

# **Settlement Agreement**

## **October - December 2004 Report**



**Prepared for the  
Technical Oversight Committee  
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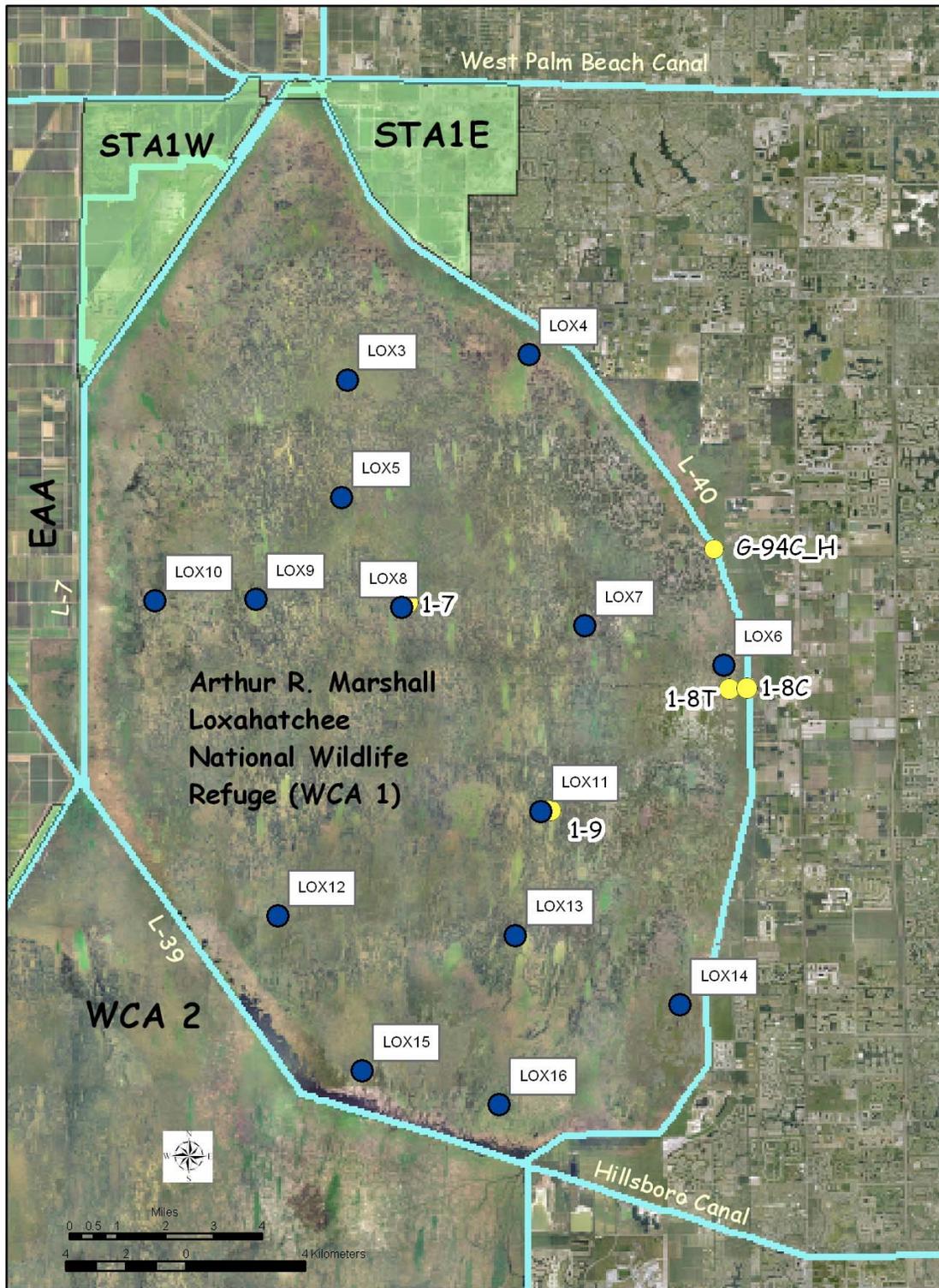
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# ARTHUR R. MARSHALL LOXAHATCHEE NATIONAL WILDLIFE REFUGE

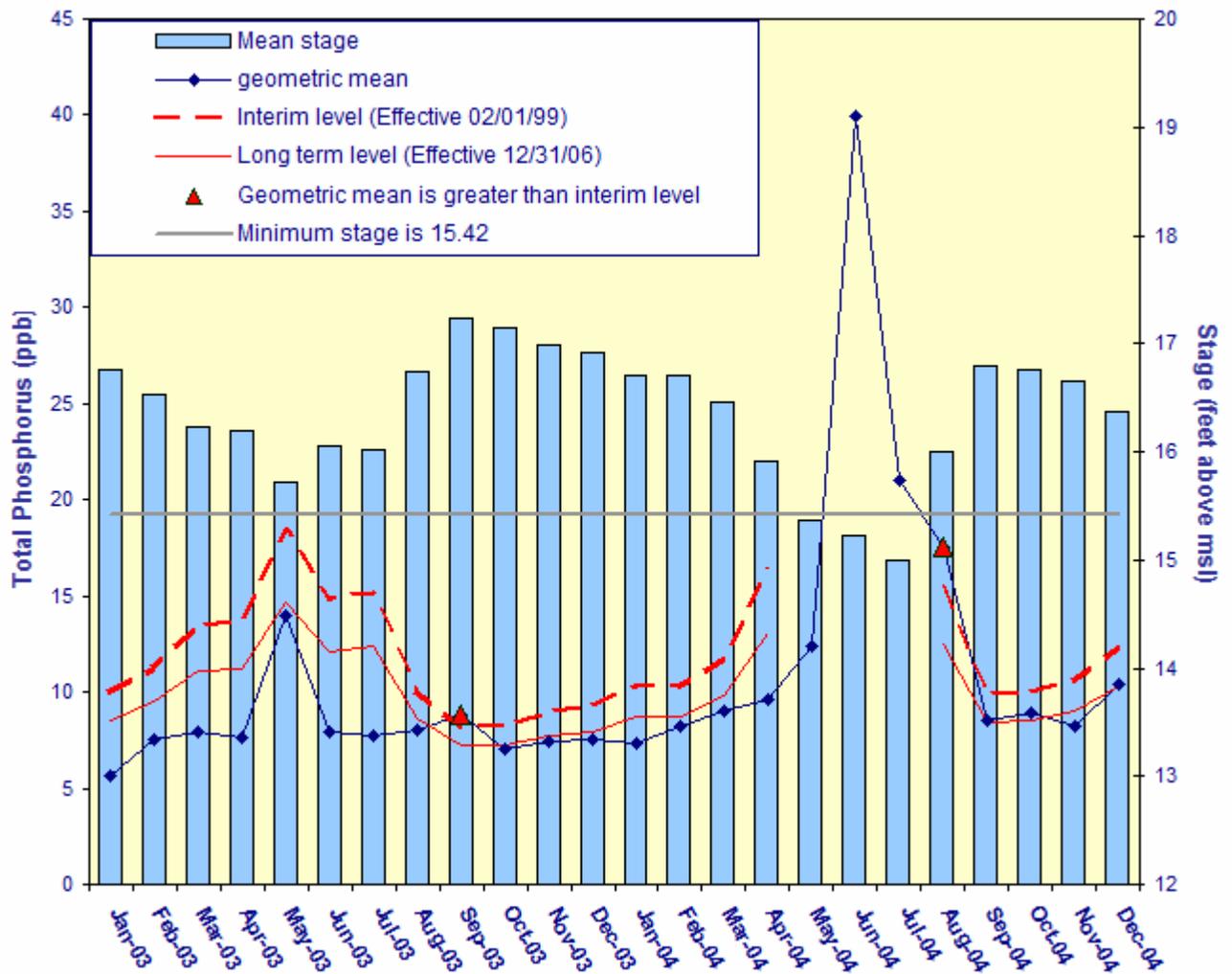
The 1991 Settlement Agreement ended the Everglades lawsuit and was entered into by the federal government, the State of Florida and the South Florida Water Management District. The subsequent Consent Decree, as modified in 1995, specified that interim and long-term phosphorus concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by Feb. 1, 1999, and Dec. 31, 2006, respectively. The concentration levels vary monthly because they are calculated as a function of water stage measured at gauging stations 1-7, 1-8C and 1-9 within the Refuge. The stage range within which the interim and long-term concentration levels are applicable is 15.42 to 17.14 feet NGVD. The monthly total phosphorus concentrations are determined from water samples collected at 14 interior marsh stations, LOX 3 through LOX 16 (**Figure 1**). As required in the Consent Decree, the concentrations are converted to a geometric mean, which is compared to the interim and long-term concentration levels.

Several hurricanes impacted Florida during the third calendar quarter of the year. Hurricane Frances, on September 4 through 8 2004, disabled the satellite data collection platform at 1-8C. The platform at 1-8C was repaired on December 2, 2004. Use of the manual readings recorded by Refuge staff was deemed most appropriate for the months of October and November in determining compliance.

Average stages in the Refuge were 16.76, 16.65 and 16.37 feet in October, November and December 2004, respectively (**Figure 2** and **Table 1**). The geometric means, calculated from total phosphorus concentrations measured in water samples collected in October, November and December 2004 were 8.9, 8.3 and 10.4 ppb, respectively. The interim limits were 10.0, 10.6 and 12.4 ppb, respectively. The long-term limits were 8.5, 9.0 and 10.3 ppb, respectively. The geometric means were less than the interim levels for the three months. However, the geometric means were higher than the long-term levels for October and December 2004.



**Figure 1.** A.R.M. Loxahatchee Refuge Water Quality Sampling and Stage Measurement Sites



**Figure 2.** Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage. Interim and Long-term limits are not shown for May – July 2004 because the mean stage was less than 15.42 ft.

**Table 1. Loxahatchee National Wildlife Refuge Total Phosphorus Compliance Tracking.**

Month - Year	Geometric Mean Concentratio	Interim Level (ppb)	Long Term Level (ppb)	Average Stage	Number of TP Samples	Number of Stage Measure-ments
	(ppb)	Effective 2/1/99	Effective 12/31/06	(ft,NGVD)		
Jan-2003	5.7	10.0	8.5	16.76	13	3
Feb-2003	7.5	11.3	9.5	16.54	11	3
Mar-2003	8.0	13.4	11.1	16.23	9	3
Apr-2003	7.6	13.7	11.2	16.20	12	3
May-2003	14.0	18.3	14.6	15.72	7	3
Jun-2003	7.9	14.8	12.1	16.06	11	3
Jul-2003	7.7	15.2	12.3	16.02	9	3
Aug-2003	8.0	10.1	8.6	16.74	14	3
Sep-2003	8.8	8.3	7.2	17.23	13	3
Oct-2003	7.0	8.3	7.2	17.15	14	3
Nov-2003	7.5	8.9	7.7	16.98	11	3
Dec-2003	7.6	9.3	8.0	16.91	14	3
Jan-2004	7.4	10.3	8.7	16.71	14	3
Feb-2004	8.2	10.3	8.7	16.71	14	3
Mar-2004	9.0	11.8	9.8	16.46	14	3
Apr-2004	9.6	16.3	13.1	15.91	9	3
May-2004	12.4	N/A	N/A	15.37	9	3
Jun-2004	40.0	N/A	N/A	15.22	2	3
Jul-2004	21.0	N/A	N/A	15.00	1	3
Aug-2004	17.5	15.4	12.5	16.00	12	3
Sep-2004	8.5	9.9	8.4	16.79	14	3
Oct-2004	8.9	10.0	8.5	16.76	13	3
Nov-2004	8.3	10.6	9.0	16.65	14	3
Dec-2004	10.4	12.4	10.3	16.37	13	3

Notes: (1) Average Stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 on the sampling date.  
(2) Highlighted rows indicate months when excursions occurred.  
(3) N/A denotes that the concentration values were not applicable because the average stage was less than 15.42 feet.

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# EVERGLADES NATIONAL PARK

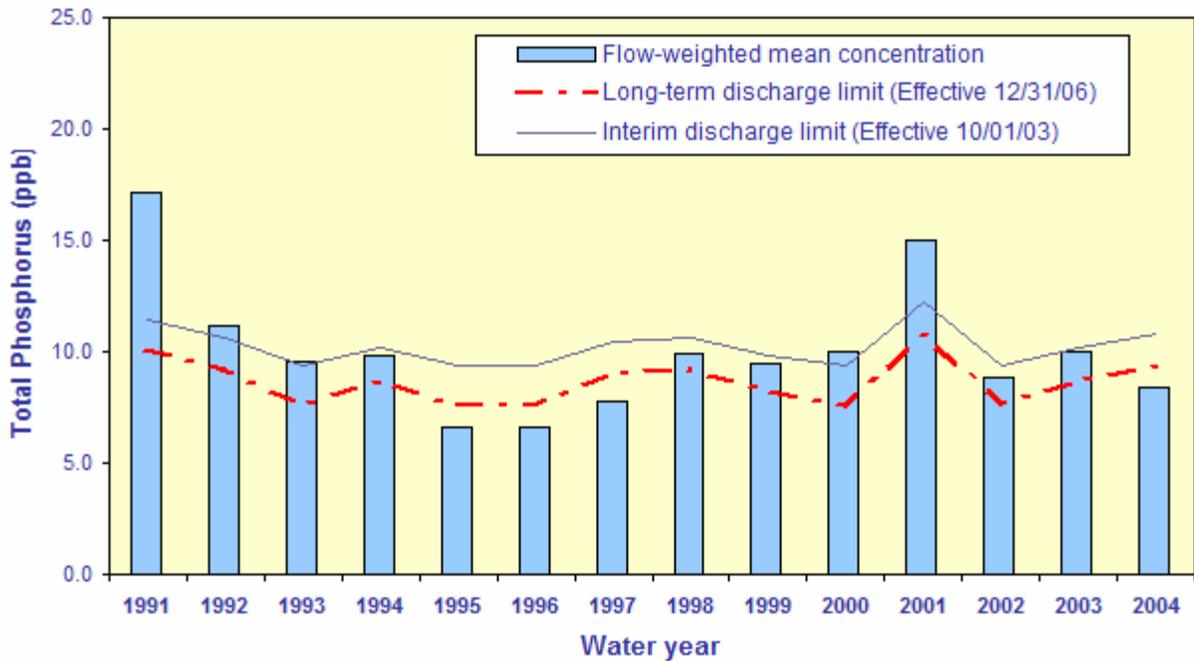
## Shark River Slough

The Consent Decree of 1995 specified that interim and long-term total phosphorus concentration limits for discharges into the Everglades National Park (ENP) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. Only the total phosphorus concentrations for the water year ending September 30 are evaluated for compliance with the Consent Decree limits. It was also specified that the total phosphorus concentrations be presented as 12-month moving flow-weighted means. The long-term total phosphorus concentration limit for inflows to Shark River Slough through structures S12A, S12B, S12C, S12D and S333 represents the concentrations delivered during the Outstanding Florida Waters baseline period of March 1, 1978 to March 1, 1979, and is adjusted for variations in flow.

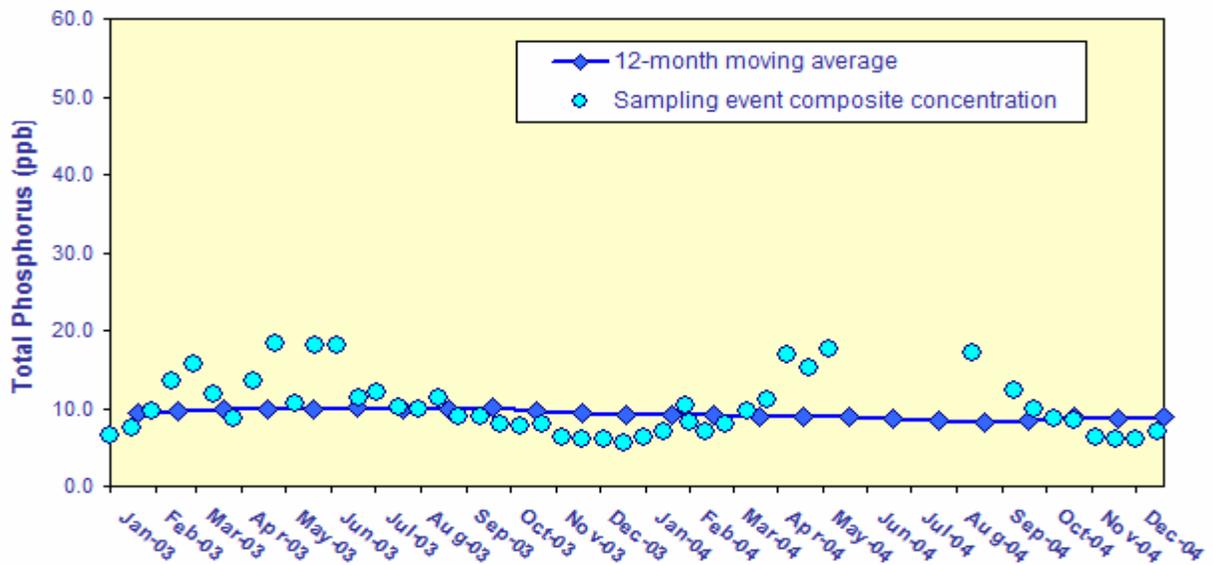
Inflow concentrations of total phosphorus through Shark River Slough are compared to the interim and long-term limits at the end of each water year from 1991 to 2004 (**Figure 3**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2004 was 8.4 ppb. Corresponding interim and long-term limits were 10.8 and 9.4 ppb, respectively. September 30, 2004 was the end of first water year when the Interim discharge limit became effective for Shark River Slough.

**Table 2** presents the moving flow-weighted mean concentrations for each 12-month period beginning in January 2003 as well as the corresponding interim and long-term total phosphorus concentration limits, calculated using the 12-month period flow. For the 12-month periods ending in October, November and December 2004, the flow-weighted mean total phosphorus concentrations were 8.9, 8.7 and 9.0 ppb, respectively. The interim limits were 10.7, 10.6 and 10.7 ppb, respectively. The long-term limits were 9.3, 9.1 and 9.2 ppb, respectively. The October, November and December 2004 concentrations were less than both the interim and long-term limits.

The Consent Decree stipulates that the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb from each sampling event in any 12-month period must not exceed a guideline value based on flow into Shark River Slough for the same 12-month period. For the 12-month periods ending October, November and December 2004, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 35.0, 33.3 and 35.0, respectively. October, November and December observed percentages were less than the guidelines (**Table 2**). The individual sampling events and the 12-month moving averages are presented in **Figure 4**.



**Figure 3.** The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the total phosphorus interim and long-term limits.



**Figure 4.** The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each month and the composite total phosphorus concentration for each sampling event. There are no sampling event values for June and July 2004 because there was no flow in those months.

**Table 2. Shark River Slough Total Phosphorus Concentration Compliance Tracking.**

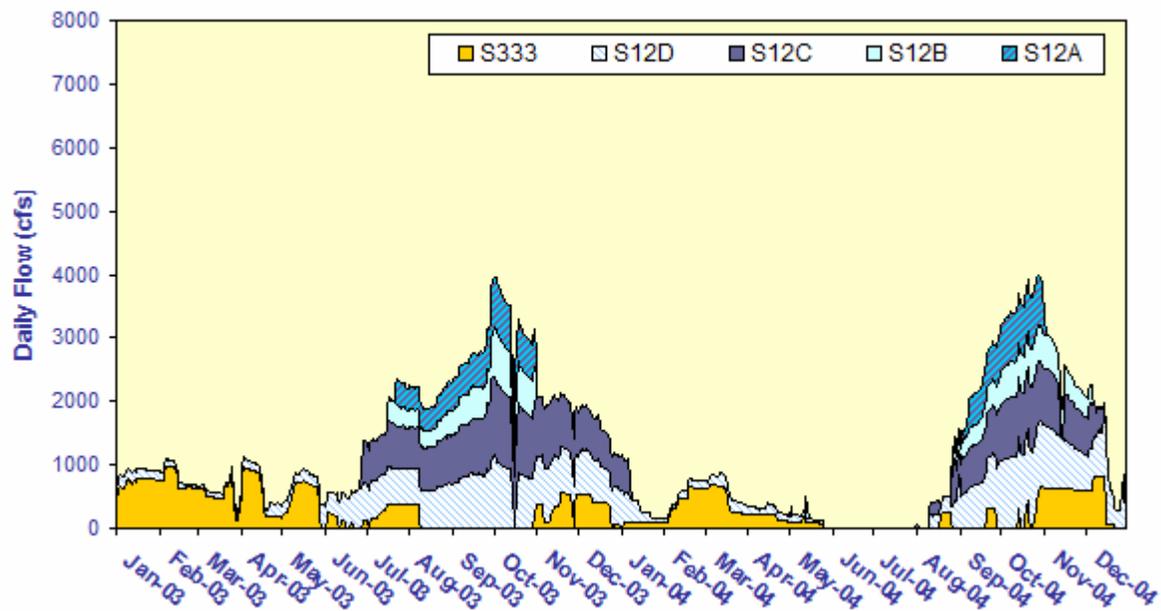
12-Month Period Ending On	Total Period Flow	Flow Weighted Mean Total Phosphorus	Interim Limit (ppb)	Long Term Limit (ppb)	Percent of Sampling Events Greater than 10 ppb	
			Effective	Effective	( <b>%</b> )	
	(Kac-ft)	(ppb)	10/1/2003	12/31/2006	Guideline	Observed
<b>31-Jan-03</b>	831.1	9.5	10.3	8.8	45.6	34.8
<b>28-Feb-03</b>	843.6	9.7	10.2	8.7	45.2	39.1
<b>31-Mar-03</b>	812.1	9.9	10.3	8.9	46.1	<b><i>47.8</i></b>
<b>30-Apr-03</b>	832.1	9.9	10.2	8.8	45.5	43.5
<b>31-May-03</b>	871.3	10.0	10.1	8.6	44.5	<b><i>45.8</i></b>
<b>30-Jun-03</b>	901.1	10.2	10.0	8.4	43.8	<b><i>50.0</i></b>
<b>31-Jul-03</b>	891.3	9.8	10.0	8.5	44.0	<b><i>50.0</i></b>
<b>31-Aug-03</b>	839.3	9.9	10.2	8.7	45.3	<b><i>50.0</i></b>
<b>30-Sep-03</b>	850.1	10.0	10.2	8.7	45.1	<b><i>50.0</i></b>
<b>31-Oct-03</b>	921.8	9.7	9.9	8.3	43.3	<b><i>50.0</i></b>
<b>30-Nov-03</b>	1001.5	9.5	9.6	7.9	41.4	<b><i>46.2</i></b>
<b>31-Dec-03</b>	1076.8	9.1	9.4	7.6	40.1	<b><i>46.2</i></b>
<b>31-Jan-04</b>	1049.0	9.2	9.4	7.7	40.4	<b><i>46.2</i></b>
<b>29-Feb-04</b>	1033.9	9.1	9.5	7.8	40.7	<b><i>44.4</i></b>
<b>31-Mar-04</b>	1036.7	8.9	9.4	7.7	40.7	37.0
<b>30-Apr-04</b>	1012.9	9.0	9.5	7.9	41.2	40.7
<b>31-May-04</b>	980.2	9.0	9.7	8.0	41.9	40.7
<b>30-Jun-04</b>	942.5	8.7	9.8	8.2	42.8	36.0
<b>31-Jul-04</b>	832.0	8.4	10.2	8.8	45.5	27.3
<b>31-Aug-04</b>	733.0	8.2	10.7	9.3	48.2	28.6
<b>30-Sep-04</b>	704.4	8.4	10.8	9.4	49.0	35.0
<b>31-Oct-04</b>	727.8	8.9	10.7	9.3	48.3	35.0
<b>30-Nov-04</b>	760.3	8.7	10.6	9.1	47.4	33.3
<b>31-Dec-04</b>	738.5	9.0	10.7	9.2	48.0	35.0

*Notes: Bold italicized values exceeded the guideline percentages.*

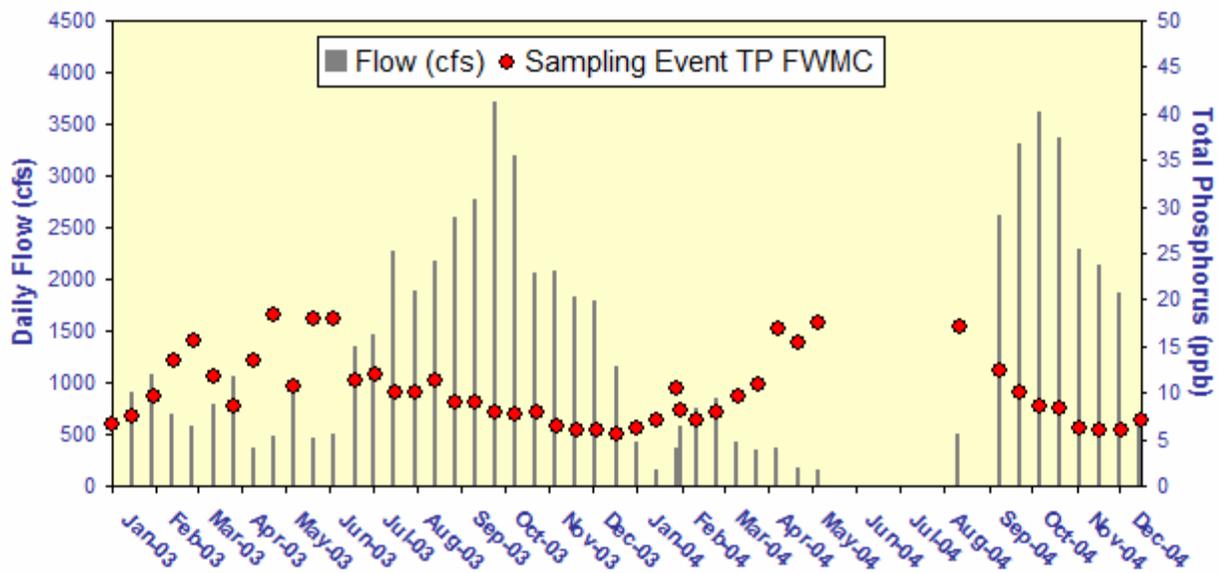
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The daily flows through the individual Shark River Slough structures and S334 from January 2003 through December 2004 are presented in **Figure 5**. Since early January 2004 through the end of May 2004 inflows to Shark River Slough have been through S333 and S12D. There was almost no flow from June through mid-August.

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean total phosphorus concentrations for individual sampling events is presented in **Figure 6**. Values follow the strong inverse relationship between flow and total phosphorus concentration expected for waters entering the Park through Shark River Slough.



**Figure 5.** Daily flows into Shark River Slough by structure.



**Figure 6.** The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events. There was no sampling event flow weighted mean concentration for the months of June and July 2004 because there was no flow in those months.

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## Taylor Slough and the Coastal Basins

Under the Consent Decree, a single total phosphorus long-term limit of 11 ppb, to be met by December 31, 2006, was set for the two points of inflow to Taylor Slough (S332 and S175) and the inflow point to the Coastal Basins (S18C). The 11 ppb limit applies to the water year ending September 30.

### C-111 Project Structures and Detention Areas

Beginning in August 1999, structure S332D, a new pump station constructed by the U.S. Army Corps of Engineers (USACE), began operation. The structure is adjacent to spillway S174 and pumps water from the L31N canal into the L31W canal. The S332D and S174 structures became the new inflow compliance monitoring sites for Taylor Slough on October 1, 1999, replacing S332 and S175.

The USACE completed construction of the remaining C-111 project structures and detention areas along the eastern boundary of the ENP in June 2002. The project was authorized by the USACE in 1995 to restore more natural hydrologic conditions in Taylor Slough and to maintain flood protection to the east of the L31N and C-111 canals. Project facilities consist of pump stations S332B, S332C and S332D, Detention Cells 1 through 5, a Connector Cell between cells 2 and 3, a Flow Way Cell originating at Berm 3 of Cell 5, and four emergency overflow structures (**Figure 7**). The Flow Way Cell is the only surface water routine discharge location to the ENP from this project.

The construction of these facilities was accelerated to respond to U.S. Fish and Wildlife requirements to give immediate relief to water conditions that threaten the Cape Sable Seaside Sparrow, an endangered species. The USACE signed a Record of Decision on July 2, 2002 that authorizes the implementation of an Interim Operational Plan (IOP) to govern the operation of the new facilities. Since July 31, 2002, the USACE has been operating the project under Emergency Orders issued by the Florida Department of Environmental Protection (FDEP).

The USACE and the South Florida Water Management District (District) will monitor the implementation of the IOP under the terms and conditions of the C-111 Project Cooperation Agreement executed in 1995. The District, on behalf of the USACE, is implementing a monitoring plan approved by FDEP that assesses the hydrologic, environmental, and surface and ground water quality changes that may occur as a result of the IOP.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. Only Emergency Overflows EO2 and EO4 would discharge into ENP if utilized. Overflows have periodically occurred at EO2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports. There were no overflows during the period from October 2003 through December 2004. Discharges from Emergency Overflows EO1 and EO3 would flow onto District property and eventually into the L31N Canal. The majority of the water pumped into the detention cells, as well as rainfall, is expected to seep into the Biscayne Aquifer directly below the project site and provide a hydrologic "curtain" to reduce ground water seepage in an easterly direction from ENP. Until FDEP issues an operating permit to the District and approves the District's related monitoring plan, the

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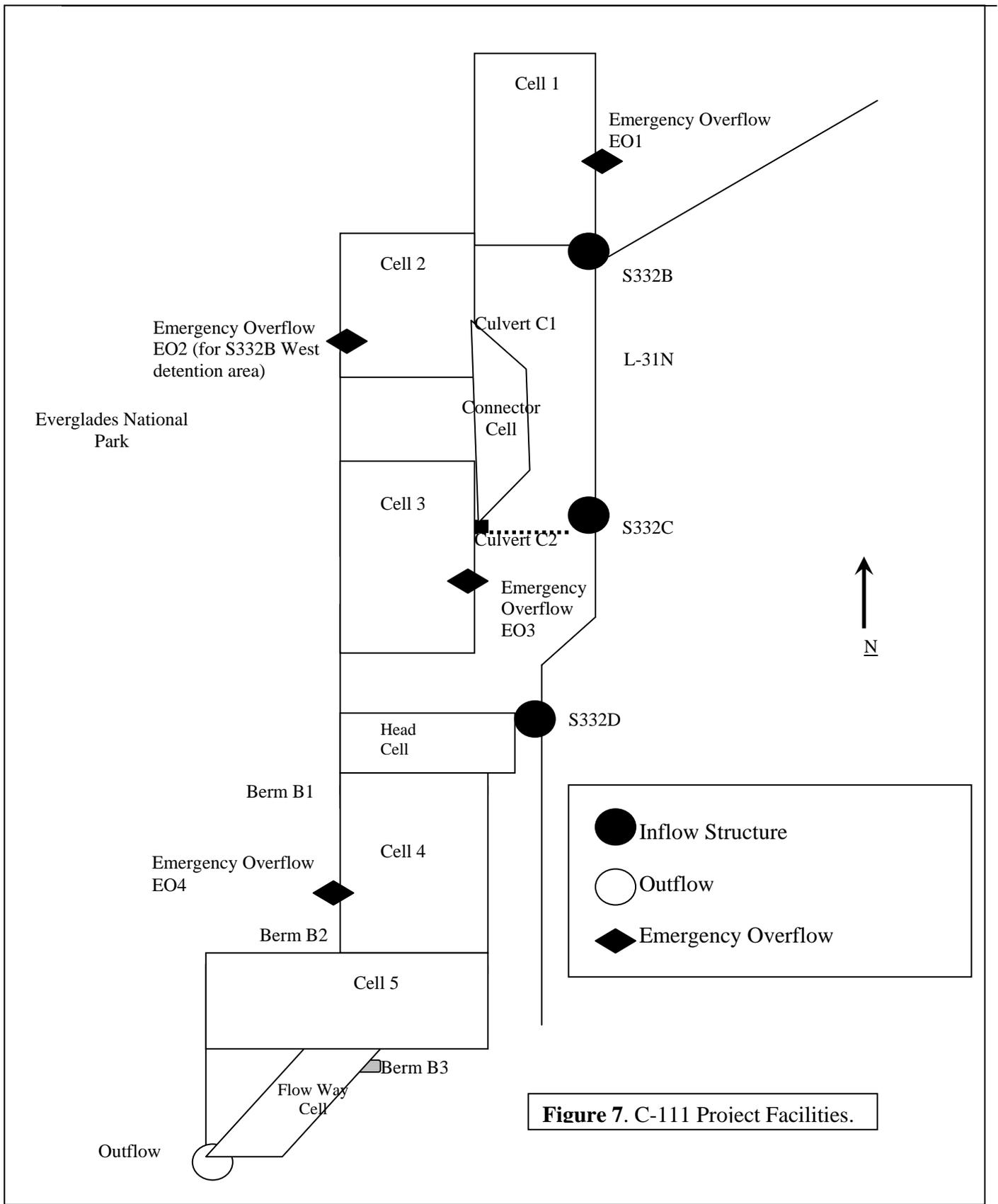
District will continue to report data from S332D and S174 to determine compliance with the Consent Decree requirements as described in the following section.

### **Compliance with Consent Decree**

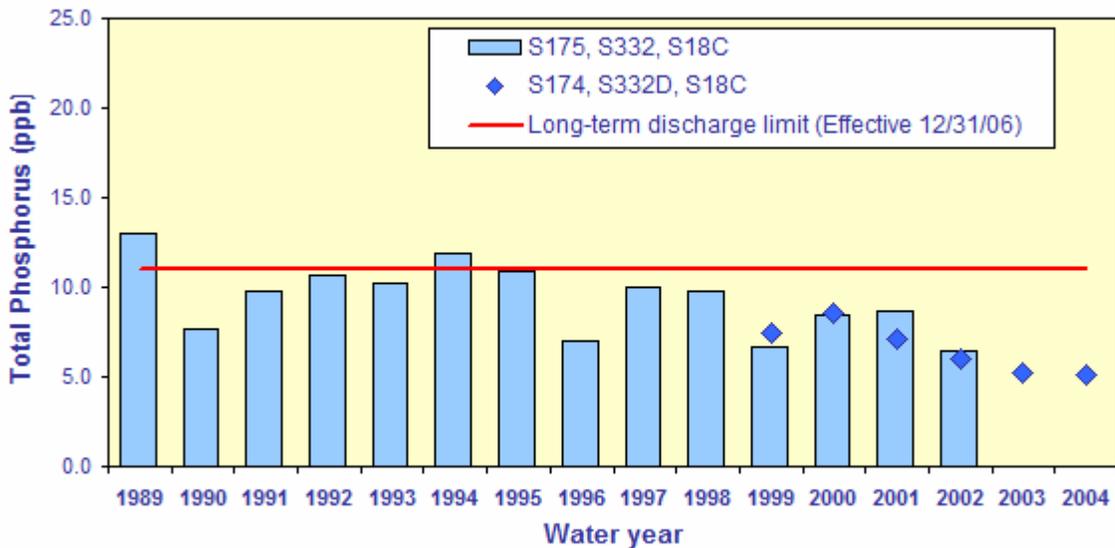
Inflow concentrations of total phosphorus to the Everglades National Park through Taylor Slough and the Coastal Basins are compared to the 11 ppb limit at the end of each water year using data from both the old (S175, S332, S18C) and new (S174, S332D, S18C) combinations of structures (**Figure 8**). The bars in **Figure 8** represent the flow-weighted mean total phosphorus concentrations from S332, S175 and S18C for water years 1989 through 2002. The diamond point values for water years 1999 through 2004 represent the new combination of structures. **Figure 9** presents the 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at the S174, S332D and S18C structures. Because of the extreme low flow values, several sampling event composite concentrations were higher than usual during May through July, 2004.

The 12-month flow-weighted mean concentrations for October, November and December 2004 were 5.3, 5.1 and 5.2 ppb, respectively, for the combined flow through S174, S332D and S18C (**Table 3**). The Consent Decree stipulates that the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb from each sampling event in any 12-month period must not exceed a fixed guideline of 53.1 percent. The percentage of flow-weighted mean total phosphorus concentrations greater than 10 ppb for the combined flow through S174, S332D and S18C was 11.9, 11.9 and 12.5 ppb for the periods ending October, November and December 2004, respectively

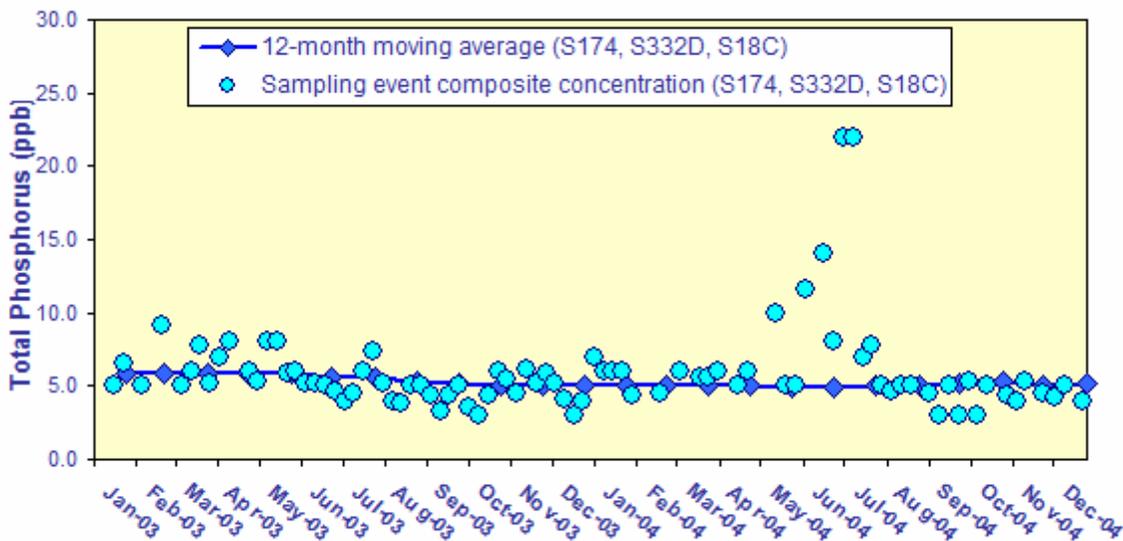
The daily flows into Everglades National Park through S332D, S174 and S18C are presented in **Figure 10**. **Figure 11** shows the relationship between the daily inflows and the corresponding flow-weighted mean total phosphorus concentrations for each sampling event. As the data indicate, there has been no observable relationship between daily mean flow and flow-weighted mean total phosphorus concentrations at these structures except for the several concentrations observed during extreme low flow periods in May through July 2004.



**Figure 7. C-111 Project Facilities.**



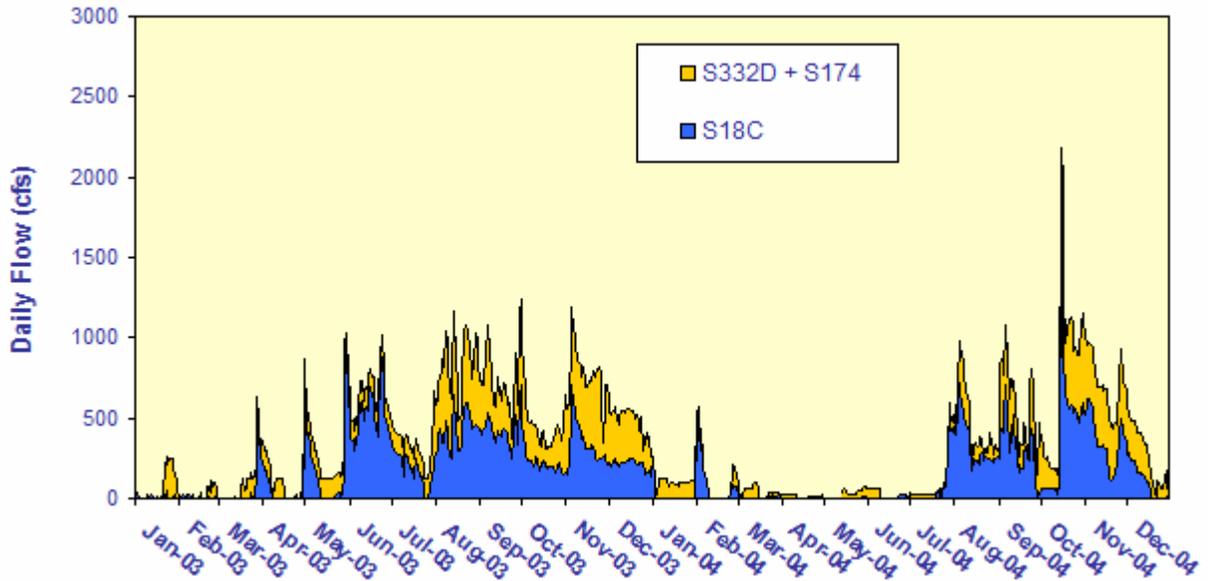
**Figure 8.** A. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term total phosphorus limit.



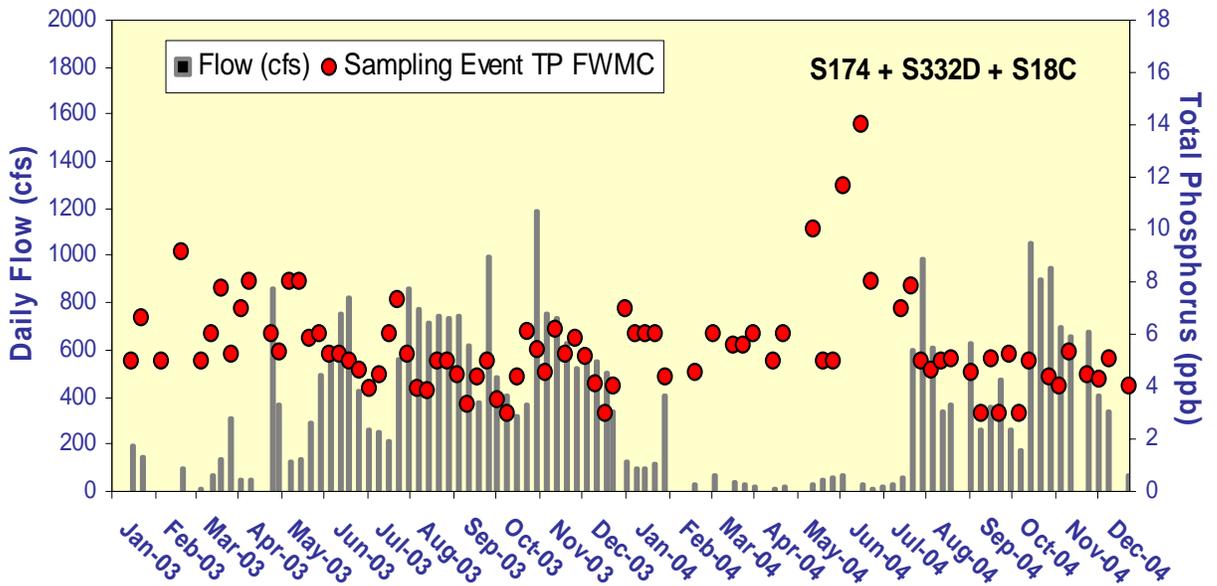
**Figure 9.** 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the composite total phosphorus concentration for each sampling event.

**Table 3. Taylor Slough and the Coastal Basins Total Phosphorus Concentration Compliance Tracking.**

12-Month Period Ending On	Total Period Flow	Flow Weighted Mean Total Phosphorus	Limit (Effective 12/31/06)	Percent of Sampling Events Greater than 10 ppb	
			(ppb)	(%)	
	(Kac-ft)	(ppb)	Long Term	Guideline	Observed
31-Jan-03	234.2	5.8	11.0	53.1	5.0
28-Feb-03	229.9	5.9	11.0	53.1	5.0
31-Mar-03	230.5	5.9	11.0	53.1	4.9
30-Apr-03	231.5	5.8	11.0	53.1	4.8
31-May-03	244.2	5.8	11.0	53.1	0.0
30-Jun-03	249.8	5.6	11.0	53.1	0.0
31-Jul-03	209.0	5.6	11.0	53.1	0.0
31-Aug-03	216.1	5.3	11.0	53.1	0.0
30-Sep-03	221.9	5.2	11.0	53.1	0.0
31-Oct-03	233.8	5.0	11.0	53.1	0.0
30-Nov-03	276.6	5.1	11.0	53.1	0.0
31-Dec-03	293.9	5.0	11.0	53.1	0.0
31-Jan-04	295.9	5.1	11.0	53.1	0.0
29-Feb-04	301.4	5.0	11.0	53.1	0.0
31-Mar-04	297.9	5.0	11.0	53.1	0.0
30-Apr-04	292.3	5.0	11.0	53.1	0.0
31-May-04	274.8	4.9	11.0	53.1	2.2
30-Jun-04	238.0	4.9	11.0	53.1	6.7
31-Jul-04	224.3	5.0	11.0	53.1	11.4
31-Aug-04	202.7	5.1	11.0	53.1	11.4
30-Sep-04	192.6	5.2	11.0	53.1	11.4
31-Oct-04	210.1	5.3	11.0	53.1	11.9
30-Nov-04	206.7	5.1	11.0	53.1	11.9
31-Dec-04	193.0	5.2	11.0	53.1	12.5



**Figure 10.** Daily flows into Everglades National Park through Taylor Slough and S18C.



**Figure 11.** The relationship between daily flows at Taylor Slough structures and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.