

Settlement Agreement January - March 2005 Report



**Prepared for the
Technical Oversight Committee
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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 February 1, 1999, and December 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.

Average stages in the Refuge were 16.17, 16.03 and 15.88 feet in January, February and March 2005, respectively (**Figure 2** and **Table 1**). The geometric means, calculated from total phosphorus concentrations measured in water samples collected in January, February and March 2005 were 7.9, 9.4 and 13.4 parts per billion (ppb), respectively. The interim limits were 13.9, 15.1 and 16.6 ppb, respectively. The long-term limits were 11.4, 12.3 and 13.4 ppb, respectively. The geometric means were less than or equal to the interim and long-term levels for January, February and March. Because the Total depth was less than 0.1 m, there were no water samples in January at stations LOX3 and LOX5, and in February and March for stations LOX3, LOX5 and LOX9.

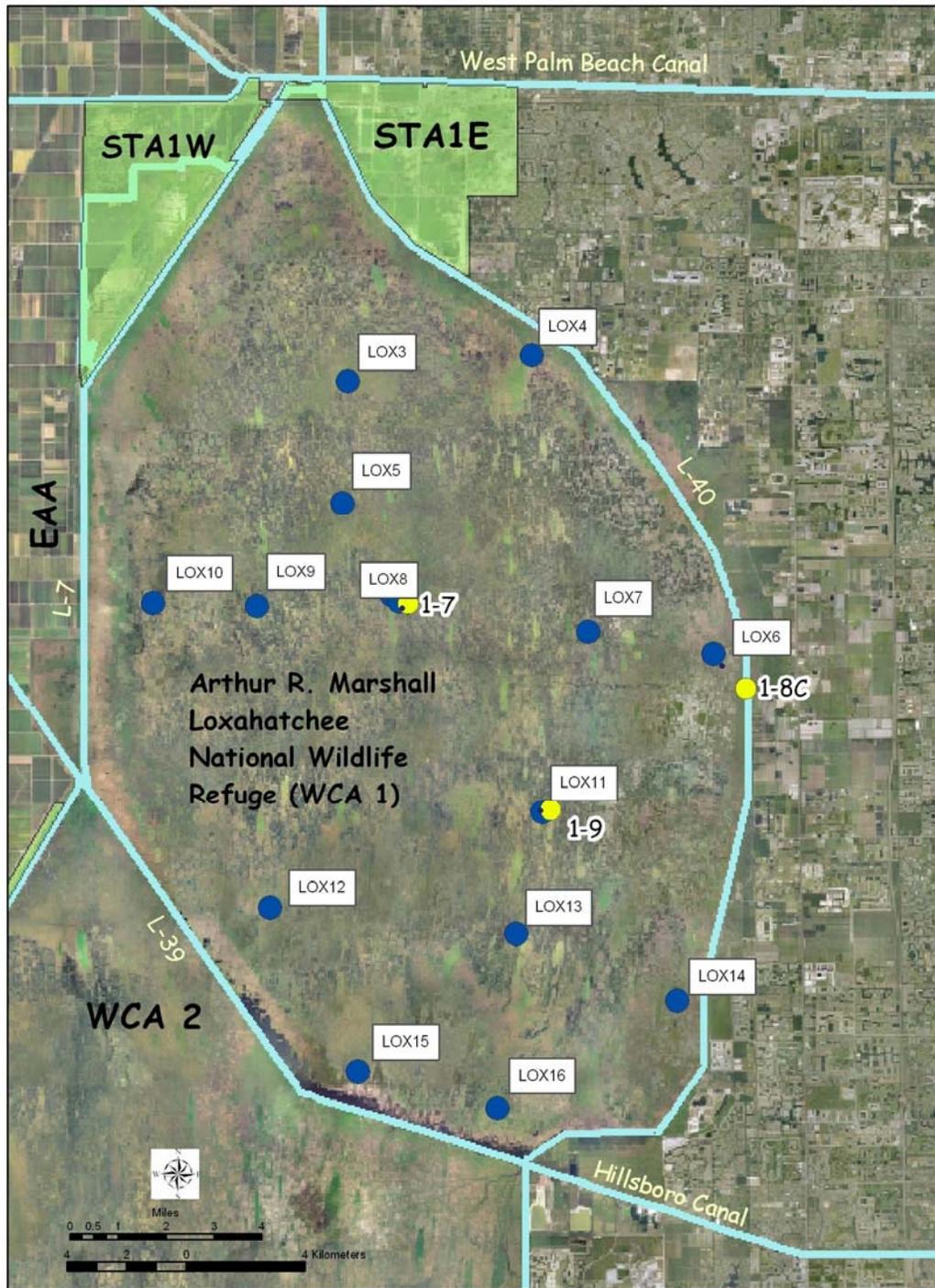


Figure 1. A.R.M. Loxahatchee Refuge Water Quality Sampling and Stage Measurement Sites

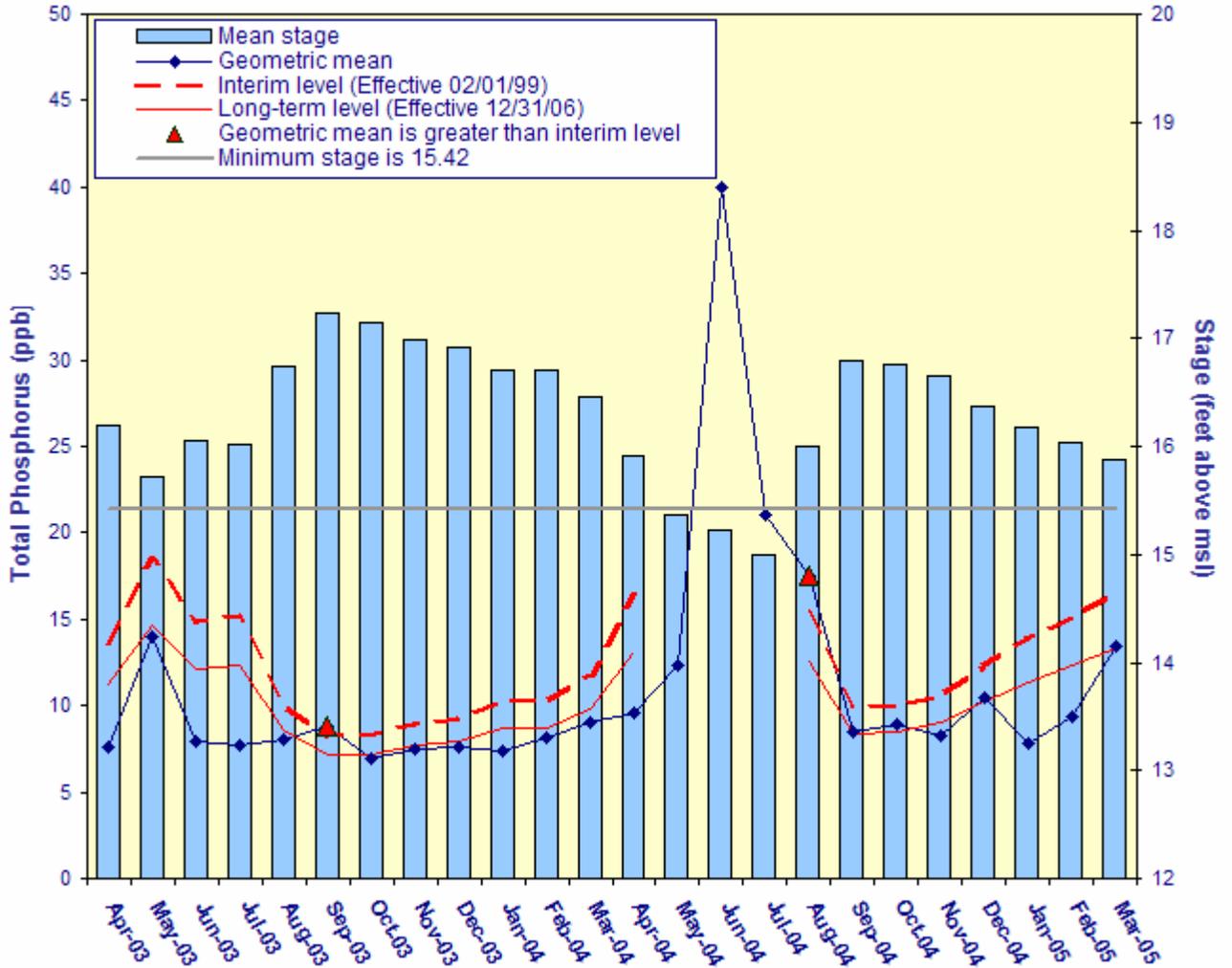


Figure 2. Monthly total phosphorus geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage. Interim and Long-term limits are not shown for May 2004 – 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 Concentration	Interim Level (ppb)	Long-Term Level (ppb)	Average Stage	Number of TP Samples	Number of Stage Measurements
	(ppb)	Effective 2/1/99	Effective 12/31/06	(ft, NGVD)		
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
Jan-2005	7.9	13.9	11.4	16.17	12	3
Feb-2005	9.4	15.1	12.3	16.03	11	3
Mar-2005	13.4	16.6	13.4	15.88	11	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 over the Interim Level occurred.
(3) N/A denotes that the concentration values were not applicable because the average stage was less than 15.42 feet.

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 through 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 (October 1st through September 30th) 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 the Shark River Slough.

Table 2 presents the moving flow-weighted mean concentrations for each 12-month period beginning in July 2002 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 January, February and March 2005, the flow-weighted mean total phosphorus concentrations were 9.0, 9.1 and 9.6 ppb, respectively. The interim limits were 10.7, 10.8 and 10.8 ppb, respectively. The long-term limits were 9.3, 9.4 and 9.4 ppb, respectively. The January, February and March 2005 concentrations were less than the interim limit. The long-term limit was exceeded in March 2005.

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 January, February and March 2005, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 38.9, 37.5 and 46.7, respectively. January, February and March observed percentages were less than the guidelines (**Table 2**). The individual sampling events and the 12-month moving average are presented in **Figure 4**.

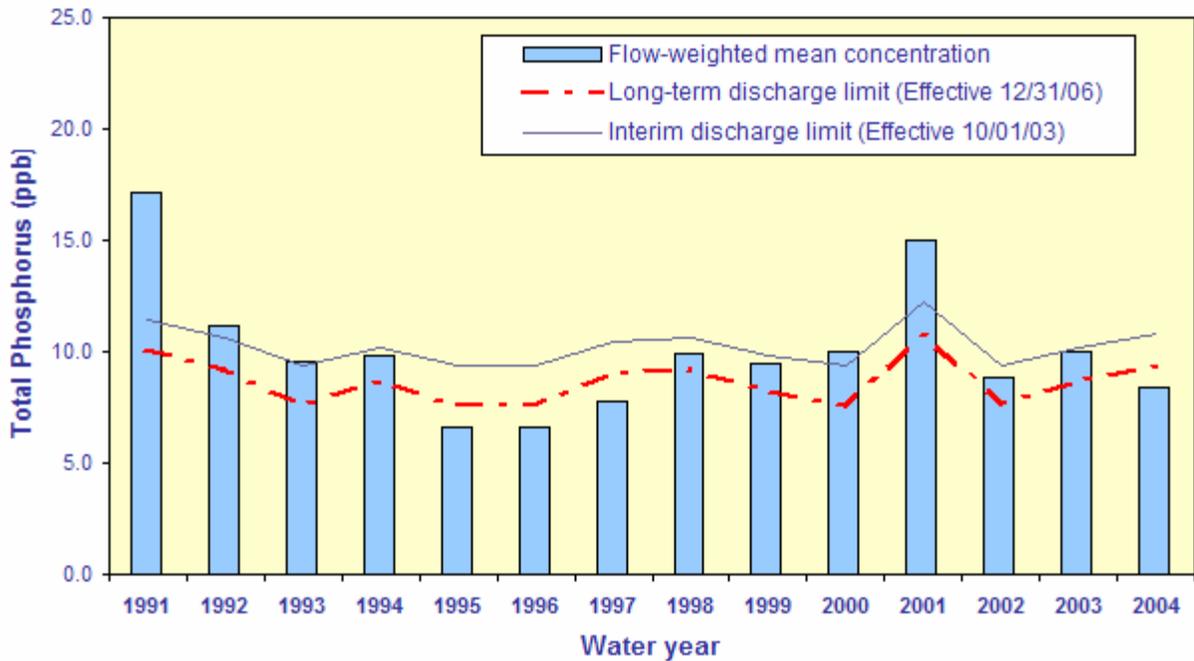


Figure 3. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the total phosphorus interim and long-term limits.

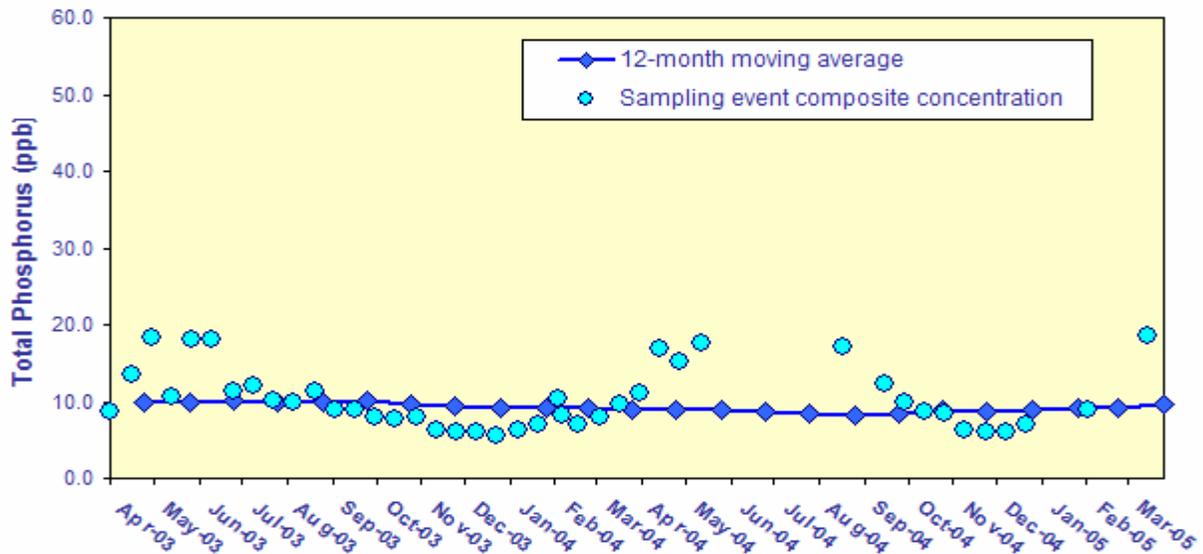


Figure 4. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each month and the composite total phosphorus concentration for each sampling event. There are no sampling event values for June, July 2004 and January 2005 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 10/1/2003	Effective 12/31/2006	(%)	
	(Kac-ft)	(ppb)			Guideline	Observed
30-Apr-03	832.1	9.9	10.2	8.8	45.5	43.5
31-May-03	871.3	10.0	10.1	8.6	44.5	45.8
30-Jun-03	901.1	10.2	10.0	8.4	43.8	50.0
31-Jul-03	891.3	9.8	10.0	8.5	44.0	50.0
31-Aug-03	839.3	9.9	10.2	8.7	45.3	50.0
30-Sep-03	850.1	10.0	10.2	8.7	45.1	50.0
31-Oct-03	921.8	9.7	9.9	8.3	43.3	50.0
30-Nov-03	1001.5	9.5	9.6	7.9	41.4	46.2
31-Dec-03	1076.8	9.1	9.4	7.6	40.1	46.2
31-Jan-04	1049.0	9.2	9.4	7.7	40.4	46.2
29-Feb-04	1033.9	9.1	9.5	7.8	40.7	44.4
31-Mar-04	1036.7	8.9	9.4	7.7	40.7	37.0
30-Apr-04	1012.9	9.0	9.5	7.9	41.2	40.7
31-May-04	980.2	9.0	9.7	8.0	41.9	40.7
30-Jun-04	942.5	8.7	9.8	8.2	42.8	36.0
31-Jul-04	832.0	8.4	10.2	8.8	45.5	27.3
31-Aug-04	733.0	8.2	10.7	9.3	48.2	28.6
30-Sep-04	704.4	8.4	10.8	9.4	49.0	35.0
31-Oct-04	727.8	8.9	10.7	9.3	48.3	35.0
30-Nov-04	760.3	8.7	10.6	9.1	47.4	33.3
31-Dec-04	738.5	9.0	10.7	9.2	48.0	35.0
31-Jan-05	717.3	9.0	10.7	9.3	48.6	38.9
28-Feb-05	709.8	9.1	10.8	9.4	48.8	37.5
31-Mar-05	703.4	9.6	10.8	9.4	49.0	46.7

Notes: Bold italicized values exceeded the guideline percentages.

The daily flows through the individual Shark River Slough structures from April 2003 through March 2005 are presented in **Figure 5**. Since mid-November 2002 inflows to Shark River Slough have been through S333 and S12D. Beginning in mid-January 2003 a large proportion of the flow in the L29 Canal was released from the system through S334 due to above-average rainfall. This condition lasted until mid-June.

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 ENP through Shark River Slough.

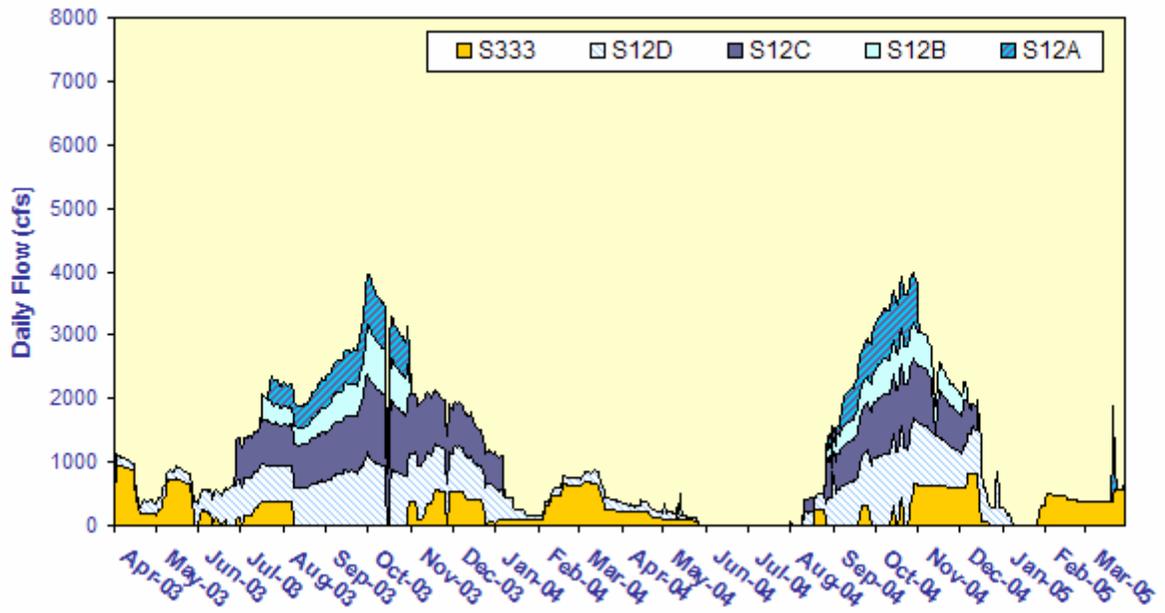


Figure 5. Daily flows into Shark River Slough by structure. On January, 2005 there was flow through structures S12D and S333. S333 was the only structure with flow for the month of February 2005. There was flow through structures S12A, S12D, and S333 in March 2005.

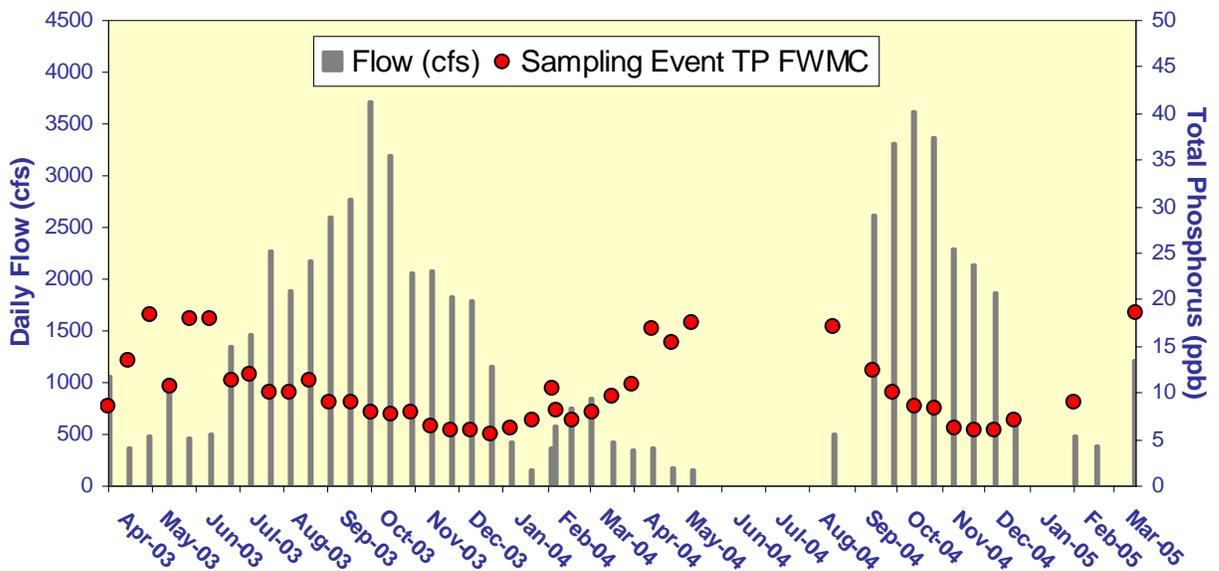


Figure 6. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events. There was no sampling event flow weighted mean concentration for the months of June through July 2004 and January 2005 because there was no flow in those months.

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.

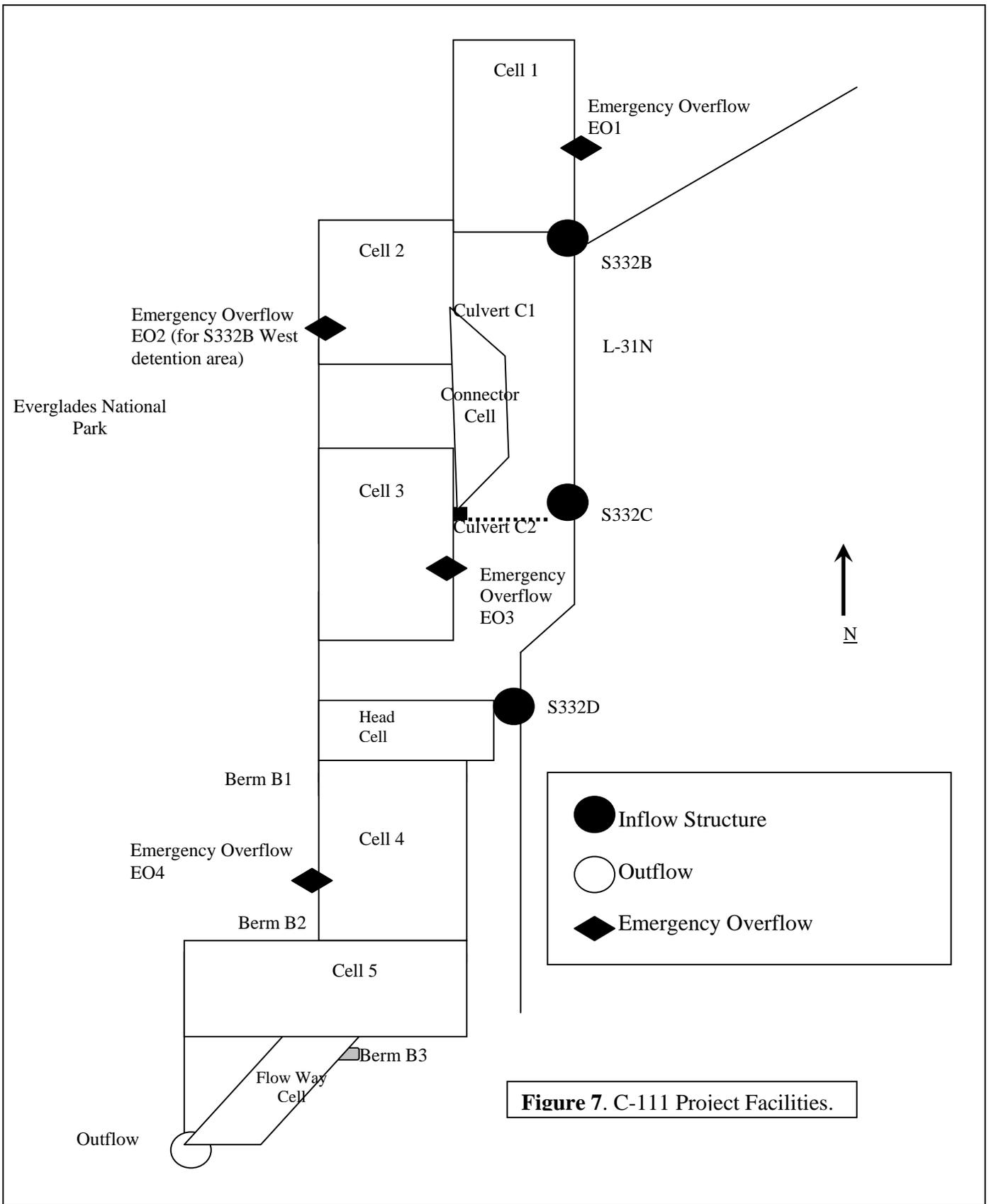
The USACE completed construction of the remaining C-111 project structures and detention areas along the eastern boundary of the ENP in June 2002. The project was authorized by the USACE in 1995 to restore more natural hydrologic conditions in Taylor Slough and to maintain flood protection to the east 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 March 2005.** 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 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 9** 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 2003 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.

Total phosphorus and flow data from both sets of structures presented in prior editions of this report through December 2001 (April 2002 report) showed that, beginning October 2000, the 12-month moving total flow for S332D, S174 and S18C was consistently greater than flow at S332, S175 and S18C. There was also a shift in flow-weighted mean total phosphorus concentration data whereby S332D, S174 and S18C concentrations became equal to and then consistently lower than the concentrations at S332, S175 and S18C. These changes reflected the switch made from S332 to S332D for water delivery to Taylor Slough between July 3 and July 5, 2000. Consequently, as of the July 2002 report, only S332D, S174 and S18C data are presented for monthly tracking of data in **Figure 9**.

The 12-month flow-weighted mean concentrations for January, February and March 2005 were 5.1, 5.2 and 5.3 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 12.5, 11.9 and 11.4 ppb for the periods ending January, February and March 2005.

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 is no observable linear relationship between daily mean flow and flow-weighted mean total phosphorus concentrations at these structures.

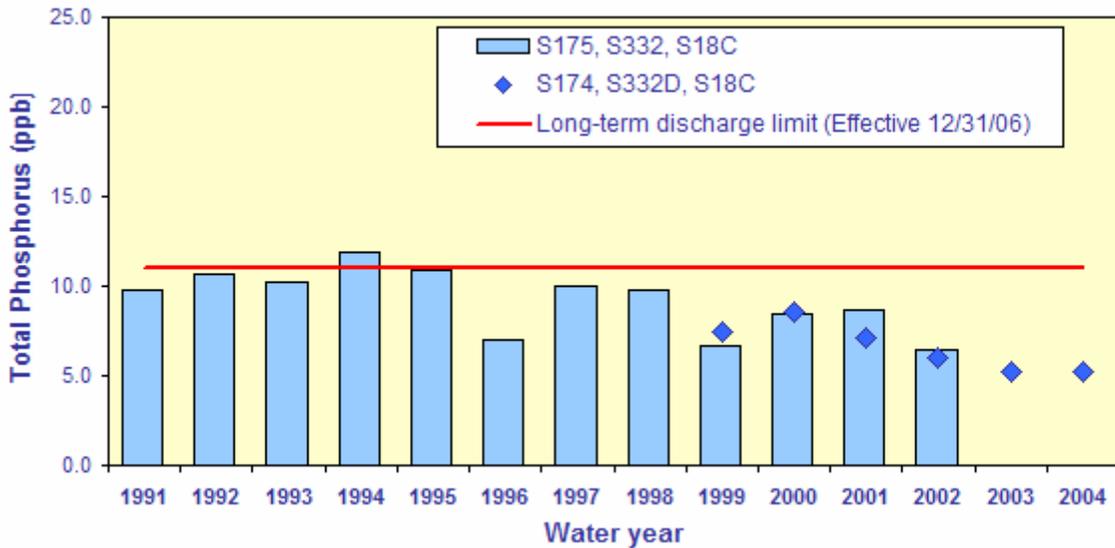


Figure 8. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term total phosphorus limit.

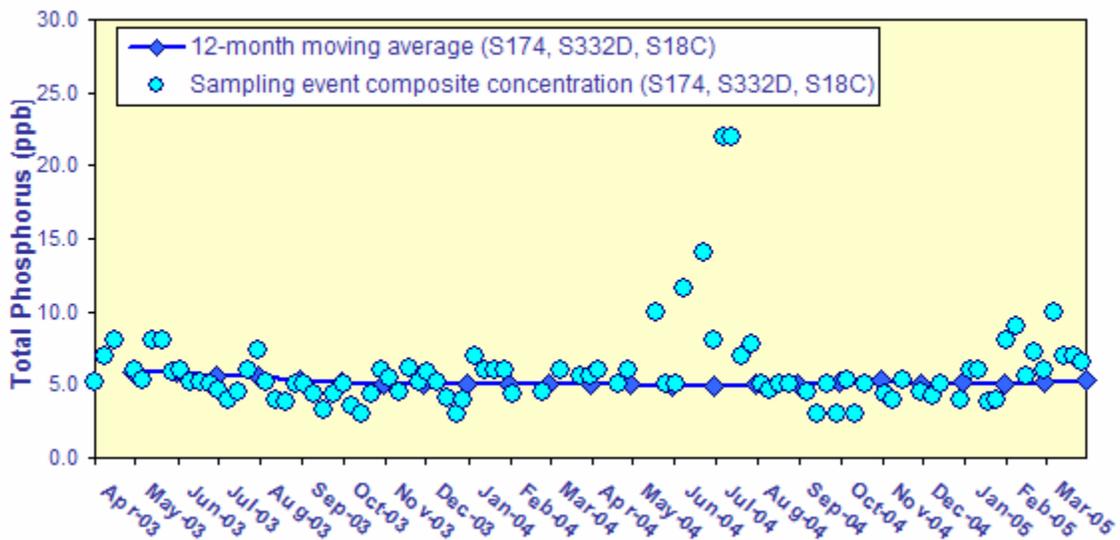


Figure 9. 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the composite total phosphorus concentration for each sampling event.

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
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
31-Jan-05	194.4	5.1	11.0	53.1	12.5
28-Feb-05	194.7	5.2	11.0	53.1	11.9
31-Mar-05	199.6	5.3	11.0	53.1	11.4

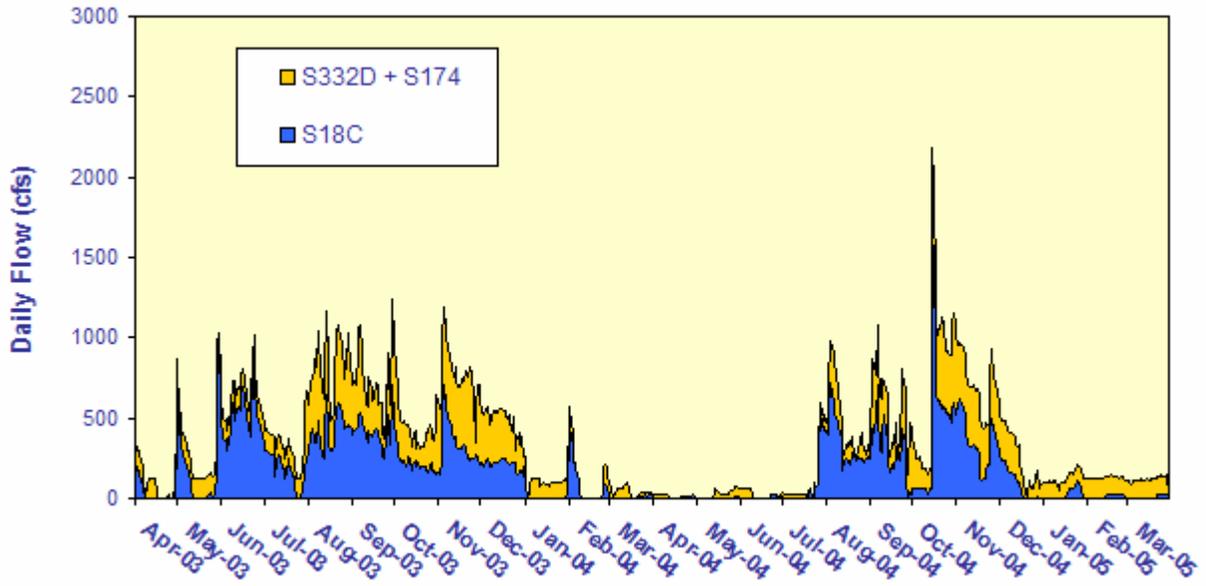


Figure 10. Daily flows into Everglades National Park through Taylor Slough (S332D + S174) and S18C.

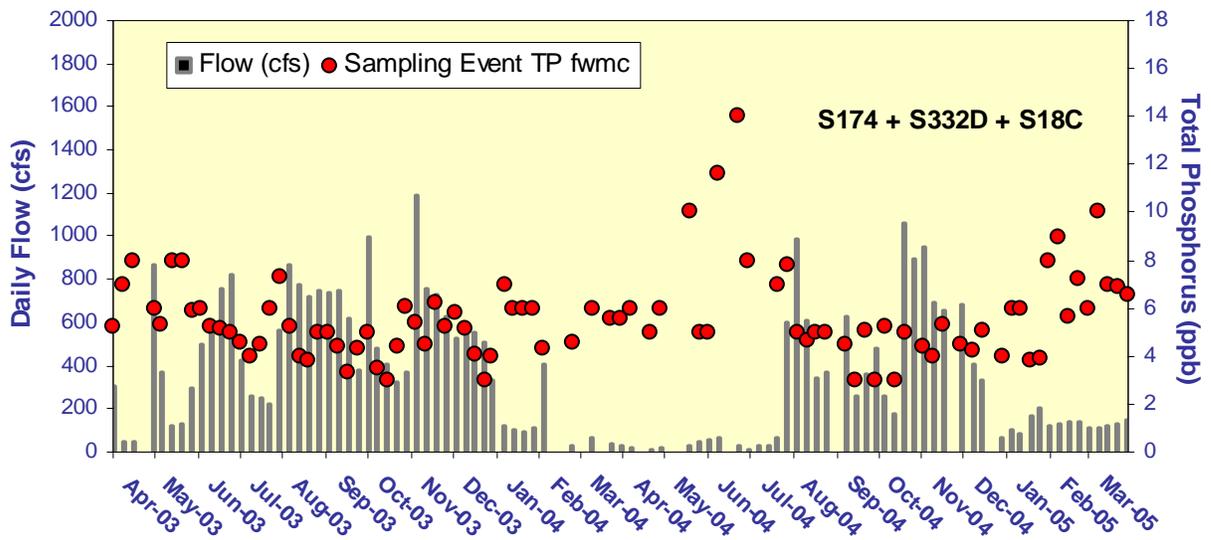


Figure 11. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.