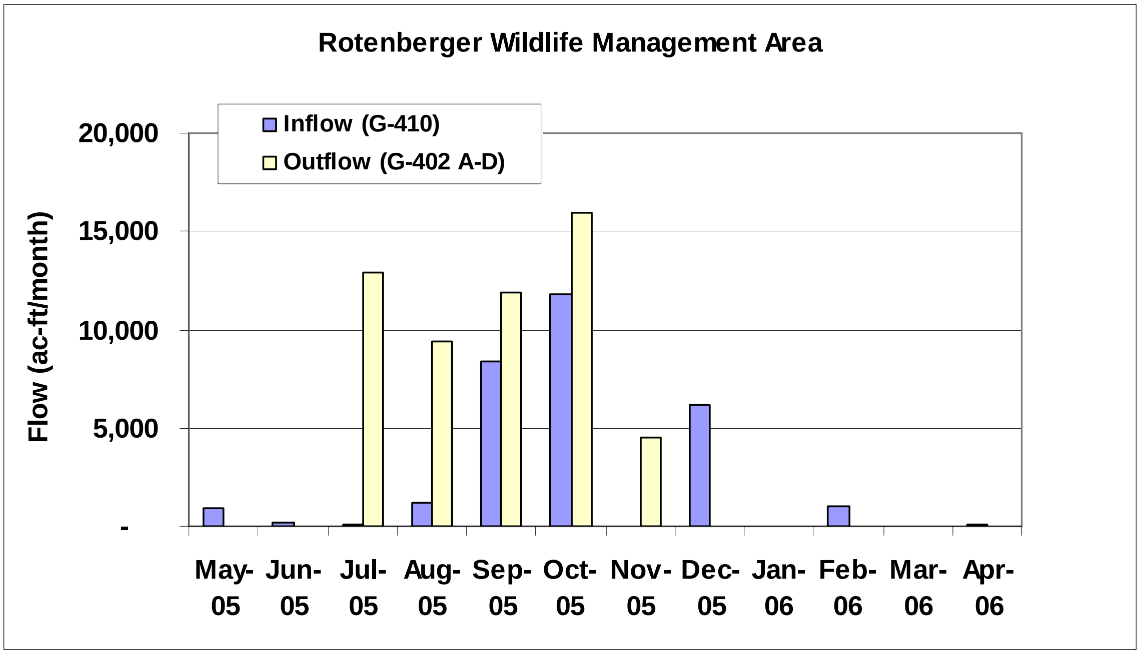


Figure 5-49. Summary of WY2006 flow for the RWMA.

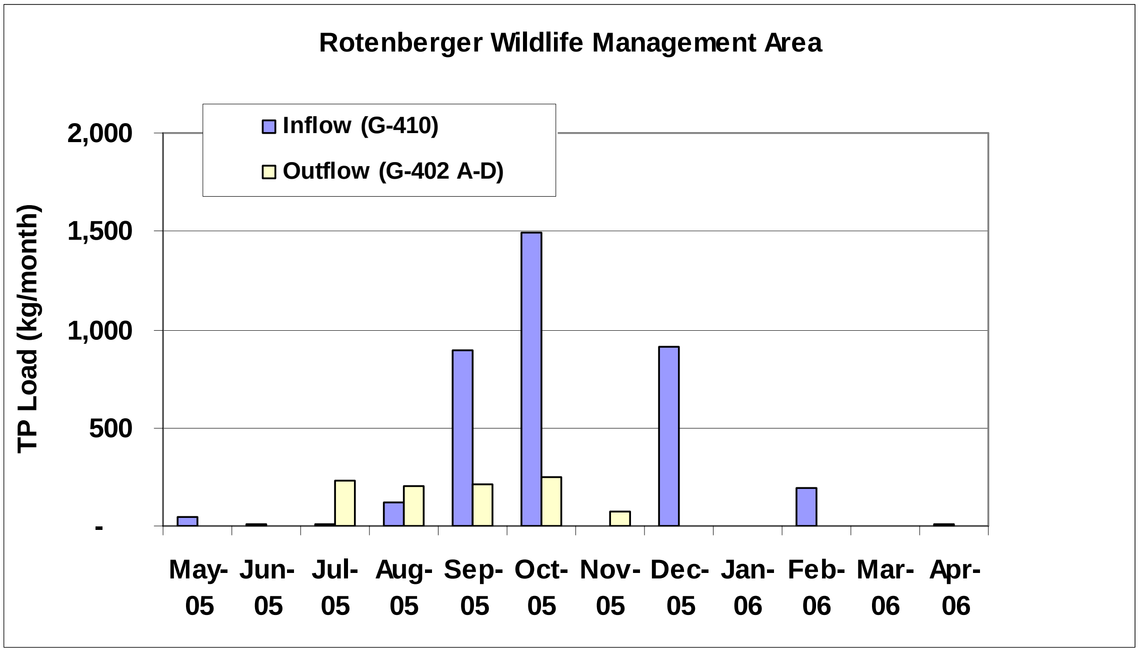


Figure 5-50. Summary of WY2006 TP load for the RWMA.

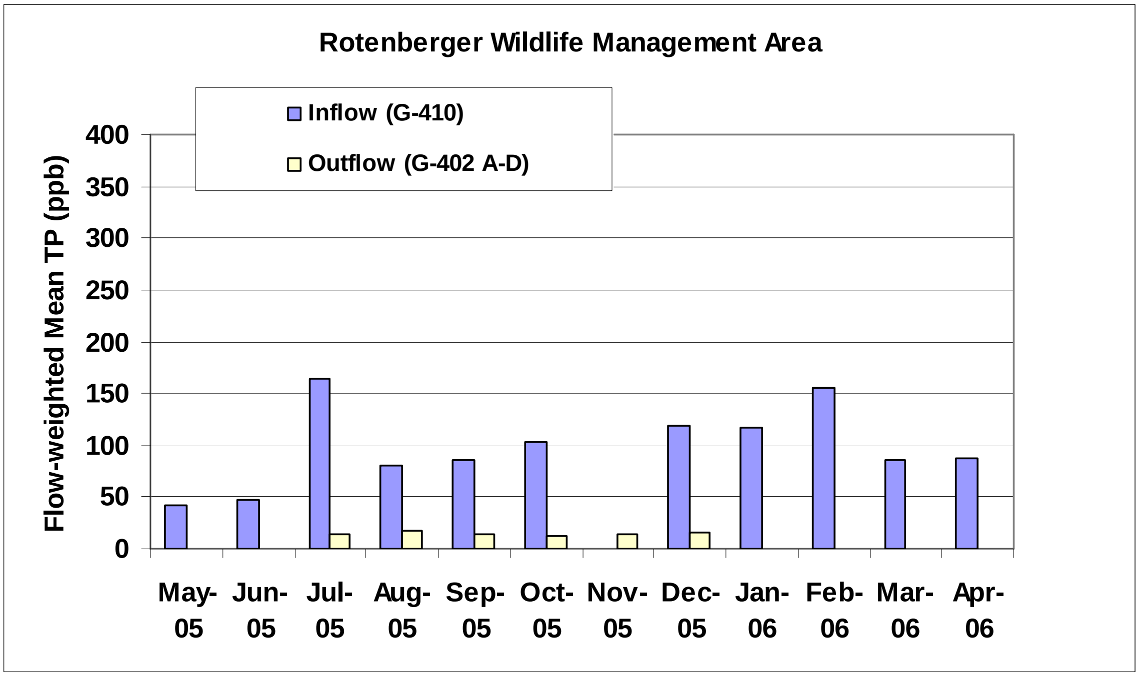


Figure 5-51. Summary of WY2006 FWM TP load for the RWMA.

STA-6 SECTION 1

STA-6 SECTION 1 CONFIGURATION

Stormwater Treatment Area 6 (STA-6) Section 1 contains approximately 870 acres of effective treatment area, arranged in two parallel flow-ways. The Northern Flow-way (Cell 5) consists of approximately 625 acres of effective treatment area while the Southern Flow-way (Cell 3) consists of approximately 245 acres of effective treatment area. A schematic of STA-6 is presented in **Figure 5-52**.

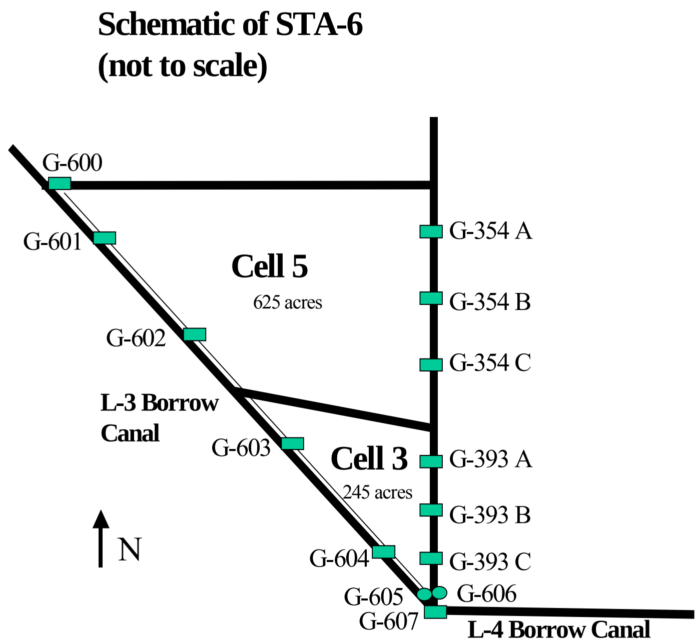


Figure 5-52. Schematic of STA-6 (not to scale). Note that structure G-606 is no longer operational.

Water enters the STA from the G-600 pump station and travels southeast in the supply canal. Water enters the treatment cells through three broad-crested weirs (G-601, G-602, and G-603), flows by gravity east through the treatment cells, and is discharged through several combination box weir/culvert structures (G-393 and G-354). The treated water is then collected in the discharge canal and flows 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 about 1,400 acres of additional treatment area to the STA-5/STA-6 system. This expansion will allow for the capture and treatment of runoff from the C-139 annex located just west of the L-3 borrow canal. STA-6 Section 2 is scheduled to be flow-capable by December 31, 2006.

STA-6 WY2006 HIGHLIGHTS

- Both treatment cells (Cells 3 and 5) were operational during WY2006.
- Water delivery and loadings to STA-6 are different from previous years due to a change in the upstream land use, which is no longer for sugar cane production. The upstream area is currently occupied with Long-Term Plan enhancements construction of a new treatment cell.
- Hurricane Wilma caused structural damage to the G-600 inflow pump station building and little damage to the vegetation.
- From September 28, 2005 through April 4, 2006, all three gates in Cell 3 were opened to help pass the large dewatering flows that originated from the new construction in Section 2 of STA-6. Under normal operations, only G-393B is open.
- Vegetation management involved spraying emergent vegetation in the SAV communities located in northern Cell 5 in December 2005.
- Construction of STA-6 Section 2 is ongoing (design completed October 2005, construction started January 2006, estimated to be flow capable by December 2006, and completed April 2007).
- Cell 3 experienced drydown conditions during May 1–4, 2005, May 12–June 5, 2005, and April 16–30, 2006.

STA-6 WILMA HURRICANE IMPACTS

Hurricane Wilma caused structural damage to the G-600 inflow pump station building, minor damage to SAV and emergent vegetation, and no damage to levees.

STA-6 PERMIT STATUS

The District initiated a water quality monitoring program for STA-6 in December 1997 for the purpose of demonstrating compliance with the above referenced conditions of the operating permit. Presently, STA-6 is in a post-stabilization phase (**Table 5-2**). STA-6 discharges do not pose any known danger to the public health, safety, or welfare. Compliance with Specific Conditions 7(a)(i) and (ii) was achieved.

STA-6 OPERATIONS

STA-6 Hydrology

At the end of March 2005, the U.S. Sugar Corporation moved out of Unit 2 and formally transferred the inflow pump station G-600 to the District. Since that time, G-600 has been used to move dewatering water from construction of the new treatment flow-way. Dry out conditions were observed in Cell 3 for May 1–4, 2005, May 12–June 5, 2005, and April 16–30, 2006. During WY2006, 40,467 ac-ft of water was captured by the inflow pump station for STA-6 (**Table 5-3**), although there existed some undetermined amount of losses to irrigation water supply, and the net flow into the treatment area was less. The inflow was about 8 percent greater than the 31-year long-term average annual simulated inflow for this STA, although annual variability was anticipated. Due to seepage losses, ET, and water supply deliveries from the STA, the net volume of treated water discharged from STA-6 during WY2006 was 26,312 ac-ft. A summary of monthly flow is presented in **Figure 5-53**.

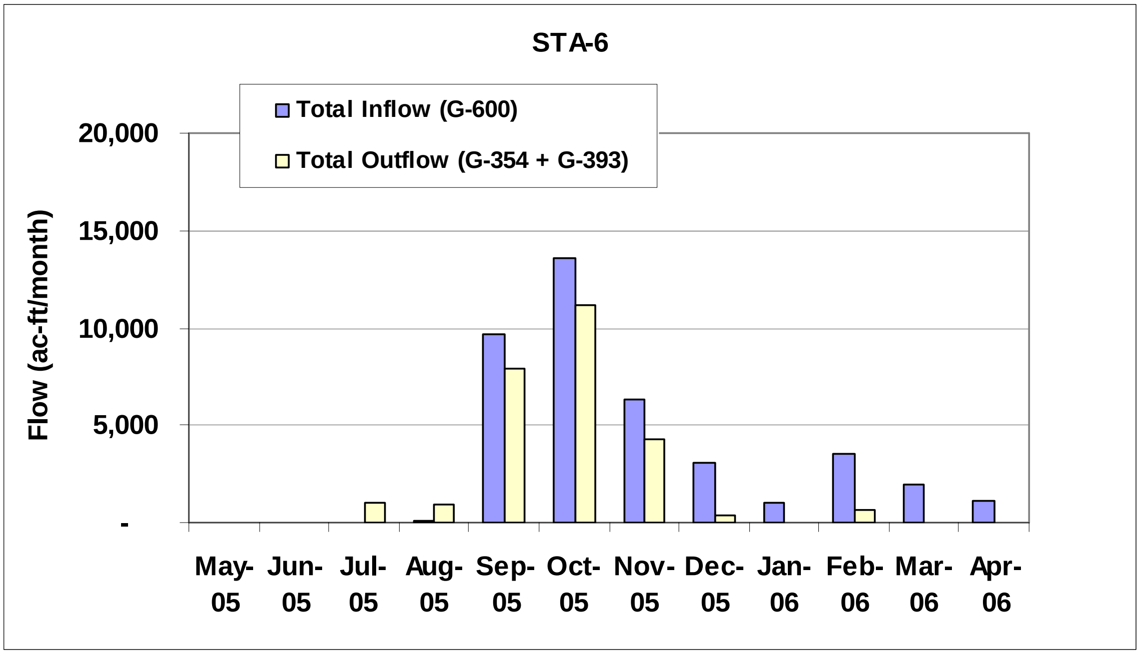


Figure 5-53. Summary of WY2006 flow for STA-6.

STA-6 Total Phosphorus

During WY2006, STA-6 received 5.2 mt of TP, equating to a phosphorus loading rate of 1.47 g/m^2 (**Table 5-3**). The inflow load was about 30 percent greater than the 31-year long-term average annual simulated inflow TP load for this STA, although annual variability was anticipated. Approximately 4.3 mt of TP was removed by STA-6 during WY2006. During WY2006, STA-6 experienced an 84 percent load reduction in TP (**Figure 5-54**). Furthermore, monthly discharge concentrations were lower than inflow concentrations (**Figure 5-55**). In June 2005, the outflow FWM concentration was high (248 ppb) but, because the outflow flow was so low, the resulting outflow TP load was also low. For the entire water year, the FWM outflow concentration was 26 ppb, well below the EFA permit requirement of 50 ppb. This represents a 75 percent reduction from the inflow concentration of 104 ppb. For informational purposes, the geometric mean TP concentration of the discharge was 36 ppb. The moving 12-month, flow-weighted average outflow ranged from 19 to 28 ppb during WY2006 (see **Figure 5-56**).

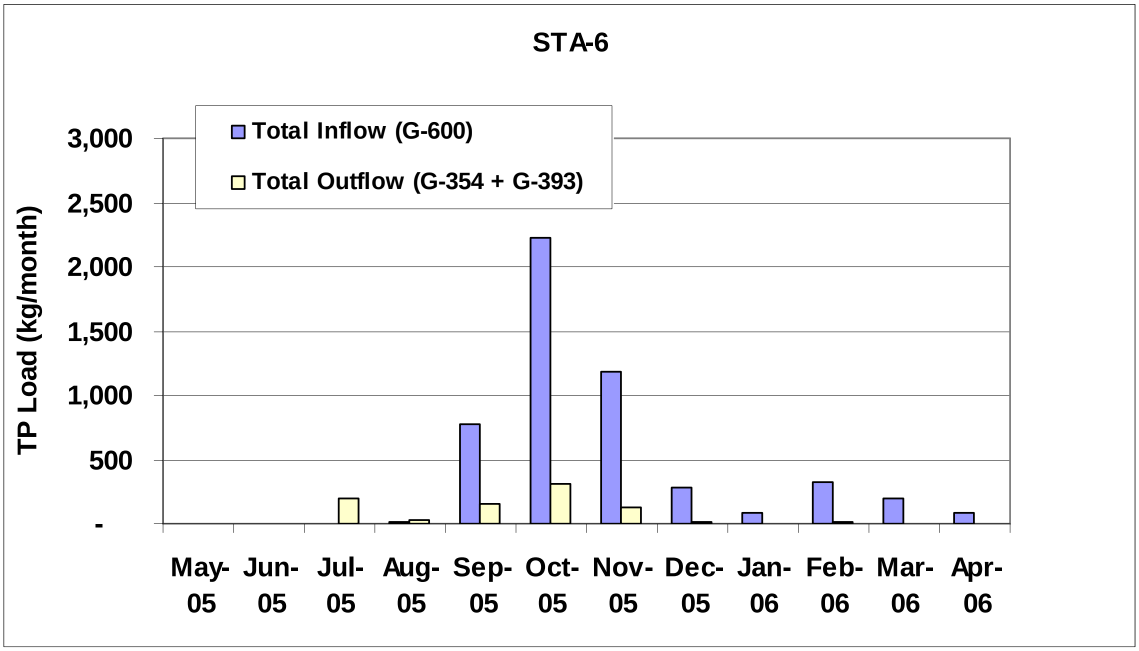


Figure 5-54. Summary of WY2006 TP load for STA-6.

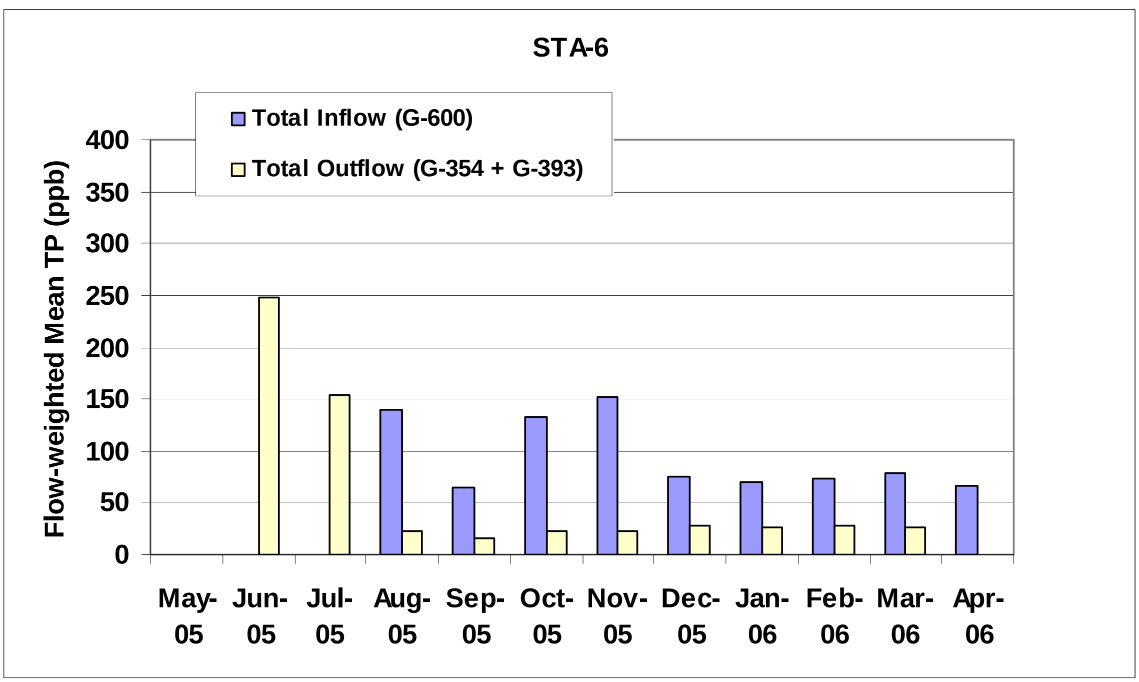


Figure 5-55. Summary of WY2006 FWM TP for STA-6.

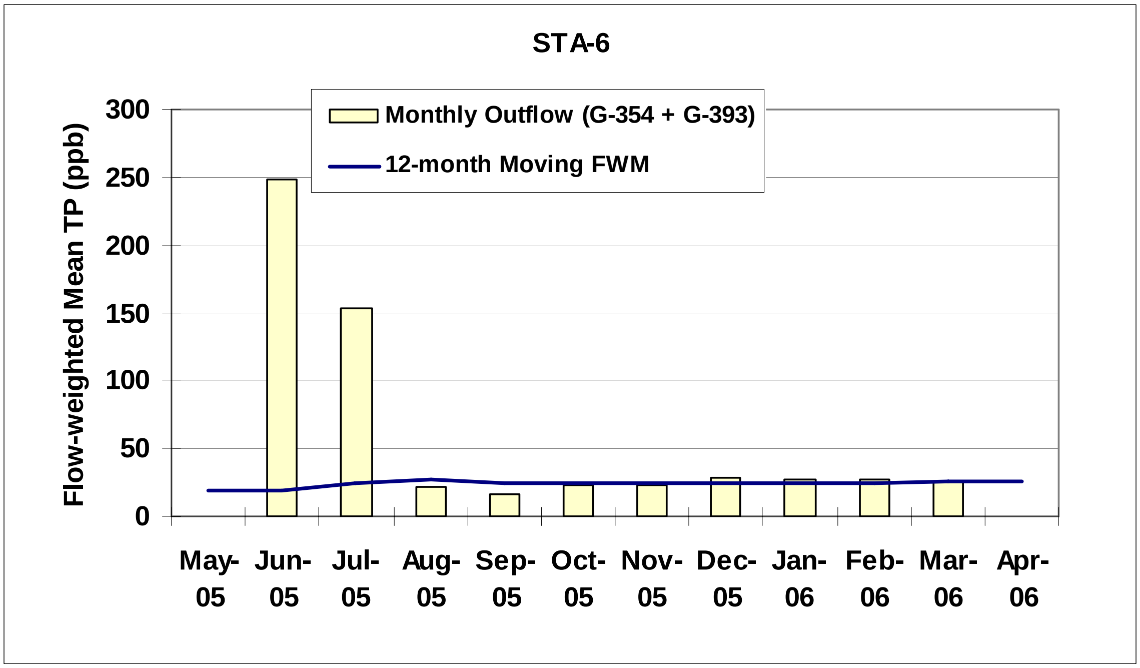


Figure 5-56. Comparison of monthly to 12-month moving average TP concentrations for WY2006 for STA-6 outflow.

STA-6 OTHER WATER QUALITY PARAMETERS

Compliance with the EFA permit is determined based on the three-part assessment presented in the *Water Quality Permit Requirements* section of this chapter. Water quality parameters with Florida Class III standards are identified in **Table 5-7**. The monitoring data for non-phosphorus parameters at STA-6 for the water year are presented in Appendix 5-14.

Outflow values for dissolved sodium, dissolved magnesium, and dissolved chloride were slightly higher than inflow values, but because these parameters have no applicable numeric state water quality standards, discharges from STA-6 are deemed to be in full compliance with the permit (**Table 5-27**). For STA-6, downstream DO monitoring is not required by the permits. Mercury monitoring results are discussed in Chapter 3B of this volume, and the annual permit compliance monitoring report for mercury in the STAs is in Appendix 5-5 of this volume.

Table 5-27. Summary of annual arithmetic averages and FWM for all parameters other than TP monitored in STA-6.

Parameter	Arithmetic Means: Inflow	Arithmetic Means: Outflow		Flow-Weighted Means: Total Inflow		Flow-Weighted Means: Total Outflow	
	G600	G354C	G393B	n	Conc.	n	Conc.
Temperature (°C)	25.2	23.7	22.8	-NA-	-NA-	-NA-	-NA-
Dissolved Oxygen (mg/L)	2.9	2.6	1.6	-NA-	-NA-	-NA-	-NA-
Specific Conductivity (µmhos/cm)	655	612	643	-NA-	-NA-	-NA-	-NA-
pH	7.3	7.4	7.3	-NA-	-NA-	-NA-	-NA-
Turbidity (NTU)	4.4	1.1	1.2	-NA-	-NA-	-NA-	-NA-
Color (PCU)	81	76	86	-NA-	-NA-	-NA-	-NA-
Total Suspended Solids (mg/L)	7.2	1.9	2.6	15 (25)	4.8	21 (50)	1.5
Unionized Ammonia (mg/L)	0.003	0.002	<0.001	15 (25)	0.003	21 (50)	<0.001
Total Kjeldahl Nitrogen (mg/L)	1.90	1.55	1.45	15 (25)	1.86	21 (50)	1.23
Orthophosphate as P (mg/L)	0.015	0.010	0.023	32 (51)	0.013	43 (100)	0.009
Total Iron (µg/L)	227	115	119	2 (4)	263	7 (10)	113
Silica (mg/L)	10.12	9.88	7.36	2 (4)	8.71	5 (8)	8.44
Sulfate (mg/L)	10.7	8.4	9.1	2 (4)	14.8	5 (8)	5.5
Alkalinity (mg/L)	244.2	204.0	228.1	15 (25)	221.5	21 (50)	159.9
Dissolved Chloride (mg/L)	57.9	67.6	64.2	15 (25)	45.7	21 (50)	21.8
Dissolved Sodium (mg/L)	44.5	53.4	53.5	2 (4)	51.6	5 (8)	27.3
Dissolved Potassium (mg/L)	4.9	5.0	4.5	2 (4)	5.3	5 (8)	3.6
Dissolved Calcium (mg/L)	89.7	70.9	80.8	15 (25)	80.2	21 (50)	59.2
Dissolved Magnesium (mg/L)	7.5	7.9	8.1	2 (4)	8.7	5 (8)	5.9

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

STA-6 DISSOLVED OXYGEN MONITORING

For STA-6, downstream DO monitoring is not required by the permits.

STA-6 VEGETATION MANAGEMENT

Specific Condition 13(b) of the EFA permit requires that the annual Everglades Consolidated Report (currently known as the *South Florida Environmental Report*) include information regarding the application of herbicides used to exclude and/or eliminate undesirable vegetation within the treatment cells. In WY2006, the District treated a total of 170 acres to control vegetation in the marsh, and glyphosate and imazapyr to control emergent vegetation (**Table 5-5**). Both aerial and ground-based spray equipment to apply these herbicides.

STA-6 WILDLIFE AND RECREATION

Recreational facilities are proposed to provide public access to STA-6. The proposed facilities include an asphalt parking area, landscaping, pedestrian gates, signage, and fencing as needed to define public access areas and to protect sensitive equipment.

STA-6 ENHANCEMENTS AND STA-6 SECTION 2

Enhancements to STA-6 proposed in the revised Part 2 of the Long-Term Plan dated November 2004 included construction of an interior levee and associated water control structures in Cell 5, as well as conversion of emergent vegetation to SAV in the new downstream cell and construction of STA-6 Section 2. The Long-Term Plan also recommended a review of the proposed enhancements to STA-6 Section 1 to assess whether these revisions were justified to improve performance or system efficiency, or to avoid redundant or unnecessary features. This assessment was conducted to predict outflow phosphorus concentrations with the full expansion of the STA into the Compartment C (build-out) area. Based on this evaluation, it was determined that the interior levees and associated water control structures in Sections 1 and 2 were not required to improve performance in the build-out condition. However, some structural modifications to STA-6 Section 1 are still required to optimize the operation of the STA-5/STA-6 system.

The 1,440-acre STA-6 Section 2 will add approximately 1,385 acres of effective treatment area to the STA-5/STA-6 system. This expansion will allow for the capture and treatment of runoff from the C-139 annex located immediately west of the L-3 borrow canal.

The design of the STA-6 enhancements and STA-6 Section 2 was completed in October 2005. Construction began in January 2006 and is estimated to be completed by April 2007, with STA-6 Section 2 being flow capable by December 31, 2006. The design and construction of STA-6 Enhancements and STA-6 Section 2 is being implemented under the District's Acceler8 program as part of the EAA STA Enhancement Project. For additional information on the status of the Acceler8 program, see Chapter 7A of this volume.

ANALYSIS AND INTERPRETATION

One of the major objectives of the Process Development and Engineering component of the Long-Term Plan is to monitor the physical/chemical environment and nutrient sequestration in the STAs. This effort was included in the plan in the belief that a better understanding of wetland structure and function will assist the District in optimizing performance of these treatment systems. The Analysis and Interpretation Project contributes to this goal by analyzing water quality at interior sites throughout each STA and developing water and constituent mass balance budgets for individual STA treatment cells or flow-ways (hereafter referred to as “cells”). The District conducts the field sampling and laboratory analyses associated with this effort under the ECP Operations Monitoring Project. The following water quality parameters were monitored at the inflow and outflow to each cell: TP, soluble reactive phosphorus (SRP), total dissolved reactive phosphorus (TDRP), ammonia (NH_4), nitrite+nitrate-complex (NO_x), chloride (Cl), calcium (Ca), and alkalinity. TP was collected as either flow- or time-proportioned composite samples or grab samples on a weekly basis. All other parameters were collected as biweekly grab samples. Dissolved organic phosphorus (DOP) was calculated as DOP = TDRP – SRP; particulate phosphorus (PP) was calculated as PP = TP – TDRP; total nitrogen (TN) was calculated as TN = TKN + NO_x.

Annual cell water budgets were developed for STA-1E (Cells 3, 4N, and 4S; **Figure 5-4**), STA-1W (Cells 1, 2, 3, 4, and 5; **Figure 5-7**), STA-2 (Cells 1, 2, and 3; **Figure 5-20**), STA-3/4 (Cells 1A, 1B, 2A, 2B, and 3; **Figure 5-28**), STA-5 (North and South Flow-ways; **Figure 5-40**), and STA-6 (Cells 3 and 5; **Figure 5-52**) using available data over the period of record (POR) from WY2001 to WY2006 (**Table 5-28**). Surface water flow estimates for STA-1E and STA-3/4 are provisional. Estimates of groundwater inflow and outflow, precipitation, and ET for these two systems were not available at the time this report was prepared.

Constituent budgets for TP (**Table 5-29**), SRP, DOP, PP, TN, NH_4, NO_x, Cl, Ca, and alkalinity (Appendix 5-15) were developed for each cell. The loads in surface water inflow and outflow were calculated using a Microsoft Excel application developed by the District (Reardon and Germain, 2005) and the same POR as for the water budgets. Only positive flow was used in the nutrient budget estimates. Loads in precipitation were based on rainfall volume (**Table 5-28**) multiplied by the median constituent concentration in rainfall monitored at STA-1W (site ENR308) from January 2000 through June 2006. Loads in groundwater outflow were based on the volume of groundwater outflow (**Table 5-28**) multiplied by the geometric mean of the annual mean inflow and outflow constituent concentrations for each cell. Residuals to the constituent budgets were regarded as mass retained within the cell.

All cell water budgets for the POR were dominated by surface water inflow (**Table 5-28**); groundwater inflow and precipitation usually made up less than 10 percent of the total water volume. Outflow also was dominated by surface water (≥ 80 percent of total outflow). Exceptions to this generalization occurred in the South Flow-way of STA-5 and STA-6 Cells 3 and 5, where seepage losses and ET made up 31 to 45 percent of total outflow. The sign of the annual water budget error term for cells in STA-1W, 2, 5, and 6 was usually both positive and negative, suggesting a random component to uncertainty in these computations (too few annual water budgets were available for STA-1E and STA-3/4 to make this comparison). Only STA-1W Cell 3 had water budget errors with all the same sign (positive), which indicates a consistent measurement bias in this cell. More that one-third of all annual cell water budgets (36 out of 81 water budgets) had errors ≥ 20 percent. These large errors were attributed primarily to inaccuracies in measuring surface water flow under low head conditions in the STAs. Flow computations at interior water control structures in the STAs are based on headwater and tailwater stage differences, which are often close to the measurement accuracy [± 3 millimeters (mm)] of the stage recorders. Small uncertainties associated with measuring stage can result in a large error in the annual flow estimates.

Given the large contribution of surface water to the cell water budgets **(Table 5-28**), it was not surprising that the corresponding cell constituent budgets were also dominated by surface water over the POR (**Table 5-29** and Appendix 5-15). Precipitation contributed 5 percent or more to the total inflow load only in the TN budget for STA-6 Cell 5 and NO_x budgets for the North and South Flow-ways of STA-5 and STA-6 Cell 5. Likewise, total outflow loads were dominated by surface water, although groundwater outflow was often important (≥ 10 percent of total outflow load) in constituent budgets for STA-2 Cell 3, the North and South Flow-ways of STA-5 and STA-6 Cells 3 and 5. Treatment efficiency, as measured by total percent mass retained for each constituent over the POR, varied substantially among cells; STA-1E Cell 4N, STA-1W Cell 5, the cells in STA-2 or STA-3/4 Cell 2B typically had the highest percent retention for nutrients. The data suggest that for all constituents, some cells exported mass over the POR. Errors in annual chloride budgets paralleled errors in the water budgets; Pearson product-moment correlation coefficients of the errors in individual cells ranged from 0.52 to 0.99, the correlation coefficient for errors pooled over all cells was 0.69.

Table 5-28. Annual water budgets for flow-ways and treatment cells in the Everglades Protection Area Stormwater Treatment Areas.[a]

	Inflows[b]				Outflows[b]						
	I_s	I_g	P	Σinflow	O_s	O_g	ET	Σoutflow	ΔS	r	ε
STA-1E, Cell 3											
WY2006	1.9	-	-	1.9	3.0	-	-	3.0	-	-1.0	-41.6%
TOTAL	1.9	-	-	1.9	3.0	-	-	3.0	-	-1.0	-41.6%
% in	100.0%	0.0%	0.0%	*% out*	100.0%	0.0%	0.0%				
STA-1E, Cell 4N											
WY2006	3.0	-	-	3.0	0.5	-	-	0.5	-	2.5	144.8%
TOTAL	3.0	-	-	3.0	0.5	-	-	0.5	-	2.5	144.8%
% in	100.0%	0.0%	0.0%	*% out*	100.0%	0.0%	0.0%				
STA-1E, Cell 4S											
WY2006	0.9	-	-	0.9	2.3	-	-	2.3	-	-1.5	-90.2%
TOTAL	0.9	-	-	0.9	2.3	-	-	2.3	-	-1.5	-90.2%
% in	100.0%	0.0%	0.0%	*% out*	100.0%	0.0%	0.0%				
STA-1W, Cell 1											
WY2001	126.5	1.9	5.2	133.6	95.0	7.7	8.3	111.0	-1.9	24.4	20.0%
WY2002	159.4	3.1	7.8	170.2	154.5	6.5	7.8	168.7	0.8	0.7	0.4%
WY2003	305.2	3.1	6.2	314.5	316.6	5.9	7.5	329.9	2.9	-18.4	-5.7%
WY2004	193.9	3.0	5.0	202.0	193.9	4.6	7.5	206.1	-3.2	-1.0	-0.5%
WY2005	207.2	2.3	6.2	215.6	272.8	2.6	7.5	282.8	-0.1	-67.2	-27.0%
WY2006	145.8	2.1	6.5	154.3	136.9	0.4	7.6	144.9	0.4	9.0	6.0%
TOTAL	1138.0	15.4	36.8	1190.2	1169.7	27.7	46.2	1243.5	-1.0	-52.3	-4.3%
% in	95.6%	1.3%	3.1%	*% out*	94.1%	2.2%	3.7%				
STA-1W, Cell 2											
WY2001	38.7	0.0	3.7	42.4	47.4	0.0	5.9	53.3	0.0	-10.9	-22.8%
WY2002	66.7	0.0	5.5	72.3	61.7	0.0	5.5	67.3	0.0	5.0	7.1%
WY2003	146.7	0.0	4.4	151.2	152.1	0.0	5.4	157.4	0.0	-6.3	-4.1%
WY2004	75.0	0.0	3.6	78.6	136.9	0.0	5.4	142.3	0.0	-63.7	-57.7%
WY2005	97.7	0.0	4.4	102.1	50.8	0.0	5.3	56.1	0.0	45.9	58.0%
WY2006	-	-	-	-	-	-	-	-	-	-	-
TOTAL	424.8	0.0	21.6	446.5	449.0	0.0	27.5	476.5	0.0	-30.0	-6.5%
% in	95.2%	0.0%	4.8%		94.2%	0.0%	5.8%		0.0%		
STA-1W, Cell 3											
WY2001	91.2	2.2	3.6	96.9	80.3	7.4	5.7	93.4	-0.5	4.0	4.2%
WY2002	143.5	3.4	5.4	152.3	121.6	6.2	5.4	133.2	0.5	18.6	13.0%
WY2003	256.9	3.4	4.3	264.6	198.8	5.6	5.2	209.6	0.9	54.1	22.8%
WY2004	163.4	3.3	3.5	170.2	127.3	4.4	5.2	136.9	-1.1	34.4	22.4%
WY2005	196.8	2.5	4.3	203.6	155.7	2.3	5.2	163.2	0.1	40.3	22.0%
WY2006	136.9	2.3	4.5	143.7	110.3	0.3	5.3	115.9	0.3	27.5	21.2%
TOTAL	988.7	17.0	25.6	1031.3	794.0	26.2	32.2	852.3	0.1	178.9	19.0%
% in	95.9%	1.6%	2.5%	*% out*	93.2%	3.1%	3.8%				

Table 5-28. Continued.

	Inflows				Outflows						
	I_s	I_g	P	Σinflow	O_s	O_g	ET	Σoutflow	ΔS	r	ε
STA-1W, Cell 4											
WY2001	47.4	0.0	1.3	48.7	38.8	0.0	2.1	40.8	0.0	7.9	17.6%
WY2002	61.7	0.0	2.0	63.7	80.7	0.0	2.0	82.7	0.0	-19.0	-26.0%
WY2003	152.1	0.0	1.6	153.6	194.6	0.0	1.9	196.5	0.0	-42.9	-24.5%
WY2004	136.9	0.0	1.3	138.2	126.7	0.0	1.9	128.5	0.0	9.6	7.2%
WY2005	50.8	0.0	1.6	52.4	83.7	0.0	1.9	85.5	0.0	-33.2	-48.1%
WY2006	-	-	-	-	-	-	-	-	-	-	-
TOTAL	449.0	0.0	7.6	456.6	524.4	0.0	9.7	534.1	0.0	-77.5	-15.7%
% in	98.3%	0.0%	1.7%		98.2%	0.0%	1.8%		0.0%		
STA-1W, Cell 5											
WY2001	217.8	0.0	10.9	228.7	27.9	0.0	17.5	45.4	-10.9	194.3	141.8%
WY2002	641.5	0.0	16.4	657.9	186.0	0.0	16.5	202.5	3.8	451.6	105.0%
WY2003	398.3	0.0	13.2	411.5	407.7	0.0	15.9	423.6	-2.0	-10.1	-2.4%
WY2004	109.6	0.0	10.6	120.2	110.8	0.0	16.0	126.8	4.7	-11.3	-9.1%
WY2005	158.1	0.0	13.1	171.1	146.2	0.0	15.8	162.0	-8.4	17.6	10.6%
WY2006	49.9	0.0	13.7	63.6	23.5	0.0	16.1	39.7	-37.1	61.0	118.3%
TOTAL	1575.1	0.0	77.9	1653.0	902.1	0.0	97.7	999.8	-50.0	703.2	53.0%
% in	95.3%		4.7%	*% out*	90.2%		9.8%				
STA-2, Cell 1											
WY2002	54.1	0.0	12.1	66.3	19.6	0.0	10.8	30.4	0.1	35.7	73.9%
WY2003	57.2	0.0	10.3	67.5	36.9	0.0	10.4	47.3	4.6	15.5	27.1%
WY2004	78.0	0.0	9.4	87.4	61.3	0.0	10.5	71.8	-0.2	15.8	19.8%
WY2005	67.8	0.0	8.9	76.8	70.6	0.0	10.4	81.0	0.1	-4.3	-5.4%
WY2006	73.4	0.0	10.4	83.9	70.8	0.0	10.6	81.4	0.0	2.5	3.1%
TOTAL	330.6	0.0	51.2	381.8	259.3	0.0	52.7	311.9	4.6	65.3	18.8%
% in	86.6%	0.0%	13.4%	*% out*	83.1%	0.0%	16.9%				
STA-2, Cell 2											
WY2002	77.0	1.6	13.5	92.2	110.2	0.2	12.0	122.4	0.3	-30.6	-28.5%
WY2003	149.3	2.0	11.5	162.8	123.8	0.1	11.7	135.5	0.3	26.9	18.1%
WY2004	111.6	2.0	10.4	124.0	110.8	0.1	11.7	122.6	-0.1	1.5	1.2%
WY2005	172.3	3.6	10.0	185.9	162.8	0.0	11.6	174.4	-0.2	11.7	6.5%
WY2006	159.0	2.5	11.6	173.2	121.6	2.0	11.8	135.4	0.0	37.8	24.5%
TOTAL	669.3	11.7	57.1	738.1	629.2	2.4	58.7	690.3	0.4	47.4	6.6%
% in	90.7%	1.6%	7.7%	*% out*	91.1%	0.3%	8.5%				
STA-2, Cell 3											
WY2002	130.8	0.0	13.5	144.3	109.3	28.9	12.0	150.2	0.3	-6.1	-4.2%
WY2003	178.7	0.0	11.5	190.2	144.7	19.5	11.7	175.8	0.3	14.1	7.7%
WY2004	137.8	0.0	10.4	148.3	129.3	17.1	11.7	158.1	-0.5	-9.3	-6.1%
WY2005	173.2	0.0	10.0	183.1	155.9	12.9	11.6	180.4	0.0	2.8	1.5%
WY2006	133.4	9.4	11.6	154.5	126.7	11.5	11.8	150.0	11.8	-7.3	-4.8%
TOTAL	753.9	9.4	57.1	820.4	665.9	89.9	58.7	814.5	11.8	-5.9	-0.7%
% in	91.9%	1.2%	7.0%	*% out*	81.8%	11.0%	7.2%				

Table 5-28. Continued.

	Inflows				Outflows						
	I_s	I_g	P	Σinflow	O_s	O_g	ET	Σoutflow	ΔS	r	ε
STA-3/4, Cell 1A											
WY2005	13.5	-	-	13.5	10.6	-	-	10.6	-	2.8	23.5%
WY2006	44.5	-	-	44.5	33.8	-	-	33.8	-	10.8	27.6%
TOTAL	58.0	-	-	58.0	44.4	-	-	44.4	-	13.6	26.6%
% in	100.0%	0.0%	0.0%	*% out*	100.0%	0.0%	0.0%				
STA-3/4, Cell 1B											
WY2005	10.6	-	-	10.6	3.5	-	-	3.5	-	7.1	101.3%
WY2006	33.7	-	-	33.7	11.2	-	-	11.2	-	22.5	100.1%
TOTAL	44.4	0.0	0.0	44.4	14.7	0.0	0.0	14.7	0.0	29.6	100.4%
% in	100.0%	0.0%	0.0%	*% out*	100.0%	0.0%	0.0%				
STA-3/4, Cell 2A											
WY2005	8.9	-	-	8.9	7.5	-	-	7.5	-	1.4	17.3%
WY2006	38.7	-	-	38.7	19.3	-	-	19.3	-	19.4	67.0%
TOTAL	47.6	0.0	0.0	47.6	26.7	0.0	0.0	26.7	0.0	20.8	56.0%
% in	100.0%	0.0%	0.0%	*% out*	100.0%	0.0%	0.0%				
STA-3/4, Cell 2B											
WY2005	10.0	-	-	10.0	1.4	-	-	1.4	-	8.7	152.2%
WY2006	25.2	-	-	25.2	8.6	-	-	8.6	-	16.6	98.3%
TOTAL	35.3	0.0	0.0	35.3	10.0	0.0	0.0	10.0	0.0	25.3	111.8%
% in	100.0%	0.0%	0.0%	*% out*	100.0%	0.0%	0.0%				
STA-3/4, Cell 3											
WY2006	9.2	-	-	9.2	3.0	-	-	3.0	-	6.2	101.9%
TOTAL	9.2	0.0	0.0	9.2	3.0	0.0	0.0	3.0	0.0	6.2	101.9%
% in	100.0%	0.0%	0.0%	*% out*	100.0%	0.0%	0.0%				
STA-5, North Flow-way											
WY2001	43.3	0.0	8.1	51.4	25.4	11.9	11.9	49.2	-2.4	4.7	9.3%
WY2002	121.0	0.0	7.5	128.5	103.3	13.1	11.2	127.6	2.7	-1.8	-1.4%
WY2003	127.6	0.0	10.1	137.7	124.5	11.8	10.8	147.2	0.0	-9.4	-6.6%
WY2004	135.7	0.0	9.6	145.3	121.7	12.8	10.8	145.3	1.3	-1.3	-0.9%
WY2005	114.6	1.1	8.0	123.7	90.2	5.7	10.7	106.5	-3.7	20.9	18.1%
WY2006	171.8	0.2	8.5	180.5	138.8	10.4	11.0	160.2	0.8	19.5	11.4%
TOTAL	713.9	1.3	51.9	767.1	603.9	65.8	66.3	736.0	-1.4	32.5	4.3%
% in	93.1%	0.2%	6.8%	*% out*	82.0%	8.9%	9.0%				
STA-5, South Flow-way											
WY2001	57.4	0.1	8.1	65.6	23.9	36.4	11.9	72.2	-1.5	-5.0	-7.3%
WY2002	114.7	0.0	7.5	122.2	52.3	38.1	11.2	101.6	3.6	17.1	15.3%
WY2003	119.6	0.0	10.1	129.7	73.5	44.9	10.8	129.2	-0.4	0.8	0.7%
WY2004	89.2	0.0	9.6	98.9	46.7	43.6	10.8	101.1	1.8	-4.1	-4.1%
WY2005	68.1	0.0	8.0	76.1	59.6	45.4	10.7	115.7	-1.5	-38.1	-39.7%
WY2006	123.0	8.9	8.5	140.4	109.0	28.5	11.0	148.4	-2.5	-5.6	-3.8%
TOTAL	572.1	9.0	51.9	632.9	365.0	236.9	66.3	668.2	-0.5	-34.8	-5.4%
% in	90.4%	1.4%	0.1	*% out*	54.6%	35.5%	9.9%				

Table 5-28. Continued.

	Inflows				Outflows						
	I_s	I_g	P	Σinflow	O_s	O_g	ET	Σoutflow	ΔS	r	ε
STA-6, Cell 3											
WY2001	17.4	0.4	1.3	19.2	11.4	8.2	1.4	21.0	0.3	-2.2	-10.8%
WY2002	24.5	0.2	1.2	25.9	13.4	5.8	1.3	20.5	0.0	5.4	23.1%
WY2003	30.9	0.6	1.2	32.7	17.7	4.0	1.3	23.1	0.8	8.8	31.6%
WY2004	24.1	0.1	1.2	25.4	20.8	5.8	1.3	27.9	-0.4	-2.0	-7.6%
WY2005	23.0	0.6	1.3	24.8	13.0	7.6	1.3	21.9	0.4	2.6	11.0%
WY2006	20.5	1.0	1.0	22.6	15.9	2.4	1.3	19.6	0.0	3.0	14.1%
TOTAL	140.4	3.0	7.2	150.7	92.3	33.7	7.9	134.0	1.2	15.6	10.9%
% in	93.2%	2.0%	4.8%	*% out*	68.9%	25.2%	5.9%				
STA-6, Cell 5											
WY2001	31.0	0.1	3.4	34.5	17.8	10.0	3.6	31.4	1.0	2.1	6.4%
WY2002	41.1	0.0	3.0	44.2	21.1	13.2	3.4	37.6	0.0	6.5	15.9%
WY2003	34.7	0.0	3.0	37.7	22.6	13.2	3.3	39.1	1.1	-2.4	-6.4%
WY2004	24.0	0.0	3.2	27.2	23.1	12.2	3.3	38.5	-0.9	-10.5	-31.9%
WY2005	19.9	0.0	3.2	23.1	14.3	4.7	3.3	22.3	0.2	0.6	2.8%
WY2006	14.4	0.2	2.7	17.3	14.6	6.5	3.3	24.4	0.4	-7.5	-35.9%
TOTAL	165.1	0.4	18.4	183.9	113.5	59.7	20.1	193.4	1.7	-11.2	-5.9%
% in	89.8%	0.2%	10.0%	*% out*	58.7%	30.9%	10.4%				

[a] All water budget terms expressed as hm^3 (= 1,000,000 m^3); 1 hm^3 = 810.713 acre-ft; data provided by W. Abtew and S. Huebner, SFWMD.

[b] I_s = surface water inflow; I_g = groundwater inflow; P = precipitation; O_s = surface water outflow; O_g = groundwater outflow; ET = evapotranspiration; ΔS = change in storage volume; r = water budget residual [= Σinflow – (Σoutflow +ΔS)]; ε = water budget error [= r ÷ {(Σinflow+Σoutflow) ÷ 2}].

Table 5-29. Annual total phosphorus budgets for flow-ways and treatment cells in the Everglades Protection Area Stormwater Treatment Areas.[a]

	Inflows[b]			Outflows[b]				
	I_s	P	Σinflow	O_s	O_g	Σoutflow	Retained	% Ret
STA-1E, Cell 3								
WY2006	1.947	-	1.947	2.971	-	2.971	-1.024	-52.6%
TOTAL	1.947	-	1.947	2.971	-	2.971	-1.024	-52.6%
% in	100.0%	0.0%	*% out*	100.0%	0.0%			
STA-1E, Cell 4N								
WY2006	2.971	-	2.971	0.476	-	0.476	2.495	84.0%
TOTAL	2.971	-	2.971	0.476	-	0.476	2.495	84.0%
% in	100.0%	0.0%	*% out*	100.0%	0.0%			
STA-1E, Cell 4S								
WY2006	0.883	-	0.883	2.335	-	2.335	-1.452	-164.4%
TOTAL	0.883	-	0.883	2.335	-	2.335	-1.452	-164.4%
% in	100.0%	0.0%	*% out*	100.0%	0.0%			
STA-1W, Cell 1								
WY2001	13.441	0.021	13.462	6.281	0.647	6.928	6.534	48.5%
WY2002	16.533	0.031	16.564	9.489	0.516	10.005	6.559	39.6%
WY2003	47.352	0.025	47.377	31.970	0.735	32.705	14.672	31.0%
WY2004	23.409	0.020	23.429	22.459	0.549	23.008	0.421	1.8%
WY2005	43.981	0.025	44.006	64.154	0.578	64.732	-20.726	-47.1%
WY2006	29.405	0.026	29.431	26.685	0.083	26.768	2.663	9.0%
TOTAL	174.121	0.147	174.268	161.038	3.107	164.145	10.124	5.8%
% in	99.9%	0.1%	*% out*	98.1%	1.9%			
STA-1W, Cell 2								
WY2001	4.334	0.015	4.349	3.678	0.000	3.678	0.671	15.4%
WY2002	6.316	0.022	6.338	3.602	0.000	3.602	2.736	43.2%
WY2003	23.266	0.018	23.284	20.733	0.000	20.733	2.551	11.0%
WY2004	10.606	0.014	10.620	18.940	0.000	18.940	-8.320	-78.3%
WY2005	30.353	0.018	30.371	14.731	0.000	14.731	15.640	51.5%
WY2006	-	-	-	-	-	-	-	-
TOTAL	74.875	0.087	74.962	61.684	0.000	61.684	13.278	17.7%
% in	99.9%	0.1%	*% out*	100.0%	0.0%			
STA-1W, Cell 3								
WY2001	2.735	0.014	2.749	2.141	0.209	2.350	0.400	14.5%
WY2002	4.272	0.022	4.294	3.206	0.173	3.379	0.915	21.3%
WY2003	12.928	0.017	12.945	8.204	0.255	8.459	4.486	34.7%
WY2004	14.140	0.014	14.154	6.330	0.291	6.621	7.533	53.2%
WY2005	36.258	0.017	36.275	17.828	0.331	18.159	18.116	49.9%
WY2006	26.685	0.018	26.703	14.128	0.048	14.176	12.527	46.9%
TOTAL	97.018	0.103	97.121	51.837	1.307	53.144	43.977	45.3%
% in	99.9%	0.1%	*% out*	97.5%	2.5%			

Table 5-29. Continued.

	Inflows			Outflows				
	I_s	P	Σinflow	O_s	O_g	Σoutflow	Retained	% Ret
STA-1W, Cell 4								
WY2001	3.678	0.005	3.683	1.028	0.000	1.028	2.655	72.1%
WY2002	3.602	0.008	3.610	2.190	0.000	2.190	1.420	39.3%
WY2003	20.733	0.006	20.739	13.353	0.000	13.353	7.386	35.6%
WY2004	18.940	0.005	18.945	9.353	0.000	9.353	9.592	50.6%
WY2005	14.731	0.006	14.737	12.966	0.000	12.966	1.771	12.0%
WY2006	-	-	-	-	-	-	-	-
TOTAL	61.684	0.031	61.715	38.890	0.000	38.890	22.825	37.0%
% in	>99.9%	<0.1%	*% out*	100.0%	0.0%			
STA-1W, Cell 5								
WY2001	24.595	0.044	24.639	2.898	0.000	2.898	21.741	88.2%
WY2002	87.684	0.066	87.750	16.858	0.000	16.858	70.892	80.8%
WY2003	61.313	0.053	61.366	33.369	0.000	33.369	27.997	45.6%
WY2004	14.182	0.043	14.225	5.381	0.000	5.381	8.844	62.2%
WY2005	38.484	0.052	38.536	25.564	0.000	25.564	12.972	33.7%
WY2006	10.329	0.055	10.384	5.064	0.000	5.064	5.320	51.2%
TOTAL	236.587	0.312	236.899	89.134	0.000	89.134	147.765	62.4%
% in	99.9%	0.1%	*% out*	100.0%	0.0%			
STA-2, Cell 1								
WY2002	1.698	0.049	1.747	0.425	0.000	0.425	1.322	75.7%
WY2003	2.985	0.041	3.026	0.522	0.000	0.522	2.504	82.8%
WY2004	6.794	0.037	6.831	0.831	0.000	0.831	6.000	87.8%
WY2005	6.699	0.036	6.735	0.716	0.000	0.716	6.019	89.4%
WY2006	7.250	0.042	7.292	1.195	0.000	1.195	6.097	83.6%
TOTAL	25.426	0.205	25.631	3.689	0.000	3.689	21.942	85.6%
% in	99.2%	0.8%	*% out*	100.0%	0.0%			
STA-2, Cell 2								
WY2002	2.052	0.054	2.106	1.742	0.004	1.746	0.360	17.1%
WY2003	10.334	0.046	10.380	2.494	0.003	2.497	7.883	75.9%
WY2004	10.279	0.042	10.321	1.750	0.004	1.754	8.567	83.0%
WY2005	20.278	0.040	20.318	6.396	0.001	6.397	13.921	68.5%
WY2006	17.391	0.046	17.437	3.447	0.112	3.559	13.879	79.6%
TOTAL	60.334	0.228	60.562	15.829	0.124	15.953	44.610	73.7%
% in	99.6%	0.4%	*% out*	99.2%	0.8%			
STA-2, Cell 3								
WY2002	3.327	0.054	3.381	1.819	0.594	2.413	0.968	28.6%
WY2003	9.527	0.046	9.573	2.279	0.564	2.843	6.730	70.3%
WY2004	11.368	0.042	11.410	1.743	0.570	2.313	9.096	79.7%
WY2005	18.874	0.040	18.914	2.754	0.567	3.321	15.593	82.4%
WY2006	12.797	0.046	12.843	2.387	0.489	2.876	9.967	77.6%
TOTAL	55.893	0.228	56.121	10.982	2.784	13.766	42.355	75.5%
% in	99.6%	0.4%	*% out*	79.8%	20.2%			

Table 5-29. Continued.

	Inflows			Outflows				
	I_s	P	Σinflow	O_s	O_g	Σoutflow	Retained	% Ret
STA-3/4, Cell 1A								
WY2005	13.450	-	13.450	10.623	-	10.623	2.827	21.0%
WY2006	44.547	-	44.547	33.756	-	33.756	10.791	24.2%
TOTAL	57.997	-	57.997	44.379	-	44.379	13.618	23.5%
% in	100.0%	0.0%	*% out*	100.0%	0.0%			
STA-3/4, Cell 1B								
WY2005	10.623	-	10.623	3.480	-	3.480	7.143	67.2%
WY2006	33.739	-	33.739	11.235	-	11.235	22.504	66.7%
TOTAL	44.362	-	44.362	14.715	-	14.715	29.647	66.8%
% in	100.0%	0.0%	*% out*	100.0%	0.0%			
STA-3/4, Cell 2A								
WY2005	8.897	-	8.897	7.483	-	7.483	1.414	15.9%
WY2006	38.661	-	38.661	19.265	-	19.265	19.396	50.2%
TOTAL	47.558	-	47.558	26.748	-	26.748	20.810	43.8%
% in	100.0%	0.0%	*% out*	100.0%	0.0%			
STA-3/4, Cell 2B								
WY2005	10.037	-	10.037	1.363	-	1.363	8.674	86.4%
WY2006	25.231	-	25.231	8.607	-	8.607	16.624	65.9%
TOTAL	35.268	-	35.268	9.970	-	9.970	25.298	71.7%
% in	100.0%	0.0%	*% out*	100.0%	0.0%			
STA-3/4, Cell 3								
WY2006	9.150	-	9.150	2.974	-	2.974	6.176	67.5%
TOTAL	9.150	-	9.150	2.974	-	2.974	6.176	67.5%
% in	100.0%	0.0%	*% out*	100.0%	0.0%			
STA-5, North Flow-way								
WY2001	5.608	0.033	5.641	3.598	1.616	5.214	0.427	7.6%
WY2002	23.748	0.030	23.778	8.762	1.692	10.454	13.324	56.0%
WY2003	23.431	0.040	23.471	17.965	1.928	19.893	3.579	15.2%
WY2004	21.015	0.039	21.054	8.406	1.326	9.732	11.321	53.8%
WY2005	15.037	0.032	15.069	5.662	0.513	6.175	8.894	59.0%
WY2006	28.695	0.034	28.729	12.444	1.273	13.717	15.012	52.3%
TOTAL	117.534	0.207	117.741	56.837	8.349	65.186	52.556	44.6%
% in	99.8%	0.2%	*% out*	87.2%	12.8%			
STA-5, South Flow-way								
WY2001	10.883	0.033	10.916	1.289	3.674	4.963	5.953	54.5%
WY2002	26.166	0.030	26.196	4.333	5.237	9.570	16.626	63.5%
WY2003	35.291	0.040	35.331	8.491	8.299	16.790	18.541	52.5%
WY2004	28.556	0.039	28.595	8.000	10.225	18.225	10.370	36.3%
WY2005	10.989	0.032	11.021	6.558	6.047	12.605	-1.584	-14.4%
WY2006	25.404	0.034	25.438	11.255	4.162	15.417	10.021	39.4%
TOTAL	137.289	0.207	137.496	39.926	37.644	77.570	59.927	43.6%
% in	99.8%	0.2%	*% out*	51.5%	48.5%			

Table 5-29. Continued.

	Inflows			Outflows				
	I_s	P	Σinflow	O_s	O_g	Σoutflow	Retained	% Ret
STA-6, Cell 3								
WY2001	0.616	0.005	0.621	0.512	0.325	0.837	-0.216	-34.7%
WY2002	0.861	0.005	0.866	0.285	0.159	0.444	0.422	48.7%
WY2003	0.974	0.005	0.979	0.496	0.120	0.616	0.363	37.1%
WY2004	0.802	0.005	0.807	0.277	0.121	0.398	0.408	50.6%
WY2005	1.767	0.005	1.772	0.239	0.284	0.523	1.249	70.5%
WY2006	1.527	0.004	1.531	0.522	0.118	0.640	0.891	58.2%
TOTAL	6.547	0.029	6.576	2.331	1.127	3.458	3.117	47.4%
% in	99.6%	0.4%	*% out*	67.4%	32.6%			
STA-6, Cell 5								
WY2001	0.907	0.013	0.920	0.477	0.279	0.756	0.165	17.9%
WY2002	1.243	0.012	1.255	0.330	0.286	0.616	0.639	50.9%
WY2003	1.108	0.012	1.120	0.644	0.398	1.042	0.078	6.9%
WY2004	0.897	0.013	0.910	0.284	0.262	0.546	0.364	40.0%
WY2005	1.422	0.013	1.435	0.276	0.175	0.451	0.984	68.6%
WY2006	1.265	0.011	1.276	0.326	0.287	0.613	0.663	51.9%
TOTAL	6.842	0.074	6.916	2.337	1.687	4.024	2.891	41.8%
% in	98.9%	1.1%	*% out*	58.1%	41.9%			

[a] All budget terms expressed as metric tonnes of phosphorus.

[b] I_s = surface water inflow; P = precipitation; O_s = surface water outflow; O_g = groundwater outflow; Retained = Σinflow – Σoutflow; %Ret = (retained/Σinflow)*100.

STA PERFORMANCE SYNOPSIS

The performance of the STAs beginning at start-up operations is shown in **Table 5-39,** and a timeline showing the water year of operation for the STAs is shown in **Table 5-1**. The cumulative values in **Table 5-39** are higher by about 18 mt more than reported in the 2006 SFER – Volume 1, because the flows and loads delivered to the STAs during start-up are now included in the summation. The addition of start-up data for STA-1E, STA-1W, STA-2, and STA-6, and partial water year data for STA-2 (WY2001) and STA-5 (WY2000) changed the total STA loadings, increasing inflows by 189,648 ac-ft and 28,680 kg, outflows by 30,226 ac-ft and 11,122 kg, and load reduction by 17,558 kg from what was previously reported. From WY1994 through WY2006, the STAs combined have removed 809 mt of phosphorus that would have entered into the Everglades.

As multiple years of STA performance data are available, a brief synopsis of phosphorus removal performance can provide insights into the phosphorus removal trends of the STAs. The flows, TP loads, and FWM TP concentrations going into and out of each STA are presented in the appendices associated with this chapter. The water budgets and phosphorus mass balance calculations for each treatment cell for each STA (excluding STA-3/4) are presented in the *Analysis and Interpretation* section of this chapter. The concentrations of the other nutrient parameters measured within the STAs are also presented in that section. During WY2006, some of the effective treatment area was temporarily taken off-line for Long-Term Plan enhancements or plant rehabilitation (**Table 5-3** and under each STA section). Compared to the previous water year, the amount of loading received by STA-1W was lower and about the same for STA-2. For STA-3/4, the hydraulic loading rate (HLR) was slightly lower and the phosphorus loading rate (PLR) was about the same. Both HLR and PLR were higher for STA-5 and STA-6 (**Figures 5-57** and **5-58**).

Long-term trends can be discerned by looking at the STA performance over the period of operation. The annual STA settling rates (**Figure 5-59**) indicate spatial and temporal variability within and among STAs, with all STAs at or above the initial design settling rate estimate of 10 m/yr. Time series plots of the load removal (**Figure 5-60**) show a constant TP load removal performance for STA-2 and STA-6 and a decline in load removal for STA-1W and STA-5. The STA combined cumulative load removal of 68 percent (**Figure 5-60**) is slightly lower than the 70 percent design assumption. The load removal in WY2006 was highest for STA-2, STA-3/4, and STA-6 (over 80 percent) and lowest for the two STAs with flow-ways off-line for Long-Term Plan enhancements construction projects, STA-1W (49 percent) and STA-5 (55 percent). The lower removal efficiency of STA-1W and STA-5 may have been due to high inflow nutrient concentrations (**Table 5-39**) and the temporary reduction in effective treatment area due to Long-Term Plan enhancements construction or plant rehabilitation. The impact of the multiple hurricanes in WY2005 and WY2006 also may have had some impact on performance.

The comparison of outflow versus inflow TP concentrations (**Figure 5-61**) shows a wide range of inflow and outflow values, with STA-1W and STA-5 having the highest concentrations. Much variability between the STAs, as well as within an STA, was also observed when comparing the STA TP load removal to inflow TP loading rate (**Figures 5-62**) and inflow hydraulic loading rate (**Figure 5-63**). The influence of hydraulic loading rate and phosphorus loading rate on the outflow TP concentration is shown in **Figures 5-64** and **5-65**.

Table 5-39. STA performance for the period of record (POR) since start-up operations.

STA-1E

(Start-up 9/04, Permit issued 10/1/2005) *Inflow = S-319, G-311, S-361* *Outflow = S-362*

Water Year	Inflow Flow ac-ft	Inflow TP Load kg	Inflow TP ppb	HLR cm/day	PLR g/m2/yr	Outflow Flow ac-ft	Outflow TP Load kg	Outflow TP ppb	TP Rmvd kg	TP Rmvd %	TP Removal g/m2/yr	Cumulative Removal kg	Avg. Annual Eff. Trt. Area acres	Avg. depth cm	HRT Days	Settling Rate m/yr
Hurricane response, start Sep. 2004 - April 2005	19,426	4,853	202	0.69	0.51	17,565	8,071	373	-3,219	-66%			4,024			
2006	52,132	12,118	188	1.08	0.74	40,572	7,295	146	4,824	40%	0.31		4,024	29.2	41	
Total	***71,559***	***16,971***	***192***			***58,137***	***15,366***	***214***	***1,605***	***9%***						

STA-1W

(ENR Start-up 10/93, Flow-through: 8/1994; STA-1W 2000)

Inflow: G250 (ENR011) for Water Year 94 - 6/99, G302 for remainder *Outflow = G-251 (ENR012) for Water Year 95-99, G-251 + G-310 for remainder.*

Water Year	Inflow Flow ac-ft	Inflow TP Load kg	Inflow TP ppb	HLR cm/day	PLR g/m2/yr	Outflow Flow ac-ft	Outflow TP Load kg	Outflow TP ppb	TP Rmvd kg	TP Rmvd %	TP Removal g/m2/yr	Cumulative Removal kg	Avg. Annual Eff. Trt. Area acres	Avg. depth cm	HRT Days	Settling Rate m/yr
1994*, partial, startup 10/93	0.00	-				0.53	0.01	20	0							
1995*, partial WY, start-up 5/94 - 7/94	0.60	0	148			0.00	0.00									
1995*, partial WY, start 8/94	92,364	15,452	136	3.47	1.72	95,333	2,718	23	12,735	82%	1.41	12,735	3,815	60	17.3	24
1996	182,670	24,464	109	4.00	1.58	172,414	5,079	24	19,385	79%	1.25	32,120	3,815	60	15.0	24
1997	118,780	14,391	98	2.60	0.93	119,198	2,750	19	11,642	81%	0.75	43,761	3,815	60	23.1	18
1998	80,304	11,536	116	1.76	0.75	80,986	2,125	21	9,410	82%	0.61	53,171	3,815	60	34.1	12
1999	88,532	11,096	102	1.94	0.72	86,376	2,045	19	9,051	82%	0.59	62,223	3,815	60	31.0	13
2000	125,584	21,139	136	2.75	1.37	121,229	3,753	25	17,386	82%	1.12	79,608	3,815	60	21.8	18
2001	93,819	17,113	148	1.26	0.68	90,517	4,319	39	12,794	75%	0.47	92,402	6,194	54	42.7	7
2002	278,857	51,767	150	3.49	1.92	267,624	12,200	37	39,567	76%	1.47	131,969	6,670	60	17.2	19
2003	591,845	112,172	154	7.41	4.16	595,999	39,234	53	72,937	65%	2.70	204,907	6,670	61	8.2	30
2004	292,690	50,733	141	3.66	1.88	297,603	17,073	47	33,661	66%	1.25	238,567	6,670	59	16.1	16
2005	341,094	103,872	247	5.24	4.72	383,365	46,489	98	57,384	55%	2.61	295,951	5,436	60	11.5	18
2006	142,678	37,415	213	2.85	2.21	137,890	19,265	113	18,150	49%	1.21	314,101	4,181	23	13.2	7
Total	***2,429,218***	***471,151***	***157***			***2,448,534***	***157,049***	***52***	***314,101***	***67%***						

STA-2

(Start-up 6/99; Flow-through: 10/2000) *Inflow = S-6 + G-328* *Outflow = G-335*

Water Year	Inflow Flow ac-ft	Inflow TP Load kg	Inflow TP ppb	HLR cm/day	PLR g/m2/yr	Outflow Flow ac-ft	Outflow TP Load kg	Outflow TP ppb	TP Rmvd kg	TP Rmvd %	TP Removal g/m2/yr	Cumulative Removal kg	Avg. Annual Eff. Trt. Area acres	Avg. depth cm	HRT Days	Settling Rate m/yr
2001* Partial WY, flow start 7/99	158,012	22,355	115	4.10	1.72	0	0						6,430			
2002	212,808	20,309	77	2.76	0.78	240,685	4,867	16	15,442	76%	0.59	15,442	6,430	45	16.3	18
2003	282,732	23,399	67	3.67	0.90	308,297	6,634	17	16,765	72%	0.64	32,207	6,430	45	12.3	21
2004	256,938	24,277	77	3.34	0.93	284,780	5,031	14	19,246	79%	0.74	51,453	6,430	45	13.5	24
2005	316,273	49,121	126	4.11	1.89	371,023	9,227	20	39,894	81%	1.53	91,347	6,430	46	11.2	30
2006	297,364	44,038	120	3.86	1.69	322,303	8,238	21	35,800	81%	1.38	127,147	6,430	47	14.8	27
Total	***1,524,127***	***183,500***	***98***			***1,527,088***	***33,997***	***18***	***149,503***	***81%***	***5.75***					

Table 5-39. Continued.

STA-3/4
(E and C FW start-up 10/03,
W FW start-up 11/03)
Flow-through: E FW 1/04, W FW 6/04, C FW 9/04

Inflow = G-370 + G-372 *Outflow = G-376, G-379, G-381*

Water Year	Inflow Flow ac-ft	Inflow TP Load kg	Inflow TP ppb	HLR cm/day	PLR g/m2/yr	Outflow Flow ac-ft	Outflow TP Load kg	Outflow TP ppb	TP Rmvd kg	TP Rmvd %	TP Removal g/m2/yr	Cumulative Removal kg	Avg. Annual Eff. Trt. Area acres	Avg. depth cm	HRT Days	Settling Rate m/yr
2004* Partial WY, start 10/03	23,303	1,407	49	0.08	0.01	27,708	546	16	861	61%	0.01	861				
2005	671,442	87,368	105	3.81	1.47	648,872	10,411	13	76,957	88%	1.37	77,818	14,731			36
2006	697,161	105,375	123	3.52	1.57	749,092	21,571	23	83,804	80%	1.25	161,622	16,543	51.8	13.8	24
Total	***1,391,906***	***194,150***	***113***			***1,425,673***	***32,528***	***18***	***161,622***	***83%***	***2.41***	***240,301***				

STA-5
(Start-up 12/30/98; Flow-
through: 10/1999)
Flow record starts in 9/99

Inflow = G-342 A-D *Outflow = G-344 A-D*

Water Year	Inflow Flow ac-ft	Inflow TP Load kg	Inflow TP ppb	HLR cm/day	PLR g/m2/yr	Outflow Flow ac-ft	Outflow TP Load kg	Outflow TP ppb	TP Rmvd kg	TP Rmvd %	TP Removal g/m2/yr	Cumulative Removal kg	Avg. Annual Eff. Trt. Area acres	Avg. depth cm	HRT Days	Settling Rate m/yr
2000* Partial WY, start 9/99.	8,088	2,260	226	0.33	0.27	13,343	2,741	167	-481	-21%						
2001	50,459	15,517	249	1.03	0.93	39,978	4,770	97	10,747	69%	0.64	10,747	4,110	41.1	40.1	4
2002	159,258	49,118	250	3.24	2.95	131,005	12,567	78	36,551	74%	2.19	47,298	4,110	49.3	15.2	14
2003	170,203	58,094	277	3.46	3.49	160,518	26,881	136	31,213	54%	1.87	78,511	4,110	56.5	16.3	9
2004	153,080	48,078	255	3.11	2.89	136,466	16,407	97	31,671	66%	1.90	110,182	4,110	58.8	18.9	11
2005	119,910	24,420	165	2.63	1.59	121,427	12,196	81	12,224	50%	0.89	122,406	3,805	58.8	22.3	7
2006	216,514	53,027	199	5.61	4.07	201,102	23,702	96	29,325	55%	1.76	151,731	3,222	41.7	5.8	19
Total	***877,512***	***250,514***	***231***			***803,838***	***99,264***	***100***	***151,249***	***60%***						

STA-6
(Start up 10/97, Flow-through
Date: 12/97)

Inflow = G-600 *Outflow = G-393 and G-354*

Water Year	Inflow Flow ac-ft	Inflow TP Load kg	Inflow TP ppb	HLR cm/day	PLR g/m2/yr	Outflow Flow ac-ft	Outflow TP Load kg	Outflow TP ppb	TP Rmvd kg	TP Rmvd %	TP Removal g/m2/yr	Cumulative Removal kg	Avg. Annual Eff. Trt. Area acres	Avg. depth cm	HRT Days	Settling Rate m/yr
1998* Partial WY, startup, 10/97	4,121	190	37													
1998* Partial WY, flow-through 12/97	26,101	1,675	52	7.52	1.43	23,984	481	16	1,194	71%	1.02	1,194	870	45.00	6.0	37
1999	40,120	3,112	63	3.85	0.88	24,035	588	20	2,524	81%	0.72	3,718	870	26.00	6.8	18
2000	59,848	5,345	72	5.74	1.52	59,261	1,115	15	4,230	79%	1.20	7,948	870	38.20	6.6	38
2001	39,395	6,813	140	3.78	1.94	26,718	986	30	5,827	86%	1.65	13,775	870	30.70	8.1	23
2002	53,437	4,536	69	5.13	1.29	30,466	563	15	3,973	88%	1.13	17,748	870	47.90	9.3	33
2003	56,252	5,360	77	5.40	1.52	35,666	1,046	24	4,314	80%	1.23	22,062	870	50.10	9.3	26
2004	52,674	3,424	53	5.06	0.97	38,682	515	11	2,910	85%	0.83	24,972	870	55.90	11.1	36
2005	34,035	3,255	78	3.27	0.92	22,187	515	19	2,740	84%	0.78	27,712	870	55.90	17.1	19
2006	40,467	5,183	104	3.88	1.47	26,312	848	26	4,335	84%	1.23	32,047	870	47.55	13.0	21
Total	***406,450***	***38,894***	***78***			***287,312***	***6,656***	***19***	***32,238***	***83%***						

Table 5-39. Continued.

Total of all STAs														
Operational STAs	**Water Year**	**Inflow Flow ac-ft**	**Inflow TP Load kg**	**Inflow TP ppb**	**HLR cm/day**	**PLR g/m2/yr**	**Outflow Flow ac-ft**	**Outflow TP Load kg**	**Outflow TP ppb**	**TP Rmvd kg**	**TP Rmvd %**	**TP Removal g/m2/yr**	**Cumulative Removal kg**	**Avg. Annual Eff. Trt. Area acres**
ENR section of STA-1W	1994	0.00	-				1	0	20	0				
ENR section of STA-1W	1995	92,364	15,452	136	3.47	1.72	95,333	2,718	23	12,735	82%	1.41	12,735	3,815
ENR Section of STA-1W	1996	182,670	24,464	109	4.00	1.58	172,414	5,079	24	19,385	79%	1.26	32,120	3,815
ENR Section of STA-1W	1997	118,780	14,391	98	2.60	0.93	119,198	2,750	19	11,642	81%	0.75	43,761	3,815
ENR Section of STA-1W, STA-6	1998	110,526	13,401	98	3.05	0.82	104,970	2,606	20	10,795	81%	0.57	54,556	4,685
ENR Section of STA-1W, STA-6	1999	128,652	14,208	90	2.53	0.75	110,411	2,633	19	11,575	81%	0.61	66,131	4,685
STA-1W, STA-5, STA-6	2000	193,520	28,744	120	3.57	1.31	193,833	7,609	32	21,135	74%	1.11	87,266	4,685
STA-1W, STA-2, STA-5, STA-6	2001	341,685	61,799	147	2.83	1.26	157,213	10,075	52	51,723	84%	0.73	138,989	17,604
STA-1W, STA-2, STA-5, STA-6	2002	704,360	125,730	145	3.34	2.12	669,780	30,197	37	95,533	76%	1.31	234,522	18,080
STA-1W, STA-2, STA-5, STA-6	2003	1,101,032	199,025	147	5.74	3.51	1,100,480	73,795	54	125,229	63%	1.71	359,751	18,080
STA-1W, STA-2, STA-3/4, STA-5, STA-6	2004	778,685	127,919	133	3.43	2.04	785,239	39,571	41	88,348	69%	1.21	448,100	18,080
STA-1W, STA-2, STA-3/4, STA-5, STA-6	2005	1,502,180	272,890	147	4.15	2.79	1,564,439	86,910	45	185,980	68%	1.51	634,080	30,413
STA-1E, STA-1W, STA-2, STA-3/4, STA-5, STA-6	2006	1,446,316	257,156	144	4.00	2.35	1,477,271	80,918	44	176,238	69%	1.28	810,318	33,897
	Total	***6,700,771***	***1,155,179***	***140***			***6,550,581***	***344,861***	***43***	***810,318***	***70%***			

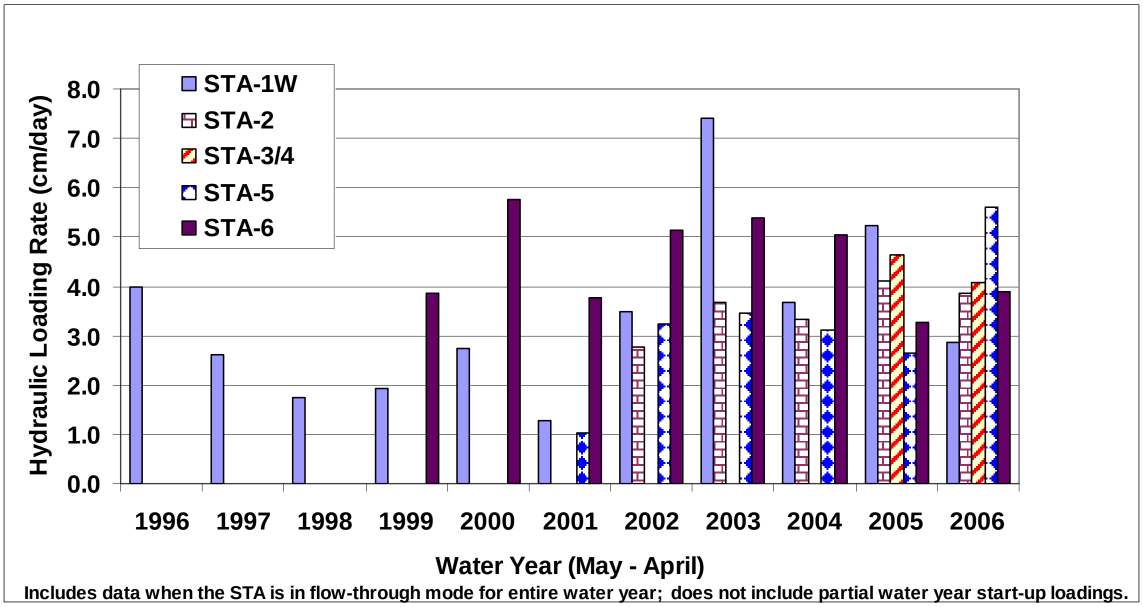


Figure 5-57. Hydraulic loading rates for the STAs when in flow-through mode.

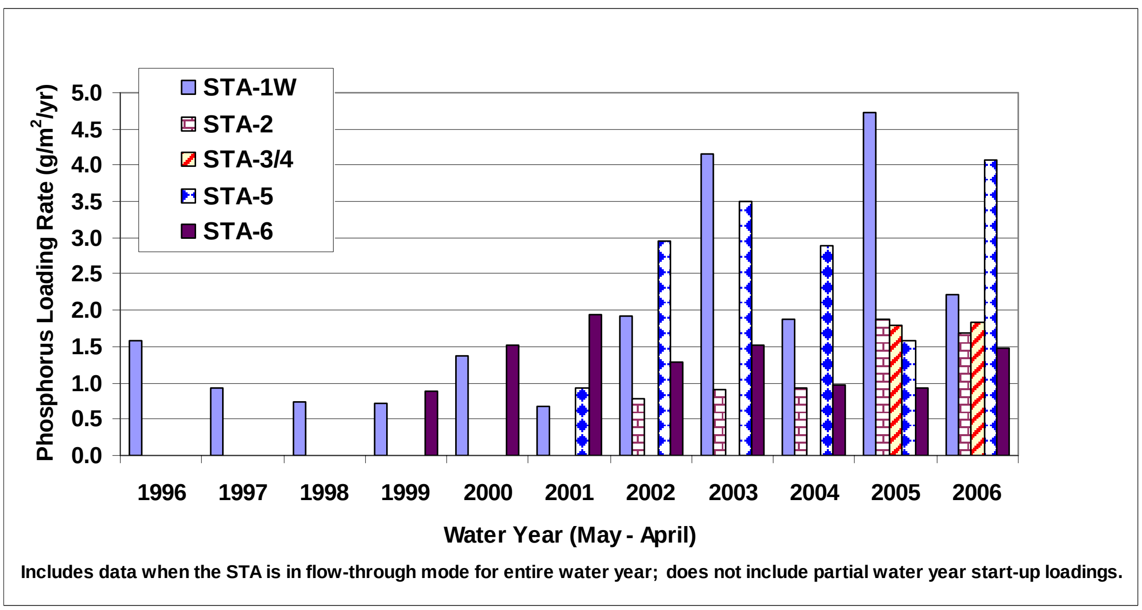


Figure 5-58. Phosphorus loading rates for the STAs when in flow-through mode.

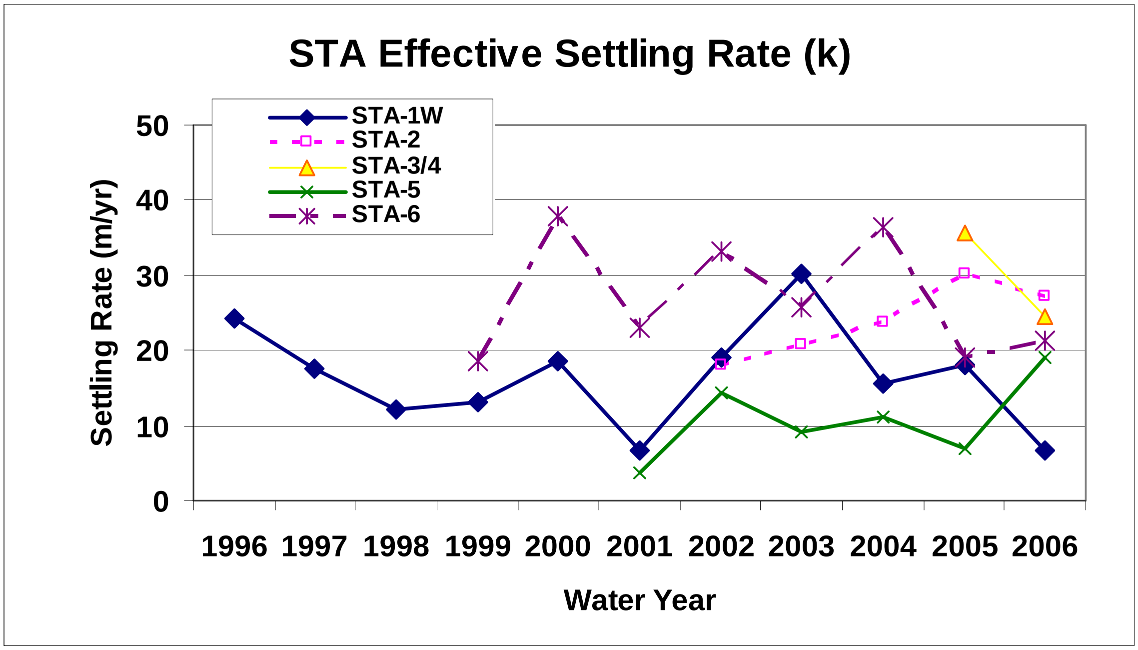


Figure 5-59. STA effective settling rates for the POR. In WY2006, STA-1W, STA-3/4, and STA-5 had reduced effective treatment areas due to Long-Term Plan enhancements construction or vegetation rehabilitation.

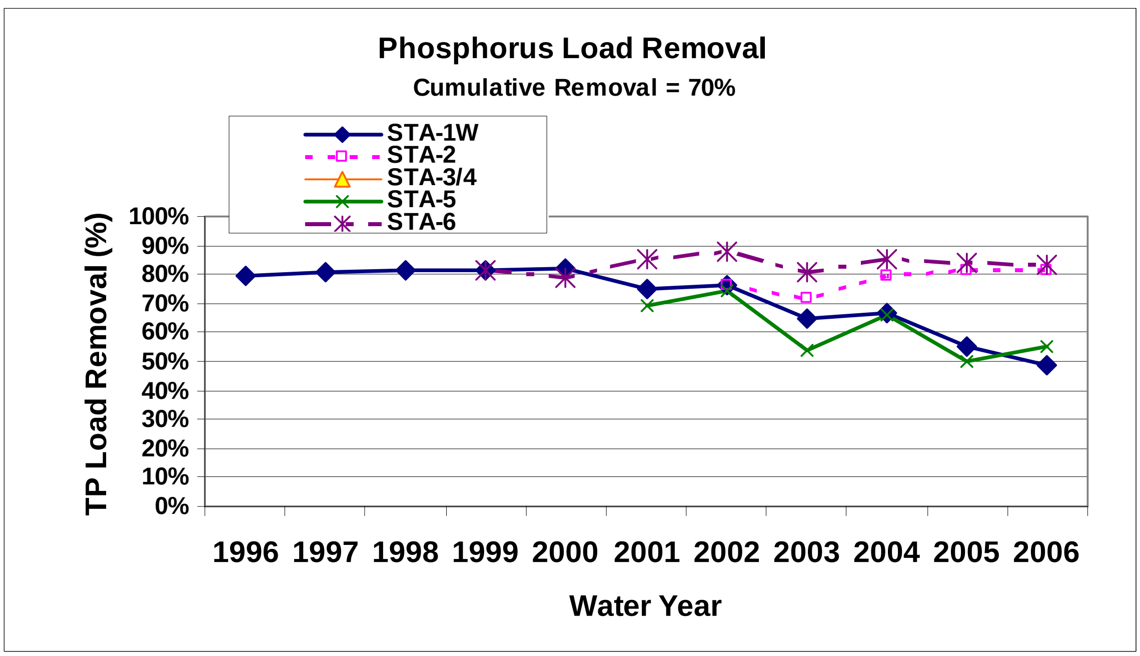


Figure 5-60. STA TP load removal for the POR. In WY2006, STA-1W, STA-3/4, and STA-5 had reduced effective treatment areas due to Long-Term Plan enhancements construction or vegetation rehabilitation.

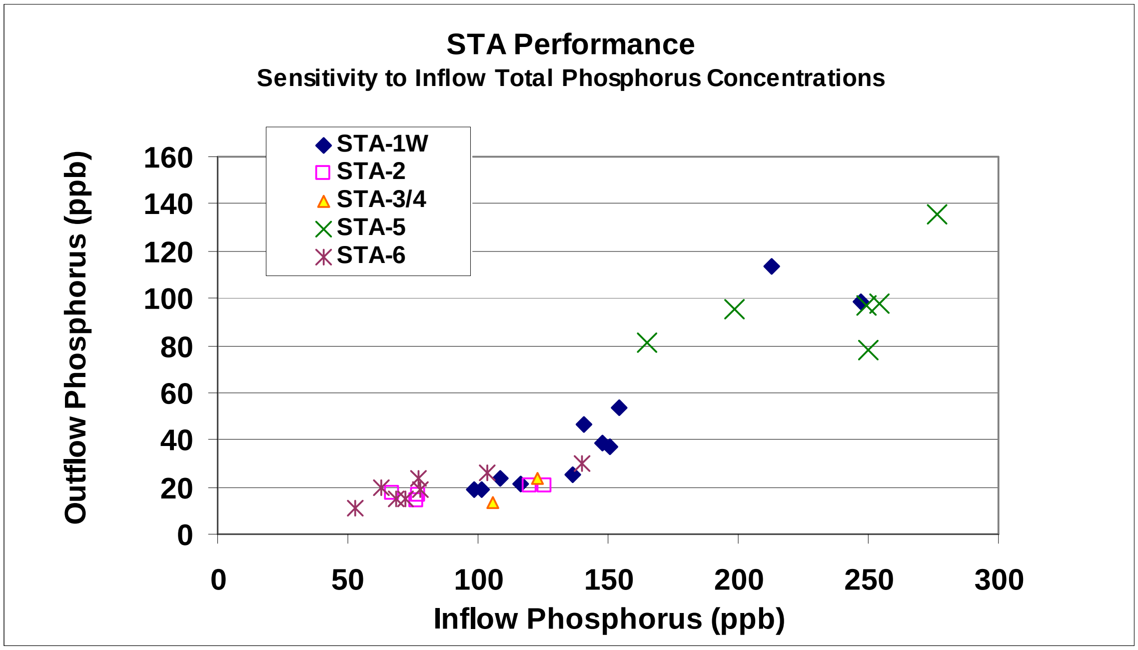


Figure 5-61. STA outflow TP concentration compared to STA inflow concentration. In WY2006, STA-1W, STA-3/4, and STA-5 had reduced effective treatment areas due to Long-Term Plan enhancements construction or vegetation rehabilitation.

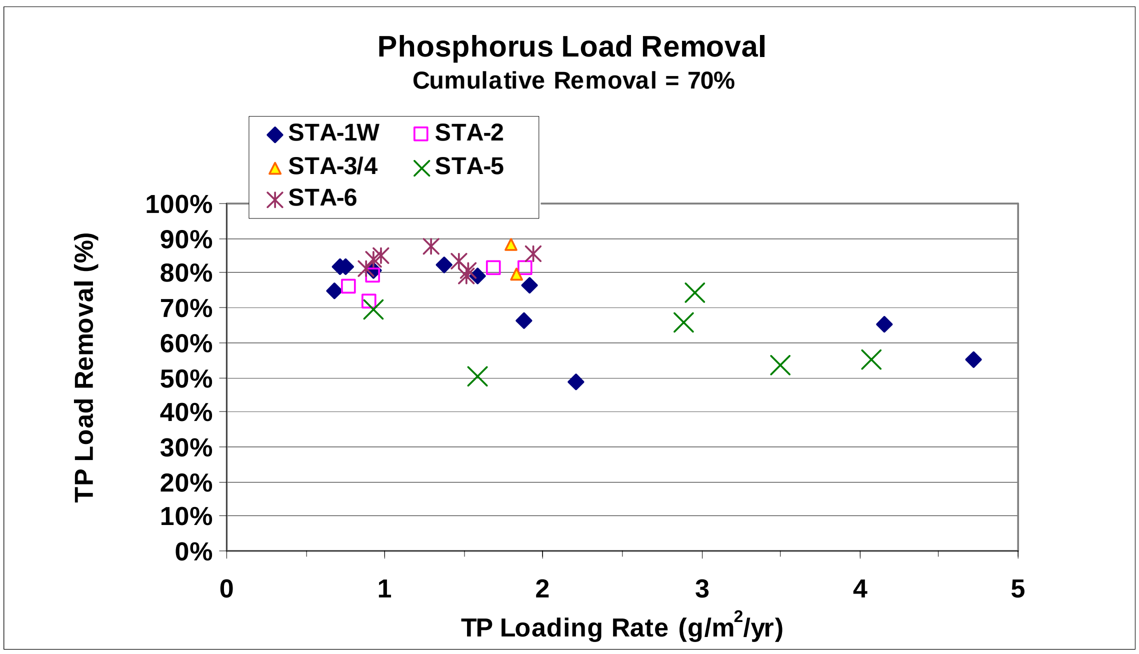


Figure 5-62. STA TP load removal compared to the inflow TP loading rate for the STAs when in flow-through mode. In WY2006, STA-1W, STA-3/4, and STA-5 had reduced effective treatment areas due to Long-Term Plan enhancements construction or vegetation rehabilitation.

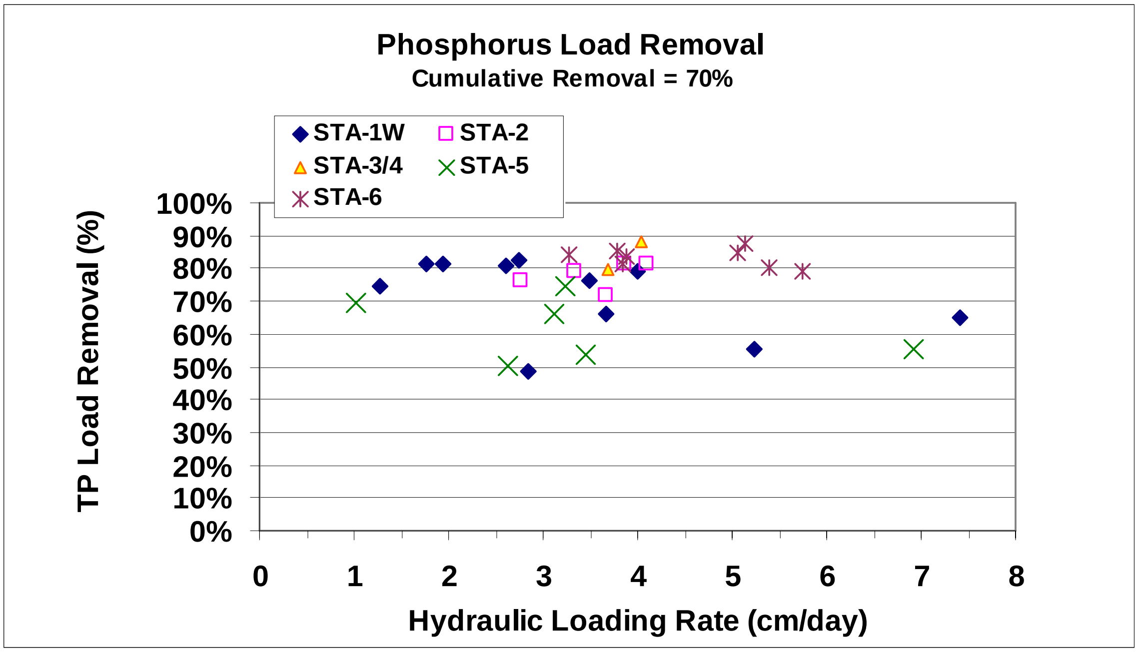


Figure 5-63. STA TP load removal compared to the inflow TP loading rate for the STAs when in flow-through mode. In WY2006, STA-1W, STA-3/4, and STA-5 had reduced effective treatment areas due to Long-Term Plan enhancements construction or vegetation rehabilitation.

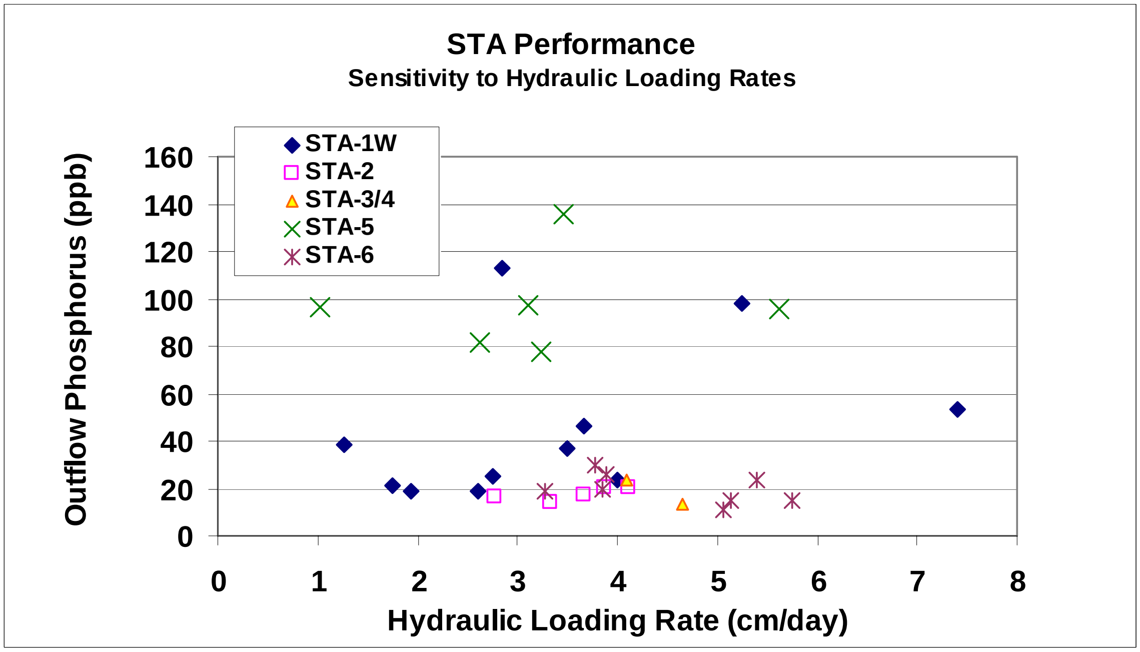


Figure 5-64. STA outflow TP concentrations compared to the inflow hydraulic loading rate for the STAs when in flow-through mode. In WY2006, STA-1W, STA-3/4, and STA-5 had reduced effective treatment areas due to Long-Term Plan enhancements construction or vegetation rehabilitation.

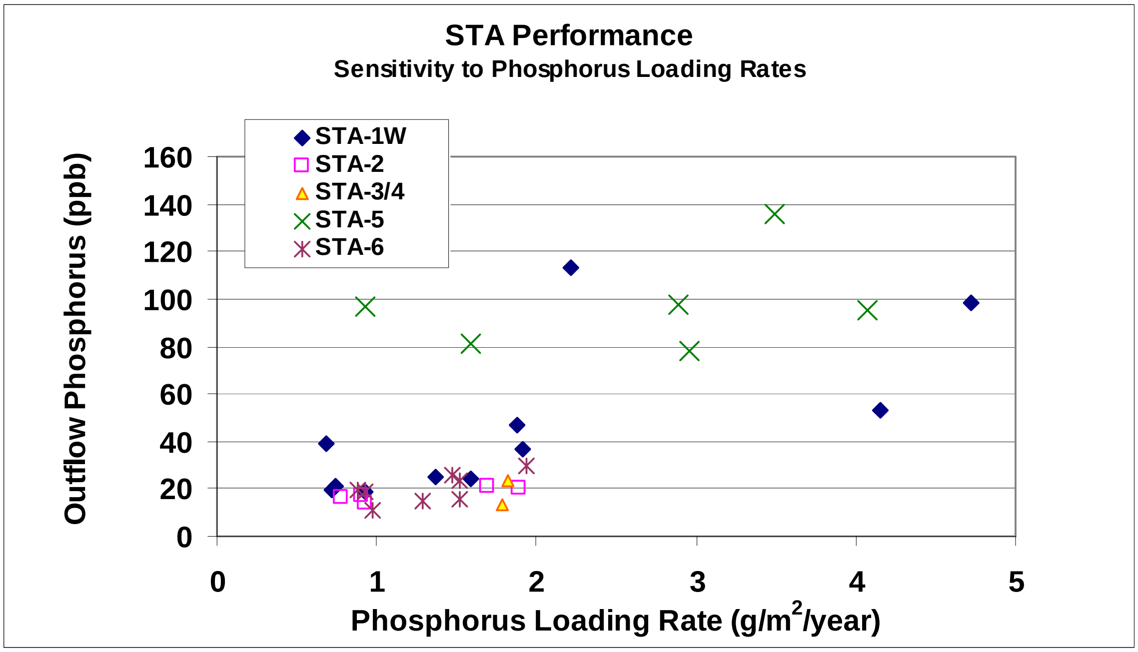


Figure 5-65. STA outflow TP concentrations compared to the inflow TP loading rate for the STAs when in flow-through mode. In WY2006, STA-1W, STA-3/4, and STA-5 had reduced effective treatment areas due to Long-Term Plan enhancements construction or vegetation rehabilitation.

STATUS OF OTHER LONG-TERM PLAN PROJECTS

HYDROLOGIC AND HYDRAULIC ASSESSMENT AND INTERNAL MEASUREMENTS

The steady-state performance model used in the design of the STAs (Burns and McDonnell, 1993) assumed plug-flow hydraulics. However, tracer studies conducted in STA-1W Cells 1 and 4, have documented that flow patterns can depart markedly from ideal plug-flow conditions and that large short-circuits may exist (DBEL, 2000 and 2003). It is thought that hydraulic inefficiency can reduce TP removal in the STAs (Kadlec, 2000). The theory is that these non-ideal flow patterns typically will persist until flow is redistributed by some structural means, such as the addition of a levee perpendicular to the direction of flow that subdivides the treatment cell into two smaller areas.

The original intent of the Hydrologic and Hydraulic Assessment Project was to conduct tracer studies to characterize the hydraulics (i.e., retention time and flow distribution) of Cell 3 in STA-2 both before and after the construction of an internal levee. Similarly, the original objective of the Internal Measurements Project was to document the spatial variability of TP concentrations in surface water within Cell 3 based on synoptic grab samples collected during both tracer studies. The STA-2 Cell 3 pre-levee tracer and synoptic measurements were administered through a single contract that began in October 2004. The final report documenting the pre-levee tracer project and associated synoptic internal measurements is available on the District's website at www.sfwmd.gov under the *Everglades* section, *Long-Term Plan for Achieving Everglades Water Quality Goals* link.

As a result of the recent proposal to delete the proposed STA-2 Cell 3 internal levee, the location of the second tracer and synoptic internal measurements is proposed to be moved to STA-1W Eastern Flow-way (Cells 1A, 1B, and 3) where a pre-levee tracer was already performed. The estimated start date for the STA-1W Cells 1A, 1B, and 3 post-levee tracer and synoptic study is fall 2008 (FY2009) and the estimated completion date is December 2008 (FY2009).

ECP OPERATIONS MONITORING PROJECT

The objective of the ECP Operations Monitoring Project is to collect water quality samples and monitor flow at inflow and outflow locations of all treatment cells within the STAs that are not covered under the operating permits. Most of the ECP operations monitoring structures are currently being monitored with the exception of some structures located in flow-ways undergoing Long-Term Plan enhancements. Additional monitoring stations are scheduled to come online in WY2007 with the STA initial expansions which are included in the Long-Term Plan and are being implemented through Acceler8.

Flow is monitored on a continuous basis. Water quality samples analyzed for flow-proportional TP concentrations are collected weekly; all other parameters are monitored biweekly. These data will be used to assess the performance of each treatment cell and will contribute to the development of strategies for improving TP removal efficiency in the STAs as a whole.

During WY2006, flow and water quality monitoring in the STAs continued at the ECP operations monitoring stations listed in **Table 5-40**. Internal, biweekly grab sampling of STA-1E began in June 2006, but auto-sampling equipment has not yet installed due to telemetry installation complications. The installation of monitoring stations in STA-3/4 was largely complete as reported last year, with the exception of the activation of monitoring stations at the new G-384 levee located in Flow-way 3. Flow-way 3 became flow capable in June 2006, and the District then commenced telemetry and water quality instrumentation. All ECP operations monitoring in STA-1W was ongoing with the exception of the structures in the Western Flow-way (Cells 2 and 4) and the Northern Flow-way (Cell 5) which were closed for construction of the Long-Term Plan recommended enhancements and rehabilitation efforts. ECP operations monitoring in the Northern Flow-way of STA-5 was discontinued for most of WY2006. Following completion of the Long-Term Plan recommended enhancements, this flow-way became flow capable around June 2006. The Southern Flow-way of STA-5 was taken off-line in January 2006 to begin the scheduled Long-Term Plan enhancements. All ECP operations monitoring in STA-2 and STA-6 is ongoing.

Table 5-40. Operational status of new and existing water quality monitoring sites at interior treatment cells within the STAs during WY2006.

Location	Description	# Sites	Status
STA-1E (not including groundwater monitoring)	New: S-366(B, D), S-367 (B, D), S-368 (B, D), S-369 (B, C), S-370 (B), S-372 (B, D), S-373 (B), S-374 (B)	13	Grab samples taken biweekly beginning in June 2007 with auto-sampler installation to be completed by end of WY2007.
	Existing: None	0	
STA-1W	New: G-302	1	Auto-sampler installed.
	Existing: G-303, G-305 (G, N), G-306(C, G), G-255, G-254 (B, D), G-253 (C, G), G-256, G-308, G-309, G-327A, ENR305, ENR306, G-250S, G-258, G-259	19	Routine monitoring ongoing in Cells 1 and 3. Cells 2, 4, and 5 were off-line during WY2006 for construction of Long-Term Plan recommended enhancements and rehabilitation efforts.
STA-2	New: None	0	---
	Existing: G-329(B), G-330(D), G-331(D), G-332, G-333(C), G-334	1	Routine monitoring ongoing at all water quality stations. Auto-sampler installation under way at G-330(D).
STA-3/4	New: None	0	---
	Existing: G-374 (B, E), G-375 (B, E), G-377 (B, D), G-378 (B, D), G-370 Seep, G-372 Seep, G-383	11	Routine water quality monitoring ongoing in Flow-ways 1 and 2. Flow-way 3 was off-line for Long-Term Plan enhancements.
STA-5	New: None	0	---
	Existing: G342 (A-D), G-343 (B, C, F, G), G344 (A-D), G-349A, G-350A	6	Routine water quality monitoring ongoing in Southern Flow-way for portion of WY2006; was taken off-line for Long-Term Plan enhancements in January 2007. Northern Flow-way off-line during WY2006 for Long-Term Plan enhancements.
STA-6	New: None	0	---
	Existing: G-602, G-603	2	All water quality stations online and monitoring ongoing

STA SITE MANAGEMENT

The District's Operations and Maintenance Department, Environmental Operations Section, currently staffs three STA site managers (one for both STA-1W and STA-1E, one for both STA-2 and STA-3/4, and one for both STA-5 and STA-6). The primary responsibility of the STA site managers is to coordinate among various departments, divisions, and external stakeholders to facilitate resolution of day-to-day STA management and operation issues. Site managers maintain an onsite presence at STAs to ensure objectives of the STA program are met.

Site managers routinely report observations of changing environmental and site conditions, maintenance concerns, or infrastructure problems to appropriate District staff. Significant additional coordination between the District's Construction Department and the site managers has been and will be required during the build-out of the Long-Term Plan components. Additionally, site managers coordinate monthly vegetation management surveys with Vegetation Management and Field Operations staff to identify priorities and strategies to meet the overall vegetation goals of the STA program. Site managers also monitor daily stormwater operations and confirm that these operations are consistent with the established STA operation plans.

ACQUISITION OF SURVEY DATA

The Acquisition of Survey Data Project as described in the October 27, 2003, the Long-Term Plan was completed in FY2005. As new STA facilities and structures are completed, acquisition of any necessary survey data will be collected on an as needed basis.

ADDITIONAL FLOW AND WATER QUALITY MONITORING STATIONS

This project consists of establishing 47 new flow and water quality monitoring stations in the STAs. These additional monitoring stations are in STA-3/4 (two seepage pumps and nine culverts), STA-1W (two culverts), and STA-1E (19 stations). The instrumentation has been completed, and flow computation has been implemented at G-258 and G-259 culverts in STA-1W. The registration in the District's hydrometeorologic database, DBHYDRO, has been completed for G-374B and E, G-375B and E, G-377B and D, G-378B and D, G-383, and seepage pumps G-370, and G-372 in STA-3/4. Currently, flow is computed at all STA-3/4 culverts using calibrated flow-rating equations. Flow is also computed at the inflow pumps G-370, G-370S (seepage), G-372, and G-372S (seepage) using the pump manufacturers' curves at these sites.

Stilling wells have been installed at the following 19 stations in STA1-E: S-363B, S-364B, S-365A and B, S-366B and D, S-367B and D, S-368B and D, S-369A and D, S-370, S-371B, S-372B and D, S-373B, S-374B, and S-375. Certification and validation of these stage sensors and replacement of the gate sensors has been completed. During FY2006, three discharge measurements were made at S-319, one measurement was made at S-361, and one measurement was made at S-362. Additional measurements will be made as more opportunities come this rainy season. Installation of sensors at structures G-380B and E and G-381B and E has been completed.

REVIEW AND CORRECTION OF FLOW MEASUREMENT ANOMALIES

The goal of this project is to address flow estimate uncertainties and to provide good quality flow data at all major flow stations in the STAs. Calibrated flow equations have been completed and implemented at 100 percent in STA-5 and STA-6, at 95 percent in STA-1W, and at 80 percent in STA-2. Theoretical flow equations for flow computation have been implemented at 100 percent in STA-1E, STA-1W, STA-2, STA-3/4, STA-5, and STA-6. In FY2007, the District will perform over 120 field flow measurements (60 in STA-3/4, and 63 in STA-1E) to complete flow rating calibration analyses at about 30 water control structures in STA-3/4 and in STA-1E.

UPDATE AND MAINTENANCE OF HYDRAULIC MODELS

In February 2004, a two-dimensional (2-D) hydraulic modeling of the STAs was initiated. During FY2005 and early FY2006, linked cells models were developed for STA-2, STA-6 Section 1, STA-1W, STA-5, STA-3/4, and STA-1E. For each of these STAs, existing conditions models were developed and three flow conditions were simulated: Low Flow, Design Flow, and Peak Flow. In mid FY2006, an updated model of STA-1W Cell 5 was developed in support of the District's plan to address issues with the cell's performance as a result of severe hurricane damage. Reports describing the 2-D models developed by Sutron Corporation, Inc., are available on the District's website at www.sfwmd.gov under the *Everglades* section, *Long-Term Plan for Achieving Everglades Water Quality Goals* link.

OPERATIONAL STRATEGY

This project is complete; no activities were scheduled or completed for this project in FY2006.

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