Settlement Agreement
January - March 2001 Report

Prepared for the
Technical Oversight Committee
July 31, 2001

Prepared by:
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ARTHUR R. MARSHALL LOXAHATCHEE NATIONAL WILDLIFE REFUGE

Phosphorus Concentrations

The 1995 Consent Decree approved modifications to the 1991 Settlement Agreement to end the Everglades lawsuit entered into by the federal government, the State of Florida and the South Florida Water Management District. The Consent Decree specified that interim and long-term phosphorus concentration levels for the 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 gaging stations 1-7, 1-8C and 1-9 within the Refuge. The stage range within which the interim and long-term level calculations are applicable is 15.42 to 17.14 feet (mean sea level). Total phosphorus concentrations are determined from water samples collected at 14 interior marsh stations (LOX 3 through LOX 16).

Average stages in the Refuge were 16.13, 15.82 and 15.08 feet in January, February and March 2001, respectively (**Figure 1**). The geometric means calculated from total phosphorus concentrations measured in water samples collected in January, February and March were 7.2, 9.6 and 19.3 ppb, respectively (**Table 1**). The geometric mean concentrations in January and February were within the calculated interim and long-term limits. The March total phosphorus concentration of 19.3 ppb was based on only two samples because many sites were dry or had water levels less than four inches, the minimum depth necessary to ensure a representative sample. The interim and long-term limits were not applicable in March since the Refuge average stage was less than 15.42 feet (**Table 1**).

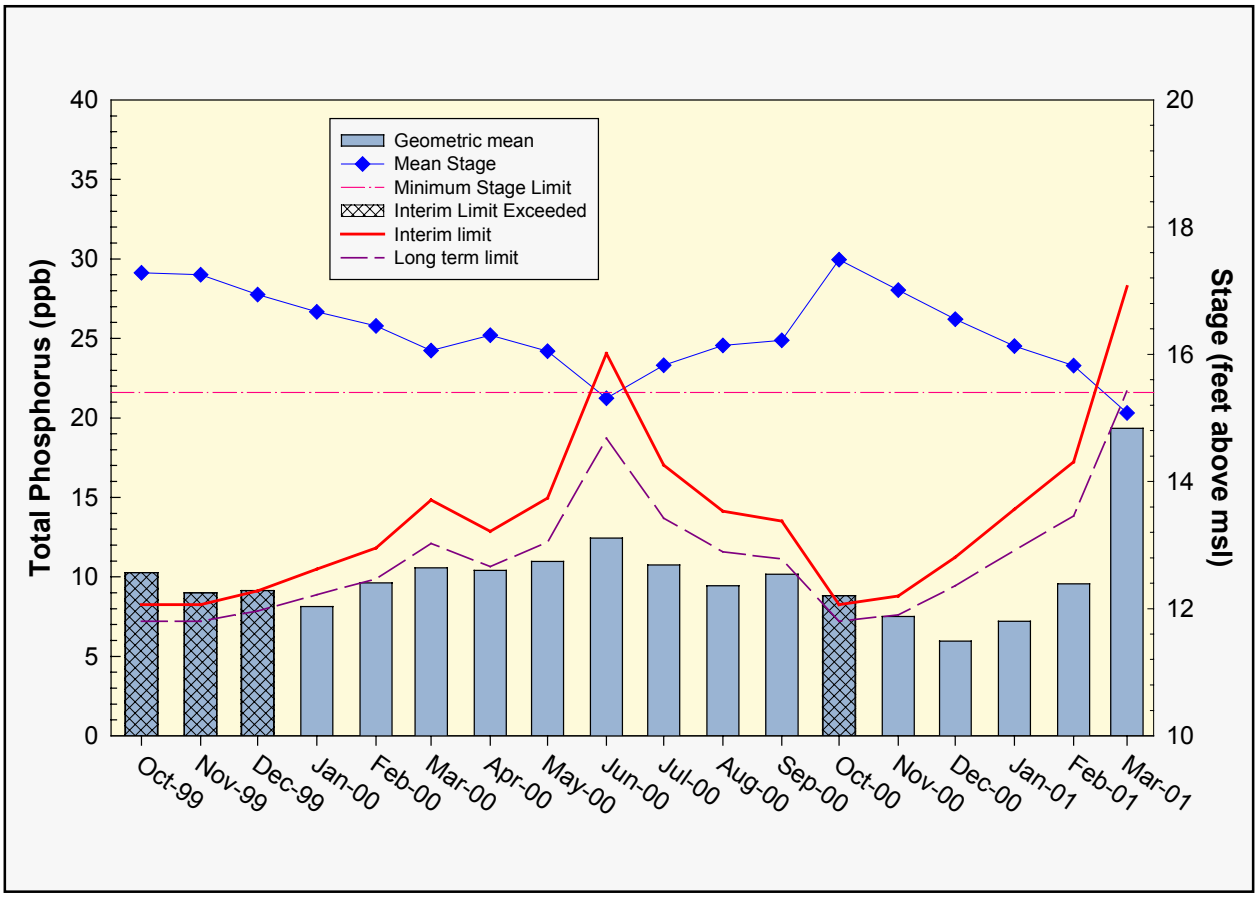

Figure 1. Monthly total phosphorus geometric mean concentration levels for the Loxahatchee National Wildlife Refuge compared to the interim and long-term targets. The calculated target concentrations are adjusted for fluctuations in water level.

Table 1. Loxahatchee National Wildlife Refuge Total Phosphorus Compliance.

Month and Year	Geometric Mean	Interim Limit	Long Term Limit	Average Stage	Number of Phosphorus Samples	Number of Stage Measurements
	(ppb)			(ft, NGVD)		
Apr-1999	11.9	N/A	N/A	15.35	3	3
May-1999	16.4	N/A	N/A	15.20	2	3
Jun-1999	14.2	11.7	9.8	16.47	13	3
Jul-1999	11.1	14.4	11.8	16.11	10	3
Aug-1999	12.7	15.1	12.3	16.03	8	3
Sep-1999	10.3	9.9	8.4	16.79	14	3
Oct-1999	10.3	8.3	7.2	17.28	14	3
Nov-1999	9.0	8.3	7.2	17.25	14	3
Dec-1999	9.1	9.1	7.9	16.94	14	3
Jan-2000	8.1	10.5	8.9	16.67	14	3
Feb-2000	9.6	11.8	9.9	16.45	13	3
Mar-2000	10.6	14.8	12.1	16.06	12	3
Apr-2000	10.4	12.9	10.6	16.30	14	3
May-2000	9.3 *(11.0)*	14.6 *(15.0)*	11.9 *(12.2)*	16.09 *(16.05)*	11 *(14,11,13,12)*	3 *(3,3,3,3)*
Jun-2000	12.4	N/A	N/A	15.31	6	3
Jul-2000	10.8	17.0	13.7	15.83	6	3
Aug-2000	9.4	14.1	11.6	16.14	10	3
Sep-2000	10.2	13.5	11.1	16.22	11	3
Oct-2000	8.8	8.3	7.2	17.49	13	3
Nov-2000	7.5	8.8	7.6	17.01	14	3
Dec-2000	6.0	11.2	9.4	16.55	9	3
Jan-2001	7.2	14.3	11.7	16.13	8	3
Feb-2001	9.6	17.2	13.8	15.82	9	3
Mar-2001	19.3	NA	NA	15.08	2	3

Notes:

(1) Average Stage is calculated using stage elevations at three stations on the sampling date.

(2) The italicized values in parentheses for May-2000 include the Lake Okeechobee Recession special sampling data.

(3) Highlighted values indicate months when exceedances occurred.

(4) NA = Limits not applicable when Refuge stage is below 15.42 feet (mean sea level).

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 through Shark River Slough to be met by October 1, 2003, and December 31, 2006, respectively. The limits apply to the water year ending September 30. 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. In addition, the Settlement Agreement requires that phosphorus concentrations be presented as 12-month moving flow-weighted means.

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 1989 to 2000 (**Figure 2a**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2000 was 10.0 ppb. Corresponding interim and long-term limits were 9.4 and 7.6 ppb, respectively. This is the first time since 1993 that both limits were exceeded for the water year ending in September.

The Settlement Agreement 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 maximum value based on flow into Shark River Slough for the same 12-month period (**Figure 2b**). For the 12-month periods ending January, February and March 2001, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb was 80.0, 85.7 and 84.6, respectively. These percentages exceeded the allowed percentages for all three 12-month periods (see **Table 2**).

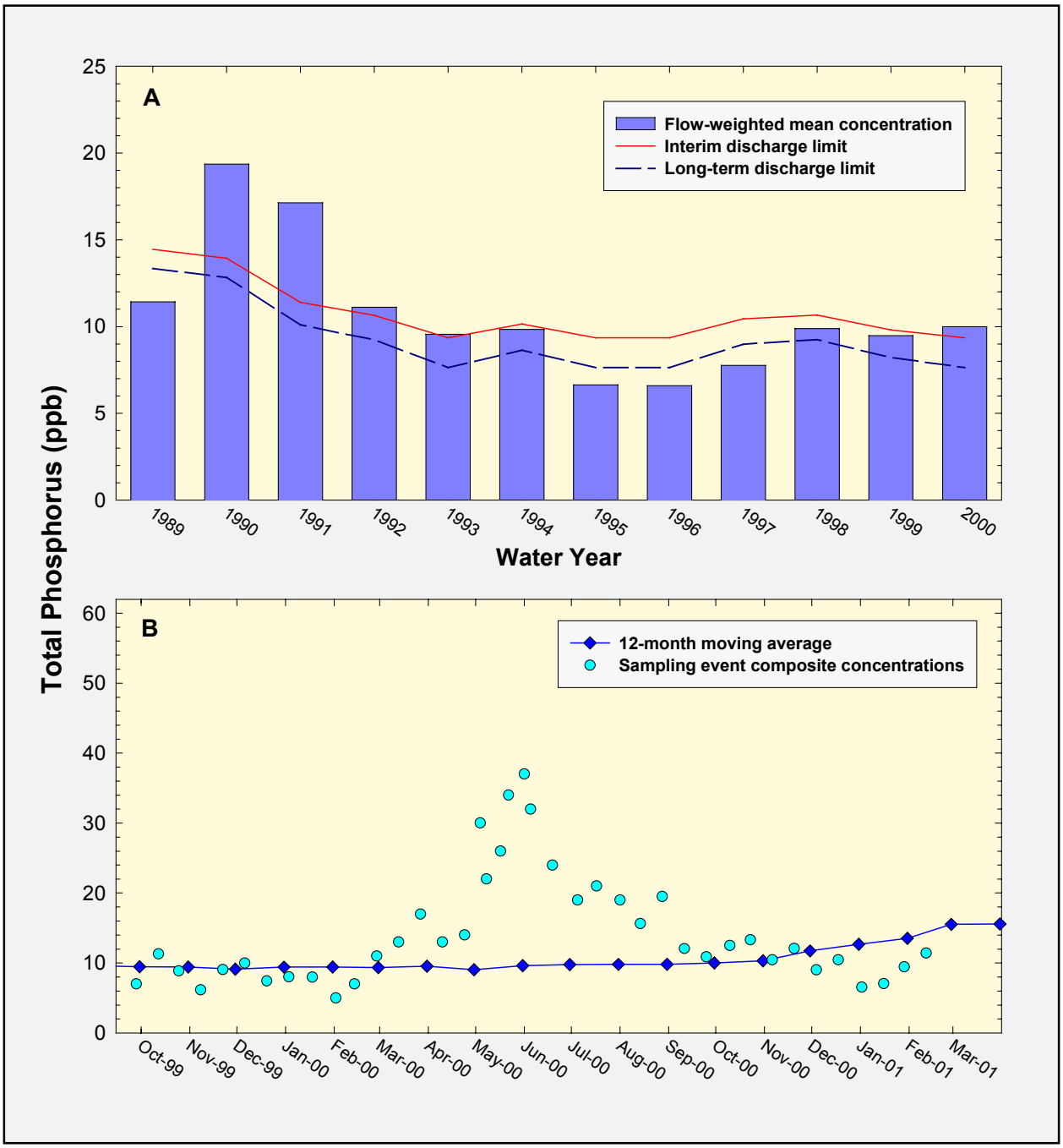

Figure 2. 12-month moving flow-weighted mean total phosphorus concentrations at the inflows to the Everglades National Park (ENP) through Shark River Slough compared to the interim and long-term targets. **a.** Concentration at the end of each water year. **b.** 12-month moving average concentration at the end of each month and the composite concentration for each sampling event.

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

12-Month Period Ending On	Total Period Flow (Kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Limits (ppb)		Percent of Samples Greater Than 10 ppb (%)	
			Interim	Long Term	Observed	Allowed
4/30/99	750	9.9	10.6	9.2	***51.9***	47.7
5/31/99	675	9.8	11.0	9.6	48.0	49.9
6/30/99	680	9.6	10.9	9.6	40.9	49.7
7/31/99	788	9.7	10.4	9.0	41.7	46.7
8/31/99	858	9.6	10.1	8.6	39.1	44.9
9/30/99	940	9.5	9.8	8.2	39.1	42.9
10/31/99	1084	9.4	9.4	7.6	39.1	40.1
11/30/99	1298	9.1	9.4	7.6	39.1	40.1
12/31/99	1345	9.4	9.4	7.6	39.1	40.1
1/31/00	1395	9.4	9.4	7.6	39.1	40.1
2/29/00	1415	9.4	9.4	7.6	***41.7***	40.1
3/31/00	1386	9.6	9.4	7.6	***52.2***	40.1
4/30/00	1385	9.1	9.4	7.6	***52.2***	40.1
5/31/00	1401	9.6	9.4	7.6	***57.7***	40.1
6/30/00	1396	9.8	9.4	7.6	***60.7***	40.1
7/31/00	1295	9.8	9.4	7.6	***64.3***	40.1
8/31/00	1215	9.8	9.4	7.6	***65.5***	40.1
9/30/00	1096	10.0	9.4	7.6	***69.0***	40.1
10/31/00	925	10.3	9.9	8.3	***72.4***	43.2
11/30/00	642	11.7	11.1	9.8	***79.3***	50.8
12/31/00	464	12.7	12.0	10.8	***82.8***	56.4
1/31/01	367	13.5	12.5	11.3	***80.0***	59.8
2/28/01	298	15.5	12.9	11.7	***85.7***	62.2
3/31/01	276	15.6	13.0	11.9	***84.6***	63.1

Note: **Bold** and *italicized* values exceeded allowed percentage.

Table 2 presents the moving flow-weighted mean concentrations for each 12-month period beginning in April 1999 as well as the corresponding interim and long-term total phosphorus concentration limits, which are calculated using the 12-month period flow. For the 12-month periods ending in January, February and March 2001, the flow-weighted mean total phosphorus concentrations were 13.5, 15.5 and 15.6 ppb, respectively. These concentrations were all greater than the interim and long-term limits for these respective months.

The daily mean flows through the individual Shark River Slough structures and S334 from October 1999 through March 2001 are presented in **Figure 3a**. From January 1 through February 12, 2001 flows into northeastern Shark River Slough through S12D and S333 averaged 40.3 and 49.2 cfs, respectively. There were no flows through either structure from February 13 through March 31. The relationship between the sum of the daily mean flows at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events is presented in **Figure 3b**. Decreasing flows into Shark River Slough in January and February resulted in gradually increasing total phosphorus flow-weighted mean concentrations.

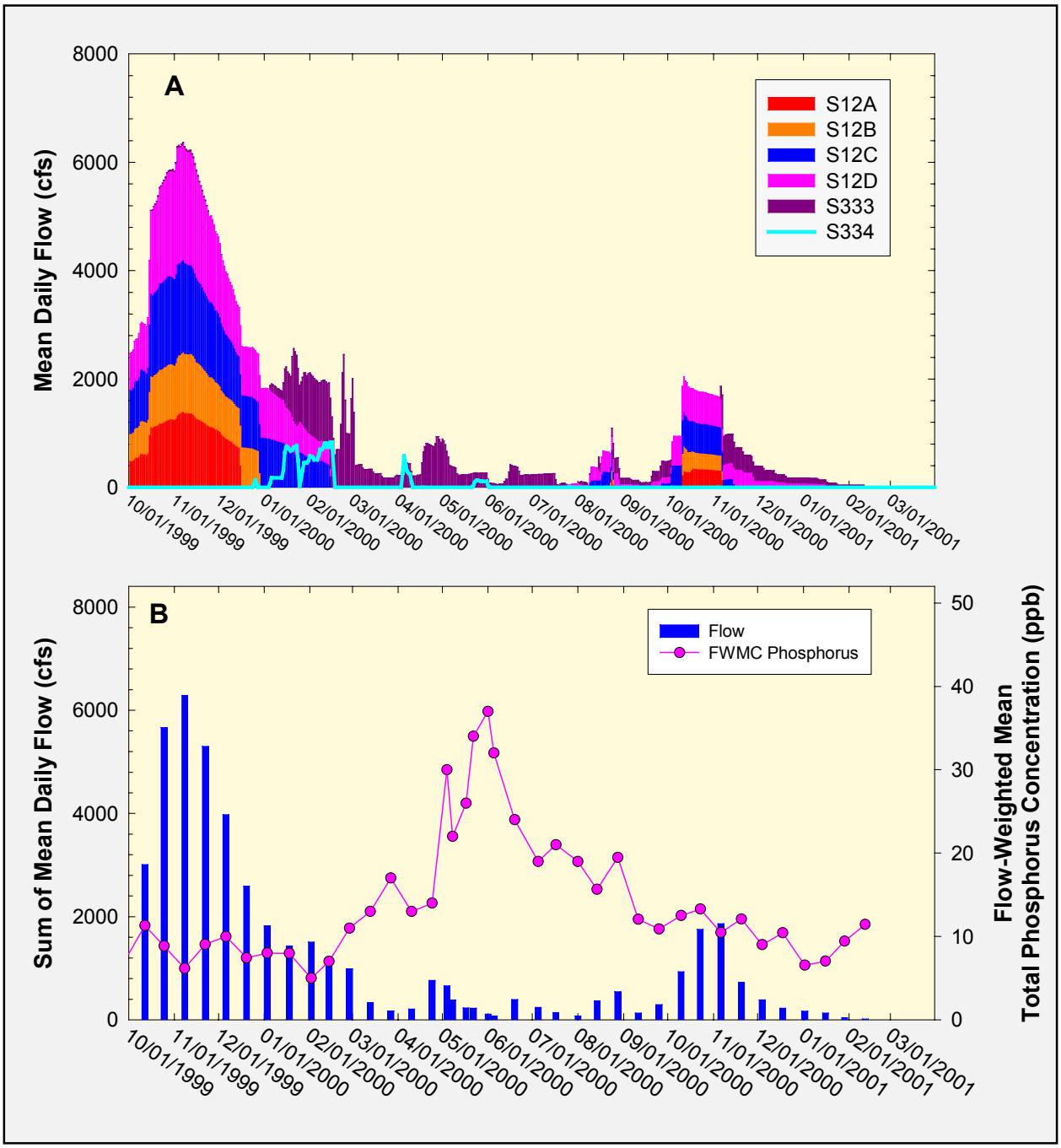

Figure 3. **a.** Mean daily flows into Shark River Slough by structure. **b.** The relationship between sum of mean daily flow at Shark River Slough structures and flow-weighted mean total phosphorus concentration for individual sampling events.

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. Beginning in August 1999, structure S332D, a new pump station constructed by the U.S. Army Corps of Engineers, 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. However, the Settlement Agreement's Technical Oversight Committee requested that data from both the old and new pairs of inflow structures to Taylor Slough be presented for one year. This request was made to determine if the observed differences between the two data sets from August 1999 through March 2000 would continue throughout a complete wet season/dry season cycle and what implications this might have on future compliance with the 11 ppb limit.

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 for the 2000 water year (**Figure 4a**). The bars in **Figure 4a** represent the flow-weighted mean total phosphorus concentrations from S332, S175 and S18C for water years 1989 through 2000. The diamond point value for water year 1999 represents the total phosphorus concentrations for S174 and S18C from October 1, 1998 through September 30, 1999 plus the S332D data from August 30, 1999 through September 30, 1999. The diamond point value for 2000 represents total phosphorus concentrations for the entire year from S174, S332D and S18C.

Figure 4b presents the 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at both the old and new combinations of structures. A lower than average number of individual sampling event flow-weighted mean total phosphorus concentrations exist from December 2000 through March 2001 due to periods of no flow at the Taylor Slough and S18C structures.

The 12-month flow-weighted mean concentrations for January, February and March 2001 were 7.8, 7.9 and 7.9 ppb, respectively, at the new combination of structures and 8.7, 9.4 and 9.5 ppb, respectively, for the old combination of structures (**Table 3**). The Settlement Agreement 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 value of 53.1 percent. The percentage of flow-weighted mean total phosphorus concentrations greater than 10 ppb for the new combination was 15.4, 21.6 and 22.9 for the periods ending January, February and March, respectively. For these same periods, the percentage for the old combination was 15.4, 16.7 and 18.2, respectively (**Table 3**).

A comparison of flows between the old and new combination of structures is presented in **Figure 5**. The flow through S18C, along with the combined flows through S332 plus S175 and S332D plus S174, is presented in **Figure 5a**. The water discharged from the downstream structures, S175 and S332, is supplied through the upstream structures, S174 and S332D. From December 10, 2000 through March 31, 2001 there were no inflows through S332D. Flow through S174 occurred from January 26 through March 4, 2001. Flows through S18C ended on January 2, 2001 and had not resumed by March 31. These flow situations resulted in no flow within the Taylor Slough system from January 3 through January 25, 2001. **Figure 5b** shows the relationship between the sum of the daily mean flows at S18C and the Taylor Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for each sampling event at both the old and new combinations of structures. The very low flow existing at S174 from January 26 through March 4 resulted in the increase in flow-weighted mean total phosphorus concentrations observed in **Figure 5b**.

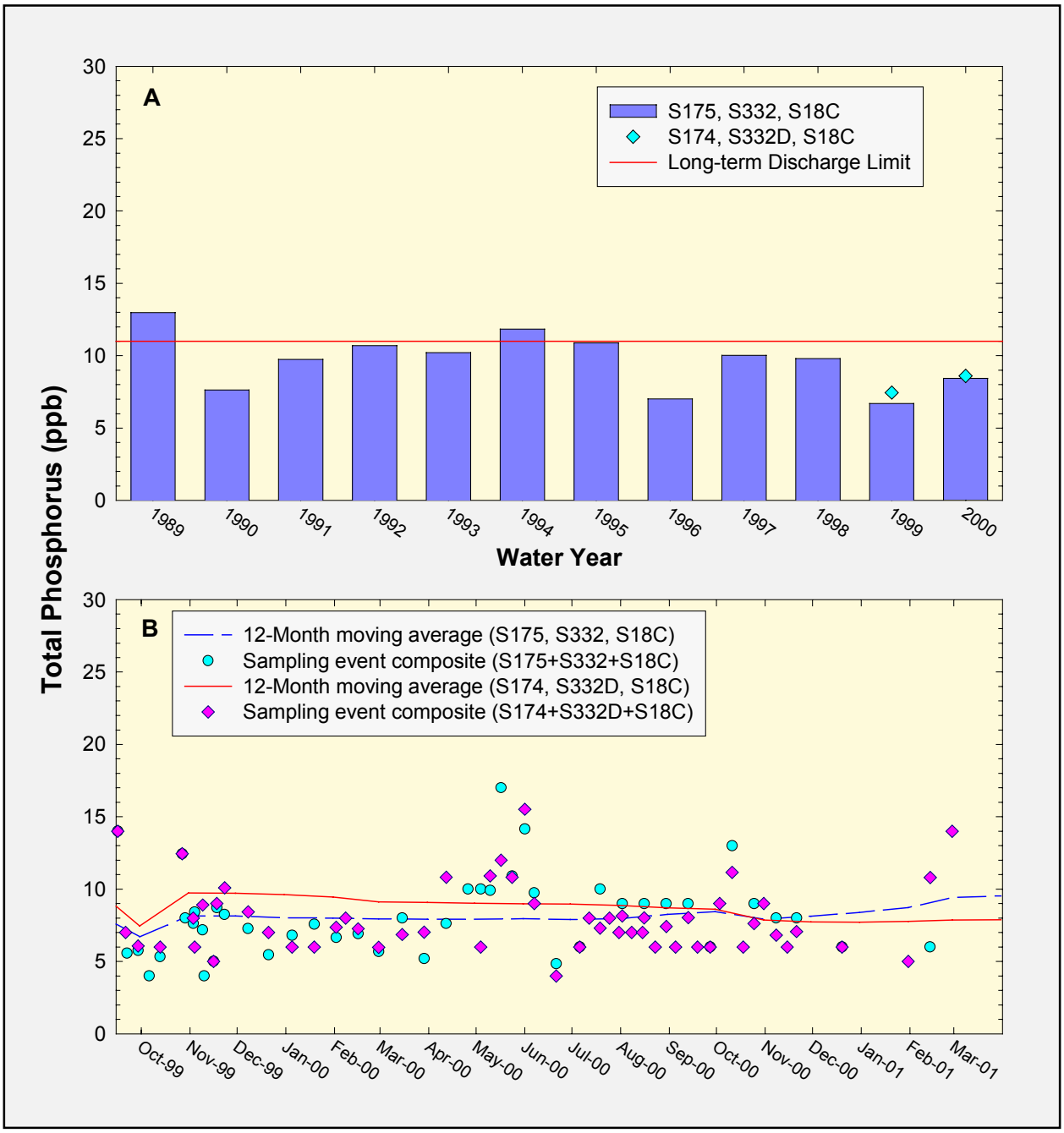

Figure 4. **a.** Flow-weighted mean total phosphorus concentration at the inflows to the Everglades National Park through Taylor Slough and the Coastal Basins compared to the 11 ppb long-term total phosphorus limit for each year. **b.** The 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at both the old and new combinations of compliance monitoring sites.

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

12-Month Period Ending On	Total Period Flow (ac-ft x 10^3)		Flow Weighted Mean Total Phosphorus (ppb)		Long Term Limit (ppb)	Percent of Samples Greater Than 10 ppb			
						Observed (%)		Allowed (%)	
	New	Old	New	Old		New	Old	New	Old
4/30/99	75	252	12.9	10.0	11.0	33.3	25.0	53.1	53.1
5/31/99	63	232	13.8	10.2	11.0	40.0	28.6	53.1	53.1
6/30/99	70	260	13.6	10.1	11.0	44.0	28.6	53.1	53.1
7/31/99	76	276	12.1	9.4	11.0	37.0	25.0	53.1	53.1
8/31/99	79	288	10.2	8.5	11.0	25.0	16.7	53.1	53.1
9/30/99	94	280	7.5	6.7	11.0	17.7	12.1	53.1	53.1
10/31/99	102	339	9.7	8.1	11.0	22.9	17.1	53.1	53.1
11/30/99	112	365	9.7	8.1	11.0	23.1	15.4	53.1	53.1
12/31/99	127	414	9.6	8.0	11.0	22.5	15.4	53.1	53.1
1/31/00	144	450	9.5	8.0	11.0	22.5	15.4	53.1	53.1
2/29/00	160	479	9.1	7.9	11.0	21.4	15.0	53.1	53.1
3/31/00	165	485	9.1	7.9	11.0	22.0	15.4	53.1	53.1
4/30/00	165	493	9.0	7.9	11.0	20.0	12.8	53.1	53.1
5/31/00	170	493	9.0	8.0	11.0	23.3	14.6	53.1	53.1
6/30/00	162	467	9.0	7.9	11.0	23.3	16.7	53.1	53.1
7/31/00	173	457	8.9	8.0	11.0	20.5	17.1	53.1	53.1
8/31/00	184	445	8.7	8.3	11.0	20.9	18.0	53.1	53.1
9/30/00	188	432	8.6	8.4	11.0	19.1	14.3	53.1	53.1
10/31/00	195	375	7.9	7.9	11.0	15.9	12.1	53.1	53.1
11/30/00	182	315	7.7	8.1	11.0	14.6	13.8	53.1	53.1
12/31/00	163	266	7.7	8.4	11.0	15.0	14.3	53.1	53.1
1/31/01	135	205	7.8	8.7	11.0	15.4	15.4	53.1	53.1
2/28/01	120	168	7.9	9.4	11.0	21.6	16.7	53.1	53.1
3/31/01	112	161	7.9	9.5	11.0	22.9	18.2	53.1	53.1

New= S174+S332D+S18C data
Old = S175+S332+S18C data

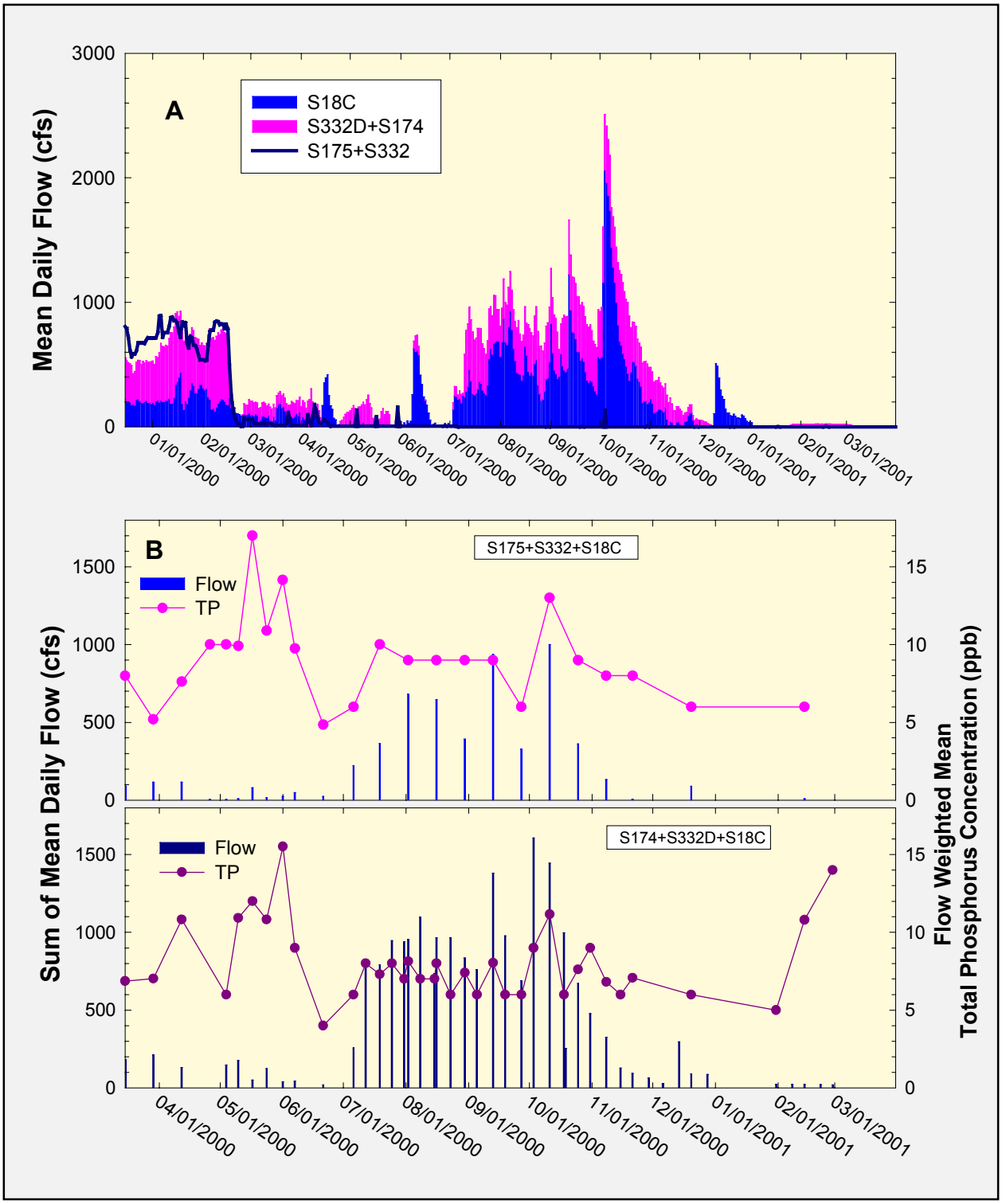

Figure 5. **a.** Daily mean flows into the Everglades National Park through Taylor Slough and the Coastal Basins control structure. **b.** Mean daily flows and corresponding flow-weighted mean total phosphorus concentrations at old and new combinations of Taylor Slough and Coastal Basin structures.

Settlement Agreement
April - June 2001 Report

Prepared for the
Technical Oversight Committee
October 31, 2001

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ARTHUR R. MARSHALL LOXAHATCHEE NATIONAL WILDLIFE REFUGE

Phosphorus Concentrations

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 Consent Decree, as modified in 1995, specified that interim and long-term phosphorus concentration levels for the 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 gaging stations 1-7, 1-8C and 1-9 within the Refuge. The stage range within which the interim and long-term level calculations are applicable is 15.42 to 17.14 feet (mean sea level). Total phosphorus concentrations are determined from water samples collected at 14 interior marsh stations (LOX 3 through LOX 16).

Average stages in the Refuge were 15.48, 14.88 and 15.42 feet in April, May and June 2001, respectively (**Figure 1**). The geometric means calculated from total phosphorus concentrations measured in water samples collected in April, May and June were 11.5, 18.3 and 15.1 ppb, respectively (**Table 1**). The geometric mean concentrations in April, May and June were less than the calculated interim and long-term limits. For completeness, the May value is provided in **Figure 1**. However, the May total phosphorus concentration of 18.3 ppb was based on only two samples because many sites were dry or had water levels less than 10 centimeters, the minimum depth necessary to ensure a representative sample. The interim and long-term limits were not applicable in May since the Refuge average stage was less than 15.42 feet (**Table 1**).

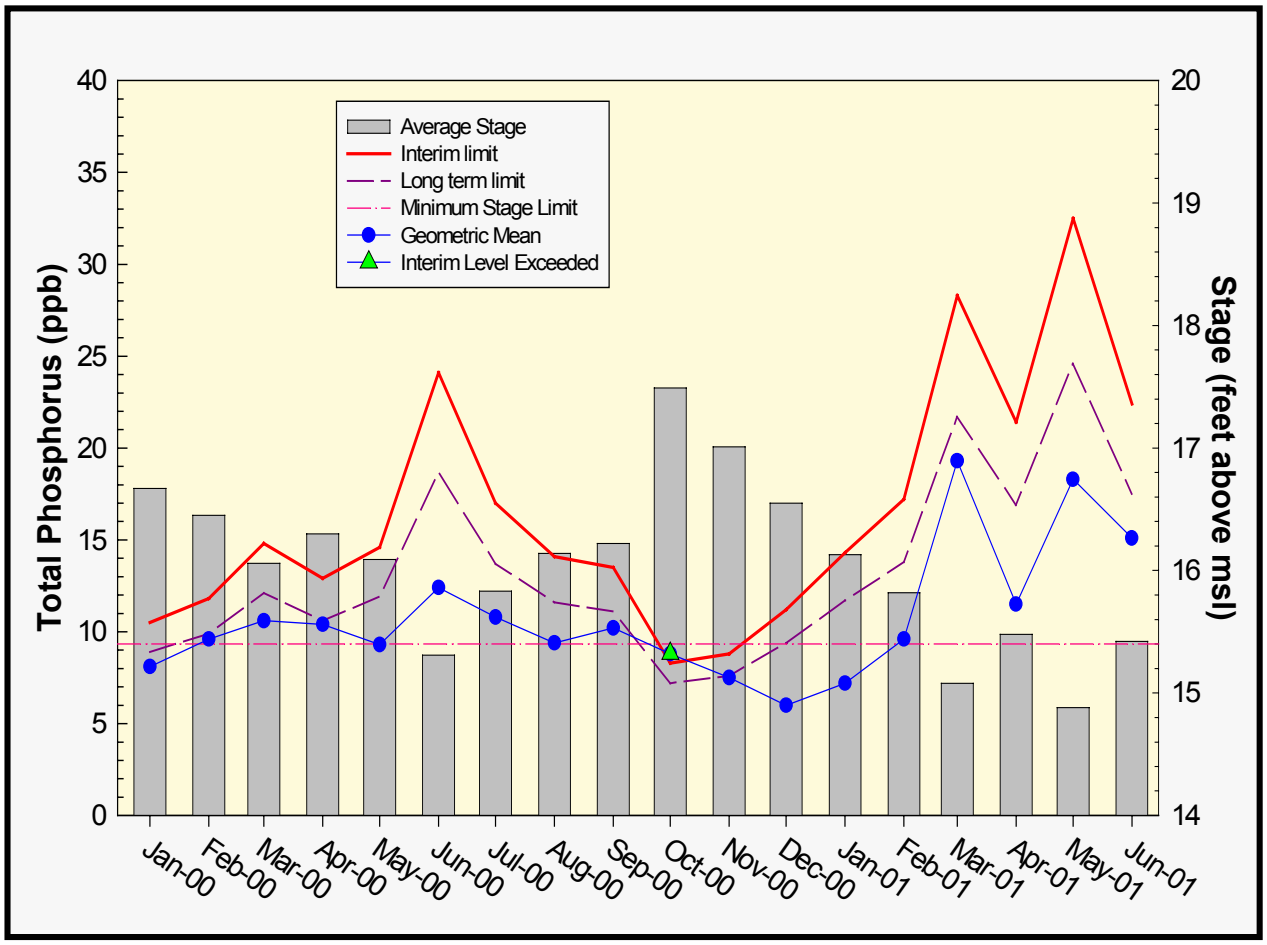

Figure 1. Monthly total phosphorus geometric mean concentration levels for the Loxahatchee National Wildlife Refuge compared to the interim and long-term targets. The calculated target concentrations are adjusted for fluctuations in water level. Due to extremely low stage levels, the geometric mean value for May 2000 is not considered for compliance with the Consent Decree.

Table 1. Loxahatchee National Wildlife Refuge Total Phosphorus Compliance.

Month and Year	Geometric Mean	Interim Limit	Long Term Limit	Average Stage	Number of Phosphorus Samples	Number of Stage Measurements
	(ppb)			(ft, NGVD)		
Jul-1999	11.1	14.4	11.8	16.11	10	3
Aug-1999	12.7	15.1	12.3	16.03	8	3
Sep-1999	10.3	9.9	8.4	16.79	14	3
Oct-1999	10.3	9.9	8.4	16.79	14	3
Nov-1999	10.3	9.9	8.4	16.79	14	3
Dec-1999	9.1	9.1	7.9	16.94	14	3
Jan-2000	8.1	10.5	8.9	16.67	14	3
Feb-2000	9.6	11.8	9.9	16.45	13	3
Mar-2000	10.6	14.8	12.1	16.06	12	3
Apr-2000	10.4	12.9	10.6	16.30	14	3
May-2000	9.3 *(11.0)*	14.6 *(15.0)*	11.9 *(12.2)*	16.09 *(16.05)*	11 *(14,11,13,12)*	3 *(3,3,3,3)*
Jun-2000	12.4	NA	NA	15.31	6	3
Jul-2000	10.8	17.0	13.7	15.83	6	3
Aug-2000	9.4	14.1	11.6	16.1	10	3
Sep-2000	10.2	13.5	11.1	16.22	11	3
Oct-2000	8.8	8.3	7.2	17.49	13	3
Nov-2000	7.5	8.8	7.6	17.01	14	3
Dec-2000	6.0	11.2	9.4	16.55	9	3
Jan-2001	7.2	14.3	11.7	16.13	8	3
Feb-2001	9.6	17.2	13.8	15.82	9	3
Mar-2001	19.3	NA	NA	15.08	2	3
Apr-2001	11.5	21.4	16.9	15.48	6	3
May-2001	18.3	NA	NA	14.88	2	3
Jun-2001	15.1	22.4	17.5	15.42	9	3

Notes:

(1) Average Stage is calculated using stage elevations at three stations on the sampling date.

(2) The italicized values in parentheses for May-2000 include the Lake Okeechobee Recession special sampling data.

(3) Highlighted values indicate months when exceedances occurred.

(4) NA = Limits not applicable when Refuge stage is below 15.42 feet (mean sea level).

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 through Shark River Slough must be met by October 1, 2003, and December 31, 2006, respectively. The limits apply to the water year ending September 30. 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. In addition, the Settlement Agreement requires that phosphorus concentrations be presented as 12-month moving flow-weighted means.

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 1989 to 2000 (**Figure 2a**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2000 was 10.0 ppb. Corresponding interim and long-term limits were 9.4 and 7.6 ppb, respectively. This is the first time since 1993 that both limits were exceeded for the water year ending in September.

The Settlement Agreement 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 maximum value based on flow into Shark River Slough for the same 12-month period (**Figure 2b**). For the 12-month periods ending April, May and June 2001, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb was 84.6, 81.8 and 80.0, respectively. These percentages exceeded the allowed percentages for all three 12-month periods (see **Table 2**).

Table 2 presents the moving flow-weighted mean total phosphorus concentrations for each 12-month period from July 1998 through June 2001, as well as the corresponding interim and long-term total phosphorus concentration limits, which are calculated using the 12-month period flow. For the 12-month periods ending in April, May and June 2001, the total phosphorus concentrations were 15.8, 13.7 and 12.8, respectively. These concentrations were all greater than the long-term limits for these respective months, whereas only the June concentration was less than the interim limit.

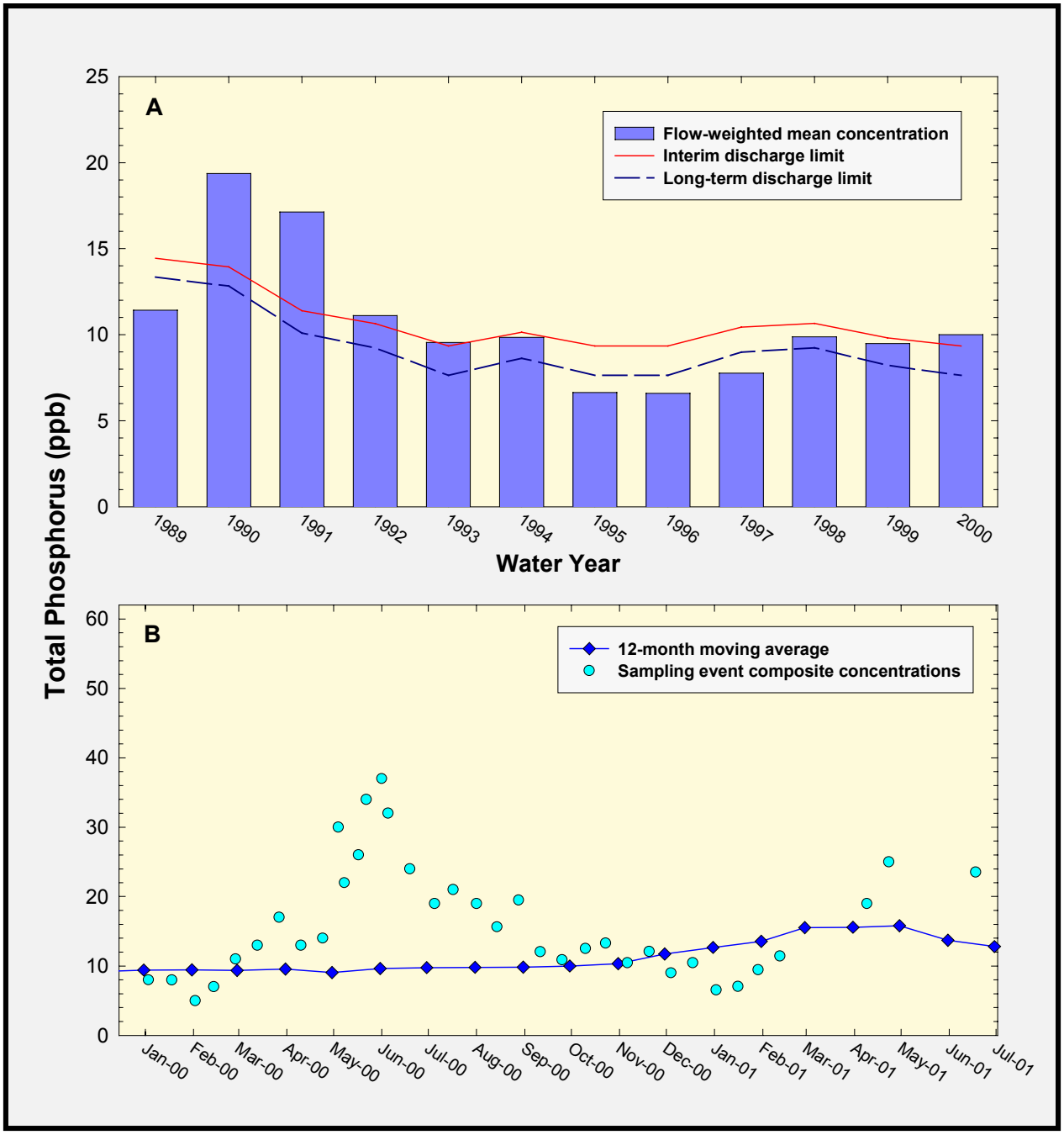

Figure 2. 12-month moving flow-weighted mean total phosphorus concentrations at the inflows to the Everglades National Park (ENP) through Shark River Slough compared to the interim and long-term targets. **a.** Concentration at the end of each water year. **b.** 12-month moving average concentration at the end of each month and the composite concentration for each sampling event.

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

12-Month Period Ending On	Total Period Flow (Kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Limits (ppb)		Percent of Samples Greater Than 10 ppb (%)	
			Interim	Long Term	Observed	Allowed
7/31/99	788.4	9.7	10.4	9.0	41.7	46.7
8/31/99	857.6	9.6	10.1	8.6	39.1	44.9
9/30/99	939.9	9.5	9.8	8.2	39.1	42.9
10/31/99	1084.4	9.4	9.4	7.6	39.1	40.1
11/30/99	1297.5	9.1	9.4	7.6	39.1	40.1
12/31/99	1344.8	9.4	9.4	7.6	39.1	40.1
1/31/00	1395.1	9.4	9.4	7.6	39.1	40.1
2/29/00	1415.5	9.4	9.4	7.6	***41.7***	40.1
3/31/00	1385.7	9.6	9.4	7.6	***52.2***	40.1
4/30/00	1385.1	9.1	9.4	7.6	***52.2***	40.1
5/31/00	1401.5	9.6	9.4	7.6	***57.7***	40.1
6/30/00	1395.9	9.8	9.4	7.6	***60.7***	40.1
7/31/00	1294.6	9.8	9.4	7.6	***64.3***	40.1
8/31/00	1215	9.8	9.4	7.6	***65.5***	40.1
9/30/00	1096	10.0	9.4	7.6	***69.0***	40.1
10/31/00	925	10.3	9.9	8.3	***72.4***	43.2
11/30/00	642	11.7	11.1	9.8	***79.3***	50.8
12/31/00	464	12.7	12.0	10.8	***82.8***	56.4
1/31/01	367	13.5	12.5	11.3	***80.0***	59.8
2/28/01	298	15.5	12.9	11.7	***85.7***	62.2
3/31/01	276	15.6	13.0	11.9	***84.6***	63.1
4/30/01	250	15.8	13.2	12.0	***84.6***	64.0
5/31/01	231	13.7	13.3	12.1	***81.8***	64.7
6/30/01	221	12.8	13.3	12.2	***80.0***	65.1

Note: ***Italicized*** values exceeded allowed percentage

The daily mean flows through the individual Shark River Slough structures and S334 from January 1999 through June 2001 are presented in **Figure 3a**. From April 1 through June 30, 2001, flows into northeastern Shark River Slough occurred only through S333 from April 9 to April 23 and only through S333 and S12D from June 13 to June 26. The total quarterly flows through S333 were 2839 acre-feet (1431 cfs) and through S12D 666 acre-feet (336 cfs). The relationship between the sum of the daily mean flows at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events is presented in **Figure 3b**. Only three composite samples were collected at Shark River Slough structures from April through June with the following results:

Date	Total Phosphorus (fwmc ppb)	Flow (daily cfs)
4/9/01	19	25
4/23/01	25	28
6/18/01	23.5	67

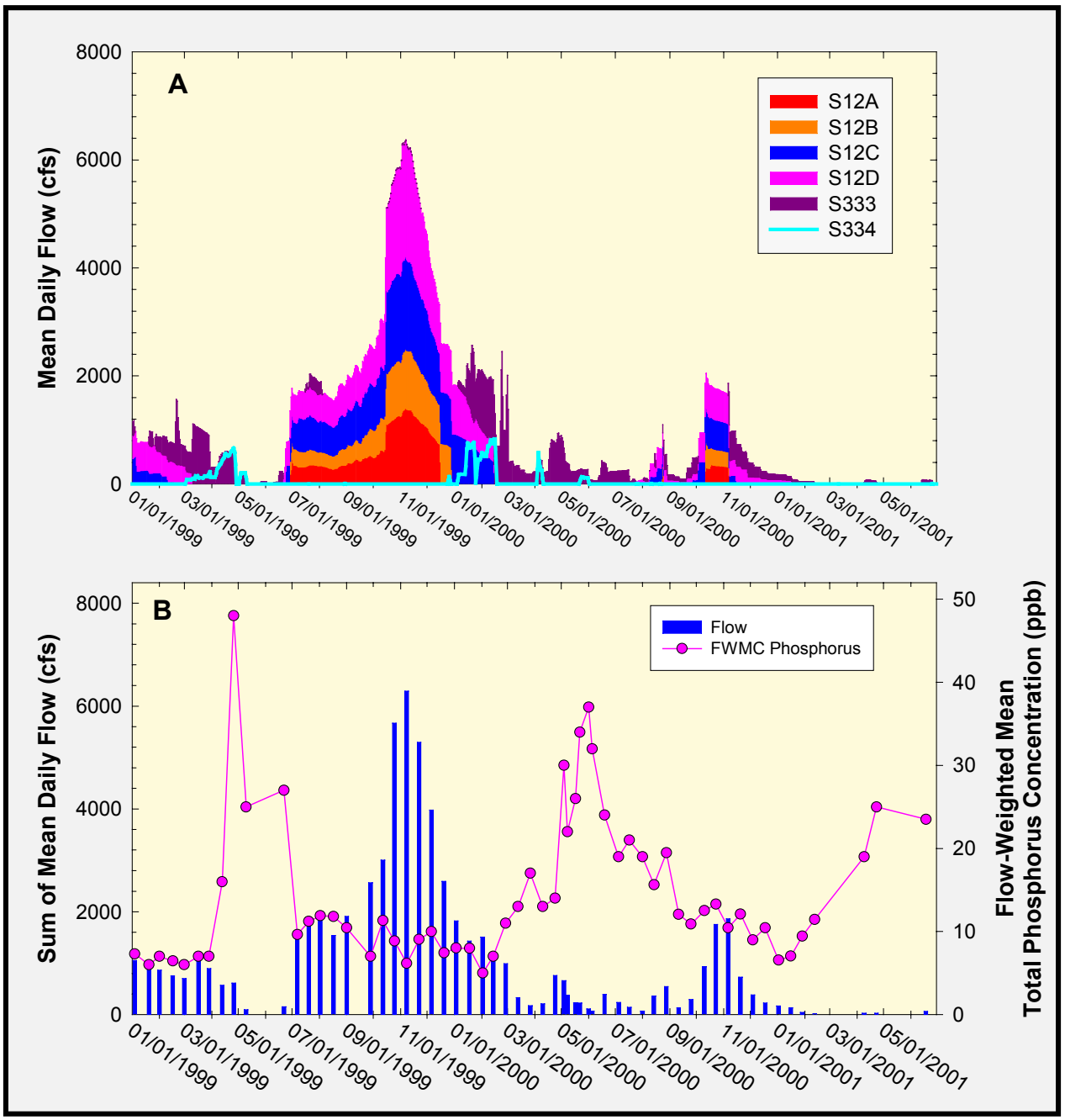

Figure 3. **a.** Mean daily flows into Shark River Slough by structure. **b.** The relationship between sum of mean daily flow at Shark River Slough structures and flow-weighted mean total phosphorus concentration for individual sampling events.

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. Beginning in August 1999, structure S332D, a new pump station constructed by the U.S. Army Corps of Engineers, 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. However, the Settlement Agreement's Technical Oversight Committee requested that data from both the old and new pairs of inflow structures to Taylor Slough be presented for one year. This request was made to determine if the observed differences between the two data sets from August 1999 through March 2000 would continue throughout a complete wet season/dry season cycle and what implications this might have on future compliance with the 11 ppb limit.

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 for the 2000 water year (**Figure 4a**). The bars in **Figure 4a** represent the flow-weighted mean total phosphorus concentrations from S332, S175 and S18C for water years 1989 through 2000. The diamond point value for water year 1999 represents the total phosphorus concentrations for S174 and S18C from October 1, 1998 through September 30, 1999 plus the S332D data from August 30, 1999 through September 30, 1999. The diamond point value for 2000 represents total phosphorus concentrations for the entire year from S174, S332D and S18C.

Figure 4b presents the 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at both the old and new combinations of structures. A lower than average number of individual sampling event flow-weighted mean total phosphorus concentrations exist from December 2000 through June 2001 due to periods of no flow at the Taylor Slough and S18C structures.

The 12-month flow-weighted mean concentrations for April, May and June 2001 were 7.8, 7.9 and 7.9 ppb, respectively, for the new combination of structures, and 8.7, 9.4 and 9.5 ppb, respectively, for the old combination of structures (**Table 3**). The Settlement Agreement 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 value of 53.1 percent. The percentage of flow-weighted

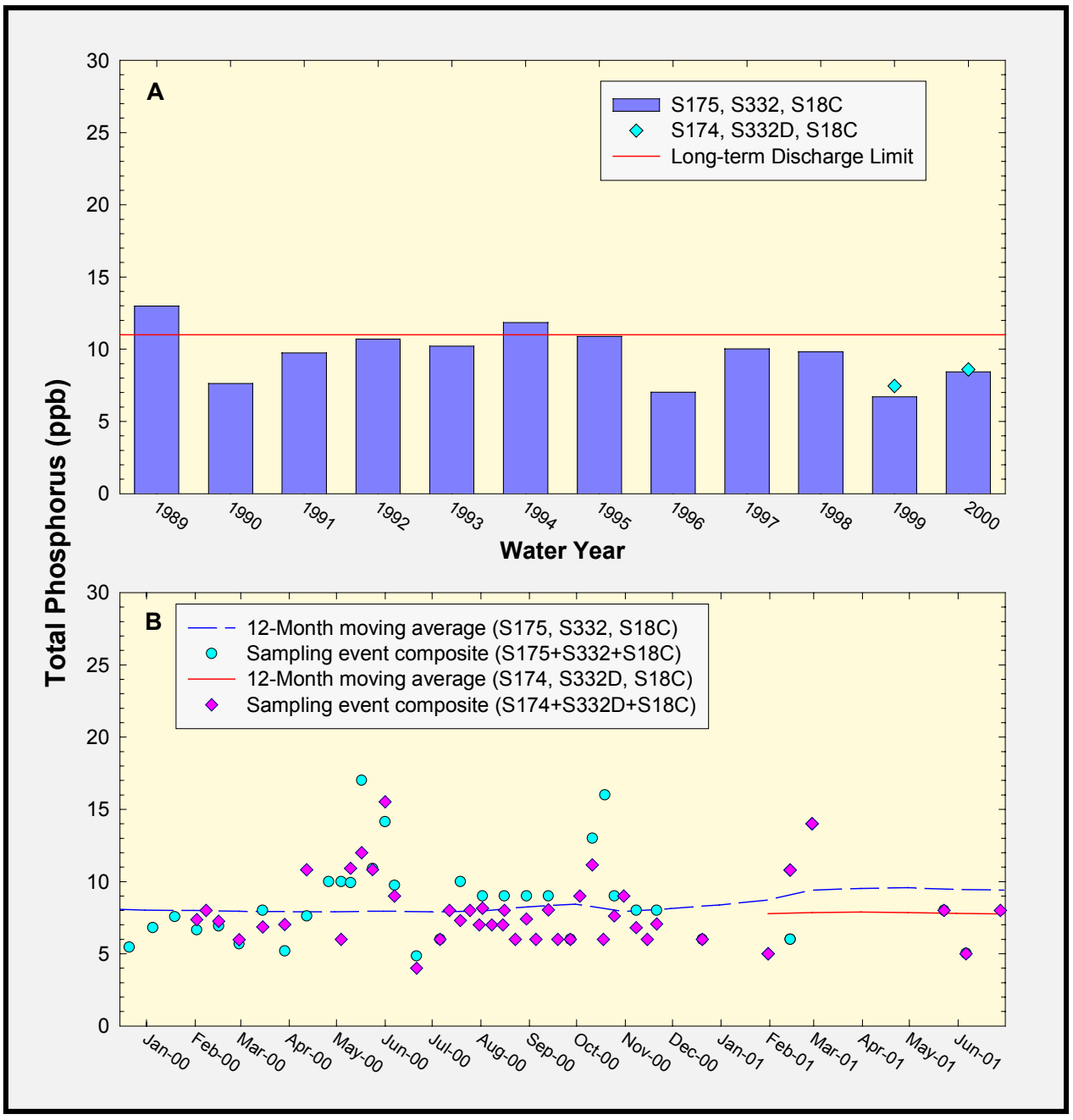

Figure 4. **a.** Flow-weighted mean total phosphorus concentration at the inflows to the Everglades National Park through Taylor Slough and the Coastal Basins compared to the 11 ppb long-term total phosphorus limit for each year. **b.** The 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at both the old and new combinations of compliance monitoring sites.

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

12-Month Period Ending On	Total Period Flow (ac-ft x 10^3)		Flow Weighted Mean Total Phosphorus (ppb)		Long Term Limit (ppb)	Percent of Samples Greater Than 10 ppb			
						Observed (%)		Allowed (%)	
	New	Old	New	Old		New	Old	New	Old
7/31/99	----	276	----	9.4	11.0	----	25.0	----	53.1
8/31/99	----	288	----	8.5	11.0	----	16.7	----	53.1
9/30/99	----	280	----	6.7	11.0	----	12.1	----	53.1
10/31/99	----	339	----	8.1	11.0	----	17.1	----	53.1
11/30/99	----	365	----	8.1	11.0	----	15.4	----	53.1
12/31/99	----	414	----	8.0	11.0	----	15.4	----	53.1
1/31/00	----	450	----	8.0	11.0	----	15.4	----	53.1
2/29/00	----	479	----	7.9	11.0	----	15.0	----	53.1
3/31/00	----	485	----	7.9	11.0	----	15.4	----	53.1
4/30/00	----	493	----	7.9	11.0	----	12.8	----	53.1
5/31/00	----	493	----	8.0	11.0	----	14.6	----	53.1
6/30/00	----	467	----	7.9	11.0	----	16.7	----	53.1
7/31/00	----	457	----	8.0	11.0	----	17.1	----	53.1
8/31/00	----	445	----	8.3	11.0	----	18.0	----	53.1
9/30/00	----	432	----	8.4	11.0	----	14.3	----	53.1
10/31/00	----	375	----	7.9	11.0	----	12.1	----	53.1
11/30/00	----	315	----	8.1	11.0	----	13.8	----	53.1
12/31/00	----	266	----	8.4	11.0	----	14.3	----	53.1
1/31/01	**308**	205	**7.8**	8.7	11.0	**15.4**	15.4	**53.1**	53.1
2/28/01	**282**	168	**7.9**	9.4	11.0	**21.6**	16.7	**53.1**	53.1
3/31/01	**269**	161	**7.9**	9.5	11.0	**22.9**	18.2	**53.1**	53.1
4/30/01	**260**	154	**7.9**	9.6	11.0	**20.6**	20.0	**53.1**	53.1
5/31/01	**254**	153	**7.8**	9.4	11.0	**12.9**	11.8	**53.1**	53.1
6/30/01	**249**	148	**7.8**	9.4	11.0	**10.0**	6.7	**53.1**	53.1

New= S174+S332D+S18C data
Old = S175+S332+S18C data

mean total phosphorus concentrations greater than 10 ppb for the new combination was 20.6, 12.9 and 10.0 for the periods ending April, May and June, respectively. For these same periods, the percentage for the old combination was 20.0, 11.8 and 6.7, respectively (**Table 3**).

A comparison of flows between the old and new combination of structures is presented in **Figure 5**. The flow through S18C, along with the combined flows through S332 plus S175 and S332D plus S174, is presented in **Figure 5a**. The water discharged from the downstream structures, S175 and S332, is supplied through the upstream structures, S174 and S332D. In April and May 2000, all flow into the Everglades National Park was through S18C. The April total flow was 212 acre-feet (107 cfs), while the May total flow increased to 1089 acre-feet (549 cfs). S18C discharged 4012 acre-feet (2023 cfs) during the month of June and S332D discharged 740 acre-feet (373 cfs) into Taylor Slough during the last three days of June. **Figure 5b** shows the relationship between the sum of the daily mean flows at S18C and the Taylor Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for each sampling event at both the old and new combinations of structures. The zero flow conditions at S174, S332 and S175 throughout the quarter and the flow through S332D from June 28 to June 30 resulted in only three composite samples being collected as follows:

Date	Total Phosphorus (fwmc ppb)	Flow (daily cfs)
5/23/01	8	11
6/6/01	5	40
6/28/01	8	348

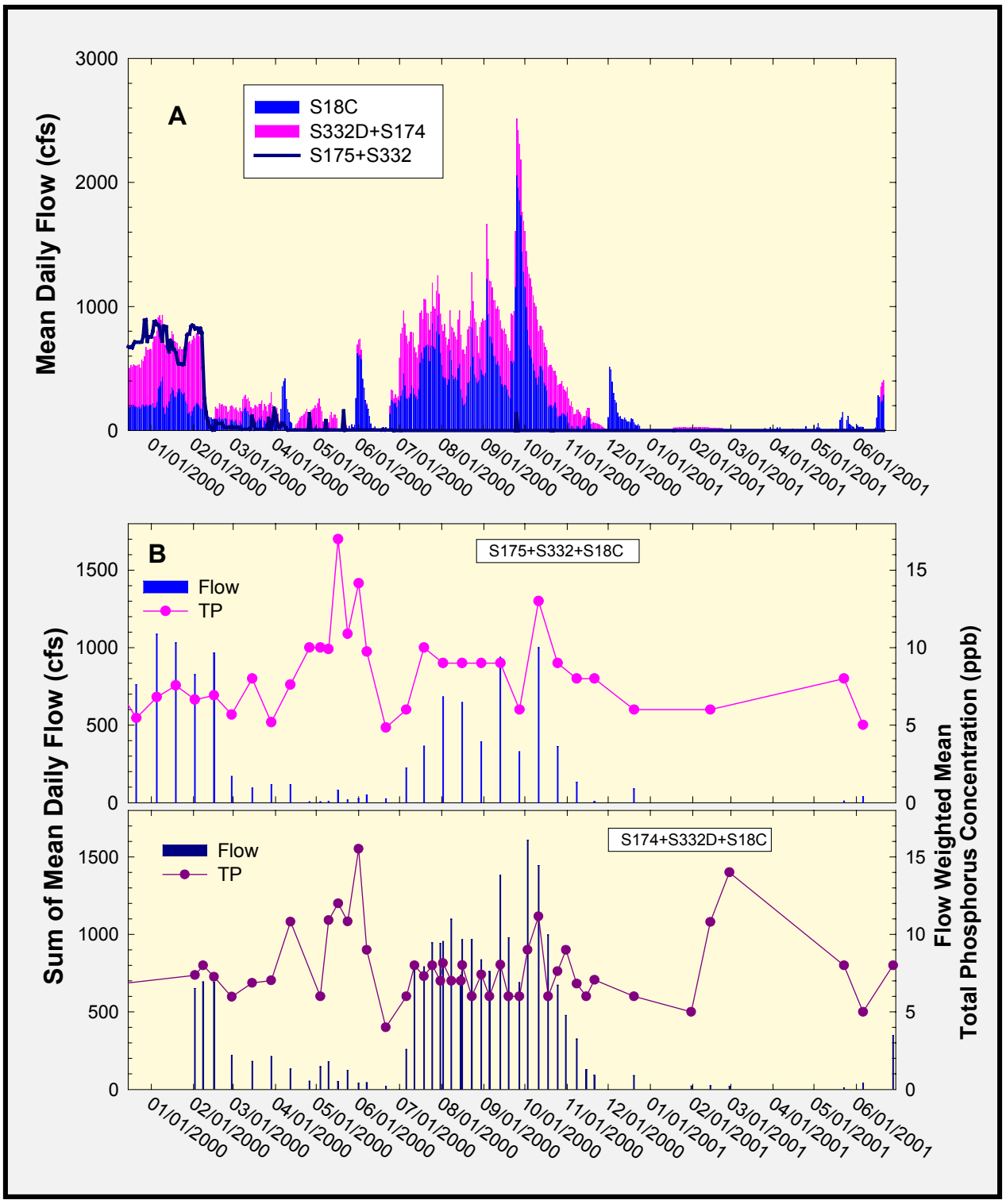

Figure 5. **a.** Daily mean flows into the Everglades National Park through Taylor Slough and the Coastal Basins control structure. **b.** Mean daily flows and corresponding flow-weighted mean total phosphorus concentrations at old and new combinations of Taylor Slough and Coastal Basin structures.

Settlement Agreement
July - September 2001 Report

Prepared for the
Technical Oversight Committee
January 29, 2002

Prepared by:
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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 gaging 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 (mean sea level). The monthly total phosphorus concentrations are determined from water samples collected at 14 interior marsh stations (LOX 3 through LOX 16). 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 15.82, 16.74 and 16.57 feet in July, August and September 2001, respectively (**Figure 1, Table 1**). The geometric means calculated from total phosphorus concentrations measured in water samples collected in July, August and September were 11.4, 10.0 and 9.6 ppb, respectively (**Table 1**). These geometric mean concentrations were within the calculated interim limits. The July geometric mean was less than the long-term limit, whereas the August and September geometric means exceeded their respective long-term limits.

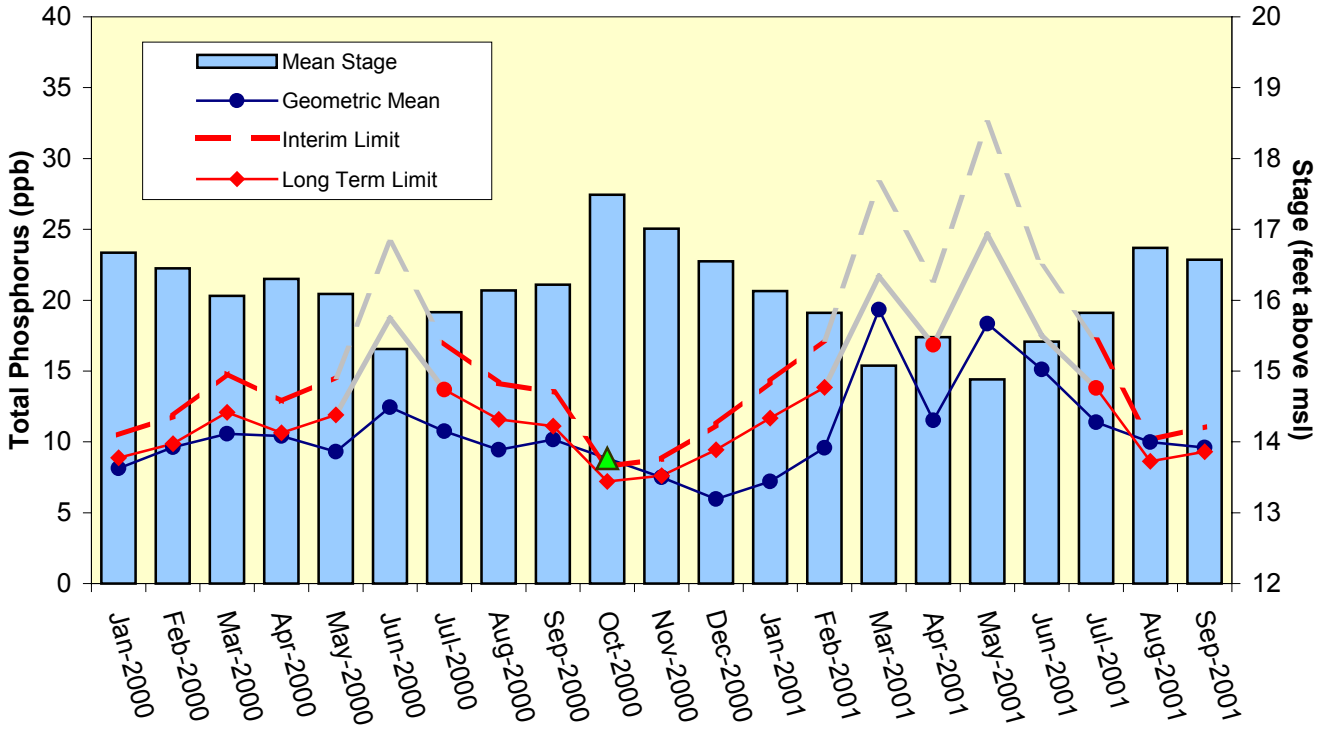

Figure 1. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term targets. The calculated target concentrations are adjusted for fluctuations in water level.

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

Month Year	Geometric Mean	Interim limit	Long Term Limit	Average Stage	Number of TP Samples	Number of Stage Measure-ments
	(ppb)			(ft,NGVD)		
Oct-1999	10.3	7.7	6.8	17.28	14	3
Nov-1999	9.0	7.8	6.9	17.25	14	3
Dec-1999	9.1	9.1	7.9	16.94	14	3
Jan-2000	8.1	10.5	8.9	16.67	14	3
Feb-2000	9.6	11.8	9.9	16.46	13	3
Mar-2000	10.6	14.8	12.1	16.06	12	3
Apr-2000	10.4	12.9	10.6	16.30	14	3
May-2000	11.0	15.0	12.2	16.05	14	3
Jun-2000	12.4	NA	NA	15.31	6	3
Jul-2000	10.8	17.0	13.7	15.84	6	3
Aug-2000	9.4	14.1	11.6	16.14	10	3
Sep-2000	10.2	13.5	11.1	16.22	11	3
Oct-2000	8.8	7.0	6.2	17.49	13	3
Nov-2000	7.5	8.8	7.6	17.01	14	3
Dec-2000	6.0	11.2	9.4	16.55	9	3
Jan-2001	7.2	14.3	11.7	16.13	8	3
Feb-2001	9.6	17.2	13.8	15.82	9	3
Mar-2001	19.3	NA	NA	15.08	2	3
Apr-2001	11.5	21.4	16.9	15.48	6	3
May-2001	18.3	N/A	N/A	14.88	2	3
Jun-2001	15.1	22.4	17.5	15.42	9	3
Jul-2001	11.4	17.2	13.8	15.82	11	3
Aug-2001	10.0	10.1	8.6	16.74	14	3
Sep-2001	9.6	11.1	9.3	16.57	14	3

Notes:

(1) Average Stage is calculated using stage elevations at three stations on the sampling date

(2) The italicized values in parentheses for May-2000 included Lake Okeechobee Recession special sampling data.

(3) Highlighted values indicate months when exceedances occurred

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 through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. The limits apply to the water year ending September 30. 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. In addition, it is required that phosphorus concentrations be presented as 12-month moving flow-weighted means.

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 1989 to 2001 (Figure 2a). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2001 was 15.0 ppb. Corresponding interim and long-term limits were 12.2 and 10.8 ppb, respectively. This is the second consecutive year that both limits were exceeded for the water year ending in September. Both the 2000 and 2001 water years were very dry, resulting in lower volumes of flow with higher total phosphorus concentrations entering the Park than those observed in wetter years.

The Settlement Agreement 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 an allowable value based on flow into Shark River Slough for the same 12-month period. For the 12-month periods ending July, August and September 2001, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb was 78.9 for each period (Table 2). These percentages exceeded the allowable percentages for all three 12-month periods. The individual sampling events and the 12-month moving average are presented in Figure 2b.

Table 2 presents the moving flow-weighted mean concentrations for each 12-month period beginning in October 1999 as well as the corresponding interim and long-term total phosphorus concentration limits, which are calculated using the 12-month period flow. For the 12-month periods ending in July, August and September 2001, the flow-weighted mean total phosphorus concentrations were 12.5, 16.0

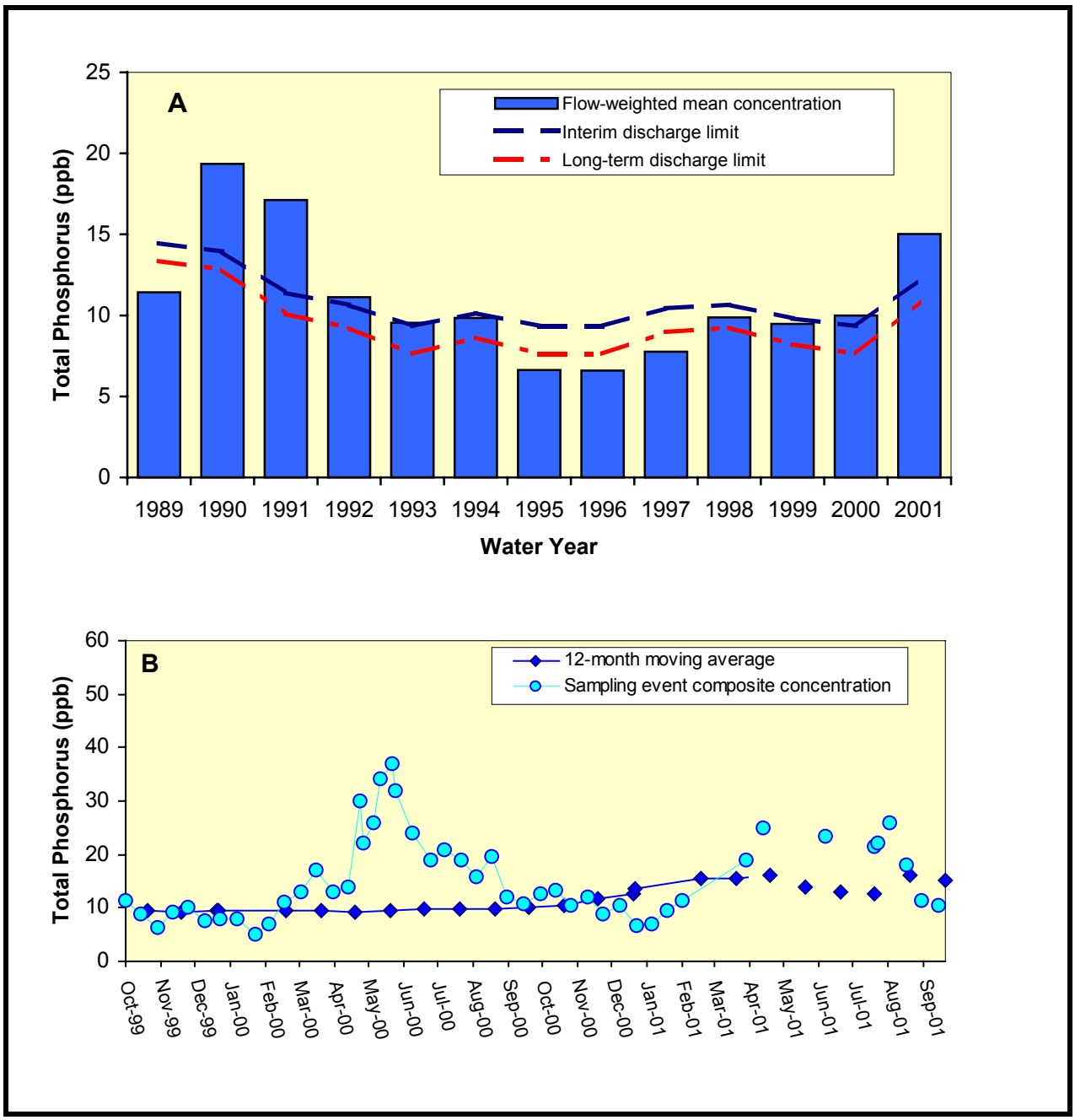

Figure 2. 12-month moving flow-weighted mean total phosphorus concentrations at the inflows to the Everglades National Park (ENP) through Shark River Slough compared to the interim and long-term targets. **A**. Concentration at the end of each water year. **B**. 12-month moving average concentration at the end of each month and the composite concentration for each sampling event

Table 2. Shark River Slough Total Phosporus Concentration Compliance Tracking

12-Month Period Ending On	Total Period Flow	Flow Weighted Mean Total Phosphorus	Limits (ppb)		Percent of Sampling Events Greater than 10 ppb (%)	
	(Kac-ft)	(ppb)	Interim	Long Term	Observed	Allowed
10/31/99	1084.4	9.4	9.4	7.6	39.1	40.1
11/30/99	1297.5	9.1	9.4	7.6	39.1	40.1
12/31/99	1344.8	9.4	9.4	7.6	39.1	40.1
01/01/00	1395.1	9.4	9.4	7.6	39.1	40.1
02/29/00	1415.5	9.4	9.4	7.6	***41.7***	40.1
03/31/00	1385.7	9.6	9.4	7.6	***52.2***	40.1
04/30/00	1385.1	9.1	9.4	7.6	***52.2***	40.1
05/31/00	1401.5	9.6	9.4	7.6	***57.7***	40.1
06/30/00	1395.9	9.8	9.4	7.6	***60.7***	40.1
07/31/00	1294.6	9.8	9.4	7.6	***64.3***	40.1
08/31/00	1214.6	9.8	9.4	7.6	***65.5***	40.1
09/30/00	1096.1	10.0	9.4	7.6	***69.0***	40.1
10/31/00	925.0	10.3	9.9	8.3	***72.4***	43.2
11/30/00	642.1	11.7	11.1	9.8	***79.3***	50.8
12/31/00	464.0	12.7	12.0	10.8	***82.8***	56.4
01/01/01	367.0	13.5	12.5	11.3	***80.0***	59.8
02/28/01	298.4	15.5	12.9	11.7	***85.7***	62.2
03/31/01	275.9	15.6	13.0	11.9	***84.6***	63.1
04/30/01	250.4	16.1	13.2	12.0	***95.0***	64.0
05/31/01	230.9	13.9	13.3	12.1	***93.8***	64.7
06/30/01	221.0	12.8	13.3	12.2	***80.0***	65.1
07/31/01	212.8	12.5	13.4	12.2	***78.9***	65.4
08/31/01	324.0	16.0	12.8	11.5	***78.9***	61.3
09/30/01	419.7	15.0	12.2	10.8	***78.9***	57.9

Note: ***Italicized values exceeded allowed percentage***

and 15.0 ppb, respectively. The July concentration was less than the interim limit but greater than the long-term limit. The August and September concentrations were greater than both the August and September interim and long-term limits.

The daily mean flows through the individual Shark River Slough structures and S334 from October 1999 through September 2001 are presented in Figure 3a. A sharp increase in flow began on July 31, 2001, ending an essentially six-month no flow period. The relationship between the sum of the daily mean flows at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events is presented in Figure 3b. Increasing flows into Shark River Slough beginning in late July through September 2001 resulted in individual sampling event total phosphorus flow-weighted mean concentrations decreasing to 10.5 ppb by the end of September.

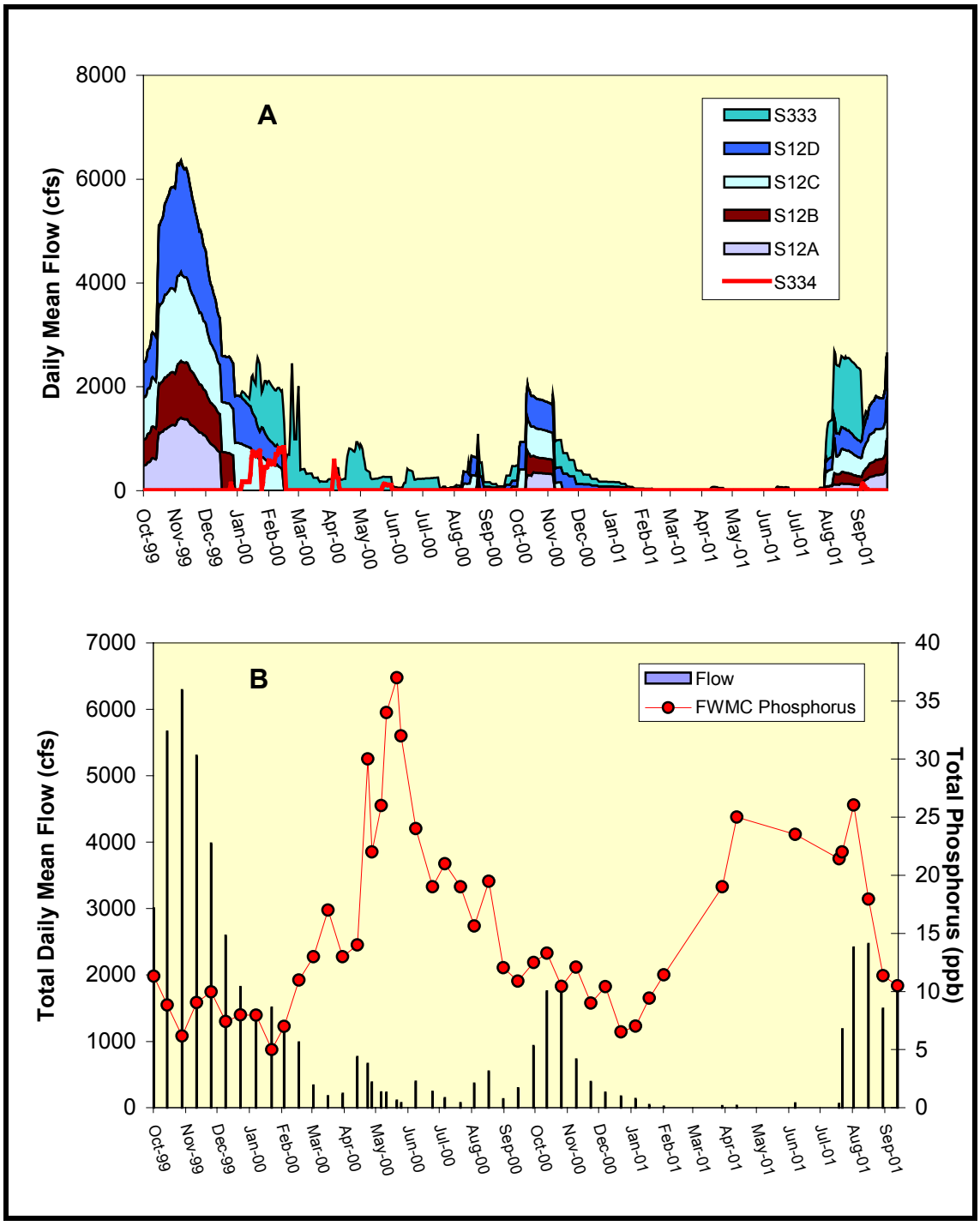

Figure 3. **A**. Mean daily flows into Shark River Slough by structure. **B**. The relationship between sum of mean daily flow at Shark River Slough structures and flow-weighted mean total phosphorus concentration for individual sampling events.

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. Beginning in August 1999, structure S332D, a new pump station constructed by the U.S. Army Corps of Engineers, 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. However, the Settlement Agreement's Technical Oversight Committee requested that data from both the old and new pairs of inflow structures to Taylor Slough be presented for one year. This request was made to determine if the differences between the two data sets observed from August 1999 through March 2000 would continue throughout a complete wet season/dry season cycle and what implications this might have on future compliance with the 11 ppb limit.

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 4a). The bars in Figure 4a represent the flow-weighted mean total phosphorus concentrations from S332, S175 and S18C for water years 1989 through 2001. The diamond point values for water years 1999, 2000 and 2001 represent the new combination of structures. Figure 4b presents the 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at both the old and new combinations of structures. When the individual sampling event concentrations from both the old and new combination of structures (Figure 4b) are compared with the daily mean flow data presented in Figure 5a, it appears that the variability between the data is less during higher flows than during low/no flow periods.

The 12-month flow-weighted mean concentrations for July, August and September 2001 were 7.5, 7.3 and 7.2 ppb, respectively, at the new combination of structures and 8.9, 8.7 and 8.7 ppb, respectively, for the old combination of structures (Table 3). The Settlement Agreement 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 value of 53.1 percent. The percentage of flow-weighted mean total phosphorus concentrations greater than 10 ppb for the new combination was 10.7, 11.5 and 11.5 for the periods ending July, August and September, respectively. For these same periods, the percentage for the old combination was 6.7, 7.1 and 7.1, respectively (Table 6).

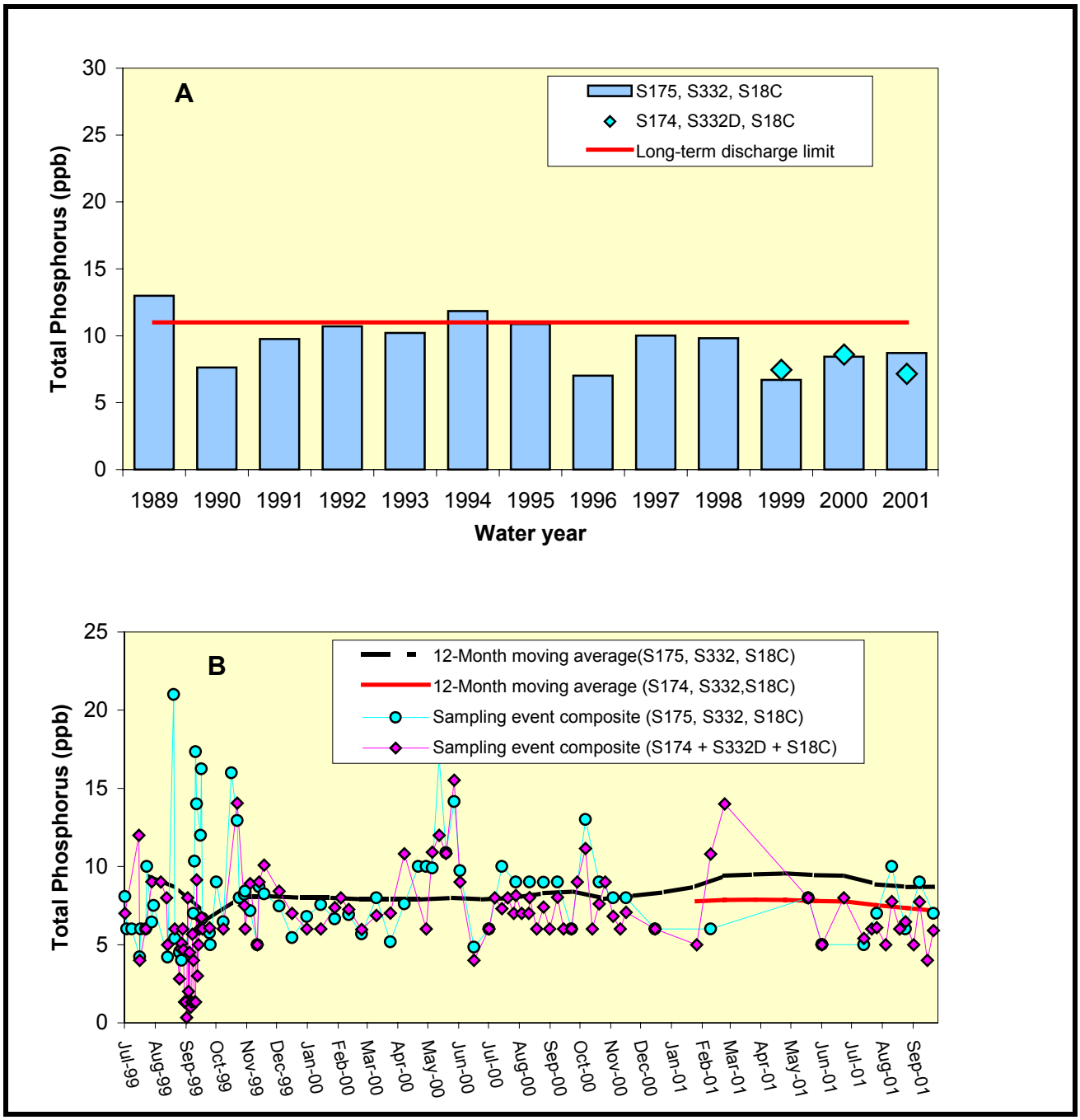

Figure 4. **A**. Flow-weighted mean total phosphorus concentration at the inflows to the Everglades National Park through Taylor Slough and the Coastal Basins compared to the 11 ppb long-term total phosphorus limit for each year. **B**. The 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at both the old and new combinations of compliance monitoring sites.

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

12-Month Period Ending On	Total Period Flow (ac-ft x 1000)		Flow Weighted Mean Total Phosphorus (ac-ft x 1000)		Long Term Limit (ppb)	Percent of Sampling Events Greater Than 10 ppb			
						Observed (%)		Allowed (%)	
	New	Old	New	Old		New	Old	New	Old
10/31/99		339		8.1	11.0		17.1		53.1
11/30/99		365		8.1	11.0		15.4		53.1
12/31/99		414		8.0	11.0		15.4		53.1
01/31/00		450		8.0	11.0		15.4		53.1
02/29/00		479		7.9	11.0		15.0		53.1
03/31/00		485		7.9	11.0		15.4		53.1
04/30/00		493		7.9	11.0		12.8		53.1
05/31/00		493		8.0	11.0		14.6		53.1
06/30/00		467		7.9	11.0		16.7		53.1
07/31/00		457		8.0	11.0		17.1		53.1
08/31/00		445		8.3	11.0		18.0		53.1
09/30/00		432		8.4	11.0		14.3		53.1
10/31/00		375		7.9	11.0		12.1		53.1
11/30/00		315		8.1	11.0		13.8		53.1
12/31/00		266		8.4	11.0		14.3		53.1
01/31/01	308	205	7.8	8.7	11.0	15.4	15.4	53.1	53.1
02/28/01	282	168	7.9	9.4	11.0	21.6	16.7	53.1	53.1
03/31/01	269	161	7.9	9.5	11.0	22.9	18.2	53.1	53.1
04/30/01	260	154	7.9	9.6	11.0	20.6	20.0	53.1	53.1
05/31/01	254	153	7.8	9.4	11.0	12.9	11.8	53.1	53.1
06/30/01	248	147	7.8	9.4	11.0	10.3	6.7	53.1	53.1
07/31/01	243	146	7.5	8.9	11.0	10.7	6.7	53.1	53.1
08/31/01	237	145	7.3	8.7	11.0	11.5	7.1	53.1	53.1
09/30/01	235	143	7.2	8.7	11.0	11.5	7.1	53.1	53.1

New = S174 + S332D + S18C data
Old = S175 + S332 + S18C data

A comparison of flows between the old and new combination of structures is presented in Figure 5.

The flow through S18C, along with the combined flows through S332 plus S175 and S332D plus S174, is presented in Figure 5a. The water discharged from the downstream structures, S175 and S332, is supplied through the upstream structures, S174 and S332D.

Figure 5b shows the sum of the daily mean flows at S18C and the Taylor Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for each sampling event at both the old and new combinations of structures. As the data indicate, there is no linear relationship between daily mean flow and flow-weighted mean total phosphorus concentrations for either set of structures.

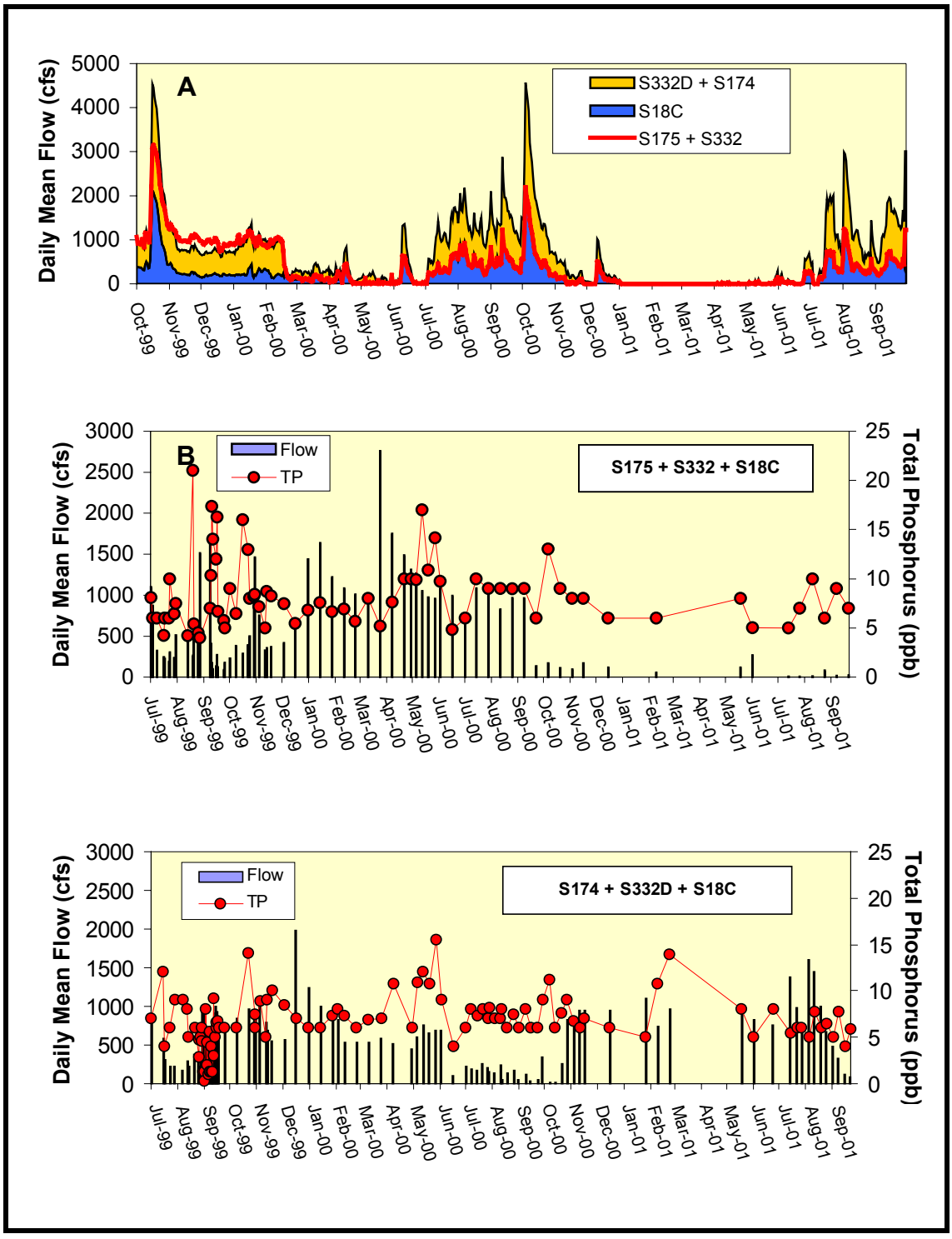

Figure 5. **A.** Daily mean flows into the Everglades National Park through Taylor Slough and the Coastal Basins control structure. **B**. Mean daily flows and corresponding flow-weighted mean total phosphorus concentrations at old and new combinations of Taylor Slough and Coastal Basin Structures.

Settlement Agreement
October-December 2001 Report

Prepared for the
Technical Oversight Committee
April 23, 2002

Prepared by:
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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 gaging 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 (mean sea level). The monthly total phosphorus concentrations are determined from water samples collected at 14 interior marsh stations (LOX 3 through LOX 16). 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 17.24, 17.46 and 16.99 feet in October, November and December 2001, respectively (**Figure 1, Table 1**). The geometric means, calculated from total phosphorus concentrations measured in water samples collected in October, November and December, were 8.8, 6.6 and 7.5 ppb, respectively (**Table 1**). The October geometric mean concentration exceeded the calculated interim and long-term limits of 8.3 and 7.2, while the November and December geometric mean concentrations were less than the interim and long-term limits. Although the October geometric mean concentration was greater than the interim limit, the Settlement Agreement does not consider this situation to be an exceedance. "An exceedance occurs if the 14 station mean concentration is greater than the computed concentration level two or more times in any 12 consecutive sample collections". The last exceedance occurred in October 2000, *i.e.* 13 months prior to October 2001. The geometric means and calculated limits for both Octobers were identical (**Table 1**) most likely reflecting the decreasing phosphorus concentrations resulting from increasing stages that occurred in both years (**Figure 1**). Similar stage conditions also existed in October of 1997, 1998 and 1999. Only the long-term limit was exceeded in 1997 and 1998, but both limits were exceeded in October and November1999 (**Table 1**).

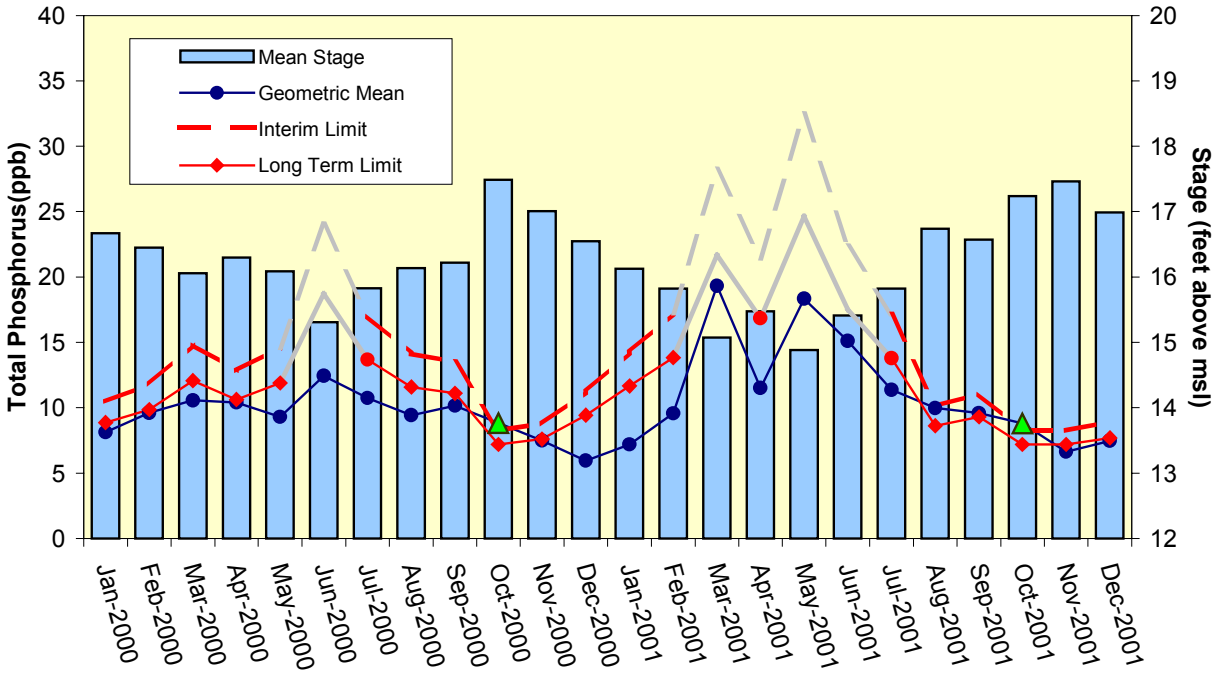

Figure 1. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term limits. The calculated limit concentrations are adjusted for fluctuations in water level.

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

Month Year	Geometric Mean	Interim limit	Long Term Limit	Average Stage	Number of TP Samples	Number of Stage Measurements
	(ppb)			(ft,NGVD)		
Oct-1999	10.3	8.3	7.2	17.28	14	3
Nov-1999	9.0	8.3	7.2	17.25	14	3
Dec-1999	9.1	9.1	7.9	16.94	14	3
Jan-2000	8.1	10.5	8.9	16.67	14	3
Feb-2000	9.6	11.8	9.9	16.46	13	3
Mar-2000	10.6	14.8	12.1	16.06	12	3
Apr-2000	10.4	12.9	10.6	16.30	14	3
May-2000	11.0	15.0	12.2	16.05	14	3
Jun-2000	12.4	NA	NA	15.31	6	3
Jul-2000	10.8	17.0	13.7	15.84	6	3
Aug-2000	9.4	14.1	11.6	16.14	10	3
Sep-2000	10.2	13.5	11.1	16.22	11	3
Oct-2000	8.8	8.3	7.2	17.49	13	3
Nov-2000	7.5	8.8	7.6	17.01	14	3
Dec-2000	6.0	11.2	9.4	16.55	9	3
Jan-2001	7.2	14.3	11.7	16.13	8	3
Feb-2001	9.6	17.2	13.8	15.82	9	3
Mar-2001	19.3	NA	NA	15.08	2	3
Apr-2001	11.5	21.4	16.9	15.48	6	3
May-2001	18.3	N/A	N/A	14.88	2	3
Jun-2001	15.1	N/A	N/A	15.42	9	3
Jul-2001	11.4	17.2	13.8	15.82	11	3
Aug-2001	10.0	10.1	8.6	16.74	14	3
Sep-2001	9.6	11.1	9.3	16.57	14	3
Oct-2001	8.8	8.3	7.2	17.24	14	3
Nov-2001	6.6	8.3	7.2	17.46	14	3
Dec-2001	7.5	8.9	7.7	16.99	14	3

Notes:

(1) Average Stage is calculated using stage elevations at three stations on the sampling date

(2) The italicized values in parentheses for May-2000 included Lake Okeechobee Recession special sampling data.

(3) Highlighted values indicate months when exceedances occurred

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 through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. The limits apply to the water year ending September 30. 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. In addition, it is required that phosphorus concentrations be presented as 12-month moving flow-weighted means.

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 1989 to 2001 (**Figure 2a**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2001 was 15.0 ppb. Corresponding interim and long-term limits were 12.2 and 10.8 ppb, respectively. This is the second consecutive year that both limits were exceeded for the water year ending in September. Both the 2000 and 2001 water years were very dry, resulting in lower volumes of flow with higher total phosphorus concentrations entering the Park than those observed in wetter years.

The Settlement Agreement 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 an allowable value based on flow into Shark River Slough for the same 12-month period. For the 12-month periods ending October, November and December 2001, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 68.4, 57.9 and 52.6 respectively (**Table 2**). These percentages exceeded the allowable percentages for all three 12-month periods. The individual sampling events and the 12-month moving average are presented in **Figure 2b**.

Table 2 presents the moving flow-weighted mean concentrations for each 12-month period beginning in October 1999 as well as the corresponding interim and long-term total phosphorus concentration limits, which are calculated using the 12-month period flow. For the 12-month periods ending in October, November and December 2001, the flow-weighted mean total phosphorus concentrations were 13.0,

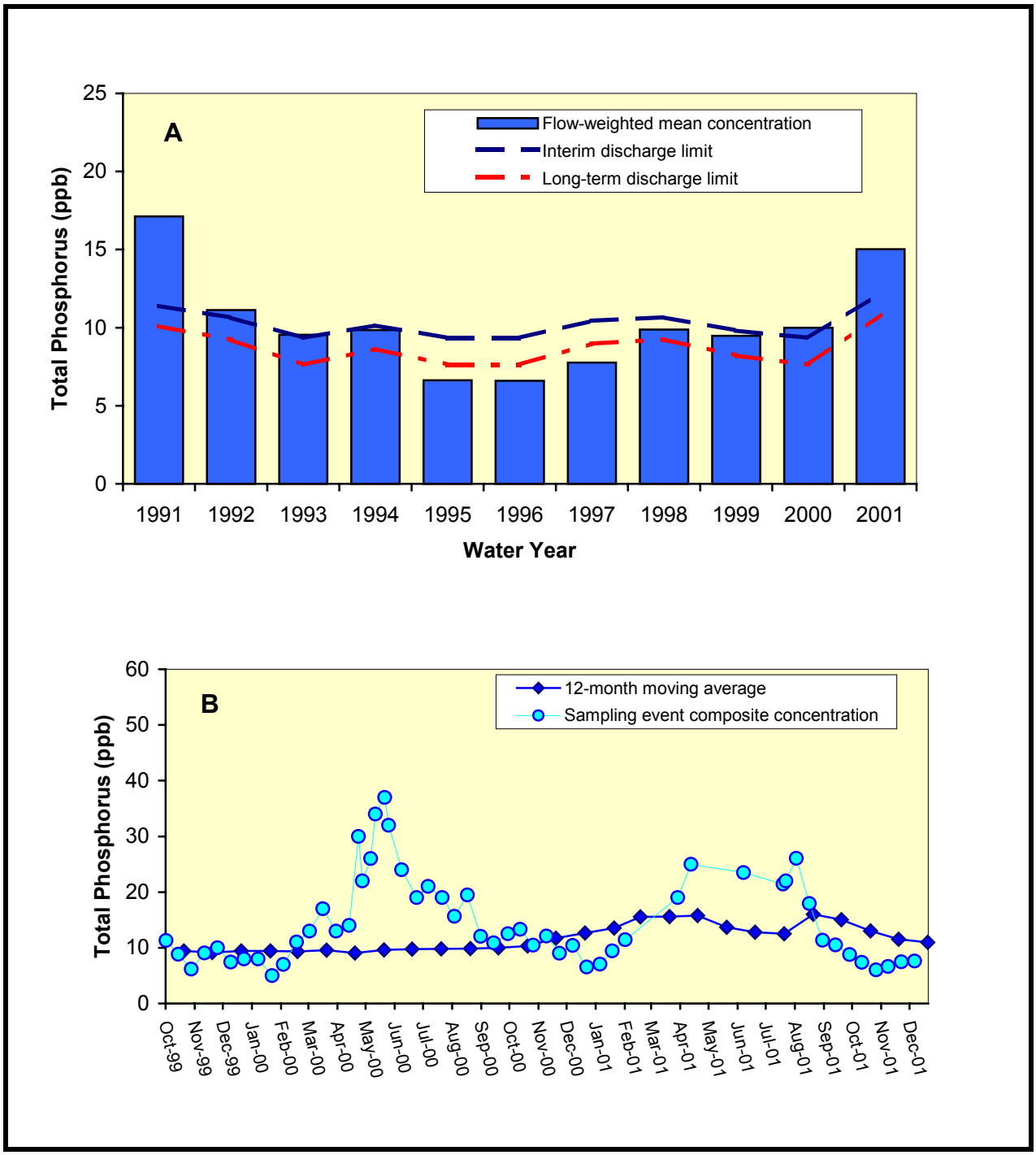

Figure 2. 12-month moving flow-weighted mean total phosphorus concentrations at the inflows to the Everglades National Park (ENP) through Shark River Slough compared to the interim and long-term targets. **A**. Concentration at the end of each water year. **B**. 12-month moving average concentration at the end of each month and the composite concentration for each sampling event

Table 2. Shark River Slough Total Phosporus Concentration Compliance Tracking

12-Month Period Ending On	Total Period Flow	Flow Weighted Mean Total Phosphorus	Limits		Percent of Sampling Events Greater than 10 ppb	
			(ppb)		(%)	
	(Kac-ft)	(ppb)	Interim	Long Term	Observed	Allowed
10/31/99	1084.4	9.4	9.4	7.6	39.1	40.1
11/30/99	1297.5	9.1	9.4	7.6	39.1	40.1
12/31/99	1344.8	9.4	9.4	7.6	39.1	40.1
01/31/00	1395.1	9.4	9.4	7.6	39.1	40.1
02/29/00	1415.5	9.4	9.4	7.6	***41.7***	40.1
03/31/00	1385.7	9.6	9.4	7.6	***52.2***	40.1
04/30/00	1385.1	9.1	9.4	7.6	***52.2***	40.1
05/31/00	1401.5	9.6	9.4	7.6	***57.7***	40.1
06/30/00	1395.9	9.8	9.4	7.6	***60.7***	40.1
07/31/00	1294.6	9.8	9.4	7.6	***64.3***	40.1
08/31/00	1214.6	9.8	9.4	7.6	***65.5***	40.1
09/30/00	1096.1	10.0	9.4	7.6	***69.0***	40.1
10/31/00	925.0	10.3	9.9	8.3	***72.4***	43.2
11/30/00	642.1	11.7	11.1	9.8	***79.3***	50.8
12/31/00	464.0	12.7	12.0	10.8	***82.8***	56.4
01/31/01	367.0	13.5	12.5	11.3	***80.0***	59.8
02/28/01	298.4	15.5	12.9	11.7	***85.7***	62.2
03/31/01	275.9	15.6	13.0	11.9	***84.6***	63.1
04/30/01	250.4	15.8	13.2	12.0	***84.6***	64.0
05/31/01	230.9	13.7	13.3	12.1	***81.8***	64.7
06/30/01	221.0	12.8	13.3	12.2	***80.0***	65.1
07/31/01	212.8	12.5	13.4	12.2	***78.9***	65.4
08/31/01	324.0	16.0	12.8	11.6	***78.9***	61.3
09/30/01	419.7	15.0	12.2	11.0	***78.9***	57.9
10/31/01	502.4	13.0	11.8	10.5	***68.4***	55.2
11/30/01	599.2	11.5	11.3	10.0	***57.9***	52.1
12/31/01	677.9	11.0	10.9	9.6	***52.6***	49.8

Note: ***Italicized values exceeded allowed percentage***

11.5 and 11.0 ppb, respectively. These flow-weighted mean concentrations were greater than the interim and long-term limits for each month of this quarter.

The daily mean flows through the individual Shark River Slough structures and S334 from October 1999 through December 2001 are presented in **Figure 3a**. A sharp increase in flow began on July 31, 2001, ending an essentially six-month no flow period. The relationship between the sum of the daily mean flows at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events is presented in **Figure 3b**. Increasing flows into Shark River Slough beginning in late July through December 2001 resulted in individual sampling event total phosphorus flow-weighted mean concentrations decreasing to 7.6 ppb by the end of December.

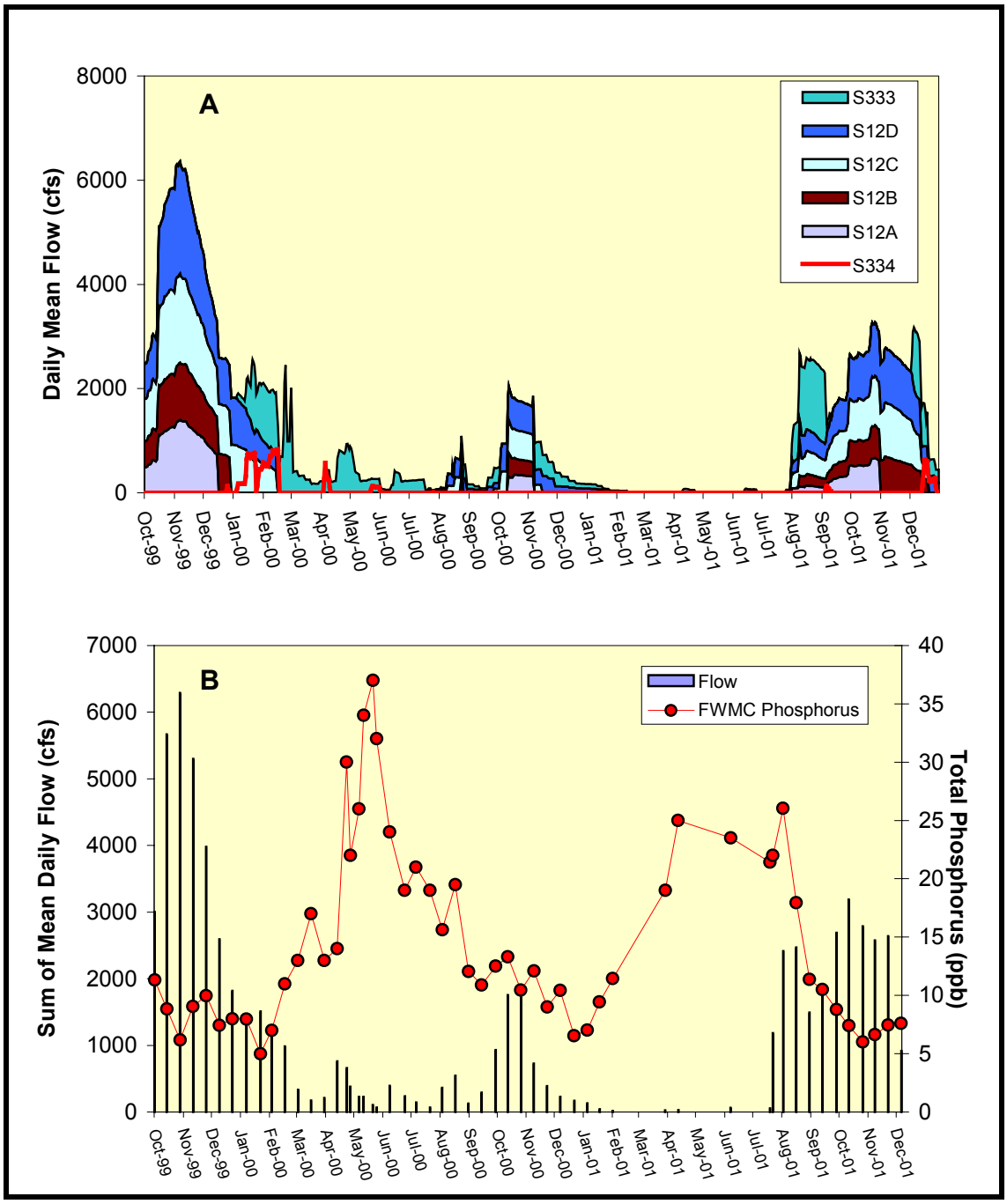

Figure 3. **A**. Mean daily flows into Shark River Slough by structure. **B**. The relationship between sum of mean daily flow at Shark River Slough structures and flow-weighted mean total phosphorus concentration for individual sampling events.

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. Beginning in August 1999, structure S332D, a new pump station constructed by the U.S. Army Corps of Engineers, 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. However, the Settlement Agreement's Technical Oversight Committee requested that data from both the old and new pairs of inflow structures to Taylor Slough be presented for one year. This request was made to determine if the differences between the two data sets observed from August 1999 through March 2000 would continue throughout a complete wet season/dry season cycle and what implications this might have on future compliance with the 11 ppb limit.

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 4a**). The bars in **Figure 4a** represent the flow-weighted mean total phosphorus concentrations from S332, S175 and S18C for water years 1989 through 2001. The diamond point values for water years 1999, 2000 and 2001 represent the new combination of structures. **Figure 4b** presents the 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at both the old and new combinations of structures. When the individual sampling event concentrations from both the old and new combination of structures (**Figure 4b**) are compared with the daily mean flow data presented in **Figure 5a**, it appears that the variability between the data is less during higher flows than during low/no flow periods.

The 12-month flow-weighted mean concentrations for October, November and December 2001 were 6.5, 6.3 and 6.2 ppb, respectively, at the new combination of structures and 8.3, 7.8 and 7.7 ppb, respectively, for the old combination of structures (**Table 3**). The Settlement Agreement 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 value of 53.1 percent. The percentage of flow-weighted mean total phosphorus concentrations greater than 10 ppb for the new combination was 8.0, 7.4 and 6.7 for the periods ending October, November and December, respectively. For these same periods, the percentage for the old combination was 7.1, 7.1 and 6.7, respectively (**Table 3**).

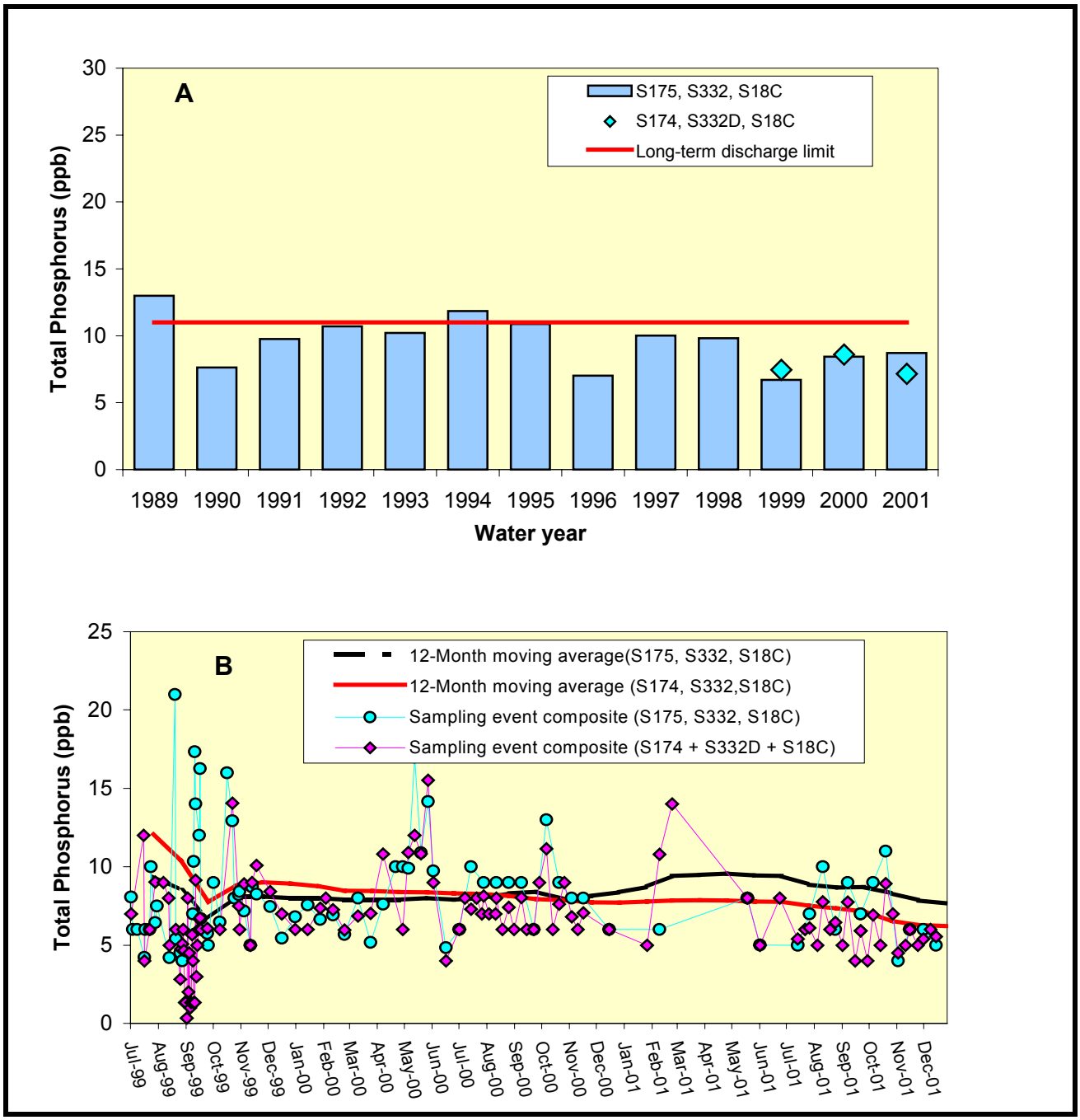

Figure 4. **A**. Flow-weighted mean total phosphorus concentration at the inflows to the Everglades National Park through Taylor Slough and the Coastal Basins compared to the 11 ppb long-term total phosphorus limit for each year. **B**. The 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at both the old and new combinations of compliance monitoring sites.

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

12-Month Period Ending On	Total Period Flow (ac-ft x 1000)		Flow Weighted Mean Total Phosphorus (ac-ft x 1000)		Long Term Limit (ppb)	Percent of Sampling Events Greater Than 10 ppb			
						Observed (%)		Allowed (%)	
	New	Old	New	Old		New	Old	New	Old
7/31/99	212	276	12.1	9.4	11.0	37.0	25.5	53.1	53.1
8/31/99	215	288	10.4	8.5	11.0	25.8	16.7	53.1	53.1
09/30/99	214	280	7.8	6.7	11.0	19.4	12.1	53.1	53.1
10/31/99	256	339	8.8	8.1	11.0	22.6	17.1	53.1	53.1
11/30/99	266	365	9.0	8.1	11.0	23.5	15.4	53.1	53.1
12/31/99	290	414	8.9	8.0	11.0	22.9	15.4	53.1	53.1
01/31/00	318	450	8.8	8.0	11.0	22.9	15.4	53.1	53.1
02/29/00	342	479	8.5	7.9	11.0	21.6	15.0	53.1	53.1
03/31/00	352	485	8.5	7.9	11.0	22.2	15.4	53.1	53.1
04/30/00	358	493	8.4	7.9	11.0	20.0	12.8	53.1	53.1
05/31/00	363	493	8.4	8.0	11.0	23.7	14.6	53.1	53.1
06/30/00	349	467	8.3	7.9	11.0	23.7	16.7	53.1	53.1
07/31/00	364	457	8.3	8.0	11.0	20.5	17.1	53.1	53.1
08/31/00	389	445	8.1	8.3	11.0	20.5	18.0	53.1	53.1
09/30/00	399	432	7.9	8.4	11.0	17.5	14.3	53.1	53.1
10/31/00	399	375	7.9	7.9	11.0	16.3	12.1	53.1	53.1
11/30/00	375	315	7.7	8.1	11.0	14.6	13.8	53.1	53.1
12/31/00	351	266	7.7	8.4	11.0	15.0	14.3	53.1	53.1
01/31/01	308	205	7.8	8.7	11.0	15.4	15.4	53.1	53.1
02/28/01	282	168	7.9	9.4	11.0	21.6	16.7	53.1	53.1
03/31/01	269	161	7.9	9.5	11.0	22.9	18.2	53.1	53.1
04/30/01	260	154	7.9	9.6	11.0	20.6	20.0	53.1	53.1
05/31/01	254	153	7.8	9.4	11.0	12.9	11.8	53.1	53.1
06/30/01	248	147	7.8	9.4	11.0	10.0	6.7	53.1	53.1
07/31/01	243	146	7.5	8.9	11.0	10.7	6.7	53.1	53.1
08/31/01	237	145	7.3	8.7	11.0	11.5	7.1	53.1	53.1
09/30/01	235	143	7.2	8.7	11.0	11.5	7.1	53.1	53.1
10/31/01	235	136	6.5	8.3	11.0	8.0	7.1	53.1	53.1
11/30/01	270	152	6.3	7.8	11.0	7.4	7.1	53.1	53.1
12/31/01	296	161	6.2	7.7	11.0	6.7	6.7	53.1	53.1

New = S174 + S332D + S18C data
Old = S175 + S332 + S18C data

A comparison of flows between the old and new combination of structures is presented in **Figure 5**.

The flow through S18C, along with the combined flows through S332 plus S175 and S332D plus S174, is presented in **Figure 5a**. The water discharged from the downstream structures, S175 and S332, is supplied through the upstream structures, S174 and S332D.

Figure 5b shows the sum of the daily mean flows at S18C and the Taylor Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for each sampling event at both the old and new combinations of structures. As the data indicate, there is no linear relationship between daily mean flow and flow-weighted mean total phosphorus concentrations for either set of structures.

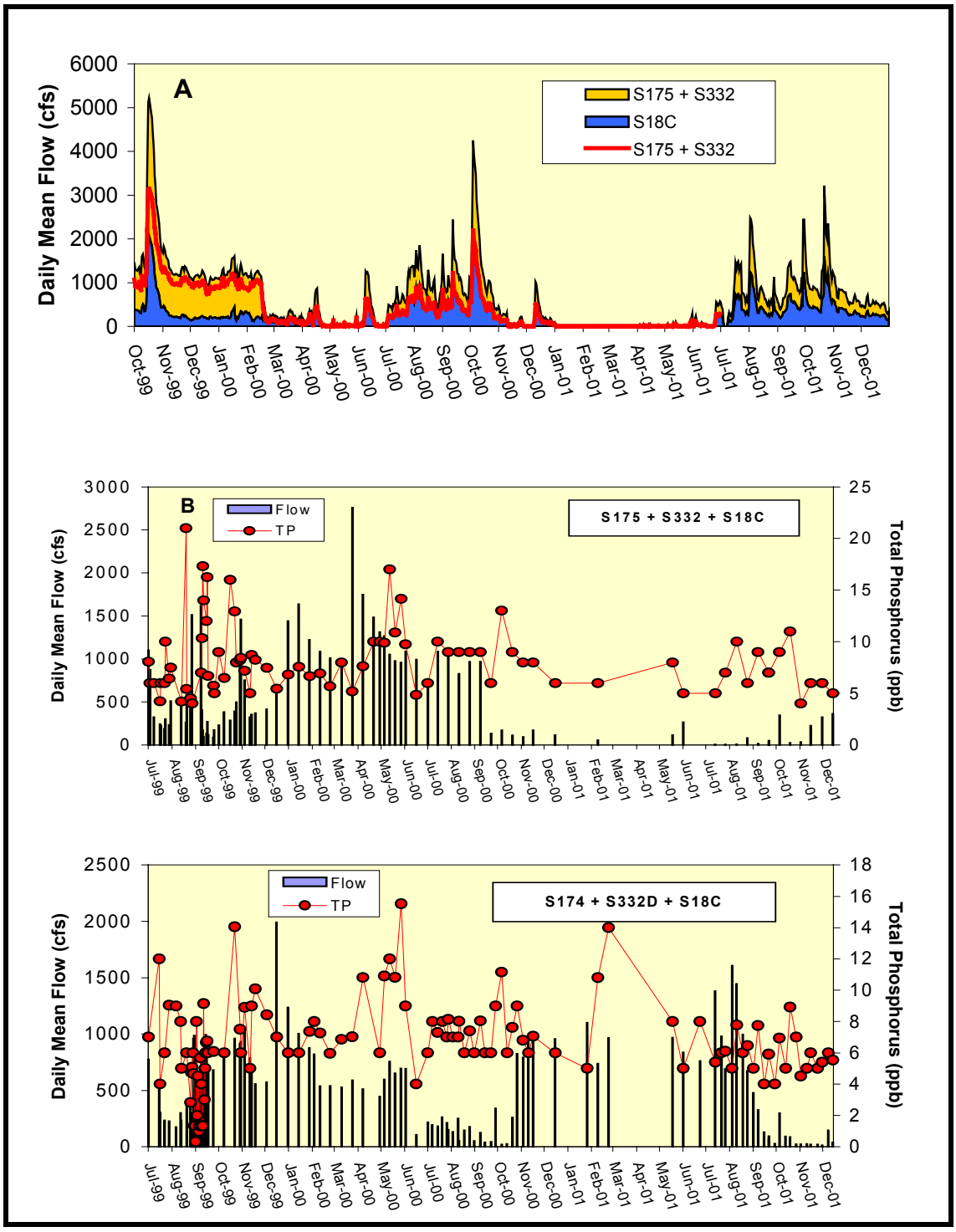

Figure 5. **A.** Daily mean flows into the Everglades National Park through Taylor Slough and the Coastal Basins control structure. **B**. Mean daily flows and corresponding flow-weighted mean total phosphorus concentrations at old and new combinations of Taylor Slough and Coastal Basin Structures.

Settlement Agreement
January-March 2002 Report

Prepared for the
Technical Oversight Committee
July 30, 2002

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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 gaging 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 (mean sea level). The monthly total phosphorus concentrations are determined from water samples collected at 14 interior marsh stations (LOX 3 through LOX 16). 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 16.69, 16.63 and 16.50 feet in January, February and March 2002, respectively (**Figure 1, Table 1)**. The geometric means, calculated from total phosphorus concentrations measured in water samples collected in January, February and March, were 6.4, 7.8 and 7.3 ppb, respectively (**Table 1**). These concentrations were all less than their respective interim and long-term limits.

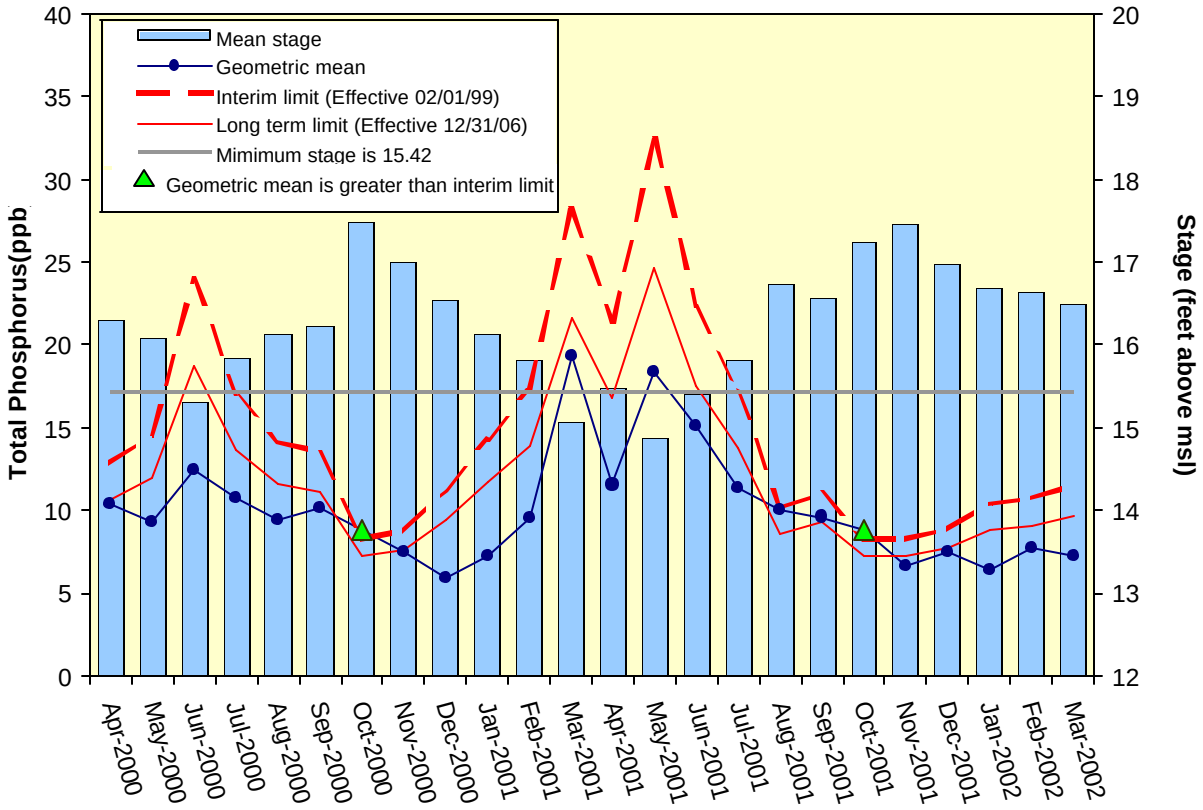

Figure 1. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term limits. The calculated limit concentrations are adjusted for fluctuations in water level.

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

Month Year	Geometric Mean	Interim limit	Long Term Limit	Average Stage	Number of TP Samples	Number of Stage Measurements
	(ppb)			(ft,NGVD)		
Apr-2000	10.4	12.9	10.6	16.30	14	3
May-2000	11.0	15.0	12.2	16.05	14	3
Jun-2000	12.4	NA	NA	15.31	6	3
Jul-2000	10.8	17.0	13.7	15.84	6	3
Aug-2000	9.4	14.1	11.6	16.14	10	3
Sep-2000	10.2	13.5	11.1	16.22	11	3
Oct-2000	8.8	8.3	7.2	17.49	13	3
Nov-2000	7.5	8.8	7.6	17.01	14	3
Dec-2000	6.0	11.2	9.4	16.55	9	3
Jan-2001	7.2	14.3	11.7	16.13	8	3
Feb-2001	9.6	17.2	13.8	15.82	9	3
Mar-2001	19.3	NA	NA	15.08	2	3
Apr-2001	11.5	21.4	16.9	15.48	6	3
May-2001	18.3	N/A	N/A	14.88	2	3
Jun-2001	15.1	N/A	N/A	15.42	9	3
Jul-2001	11.4	17.2	13.8	15.82	11	3
Aug-2001	10.0	10.1	8.6	16.74	14	3
Sep-2001	9.6	11.1	9.3	16.57	14	3
Oct-2001	8.8	8.3	7.2	17.24	14	3
Nov-2001	6.6	8.3	7.2	17.46	14	3
Dec-2001	7.5	8.9	7.7	16.99	14	3
Jan-2002	6.4	10.4	8.8	16.69	14	3
Feb-2002	7.8	10.7	9.1	16.63	14	3
Mar-2002	7.3	11.5	9.7	16.50	14	3

Notes:

(1) Average Stage is calculated using stage elevations at three stations on the sampling date

(2) Highlighted values indicate months when exceedances occurred

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 through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. The limits apply to the water year ending September 30. 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. In addition, it is required that phosphorus concentrations be presented as 12-month moving flow-weighted means.

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 2001 (**Figure 2a**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2001 was 15.0 ppb. Corresponding interim and long-term limits were 12.2 and 10.8 ppb, respectively. This was the second consecutive year that both limits were exceeded for the water year ending in September. Both the 2000 and 2001 water years were very dry, resulting in lower volumes of flow with higher total phosphorus concentrations entering the Park than those observed in wetter years.

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 an allowable value based on flow into Shark River Slough for the same 12-month period. For the 12-month periods ending January, February and March 2002, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 52.6, 45.0 and 40.9, respectively (**Table 2**). Only the January percentage exceeded the allowable percentage for the three 12-month periods. The individual sampling events and the 12-month moving average are presented in **Figure 2b**.

Table 2 also presents the moving flow-weighted mean concentrations for each 12-month period beginning in April 2000 as well as the corresponding interim and long-term total phosphorus concentration limits, calculated using the 12-month period flow.

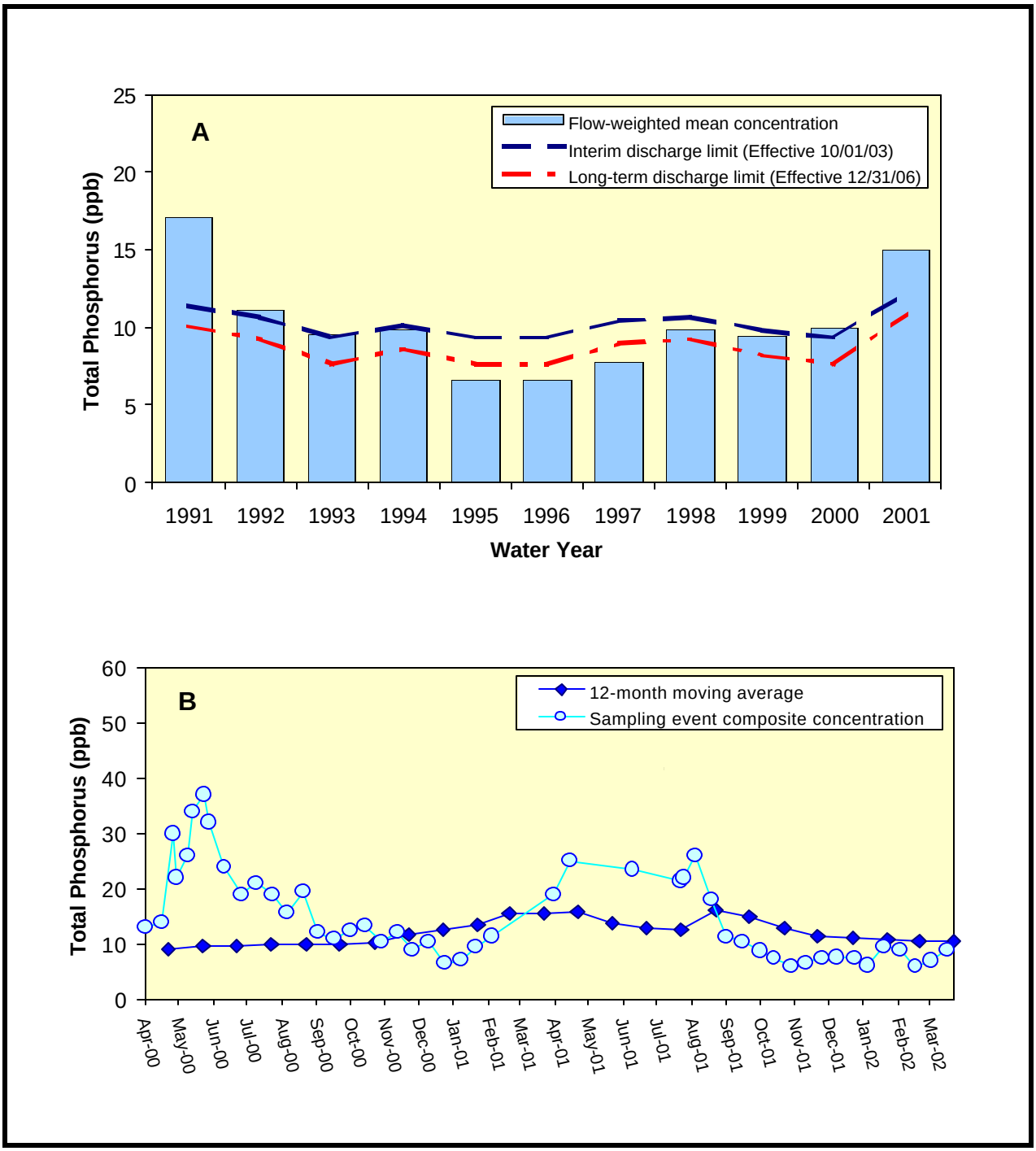

Figure 2. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough. **A**. The 12-month moving average fwmc at the end of each water year compared to the total phosphorus interim and long-term limits. **B**. The 12-month moving average fwmc at the end of each month and the composite total phosphorus concentration for each sampling event.

Table 2. Shark River Slough Total Phosporus Concentration Compliance Tracking

12-Month Period Ending On	Total Period Flow	Flow Weighted Mean Total Phosphorus	Limits (ppb)		Percent of Sampling Events Greater than 10 ppb (%)	
	(Kac-ft)	(ppb)	Interim	Long Term	Allowed	Observed
04/30/00	1385.1	9.1	9.4	7.6	40.1	***52.2***
05/31/00	1401.5	9.6	9.4	7.6	40.1	***57.7***
06/30/00	1395.9	9.8	9.4	7.6	40.1	***60.7***
07/31/00	1294.6	9.8	9.4	7.6	40.1	***64.3***
08/31/00	1214.6	9.8	9.4	7.6	40.1	***65.5***
09/30/00	1096.1	10.0	9.4	7.6	40.1	***69.0***
10/31/00	925.0	10.3	9.9	8.3	43.2	***72.4***
11/30/00	642.1	11.7	11.1	9.8	50.8	***79.3***
12/31/00	464.0	12.7	12.0	10.8	56.4	***82.8***
01/31/01	367.0	13.5	12.5	11.3	59.8	***80.0***
02/28/01	298.4	15.5	12.9	11.7	62.2	***85.7***
03/31/01	275.9	15.6	13.0	11.9	63.1	***84.6***
04/30/01	250.4	15.8	13.2	12.0	64.0	***84.6***
05/31/01	230.9	13.7	13.3	12.1	64.7	***81.8***
06/30/01	221.0	12.8	13.3	12.2	65.1	***80.0***
07/31/01	212.8	12.5	13.4	12.2	65.4	***78.9***
08/31/01	324.0	16.0	12.8	11.6	61.3	***78.9***
09/30/01	419.7	15.0	12.2	11.0	57.9	***78.9***
10/31/01	502.4	13.0	11.8	10.5	55.2	***68.4***
11/30/01	599.2	11.5	11.3	10.0	52.1	***57.9***
12/31/01	677.9	11.0	10.9	9.6	49.8	***52.6***
01/31/02	695.1	10.9	10.8	9.5	49.3	***52.6***
02/28/02	728.3	10.7	10.7	9.3	48.3	45.0
03/31/02	779.2	10.5	10.5	9.0	46.9	40.9

Note: ***Italicized values exceeded allowed percentage***

For the 12-month periods ending in January, February and March 2002, the flow-weighted mean total phosphorus concentrations were 10.9, 10.7 and 10.5 ppb, respectively. The January flow-weighted mean concentration was greater than the interim and long-term limits, whereas the February and March concentrations equaled the interim limits but exceeded the long-term limits.

The daily flows through the individual Shark River Slough structures and S334 from April 2000 through March 2002 are presented in **Figure 3a**. A sharp increase in flow began on July 31, 2001, ending an essentially six-month no flow period. Beginning in mid-December, the majority of the inflow was shifted to Northeast Shark River Slough through S333 by closing the S12A, B and C structures. During this period, some flow was routed through S334.

The relationship between the sum of the daily flows at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentration for individual sampling events is presented in **Figure 3b.**

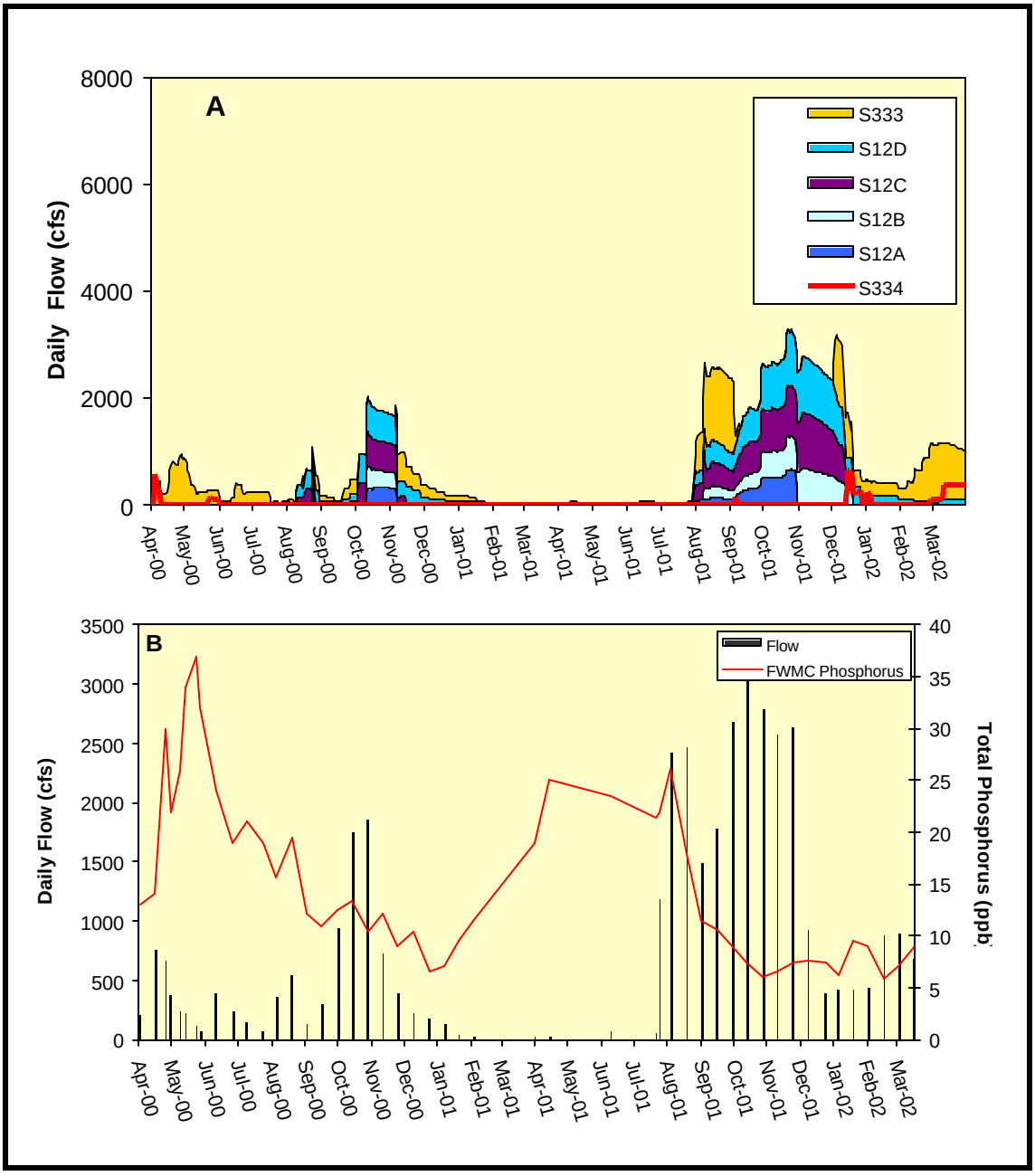

Figure 3. **A**. Daily flows into Shark River Slough by structure. **B**. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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. Beginning in August 1999, structure S332D, a new pump station constructed by the U.S. Army Corps of Engineers, 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. However, the Settlement Agreement's Technical Oversight Committee requested that data from both the old and new pairs of inflow structures to Taylor Slough be presented for one year. This request was made to determine if the differences between the two data sets observed from August 1999 through March 2000 would continue throughout a complete wet season/dry season cycle and what implications this might have on future compliance with the 11 ppb limit.

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 data for S332D/S174/S18C was consistently greater than flow at S332/S175/S18C. There was also a shift in flow-weighted mean total phosphorus concentration data whereby S332D/S174/S18C concentrations became equal to and then consistently lower than the concentrations at S332/S175/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 this report, only S332D/S174/S18C data will be presented with the exception of data in **Figure 4a**.

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 4a**). The bars in **Figure 4a** represent the flow-weighted mean total phosphorus concentrations from S332, S175 and S18C for water years 1989 through 2001. The diamond point values for water years 1999, 2000 and 2001 represent the new combination of structures. **Figure 4b** presents the 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at the S174, S332D and S18C structures.

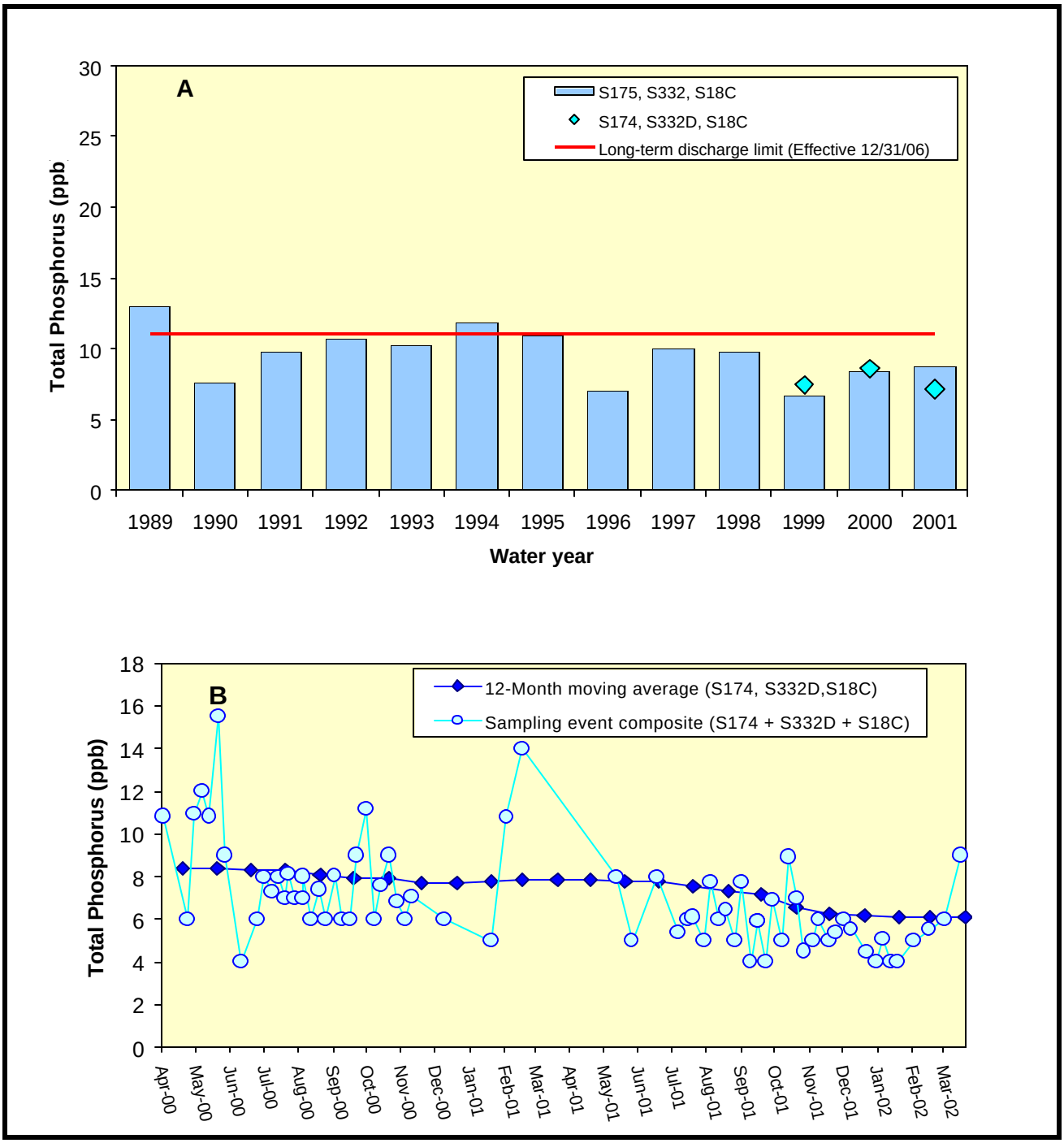

Figure 4. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins. **A.** The 12-month moving average fwmc at the end of each water year compared to the 11 ppb long-term total phosphorus limit. **B**. The 12-month moving average fwmc 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	Long Term Limit	Percent of Sampling Events Greater Than 10 ppb (%)	
	(ac-ft x 1000)	(ppb)	(ppb)	Allowed	Observed
04/30/00	358	8.4	11.0	53.1	20.0
05/31/00	363	8.4	11.0	53.1	23.7
06/30/00	349	8.3	11.0	53.1	23.7
07/31/00	364	8.3	11.0	53.1	20.5
08/31/00	389	8.1	11.0	53.1	20.5
09/30/00	399	7.9	11.0	53.1	17.5
10/31/00	399	7.9	11.0	53.1	16.3
11/30/00	375	7.7	11.0	53.1	14.6
12/31/00	351	7.7	11.0	53.1	15.0
01/31/01	308	7.8	11.0	53.1	15.4
02/28/01	282	7.9	11.0	53.1	21.6
03/31/01	269	7.9	11.0	53.1	22.9
04/30/01	260	7.9	11.0	53.1	20.6
05/31/01	254	7.8	11.0	53.1	12.9
06/30/01	248	7.8	11.0	53.1	10.0
07/31/01	243	7.5	11.0	53.1	10.7
08/31/01	237	7.3	11.0	53.1	11.5
09/30/01	235	7.2	11.0	53.1	11.5
10/31/01	235	6.5	11.0	53.1	8.0
11/30/01	270	6.3	11.0	53.1	7.4
12/31/01	296	6.2	11.0	53.1	6.7
01/31/02	316	6.1	11.0	53.1	5.9
02/28/02	321	6.1	11.0	53.1	0.0
03/31/02	326	6.1	11.0	53.1	0.0

The 12-month flow-weighted mean concentrations for January, February and March 2002 were 6.1 ppb for each month at the S174, S332D and S18C structures (**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 value of 53.1 percent. The percentage of flow-weighted mean total phosphorus concentrations greater than 10 ppb for the S174, S332D and S18C structures was 5.9, 0 and 0 for the periods ending January, February and March, respectively, (**Table 3**).

The daily flows into Everglades National Park through Taylor Slough structures and S18C are presented in **Figure 5a**. **Figure 5b** shows the daily flows at S18C, S174 and S332D and the corresponding flow-weighted mean total phosphorus concentrations for each sampling event. As the data indicate, there is no linear relationship between daily mean flow and flow-weighted mean total phosphorus concentrations at these structures.

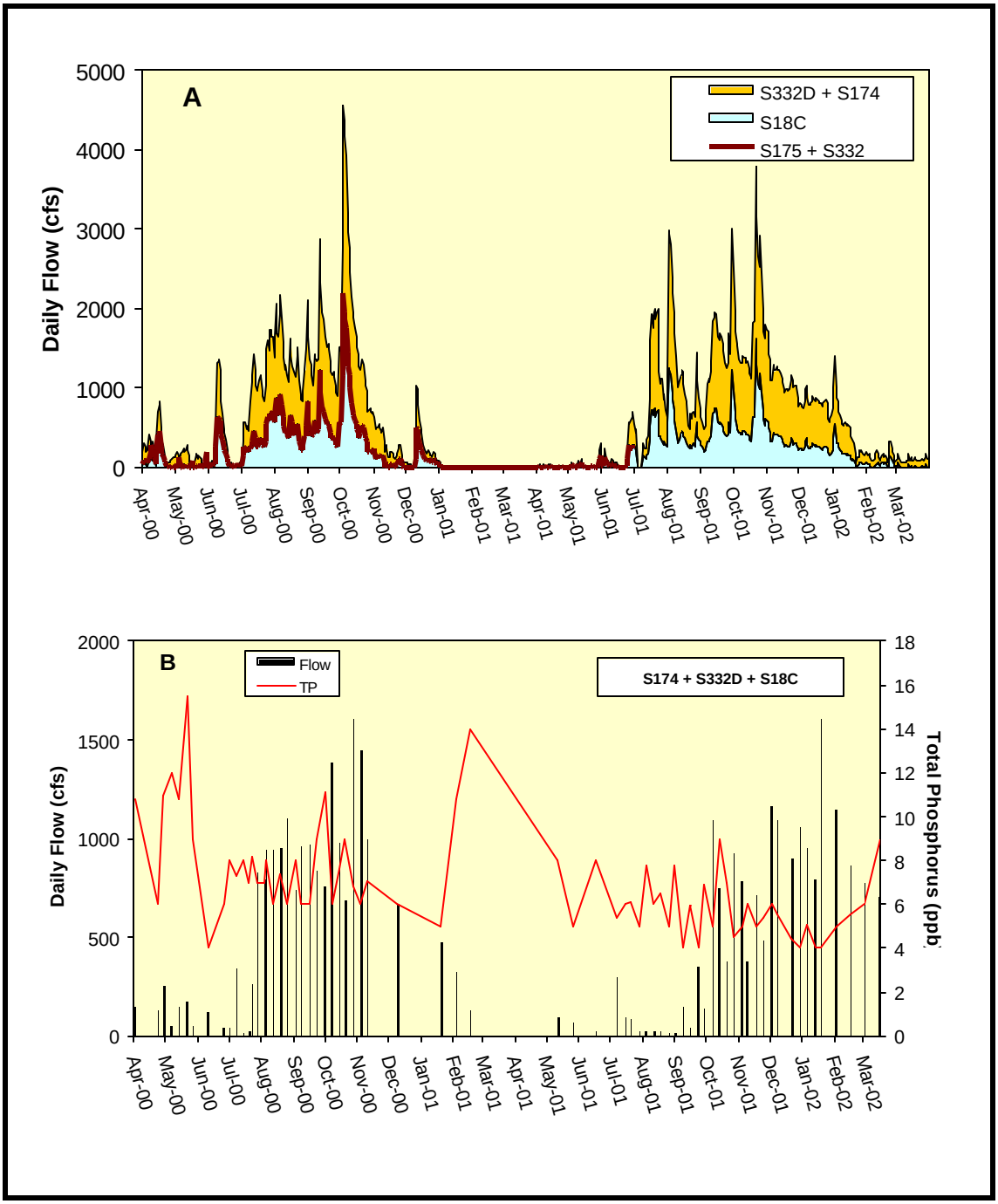

Figure 5. **A.** Daily flows into Everglades National Park through Taylor Slough and S18C. **B**. The relationship between daily flows at Taylor Slough structures and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
April-June 2002 Report

Prepared for the
Technical Oversight Committee
October 28, 2002

Prepared by:
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West Palm Beach, FL 33406

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 gaging 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 (mean sea level). The monthly total phosphorus concentrations are determined from water samples collected at 14 interior marsh stations (LOX 3 through LOX 16). 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 15.98, 15.04 and 15.94 feet in April, May and June 2002, respectively.(**Figure 1, Table 1)**. The May interim and long-term levels were not applicable because the average stage at that time was less than 15.42 feet. The geometric means, calculated from total phosphorus concentrations measured in water samples collected in April, May and June were 7.5, 10.0 and 13.4 ppb, respectively (**Table 1**). The April geomean total phosphorus concentration was less than the interim and long-term levels which were 15.6 and 12.7 ppb, respectively. The June geomean concentration was less than the interim level of 16.0 ppb, but 0.5 ppb greater than the long-term level of 12.9 ppb.

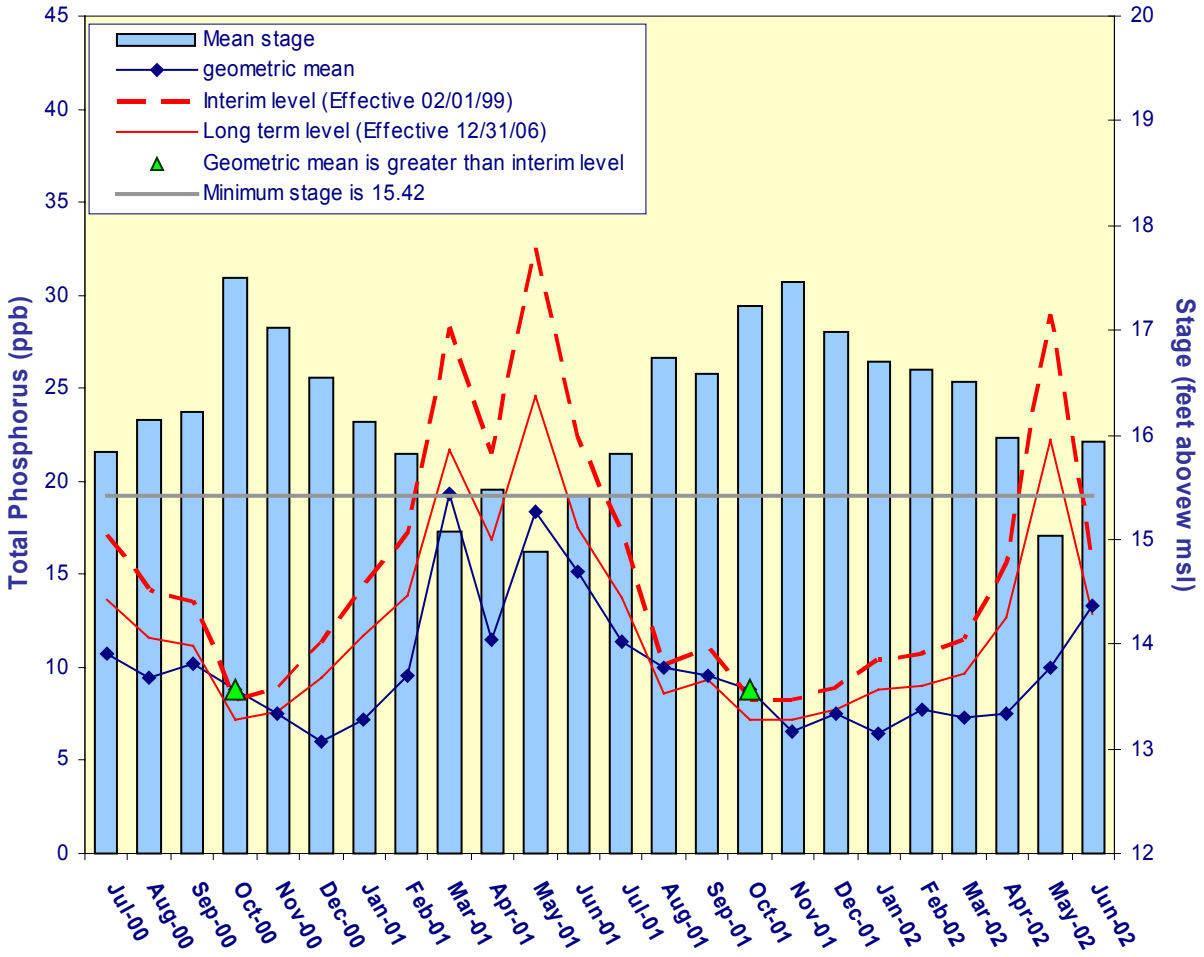

Figure 1. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

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

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft,NGVD)	Number of TP Samples	Number of Stage Measure-ments
Jul-2000	10.8	17.0	13.7	15.84	6	3
Aug-2000	9.4	14.1	11.6	16.14	10	3
Sep-2000	10.2	13.5	11.1	16.22	11	3
Oct-2000	8.8	8.3	7.2	17.49	13	3
Nov-2000	7.5	8.8	7.6	17.01	14	3
Dec-2000	6.0	11.2	9.4	16.55	9	3
Jan-2001	7.2	14.3	11.7	16.13	8	3
Feb-2001	9.6	17.2	13.8	15.82	9	3
Mar-2001	19.3	0.0	0.0	15.08	2	3
Apr-2001	11.5	21.4	16.9	15.48	6	3
May-2001	18.3	-	-	14.88	2	3
Jun-2001	15.1	-	-	15.42	9	3
Jul-2001	11.4	17.2	13.8	15.82	11	3
Aug-2001	10.0	10.1	8.6	16.74	14	3
Sep-2001	9.6	11.1	9.3	16.57	14	3
Oct-2001	8.8	8.3	7.2	17.24	14	3
Nov-2001	6.6	8.3	7.2	17.46	14	3
Dec-2001	7.5	8.9	7.7	16.99	14	3
Jan-2002	6.4	10.4	8.8	16.69	14	3
Feb-2002	7.8	10.7	9.1	16.63	14	3
Mar-2002	7.3	11.5	9.7	16.50	14	3
Apr-2002	7.5	15.6	12.7	15.98	11	3
May-2002	10.0	-	-	15.04	3	3
Jun-2002	13.4	16.0	12.9	15.94	10	3

Notes:
(1) Average Stage is calculated using stage elevations at three stations on the sampling date.
(2) Highlighted values indicate months when exceedances occurred. (The geomean concentration must be greater than the interim level two or more times within a 12-month period to constitute an exeedance.)
(3) Levels do not apply when the stage is 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. The limits apply to the water year ending September 30. 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. In addition, it is required that phosphorus concentrations be presented as 12-month moving flow-weighted means.

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 2001 (**Figure 2a**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2001 was 15.0 ppb. Corresponding interim and long-term limits were 12.2 and 10.8 ppb, respectively. This was the second consecutive year that both limits were exceeded for the water year ending in September. Both the 2000 and 2001 water years were very dry, resulting in lower volumes of flow with higher total phosphorus concentrations entering the Park than those observed in wetter years. Analysis of the TP concentrations in Shark River Slough by the TOC is continuing. Preliminary evaluation suggests that drought conditions, implementation of phosphorus controls and local water management are contributing factors to the ambient concentrations.

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 April, May and June 2002, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 40.9, 43.5 and 40.9, respectively. These observed values were all less than their respective guidelines (**Table 2**). The individual sampling events and the 12-month moving average are presented in **Figure 2b**.

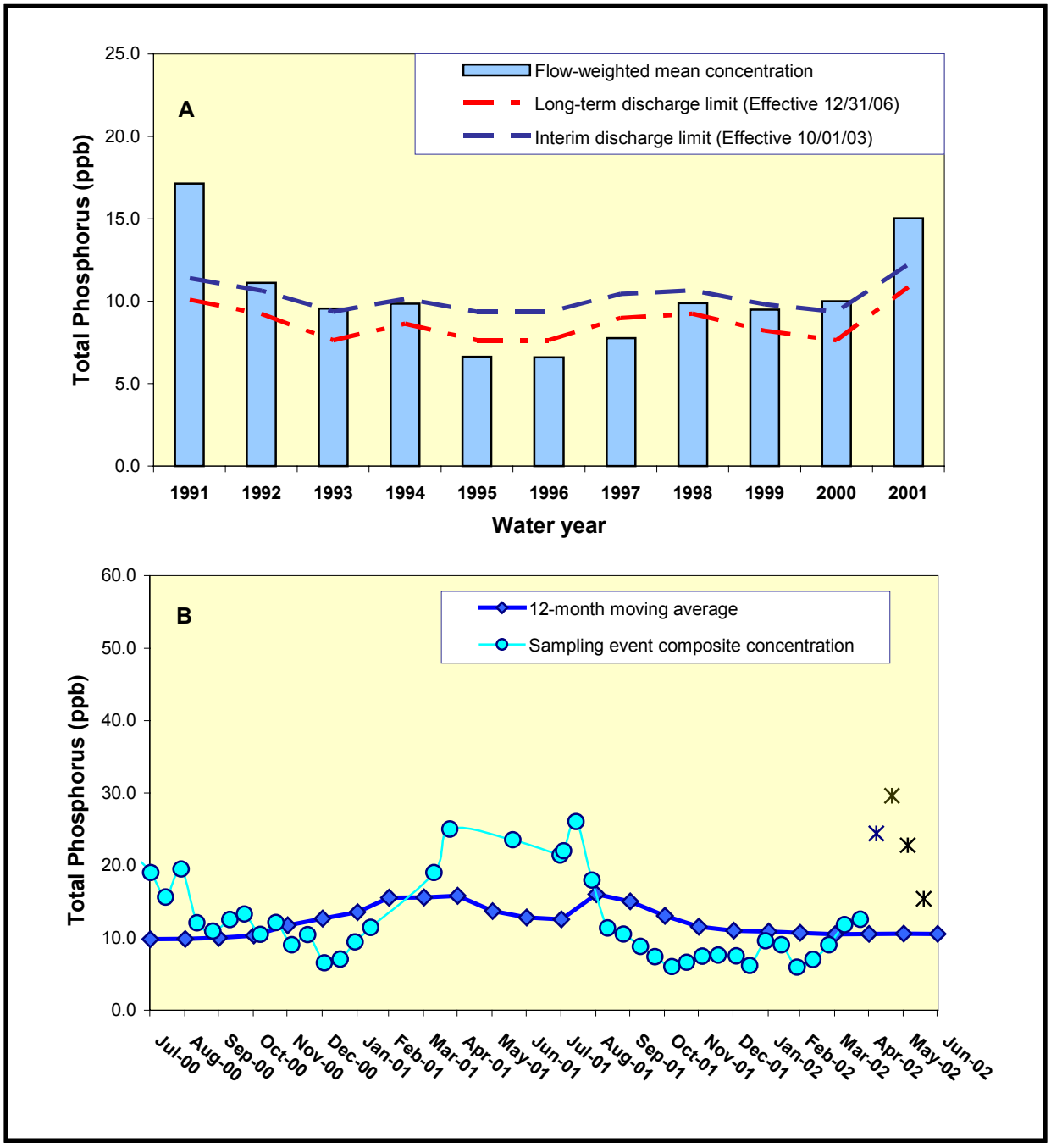

Figure 2. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough.
A. The 12-month moving average fwmc at the end of each water year compared to the total phosphorus interim and long-term limits.
B. The 12-month moving average fwmc at the end of each month and the composite total phosphorus concentration for each sampling event. *(star): denotes arithmetic average for biweekly samples in May and June 2002 as there was no flow on the sampling dates.

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	(%)	
	(Kac-ft)	(ppb)	10/1/2003	12/31/2006	Guideline	Observed
31-Jul-00	1294.6	9.8	9.4	7.6	40.1	*64.3*
31-Aug-00	1214.6	9.8	9.4	7.6	40.1	*65.5*
30-Sep-00	1096.1	10.0	9.4	7.6	40.1	*69.0*
31-Oct-00	925.0	10.3	9.9	8.3	43.2	*72.4*
30-Nov-00	642.1	11.7	11.1	9.8	50.8	*79.3*
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30-Nov-01	599.2	11.5	11.3	10.0	52.1	*57.9*
31-Dec-01	677.9	11.0	10.9	9.6	49.8	*52.6*
31-Jan-02	695.1	10.9	10.8	9.5	49.3	*52.6*
28-Feb-02	728.3	10.7	10.7	9.3	48.3	45.0
31-Mar-02	779.2	10.5	10.5	9.0	46.9	40.9
30-Apr-02	797.1	10.5	10.4	8.9	46.4	40.9
31-May-02	800.7	10.6	10.4	8.9	46.3	43.5
30-Jun-02	806.8	10.5	10.4	8.9	46.2	40.9

Notes: Italicized values exceeded allowed percentage

Table 2 also presents the moving flow-weighted mean concentrations for each 12-month period beginning in July 2000 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 April, May and June 2002, the flow-weighted mean total phosphorus concentrations were 10.5, 10.6 and 10.5 ppb, respectively. These concentrations were 0.1 to 0.2 ppb greater than the interim limit concentrations in these three months.

The daily flows through the individual Shark River Slough structures and S334 from July 2000 through June 2002 are presented in **Figure 3a**. A sharp increase in flow began on July 31, 2001, ending an essentially six-month no flow period. Beginning in mid-December, the majority of the inflow was shifted to Northeast Shark River Slough through S333 by closing the S12A, B and C structures. During this period, some flow was routed through S334. Inflows gradually decreased from the beginning of April until mid-May when inflow ceased. Inflows commenced the last week in June

The relationship between the sum of the daily flows at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentration for individual sampling events is presented in **Figure 3b.**

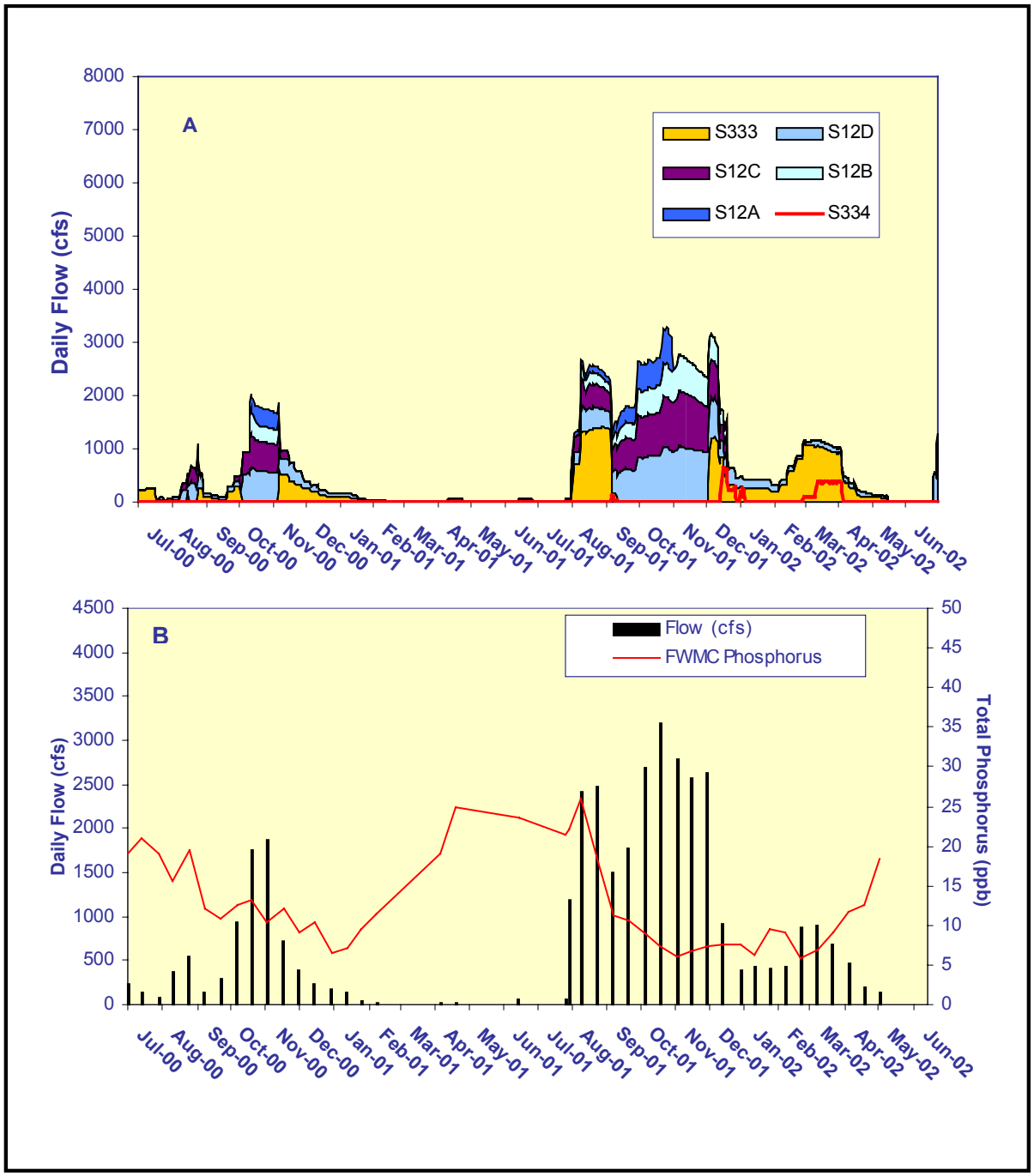

Figure 3. **A**. Daily flows into Shark River Slough by structure. **B**. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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. 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. However, the Settlement Agreement's Technical Oversight Committee requested that data from both the old and new pairs of inflow structures to Taylor Slough be presented for one year. This request was made to determine if the differences between the two data sets observed from August 1999 through March 2000 would continue throughout a complete wet season/dry season cycle and what implications this might have on future compliance with the 11 ppb limit.

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 data for S332D/S174/S18C was consistently greater than flow at S332/S175/S18C. There was also a shift in flow-weighted mean total phosphorus concentration data whereby S332D/S174/S18C concentrations became equal to and then consistently lower than the concentrations at S332/S175/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/S18C data are presented, with the exception of data in **Figure 5a**.

C-111 Project Structures and Detention Areas

The USACE completed construction of the remaining C-111 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 4**). 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. On July 31, 2002, the Florida Department of Environmental Protection (FDEP) issued Emergency Order #7 to allow the USACE to operate the new and existing facilities in accordance with the IOP.

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. As local sponsor, the District will operate and maintain the project facilities. The USACE and District are in the process of jointly developing a monitoring plan to be submitted to FDEP that, when implemented, will assess 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. Discharges from Emergency Overflows EO1 and EO3 would discharge onto District property and eventually flow 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 the monitoring plan is approved, 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 5a**). The bars in **Figure 5a** represent the flow-weighted mean total phosphorus concentrations from S332, S175 and S18C for water years 1989 through 2001. The diamond point values for water years 1999, 2000 and 2001 represent the new combination of structures. **Figure 5b** presents the 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at the S174, S332D and S18C structures.

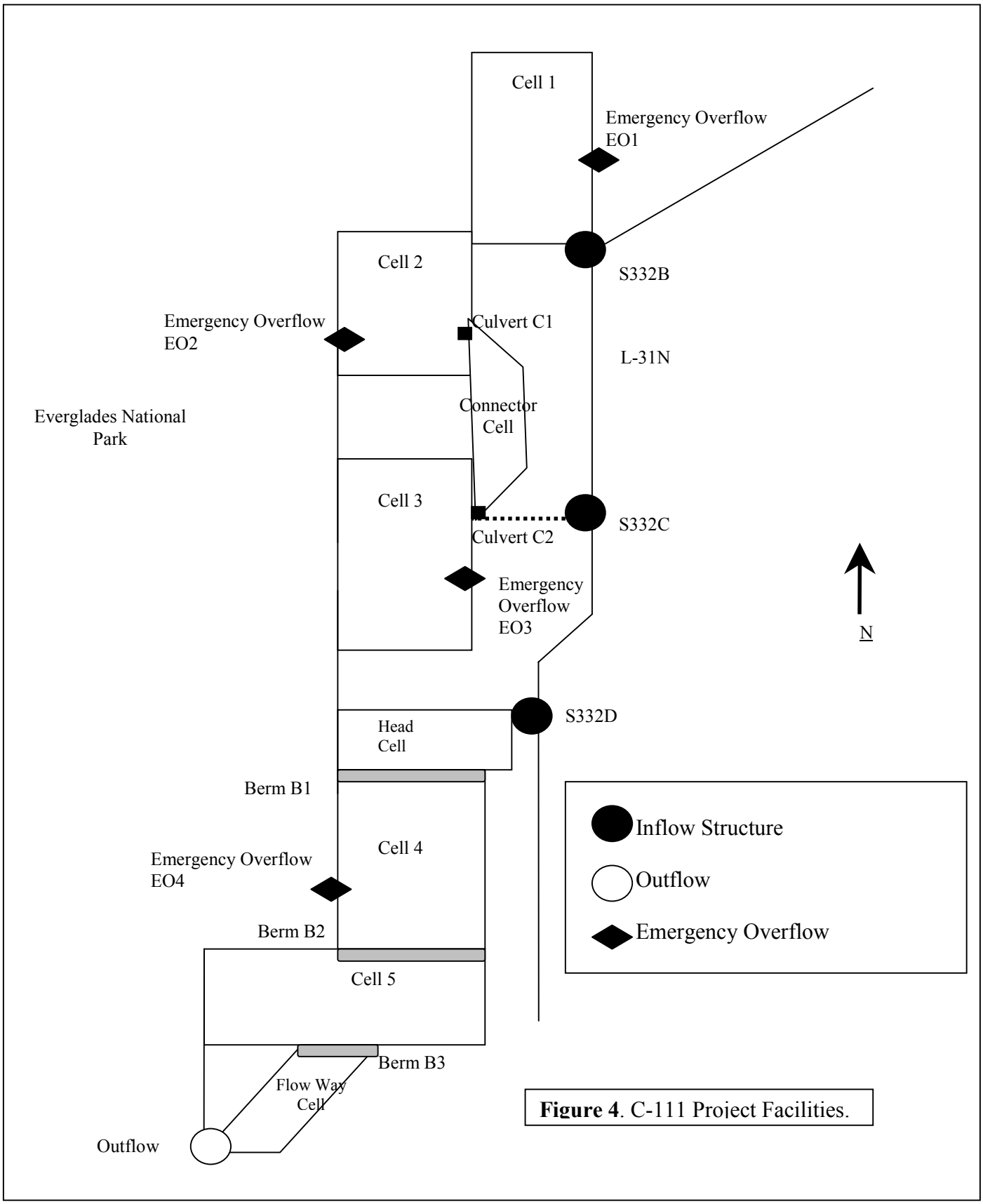

Figure 4. C-111 Project Facilities.

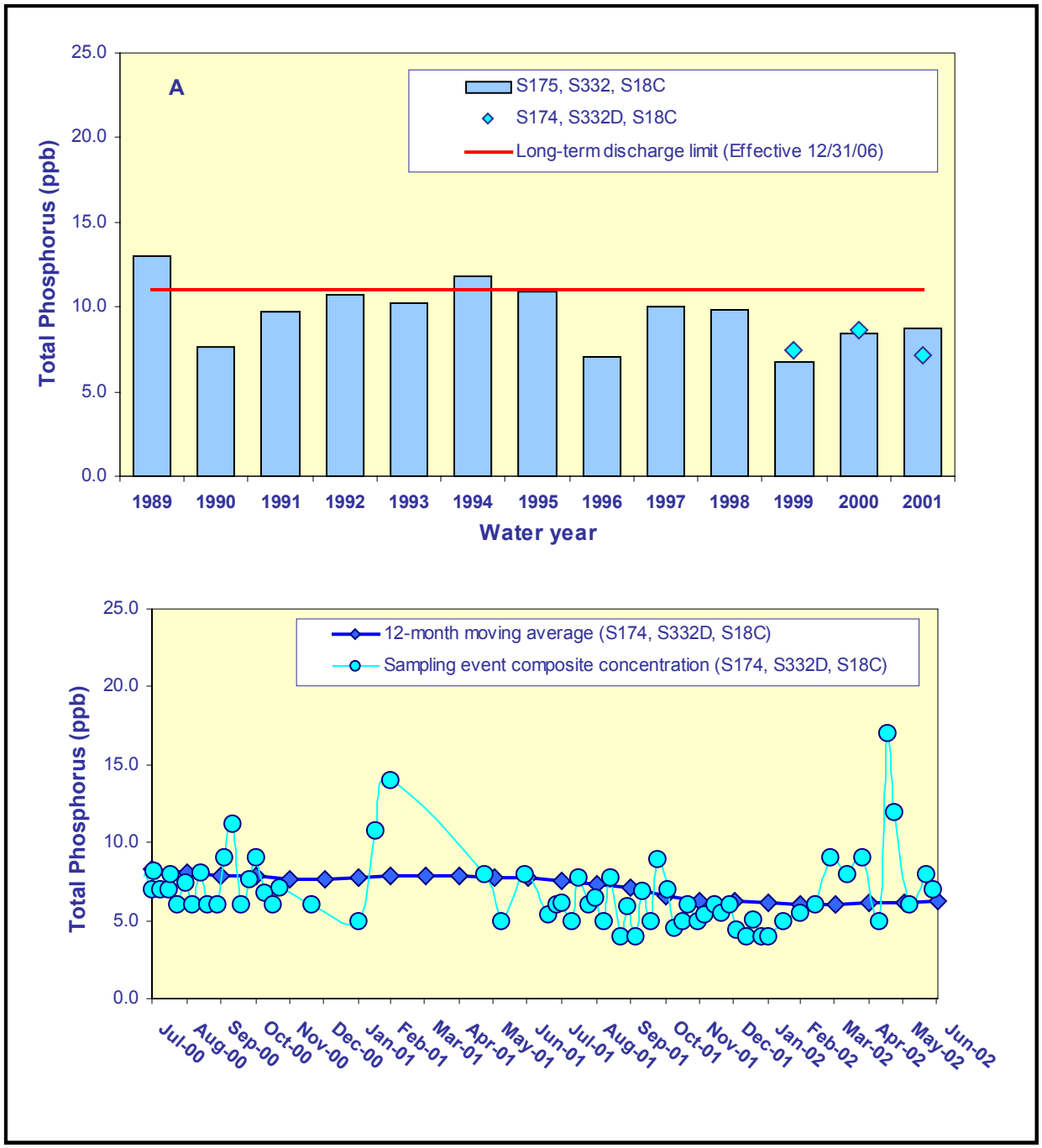

Figure 5. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins. **A.** The 12-month moving average fwmc at the end of each water year compared to the 11 ppb long-term total phosphorus limit. **B**. The 12-month moving average fwmc 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-Jul-00	364.0	8.3	11.0	53.1	20.5
31-Aug-00	389.0	8.1	11.0	53.1	20.5
30-Sep-00	399.0	7.9	11.0	53.1	17.5
31-Oct-00	399.0	7.9	11.0	53.1	16.3
30-Nov-00	375.0	7.7	11.0	53.1	14.6
31-Dec-00	351.0	7.7	11.0	53.1	15.0
31-Jan-01	307.9	7.8	11.0	53.1	15.4
28-Feb-01	281.6	7.9	11.0	53.1	21.6
31-Mar-01	269.5	7.9	11.0	53.1	22.9
30-Apr-01	260.1	7.9	11.0	53.1	20.6
31-May-01	254.1	7.8	11.0	53.1	12.9
30-Jun-01	249.0	7.8	11.0	53.1	10.0
31-Jul-01	243.0	7.5	11.0	53.1	10.7
31-Aug-01	237.1	7.3	11.0	53.1	11.5
30-Sep-01	235.1	7.2	11.0	53.1	11.5
31-Oct-01	235.2	6.5	11.0	53.1	8.0
30-Nov-01	269.7	6.3	11.0	53.1	7.4
31-Dec-01	296.5	6.2	11.0	53.1	6.7
31-Jan-02	316.0	6.1	11.0	53.1	5.9
28-Feb-02	320.6	6.1	11.0	53.1	0.0
31-Mar-02	325.9	6.1	11.0	53.1	0.0
30-Apr-02	331.1	6.1	11.0	53.1	0.0
31-May-02	336.4	6.1	11.0	53.1	5.0
30-Jun-02	364.3	6.2	11.0	53.1	4.9

The 12-month flow-weighted mean concentrations for April, May and June 2002 were 6.1, 6.1 and 6.2 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 value 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, 0.0, 5.0 and 4.9 for the periods ending, April, May and June, respectively, (**Table 3**).

The daily flows into Everglades National Park through S332D, S174 and S18C are presented in **Figure 6a**. **Figure 6b** 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 linear relationship between daily mean flow and flow-weighted mean total phosphorus concentrations at these structures.

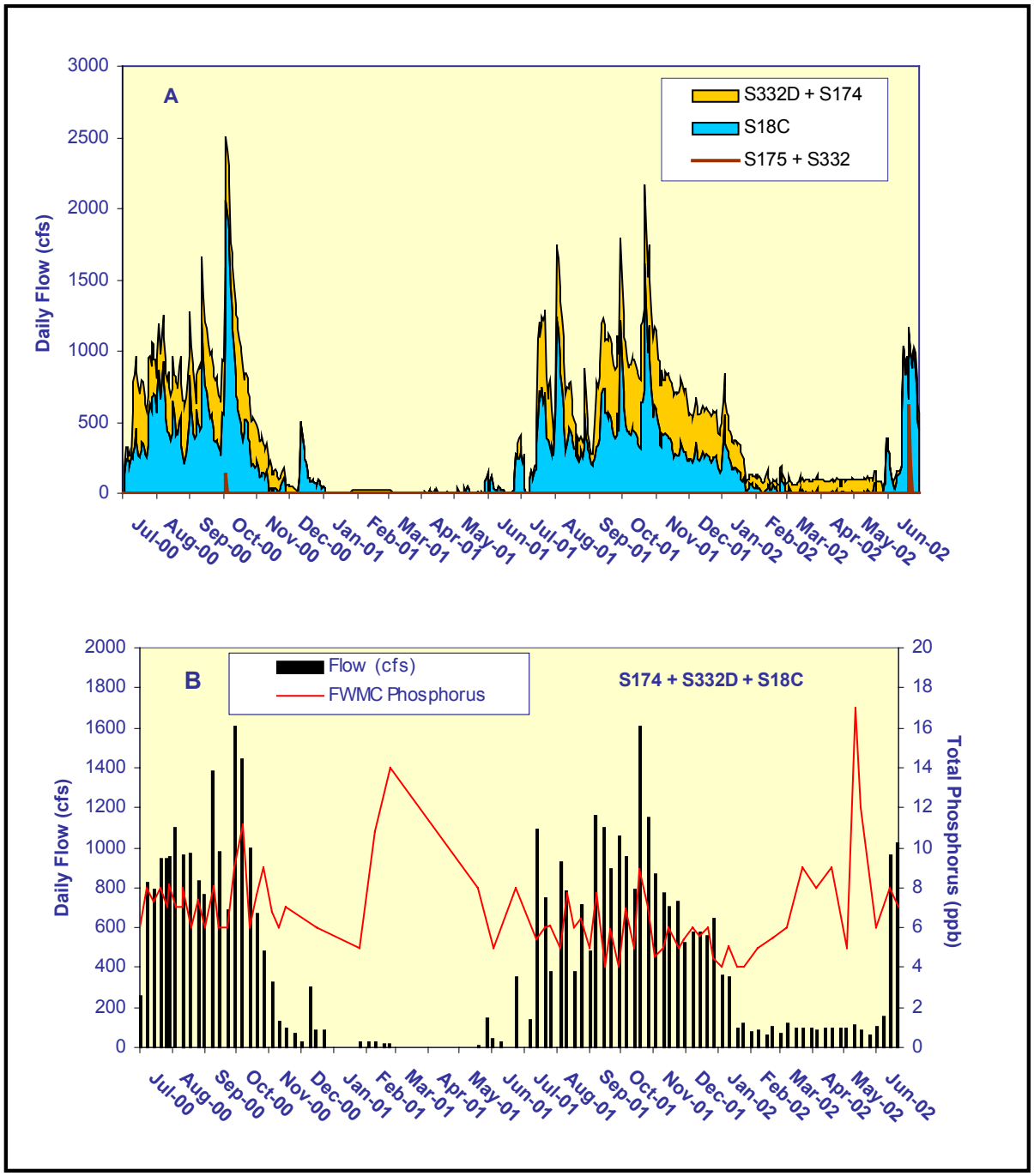

Figure 6. **A.** Daily flows into Everglades National Park through Taylor Slough and S18C. **B**. The relationship between daily flows at Taylor Slough structures and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
July-September 2002 Report

Prepared for the
Technical Oversight Committee
February 19, 2003

Prepared by:
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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 gaging 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 (mean sea level). 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 16.82, 16.22 and 16.66 feet in July, August and September 2002, respectively (**Figure 2, Table 1)**. The geometric means, calculated from total phosphorus concentrations measured in water samples collected in July, August and September were 11.2, 9.0 and 8.2 ppb, respectively (**Table 1**). The July geomean total phosphorus concentration was greater than the interim and long-term levels of 9.7 and 8.3 ppb, respectively. The August and September geomean total phosphorus concentrations were less than the respective interim and long-term levels.

Water samples were collected on July 15 and 16 when the Refuge's average stage was 16.82 feet. This was two days after the highest daily average stage of the quarter was recorded at 16.85 feet. Prior to this peak stage, the Refuge stage had been increasing steadily from a daily average of 15.94 feet during the sampling event on June 17 and 18 due to rainfall and discharges into the Refuge. Although the July total phosphorus geomean of 11.2 ppb was less than the 13.4 ppb geomean in June, the calculated interim and long-term levels in July decreased as a function of the rising stage to the point that both limits were exceeded. This phenomenon has occurred previously under rapidly increasing stage conditions (**Figure 2** and as reported in prior Settlement Agreement Reports for October-December 2001, 2000 and 1999).

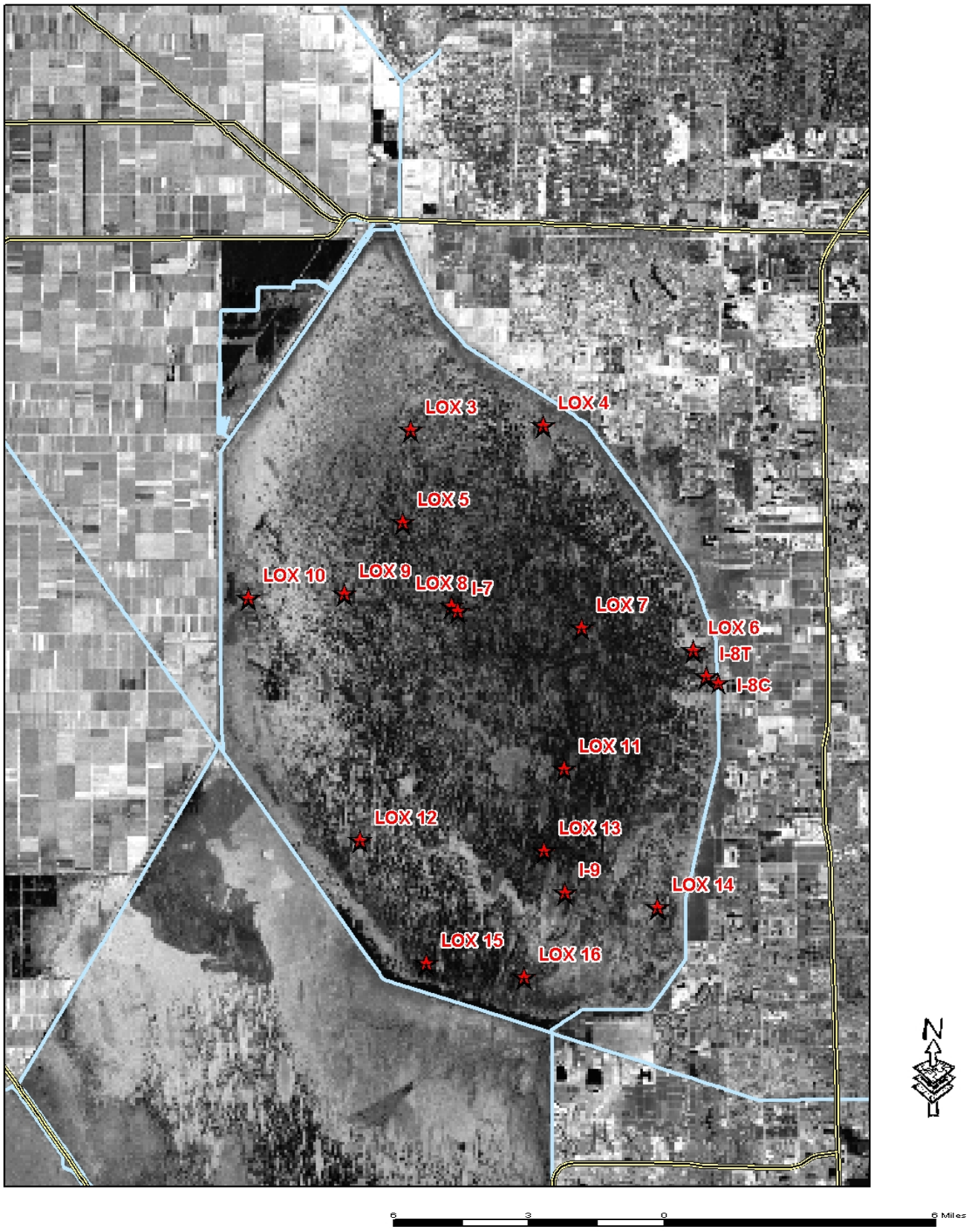

Figure 1. A.R.M. Loxahatchee Refuge Water Quality Sampling and Stage Measurement Sites

★ Station Location

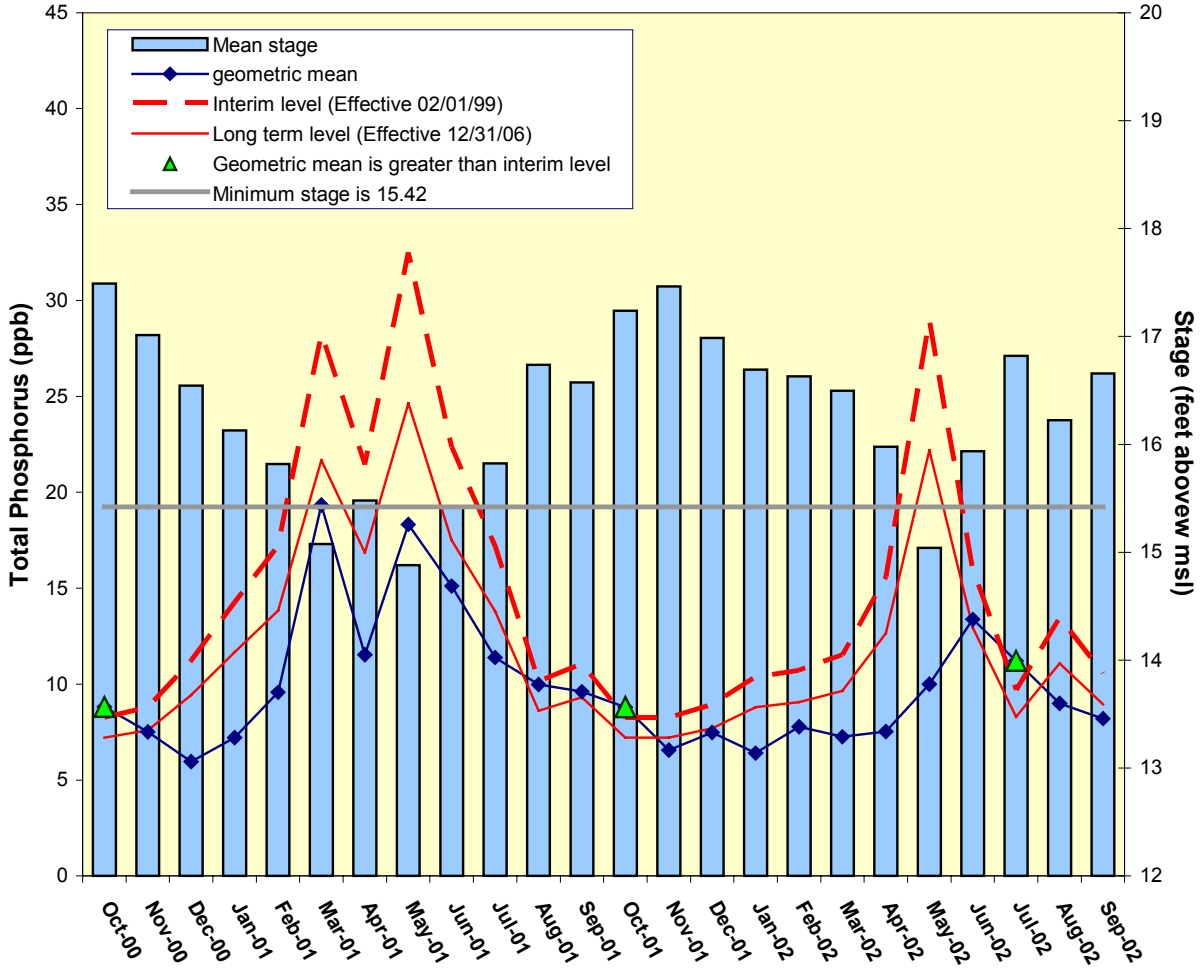

Figure 2. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated total phosphorus levels are adjusted for fluctuations in stage.

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

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft,NGVD)	Number of TP Samples	Number of Stage Measure-ments
Oct-2000	8.8	8.3	7.2	17.49	13	3
Nov-2000	7.5	8.8	7.6	17.01	14	3
Dec-2000	6.0	11.2	9.4	16.55	9	3
Jan-2001	7.2	14.3	11.7	16.13	8	3
Feb-2001	9.6	17.2	13.8	15.82	9	3
Mar-2001	19.3	0.0	0.0	15.08	2	3
Apr-2001	11.5	21.4	16.9	15.48	6	3
May-2001	18.3	0.0	0.0	14.88	2	3
Jun-2001	15.1	0.0	0.0	15.42	9	3
Jul-2001	11.4	17.2	13.8	15.82	11	3
Aug-2001	10.0	10.1	8.6	16.74	14	3
Sep-2001	9.6	11.1	9.3	16.57	14	3
Oct-2001	8.8	8.3	7.2	17.24	14	3
Nov-2001	6.6	8.3	7.2	17.46	14	3
Dec-2001	7.5	8.9	7.7	16.99	14	3
Jan-2002	6.4	10.4	8.8	16.69	14	3
Feb-2002	7.8	10.7	9.1	16.63	14	3
Mar-2002	7.3	11.5	9.7	16.50	14	3
Apr-2002	7.5	15.6	12.7	15.98	11	3
May-2002	10.0	0.0	0.0	15.04	3	3
Jun-2002	13.4	16.0	12.9	15.94	10	3
Jul-2002	11.2	9.7	8.3	16.82	14	3
Aug-2002	9.0	13.5	11.1	16.22	12	3
Sep-2002	8.2	10.6	8.9	16.66	12	3

Notes:
(1) Average Stage is calculated using stage elevations at three stations on the sampling date.
(2) Highlighted values indicate months when exceedances occurred. (The geomean concentration must be greater than the interim level two or more times within a 12-month period to constitute an exeedance.)
(3) Levels do not apply when the stage is 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. The limits apply to the water year ending September 30. 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. In addition, it is required that phosphorus concentrations be presented as 12-month moving flow-weighted means.

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 2002 (**Figure 3a**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2002 was 8.8 ppb. Corresponding interim and long-term limits were 9.6 and 7.9 ppb, respectively. This was the first year since 1999 that the interim limit was not exceeded for the water year ending on September 30. This return to lower concentrations observed in the mid-1990s corresponds with increasing flow into Shark River Slough. Both the interim and long-term limits have not been met in the same year since 1997.

Table 2 presents the moving flow-weighted mean concentrations for each 12-month period beginning in October 2000, 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 July, August and September 2002, the flow-weighted mean total phosphorus concentrations were 10.9, 9.1 and 8.8 ppb, respectively.

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 should not exceed a calculated guideline value based on flow into Shark River Slough for the same 12-month period. For the 12-month periods ending July, August and September 2002, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 45.8, 39.1 and 30.4, respectively. The July observed percentage was greater than the guideline, but the August and September percentages were lower than their respective guidelines (**Table 2**). The individual sampling events and the 12-month moving averages are presented in **Figure 3b**.

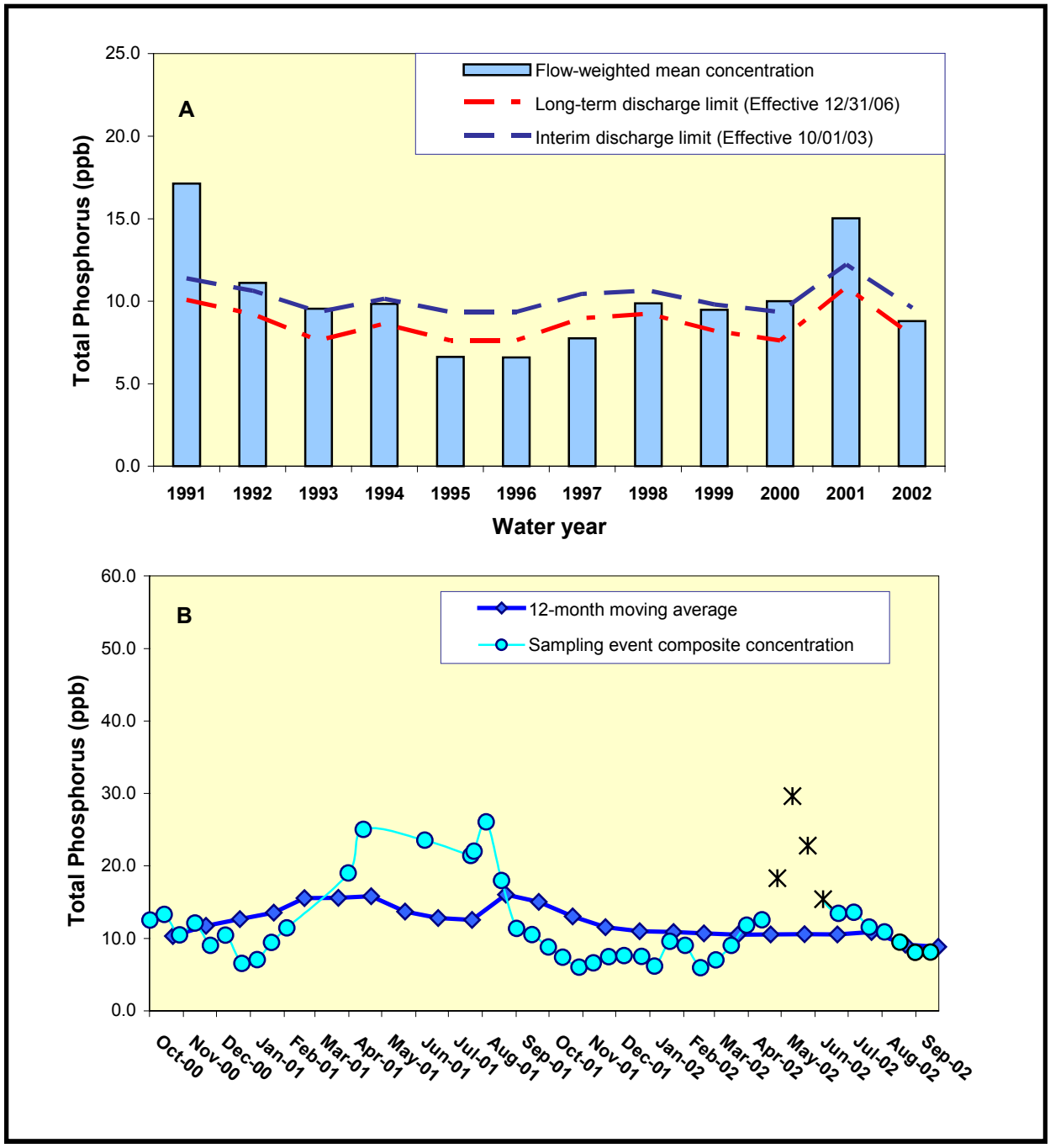

Figure 3. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough.
A. The 12-month moving average fwmc at the end of each water year compared to the total phosphorus interim and long-term limits.
B. The 12-month moving average fwmc at the end of each month and the composite total phosphorus concentration for each sampling event. *(star): denotes arithmetic average for biweekly samples in May and June 2002 as there was no flow on the sampling dates.

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	(%)	
	(Kac-ft)	(ppb)	10/1/2003	12/31/2006	Guideline	Observed
31-Oct-00	925.0	10.3	9.9	8.3	43.2	*72.4*
30-Nov-00	642.1	11.7	11.1	9.8	50.8	*79.3*
31-Dec-00	464.0	12.7	12.0	10.8	56.4	*82.8*
31-Jan-01	367.0	13.5	12.5	11.3	59.8	*80.0*
28-Feb-01	298.4	15.5	12.9	11.7	62.2	*85.7*
31-Mar-01	275.9	15.6	13.0	11.9	63.1	*84.6*
30-Apr-01	250.4	15.8	13.2	12.0	64.0	*84.6*
31-May-01	230.9	13.7	13.3	12.1	64.7	*81.8*
30-Jun-01	221.0	12.8	13.3	12.2	65.1	*80.0*
31-Jul-01	212.8	12.5	13.4	12.2	65.4	*78.9*
31-Aug-01	324.0	16.0	12.8	11.6	61.3	*78.9*
30-Sep-01	419.7	15.0	12.2	11.0	57.9	*78.9*
31-Oct-01	502.4	13.0	11.8	10.5	55.2	*68.4*
30-Nov-01	599.2	11.5	11.3	10.0	52.1	*57.9*
31-Dec-01	677.9	11.0	10.9	9.6	49.8	*52.6*
31-Jan-02	695.1	10.9	10.8	9.5	49.3	*52.6*
28-Feb-02	728.3	10.7	10.7	9.3	48.3	45.0
31-Mar-02	779.2	10.5	10.5	9.0	46.9	40.9
30-Apr-02	797.1	10.5	10.4	8.9	46.4	40.9
31-May-02	800.7	10.6	10.4	8.9	46.3	43.5
30-Jun-02	806.8	10.5	10.4	8.9	46.2	40.9
31-Jul-02	925.7	10.9	9.9	8.3	43.2	*45.8*
31-Aug-02	956.7	9.1	9.7	8.1	42.5	39.1
30-Sep-02	996.3	8.8	9.6	7.9	41.6	30.4

Notes: Italicized values exceeded allowed percentage

The daily flows through the individual Shark River Slough structures and S334 from October 2000 through September 2002 are presented in **Figure 4a**. A sharp increase in flow through all structures began in late June 2002. Total daily flows exceeded 2000 cfs from early July through September.

The relationship between the sum of the daily flows at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentration for individual sampling events is presented in **Figure 4b.** Higher flows correlate well with lower levels of total phosphorus.

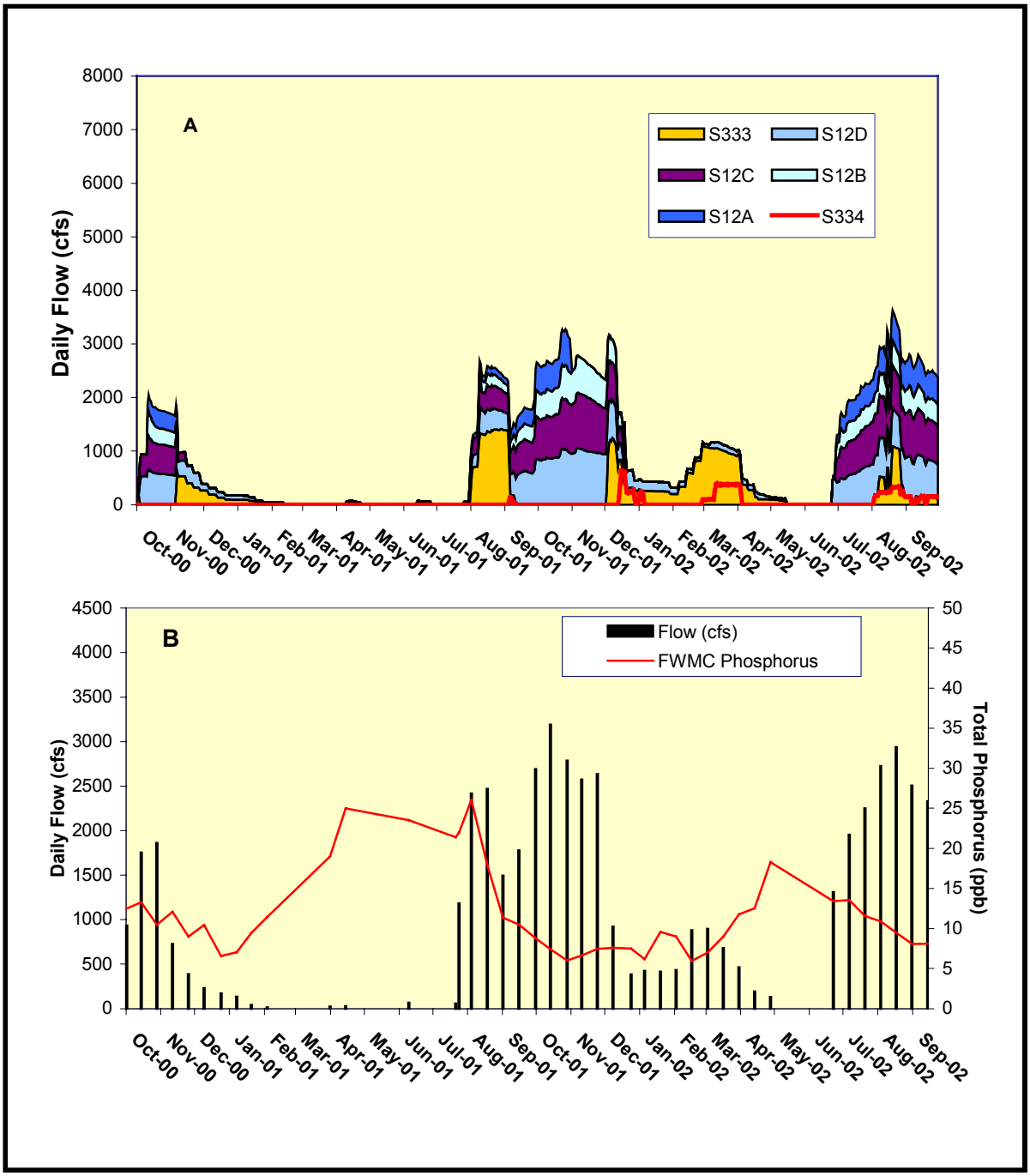

Figure 4. **A**. Daily flows into Shark River Slough by structure. **B**. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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. 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. However, the Settlement Agreement's Technical Oversight Committee requested that data from both the old and new pairs of inflow structures to Taylor Slough be presented for one year. This request was made to determine if the differences between the two data sets observed from August 1999 through March 2000 would continue throughout a complete wet season/dry season cycle and what implications this might have on future compliance with the 11 ppb limit.

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 data for S332D/S174/S18C was consistently greater than flow at S332/S175/S18C. There was also a shift in flow-weighted mean total phosphorus concentration data whereby S332D/S174/S18C concentrations became equal to and then consistently lower than the concentrations at S332/S175/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/S18C data are presented, with the exception of data in **Figure 5a**.

C-111 Project Structures and Detention Areas

The USACE completed construction of the remaining C-111 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 5**). The Flow Way Cell is the only routine surface water 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. On July 31, 2002, the Florida Department of Environmental Protection (FDEP) issued Emergency Order #7 to allow the USACE to operate the new and existing facilities in accordance with the IOP.

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. As local sponsor, the District will eventually operate and maintain the project facilities. The USACE has implemented a monitoring plan that was 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. Discharges from Emergency Overflows EO1 and EO3 would discharge onto District property and eventually flow 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 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 6a**). The bars in **Figure 6a** 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 2002 represent the new combination of structures. **Figure 6b** presents the 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at the S174, S332D and S18C structures.

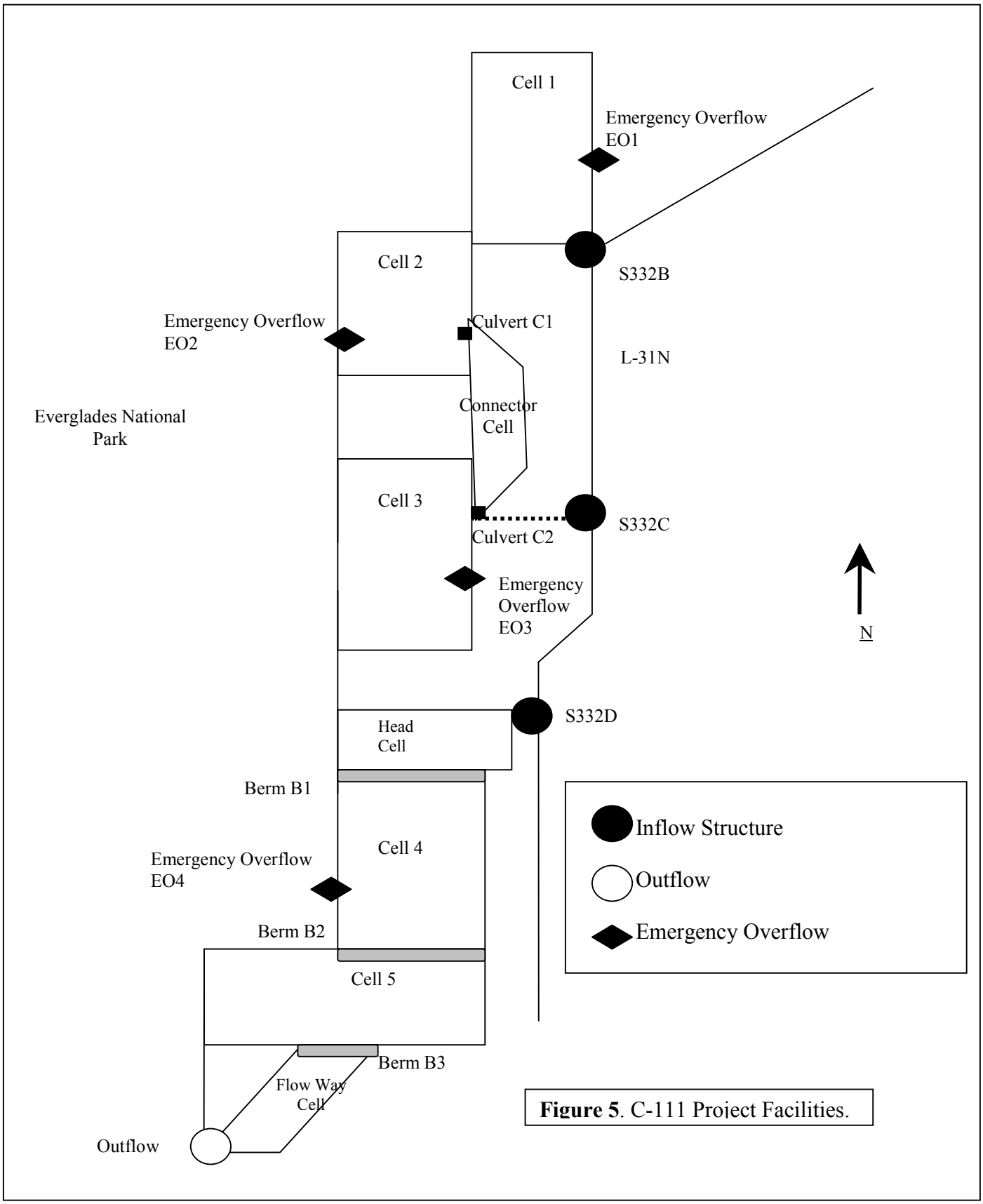

Figure 5. C-111 Project Facilities.

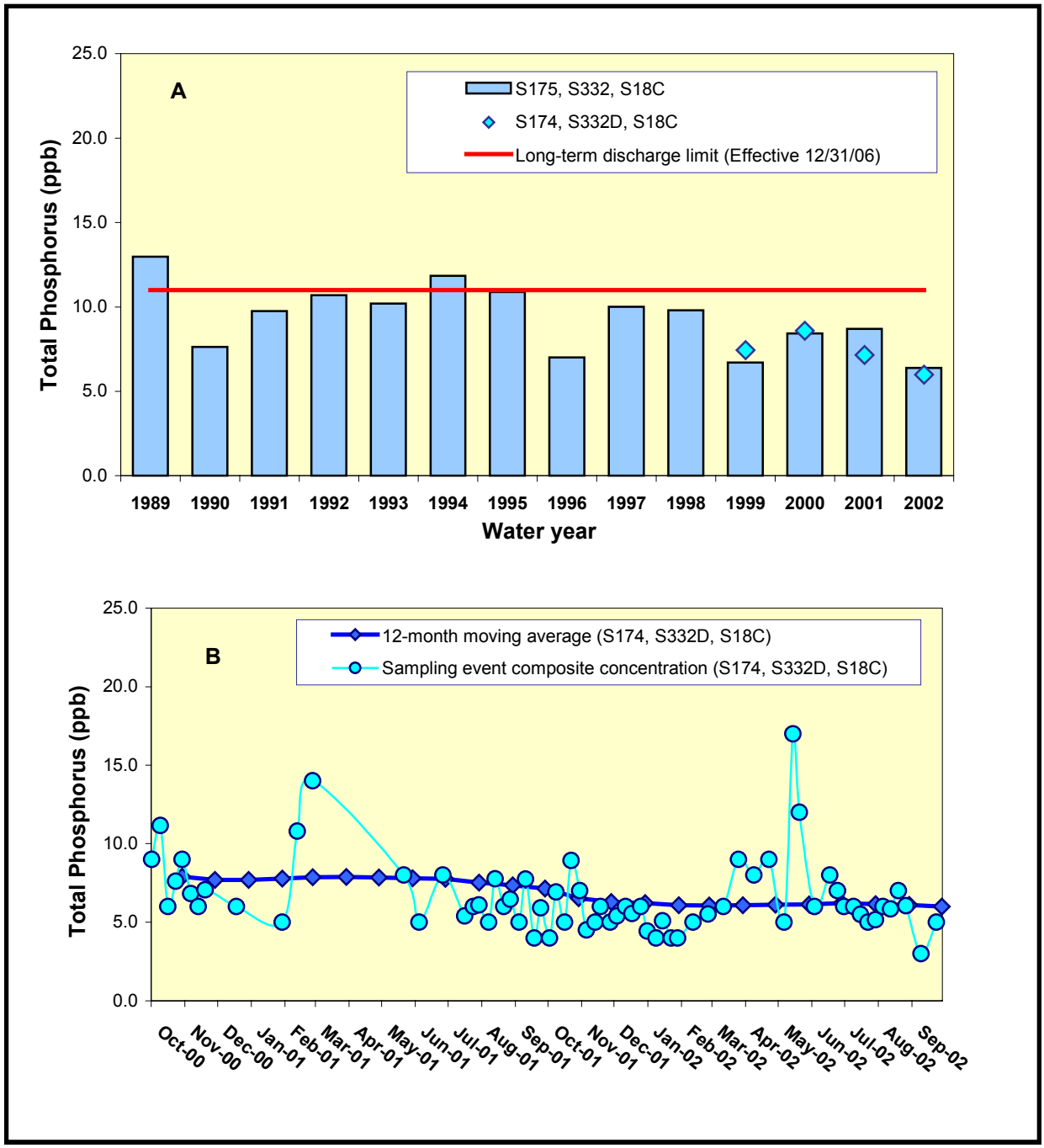

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Table 3. Taylor Slough and the Coastal Basins Total Phosphorus Concentration Compliance Tracking

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-Oct-00	399.0	7.9	11.0	53.1	16.3
30-Nov-00	375.0	7.7	11.0	53.1	14.6
31-Dec-00	351.0	7.7	11.0	53.1	15.0
31-Jan-01	307.9	7.8	11.0	53.1	15.4
28-Feb-01	281.6	7.9	11.0	53.1	21.6
31-Mar-01	269.5	7.9	11.0	53.1	22.9
30-Apr-01	260.1	7.9	11.0	53.1	20.6
31-May-01	254.1	7.8	11.0	53.1	12.9
30-Jun-01	249.0	7.8	11.0	53.1	10.0
31-Jul-01	243.0	7.5	11.0	53.1	10.7
31-Aug-01	237.1	7.3	11.0	53.1	11.5
30-Sep-01	235.1	7.2	11.0	53.1	11.5
31-Oct-01	235.2	6.5	11.0	53.1	8.0
30-Nov-01	269.7	6.3	11.0	53.1	7.4
31-Dec-01	296.5	6.2	11.0	53.1	6.7
31-Jan-02	316.0	6.1	11.0	53.1	5.9
28-Feb-02	320.6	6.1	11.0	53.1	0.0
31-Mar-02	325.9	6.1	11.0	53.1	0.0
30-Apr-02	331.1	6.1	11.0	53.1	0.0
31-May-02	336.4	6.1	11.0	53.1	5.0
30-Jun-02	364.3	6.2	11.0	53.1	4.9
31-Jul-02	392.1	6.1	11.0	53.1	4.7
31-Aug-02	388.3	6.1	11.0	53.1	4.7
30-Sep-02	357.1	6.0	11.0	53.1	4.9

The 12-month flow-weighted mean concentrations for July, August and September 2002 were 6.1, 6.1 and 6.0 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 value 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, 4.7, 4.7 and 4.9 for the periods ending, July, August and September, respectively, (**Table 3**).

The daily flows into Everglades National Park through S332D, S174 and S18C are presented in **Figure 7a**. **Figure 7b** 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 linear relationship between daily mean flow and flow-weighted mean total phosphorus concentrations at these structures.

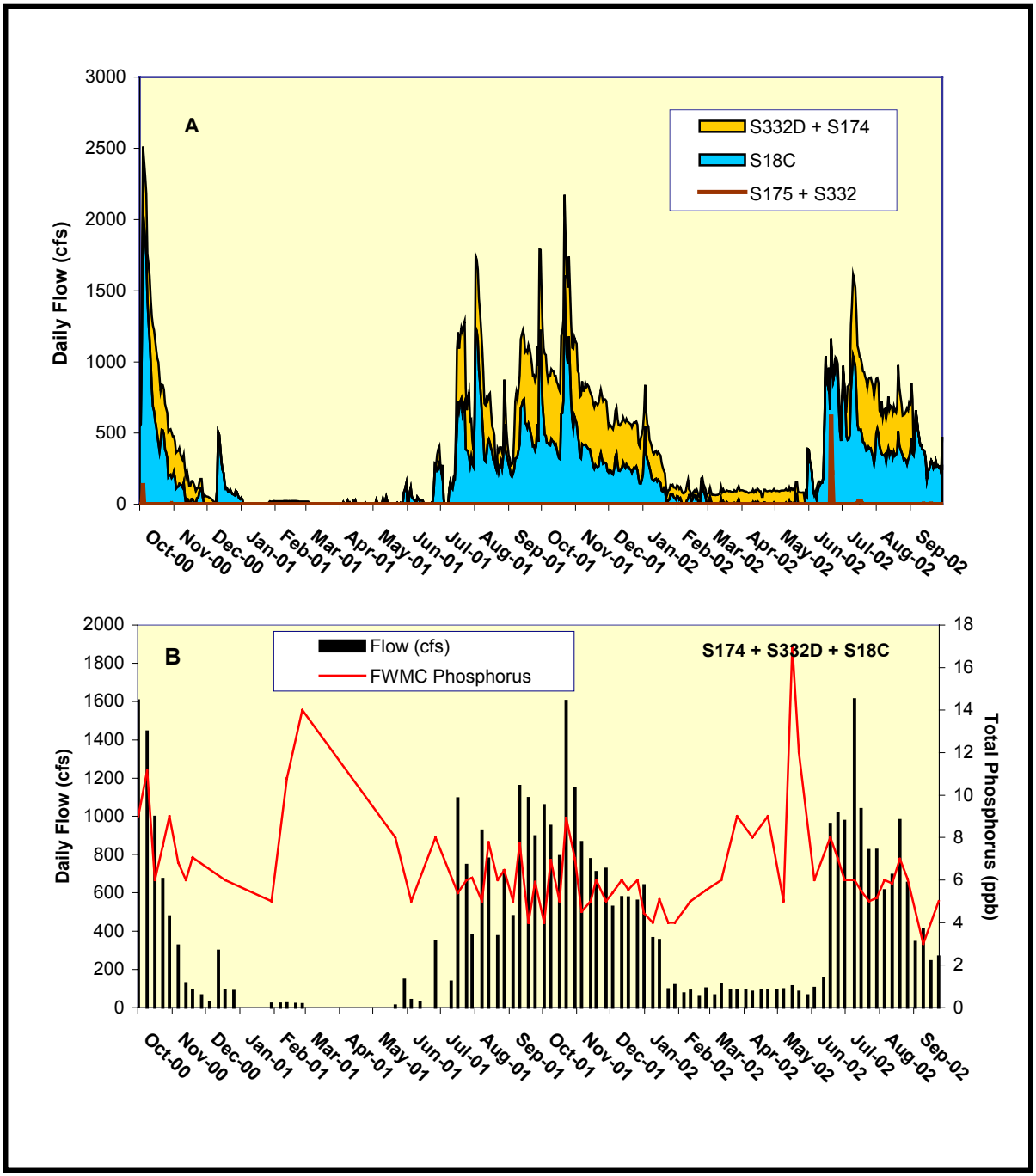

Figure 7. **A.** Daily flows into Everglades National Park through Taylor Slough and S18C. **B**. The relationship between daily flows at Taylor Slough structures and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
October-December 2002 Report

Prepared for the
Technical Oversight Committee
April 30, 2003

Prepared by:
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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 gaging 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 (mean sea level). 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 16.64, 16.66 and 16.93 feet in October, November and December 2002, respectively (**Figure 2, Table 1)**. The geometric means, calculated from total phosphorus concentrations measured in water samples collected in October, November and December were 7.5, 6.9 and 5.9 ppb, respectively (**Table 1**). The October, November and December geomeans were less than the interim and long-term levels for these months.

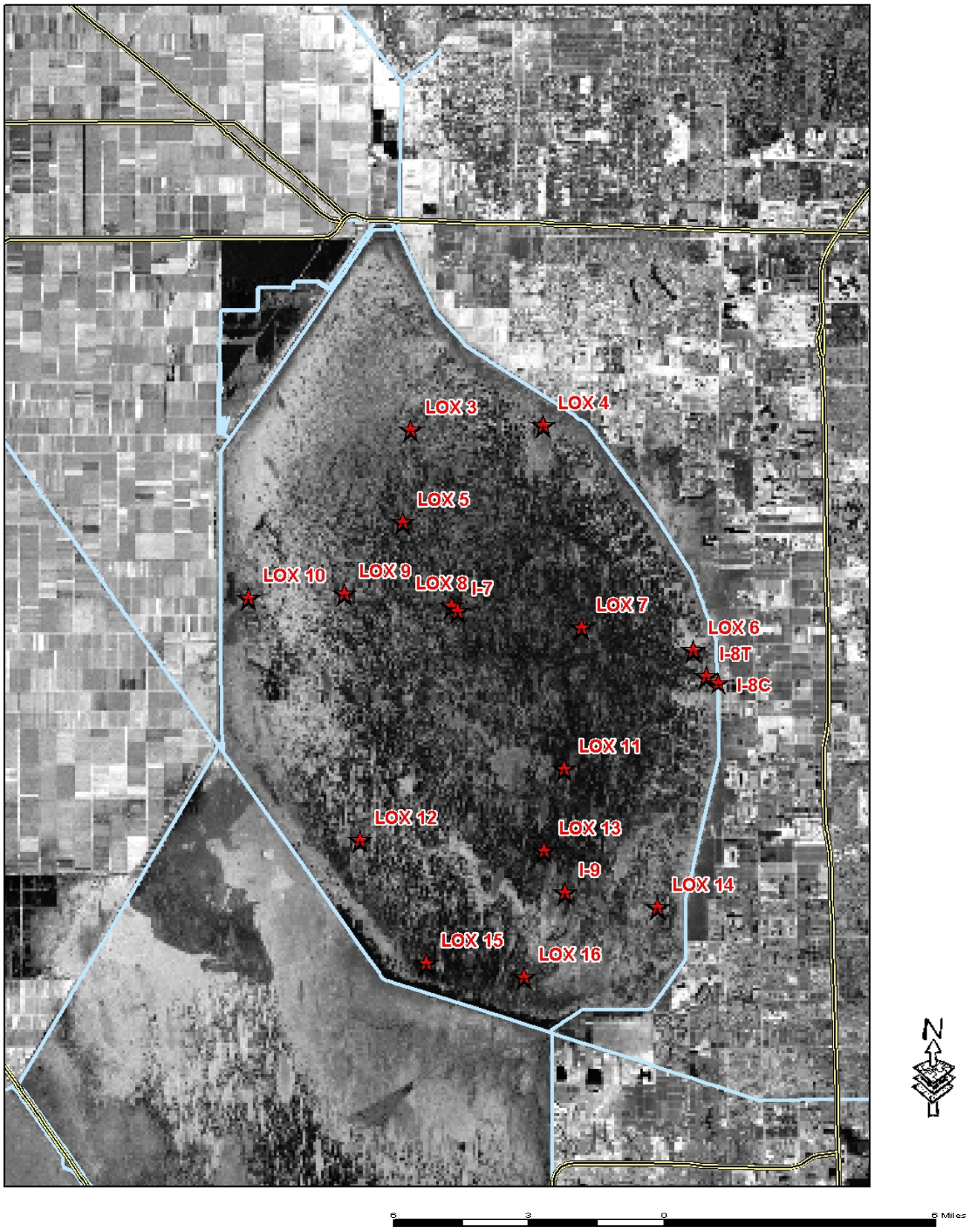

Figure 1. A.R.M. Loxahatchee Refuge Water Quality Sampling and Stage Measurement Sites

★ Station Location

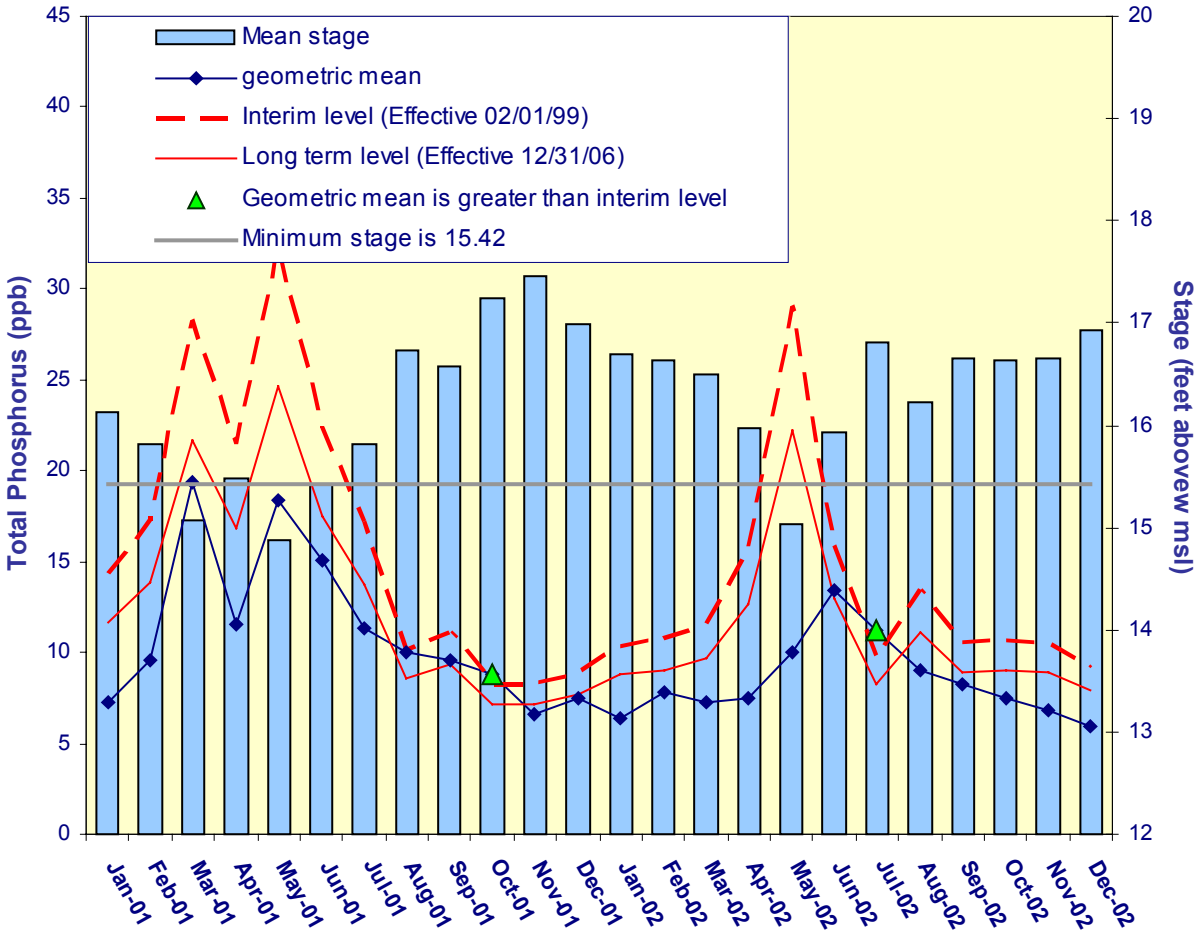

Figure 2. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

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

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft,NGVD)	Number of TP Samples	Number of Stage Measure-ments
Jan-2001	7.2	14.3	11.7	16.13	8	3
Feb-2001	9.6	17.2	13.8	15.82	9	3
Mar-2001	19.3	0.0	0.0	15.08	2	3
Apr-2001	11.5	21.4	16.9	15.48	6	3
May-2001	18.3	0.0	0.0	14.88	2	3
Jun-2001	15.1	0.0	0.0	15.42	9	3
Jul-2001	11.4	17.2	13.8	15.82	11	3
Aug-2001	10.0	10.1	8.6	16.74	14	3
Sep-2001	9.6	11.1	9.3	16.57	14	3
Oct-2001	8.8	8.3	7.2	17.24	14	3
Nov-2001	6.6	8.3	7.2	17.46	14	3
Dec-2001	7.5	8.9	7.7	16.99	14	3
Jan-2002	6.4	10.4	8.8	16.69	14	3
Feb-2002	7.8	10.7	9.1	16.63	14	3
Mar-2002	7.3	11.5	9.7	16.50	14	3
Apr-2002	7.5	15.6	12.7	15.98	11	3
May-2002	10.0	0.0	0.0	15.04	3	3
Jun-2002	13.4	16.0	12.9	15.94	10	3
Jul-2002	11.2	9.7	8.3	16.82	14	3
Aug-2002	9.0	13.5	11.1	16.22	12	3
Sep-2002	8.2	10.6	8.9	16.66	11	3
Oct-2002	7.5	10.7	9.0	16.64	12	3
Nov-2002	6.9	10.5	8.9	16.66	12	3
Dec-2002	5.9	9.2	7.9	16.93	14	3

Notes: (1) Average Stage is calculated using stage elevations at three stations on the sampling date
(2) Highlighted values indicate months when exceedances occurred

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 2002 (**Figure 3a**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2002 was 8.8 ppb. Corresponding interim and long-term limits were 9.6 and 7.9 ppb, respectively. For the nine-year period 1994 through 2002, the interim limit applicable to Shark River Slough has been met in seven times. The limit was exceeded in Water Years 2000 and 2001.

Table 2 presents the moving flow-weighted mean concentrations for each 12-month period beginning in January 2001 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 2002, the flow-weighted mean total phosphorus concentrations were 8.9, 9.3 and 9.5 ppb, respectively.

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 2002, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 30.4, 31.8 and 30.4, respectively. These observed percentages were all less than the guidelines (**Table 2**). The individual sampling events and the 12-month moving average are presented in **Figure 3b**. All individual sampling events from September through December 2002 had total phosphorus concentrations less than 10 ppb.

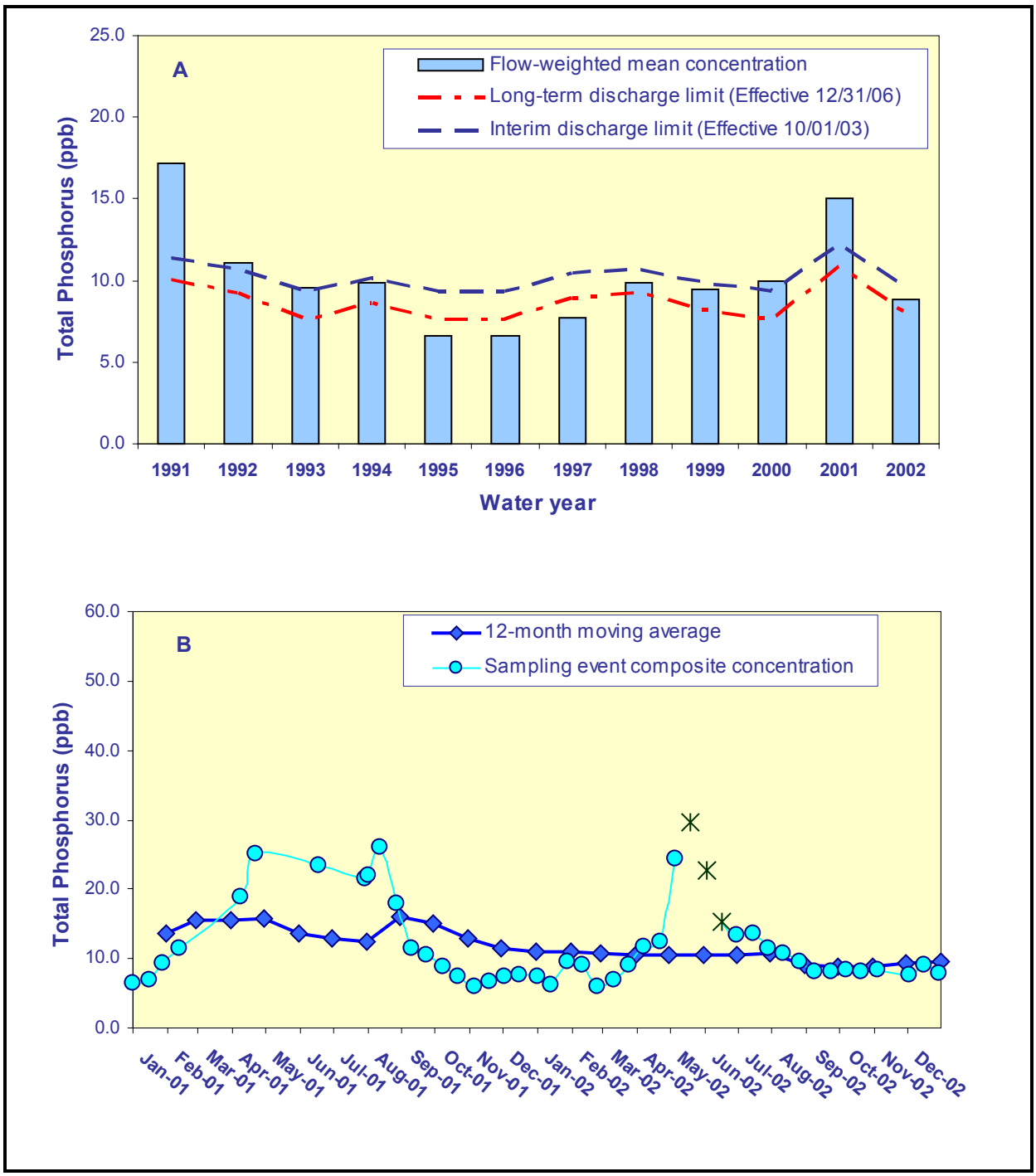

Figure 3. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough.
A. The 12-month moving average fwmc at the end of each water year compared to the total phosphorus interim and long-term limits.
B. The 12-month moving average fwmc at the end of each month and the composite total phosphorus concentration for each sampling event. *(star): denotes arithmetic average for biweekly samples in May and June 2002 as there was no flow on the sampling dates.

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	(%)	
	(Kac-ft)	(ppb)	10/1/2003	12/31/2006	Guideline	Observed
31-Jan-01	367.0	13.5	12.5	11.3	59.8	***80.0***
28-Feb-01	298.4	15.5	12.9	11.7	62.2	***85.7***
31-Mar-01	275.9	15.6	13.0	11.9	63.1	***84.6***
30-Apr-01	250.4	15.8	13.2	12.0	64.0	***84.6***
31-May-01	230.9	13.7	13.3	12.1	64.7	***81.8***
30-Jun-01	221.0	12.8	13.3	12.2	65.1	***80.0***
31-Jul-01	212.8	12.5	13.4	12.2	65.4	***78.9***
31-Aug-01	324.0	16.0	12.8	11.6	61.3	***78.9***
30-Sep-01	419.7	15.0	12.2	11.0	57.9	***78.9***
31-Oct-01	502.4	13.0	11.8	10.5	55.2	***68.4***
30-Nov-01	599.2	11.5	11.3	10.0	52.1	***57.9***
31-Dec-01	677.9	11.0	10.9	9.6	49.8	***52.6***
31-Jan-02	695.1	10.9	10.8	9.5	49.3	***52.6***
28-Feb-02	728.3	10.7	10.7	9.3	48.3	45.0
31-Mar-02	779.2	10.5	10.5	9.0	46.9	40.9
30-Apr-02	797.1	10.5	10.4	8.9	46.4	40.9
31-May-02	800.7	10.6	10.4	8.9	46.3	43.5
30-Jun-02	806.8	10.5	10.4	8.9	46.2	40.9
31-Jul-02	925.7	10.9	9.9	8.3	43.2	***45.8***
31-Aug-02	956.7	9.1	9.7	8.1	42.5	39.1
30-Sep-02	996.3	8.8	9.6	7.9	41.6	30.4
31-Oct-02	945.7	8.9	9.8	8.2	42.7	30.4
30-Nov-02	830.3	9.3	10.3	8.8	45.6	31.8
31-Dec-02	758.0	9.5	10.6	9.1	47.5	30.4

Notes: *Italicized values exceeded allowed percentage*

The daily flows through the individual Shark River Slough structures and S334 from January 2001 through December 2002 are presented in **Figure 4a**. A sharp increase in flow through all structures began in late June 2002. Total daily flows exceeded 1500 cfs from early July through October and were dominated by water moving via the S12 structures.

The relationship between the sum of the daily flows at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentration for individual sampling events is presented in **Figure 4b.** Values for Water Years 2001 and 2002 follow the strong inverse relationship between flow and total phosphorus concentration expected for waters entering the Park through Shark River Slough.

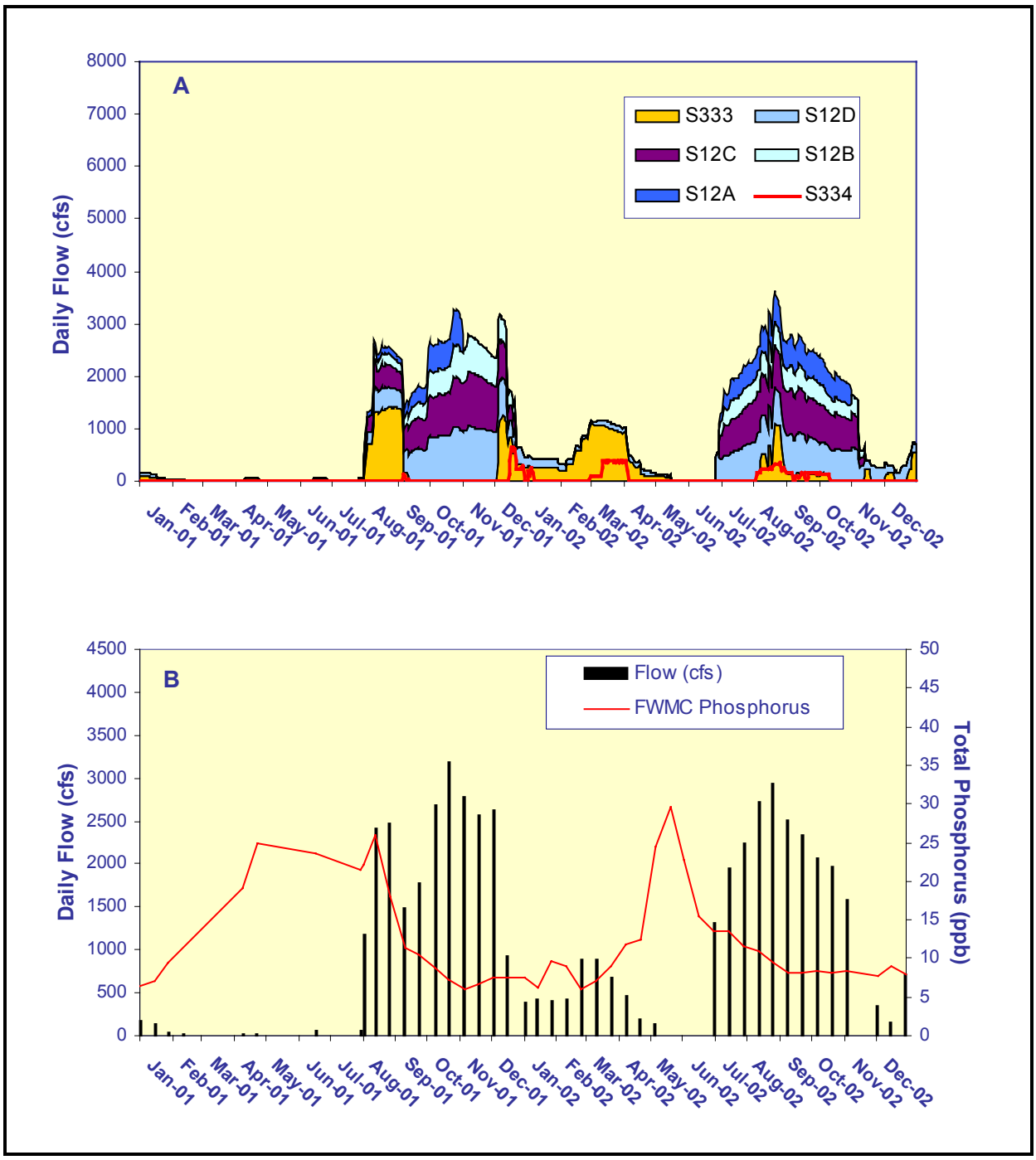

Figure 4. **A**. Daily flows into Shark River Slough by structure. **B**. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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 5**). 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. On July 31, 2002, the Florida Department of Environmental Protection (FDEP) issued Emergency Order #7 to allow the USACE to operate the new and existing facilities in accordance with the IOP.

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. As local sponsor, the District will eventually operate and maintain the project facilities. The USACE has implemented a monitoring plan that was 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. Discharges from Emergency Overflows EO1 and EO3 would discharge onto District property and eventually flow 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 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.

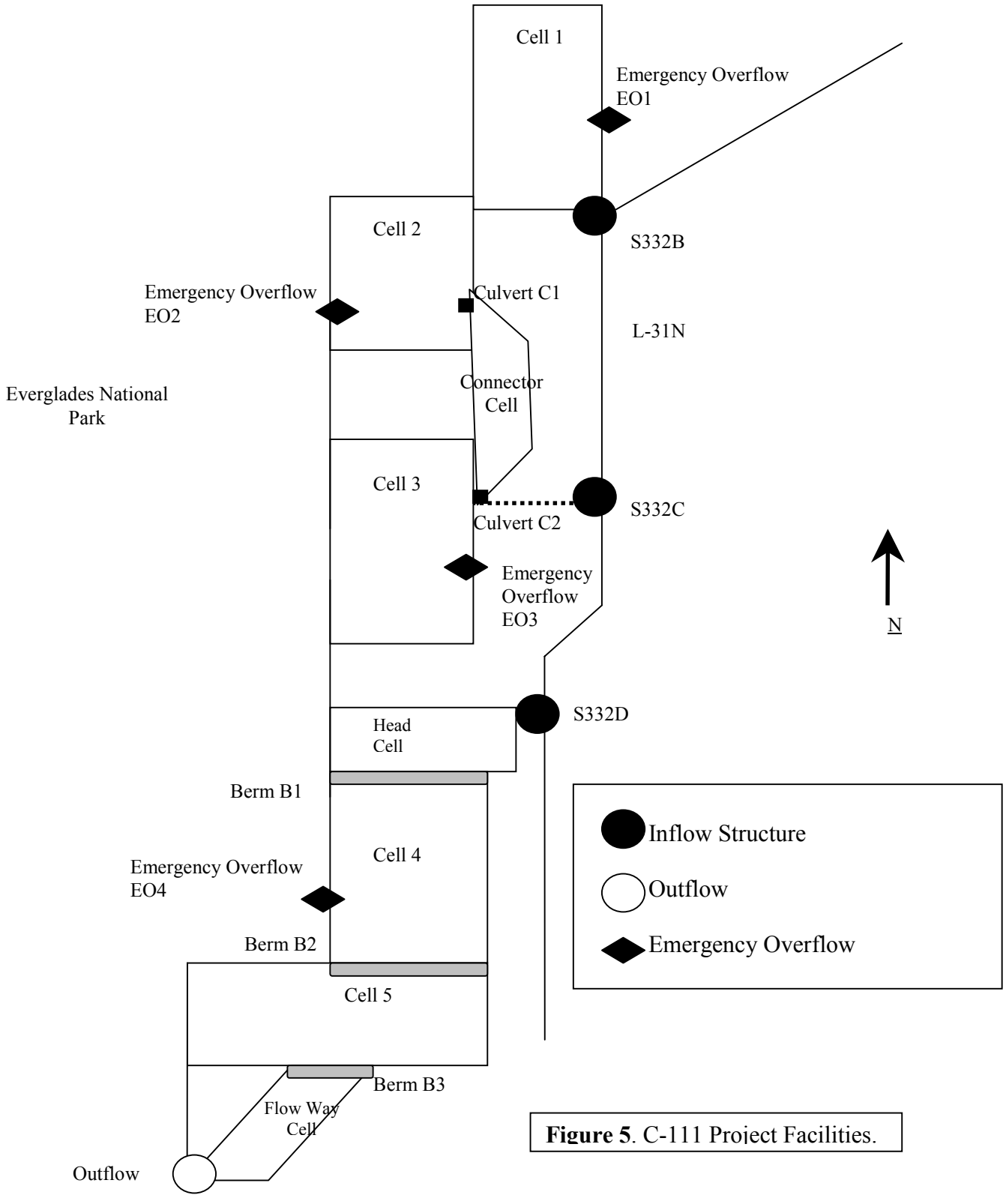

Figure 5. C-111 Project Facilities.

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 6a**). The bars in **Figure 6a** 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 2002 represent the new combination of structures. **Figure 6b** 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 6b**.

The 12-month flow-weighted mean concentrations for October, November and December 2002 were 5.7, 5.8 and 5.8 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 4.8, 5.0 and 4.9 for the periods ending October, November and December 2002, respectively (**Table 3**), less than one-tenth the guideline.

The daily flows into Everglades National Park through S332D, S174 and S18C are presented in **Figure 7a**. **Figure 7b** 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.

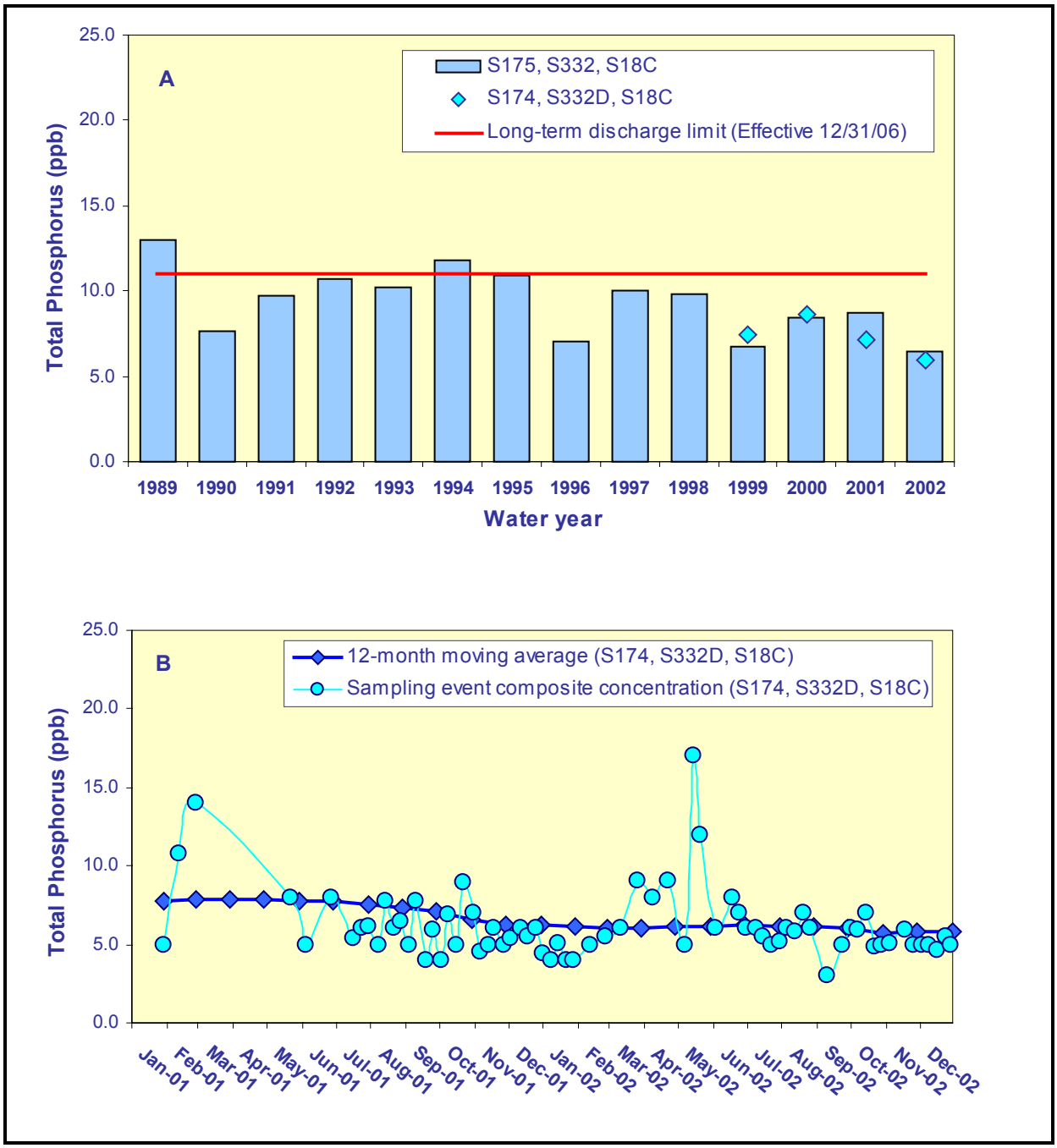

Figure 6. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins. **A.** The 12-month moving average fwmc at the end of each water year compared to the 11 ppb long-term total phosphorus limit. **B**. The 12-month moving average fwmc 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-01	307.9	7.8	11.0	53.1	15.4
28-Feb-01	281.6	7.9	11.0	53.1	21.6
31-Mar-01	269.5	7.9	11.0	53.1	22.9
30-Apr-01	260.1	7.9	11.0	53.1	20.6
31-May-01	254.1	7.8	11.0	53.1	12.9
30-Jun-01	249.0	7.8	11.0	53.1	10.0
31-Jul-01	243.0	7.5	11.0	53.1	10.7
31-Aug-01	237.1	7.3	11.0	53.1	11.5
30-Sep-01	235.1	7.2	11.0	53.1	11.5
31-Oct-01	235.2	6.5	11.0	53.1	8.0
30-Nov-01	269.7	6.3	11.0	53.1	7.4
31-Dec-01	296.5	6.2	11.0	53.1	6.7
31-Jan-02	316.0	6.1	11.0	53.1	5.9
28-Feb-02	320.6	6.1	11.0	53.1	0.0
31-Mar-02	325.9	6.1	11.0	53.1	0.0
30-Apr-02	331.1	6.1	11.0	53.1	0.0
31-May-02	336.4	6.1	11.0	53.1	5.0
30-Jun-02	364.3	6.2	11.0	53.1	4.9
31-Jul-02	392.1	6.1	11.0	53.1	4.7
31-Aug-02	388.3	6.1	11.0	53.1	4.7
30-Sep-02	357.1	6.0	11.0	53.1	4.9
31-Oct-02	301.2	5.7	11.0	53.1	4.8
30-Nov-02	256.9	5.8	11.0	53.1	5.0
31-Dec-02	235.1	5.8	11.0	53.1	4.9

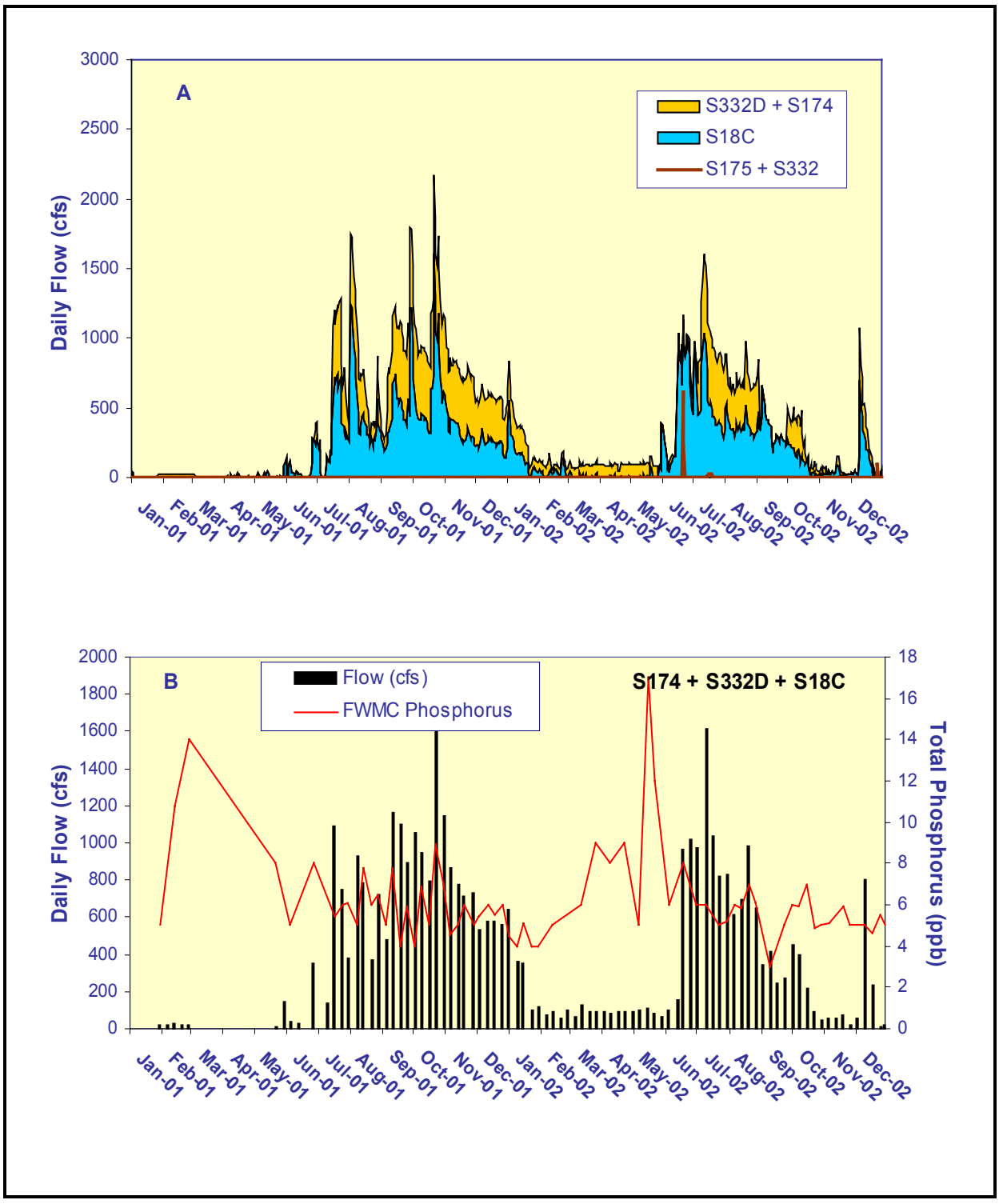

Figure 7. **A.** Daily flows into Everglades National Park through Taylor Slough and S18C. **B**. The relationship between daily flows at Taylor Slough structures and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
January-March 2003 Report

Prepared for the
Technical Oversight Committee
July 14, 2003

Prepared by:
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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 gaging 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 (mean sea level). 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 16.76, 16.54 and 16.23 feet in January, February and March 2003, respectively (**Figure 2, Table 1)**. The geometric means, calculated from total phosphorus concentrations measured in water samples collected in January, February and March were 5.7, 7.5 and 8.0 ppb, respectively (**Table 1**). The January, February and March geomeans were less than the interim and long-term levels for these months.

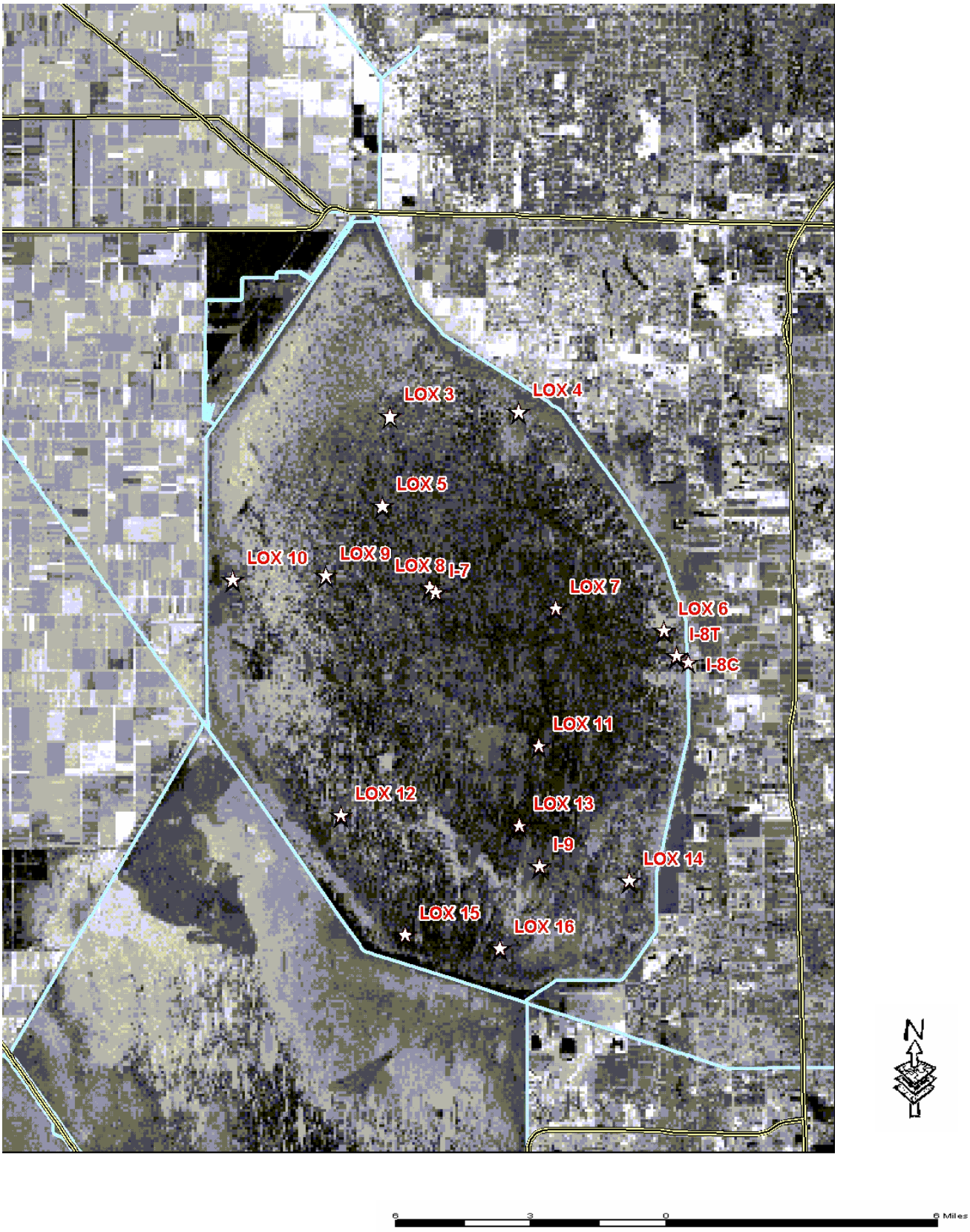

Figure 1. A.R.M. Loxahatchee Refuge Water Quality Sampling and Stage Measurement Sites

☆ Station Location

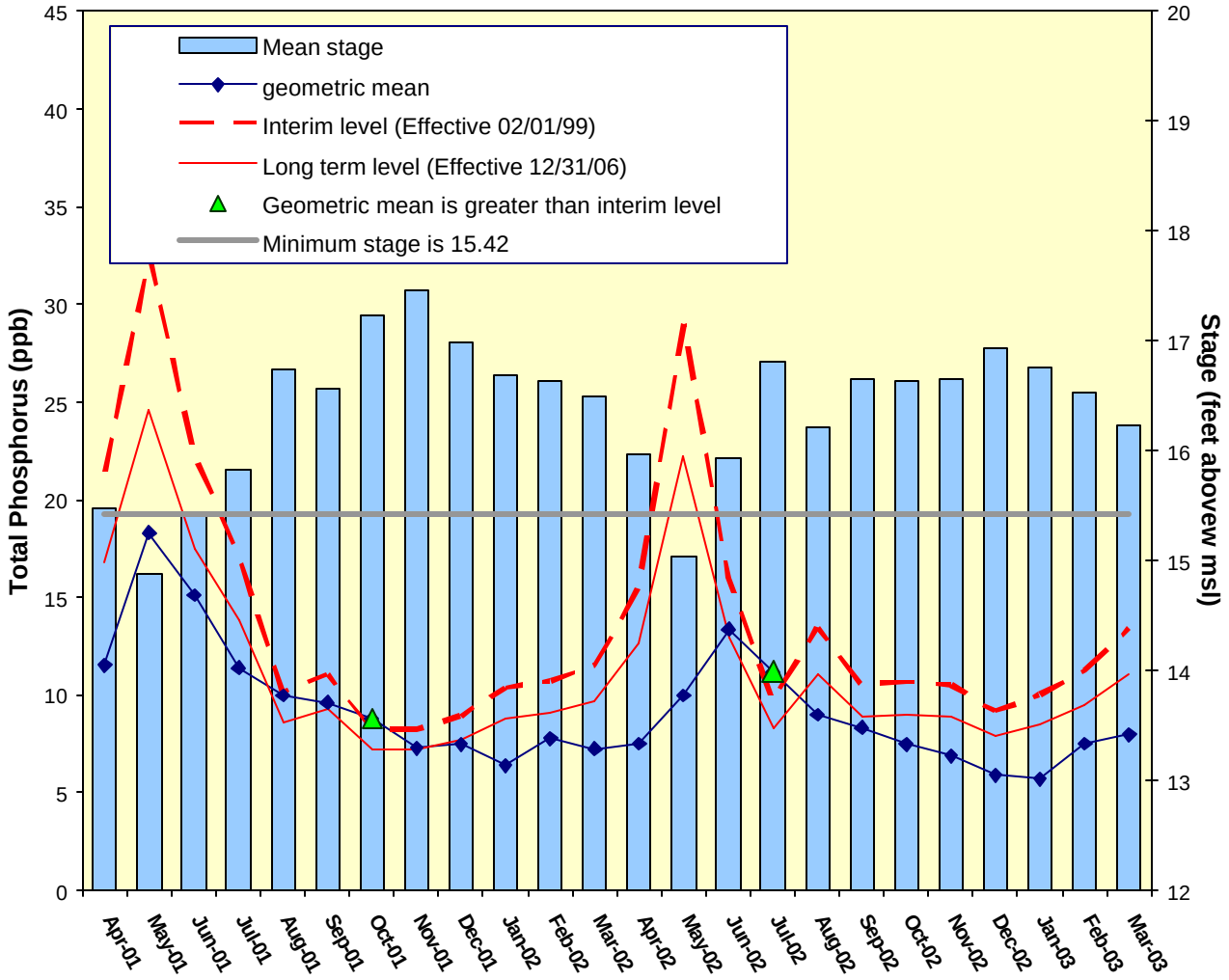

Figure 2. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

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

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft,NGVD)	Number of TP Samples	Number of Stage Measure-ments
Apr-2001	11.5	21.4	16.9	15.48	6	3
May-2001	18.3	0.0	0.0	14.88	2	3
Jun-2001	15.1	0.0	0.0	15.42	9	3
Jul-2001	11.4	17.2	13.8	15.82	11	3
Aug-2001	10.0	10.1	8.6	16.74	14	3
Sep-2001	9.6	11.1	9.3	16.57	14	3
Oct-2001	8.8	8.3	7.2	17.24	14	3
Nov-2001	7.3	8.3	7.2	17.46	14	3
Dec-2001	7.5	8.9	7.7	16.99	14	3
Jan-2002	6.4	10.4	8.8	16.69	14	3
Feb-2002	7.8	10.7	9.1	16.63	14	3
Mar-2002	7.3	11.5	9.7	16.50	14	3
Apr-2002	7.5	15.6	12.7	15.98	11	3
May-2002	10.0	0.0	0.0	15.04	3	3
Jun-2002	13.4	16.0	12.9	15.94	10	3
Jul-2002	11.2	9.7	8.3	16.82	14	3
Aug-2002	9.0	13.5	11.1	16.22	12	3
Sep-2002	8.3	10.6	8.9	16.66	11	3
Oct-2002	7.5	10.7	9.0	16.64	12	3
Nov-2002	6.9	10.5	8.9	16.66	12	3
Dec-2002	5.9	9.2	7.9	16.93	14	3
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	11.0	16.23	9	3

Notes: (1) Average Stage is calculated using stage elevations at three stations on the sampling date
(2) Highlighted values indicate months when exceedances occurred

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 2002 (**Figure 3a**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2002 was 8.8 ppb. Corresponding interim and long-term limits were 9.6 and 7.9 ppb, respectively. For the nine-year period 1994 through 2002, the interim limit applicable to Shark River Slough has been met seven times. The limit was exceeded in Water Years 2000 and 2001.

Table 2 presents the moving flow-weighted mean concentrations for each 12-month period beginning in April 2001 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 2003, the flow-weighted mean total phosphorus concentrations were 9.4, 9.7 and 10.1 ppb, respectively. These concentrations were less than the respective interim limits, but greater than the respective 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 January, February and March 2003, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 32.0, 37.0 and 48.3, respectively. The March observed percentage was 0.7 percent greater than the guideline (**Table 2**). The individual sampling events and the 12-month moving average are presented in **Figure 3b**. Individual sampling events in February and March 2003 had total phosphorus concentrations greater than 10 ppb due to low flows through S12D and S333.

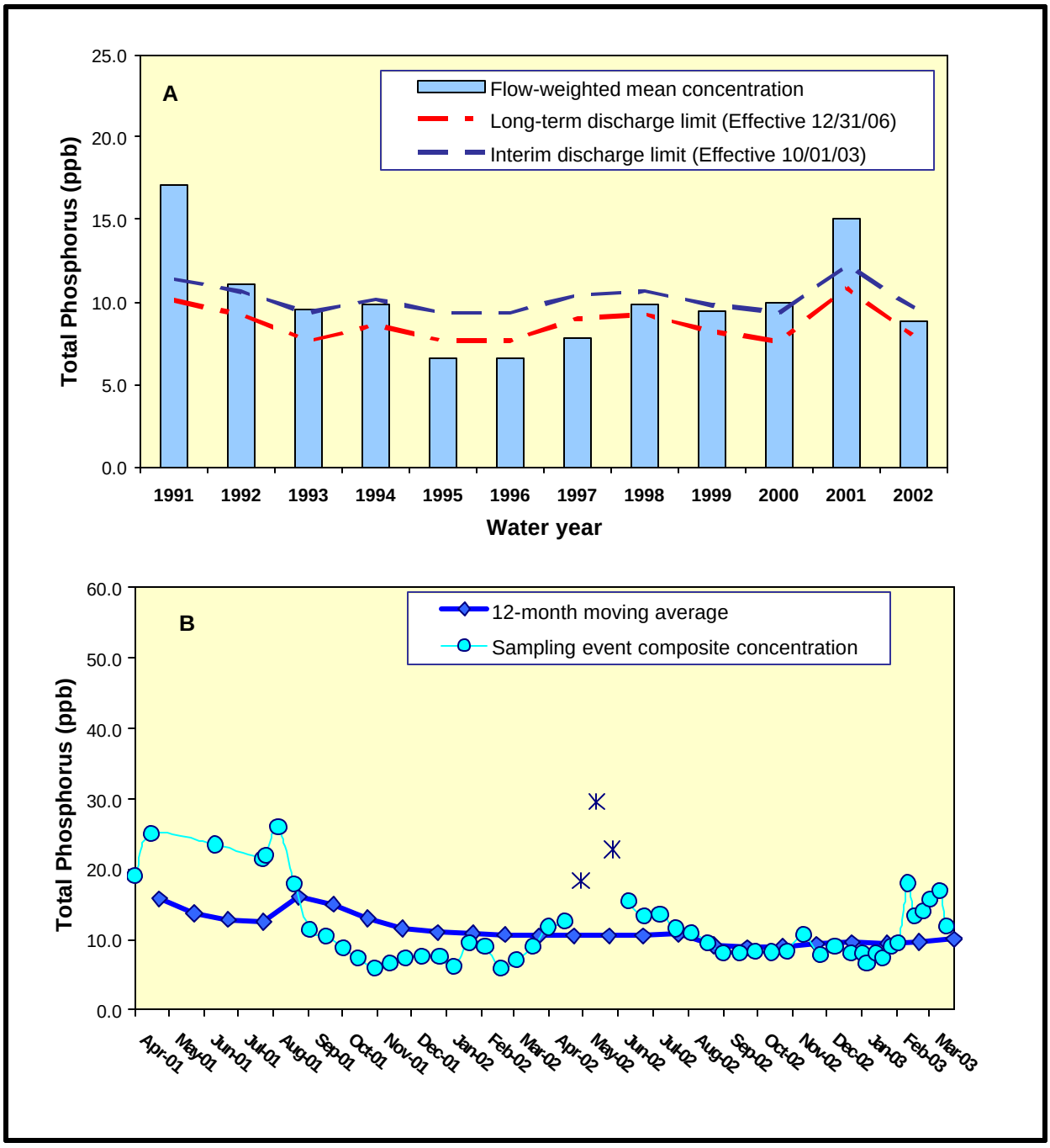

Figure 3. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough.
A. The 12-month moving average fwmc at the end of each water year compared to the total phosphorus interim and long-term limits.
B. The 12-month moving average fwmc at the end of each month and the composite total phosphorus concentration for each sampling event. *(star): denotes arithmetic average for biweekly samples in May and June 2002 as there was no flow on the sampling dates.

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	(%)	
	(Kac-ft)	(ppb)	10/1/2003	12/31/2006	Guideline	Observed
30-Apr-01	250.4	15.8	13.2	12.0	64.0	***84.6***
31-May-01	230.9	13.7	13.3	12.1	64.7	***81.8***
30-Jun-01	221.0	12.8	13.3	12.2	65.1	***80.0***
31-Jul-01	212.8	12.5	13.4	12.2	65.4	***78.9***
31-Aug-01	324.0	16.0	12.8	11.6	61.3	***78.9***
30-Sep-01	419.7	15.0	12.2	11.0	57.9	***78.9***
31-Oct-01	502.4	13.0	11.8	10.5	55.2	***68.4***
30-Nov-01	599.2	11.5	11.3	10.0	52.1	***57.9***
31-Dec-01	677.9	11.0	10.9	9.6	49.8	***52.6***
31-Jan-02	695.1	10.9	10.8	9.5	49.3	***52.6***
28-Feb-02	728.3	10.7	10.7	9.3	48.3	45.0
31-Mar-02	779.2	10.5	10.5	9.0	46.9	40.9
30-Apr-02	800.8	10.5	10.4	8.9	46.3	40.9
31-May-02	804.4	10.5	10.4	8.9	46.3	43.5
30-Jun-02	810.5	10.5	10.3	8.9	46.1	40.9
31-Jul-02	929.4	10.9	9.9	8.3	43.1	***45.8***
31-Aug-02	962.0	9.1	9.7	8.1	42.3	39.1
30-Sep-02	1001.9	8.8	9.6	7.9	41.4	30.4
31-Oct-02	951.4	8.9	9.8	8.2	42.6	30.4
30-Nov-02	836.0	9.4	10.2	8.7	45.4	34.8
31-Dec-02	762.7	9.6	10.5	9.1	47.4	33.3
31-Jan-03	786.8	9.4	10.4	9.0	46.7	32.0
28-Feb-03	781.1	9.7	10.5	9.0	46.9	37.0
31-Mar-03	755.2	10.1	10.6	9.1	47.6	***48.3***

Notes: *(1) Italicized values exceeded guideline*
(2) Highlighted concentration indicates water year in which interim limit was exceeded

The daily flows through the individual Shark River Slough structures and S334 from April 2001 through March 2003 are presented in **Figure 4a**. Beginning in November 2002 a sharp decrease in flow occurred at all structures. Flows were low between mid-November and mid-December, reaching a minimum of 161 cfs/day on December 16. Thereafter, flows into Shark River Slough steadily increased to a maximum of 953 cfs/day on January 9, 2003 and then slowly declined through the end of March. Water was removed from the system via S334 from January 17 through March 31, 2003.

The relationship between the sum of the daily flows at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentration for individual sampling events is presented in **Figure 4b.** Values for Water Years 2001 and 2002 follow the strong inverse relationship between flow and total phosphorus concentration expected for waters entering the Park through Shark River Slough.

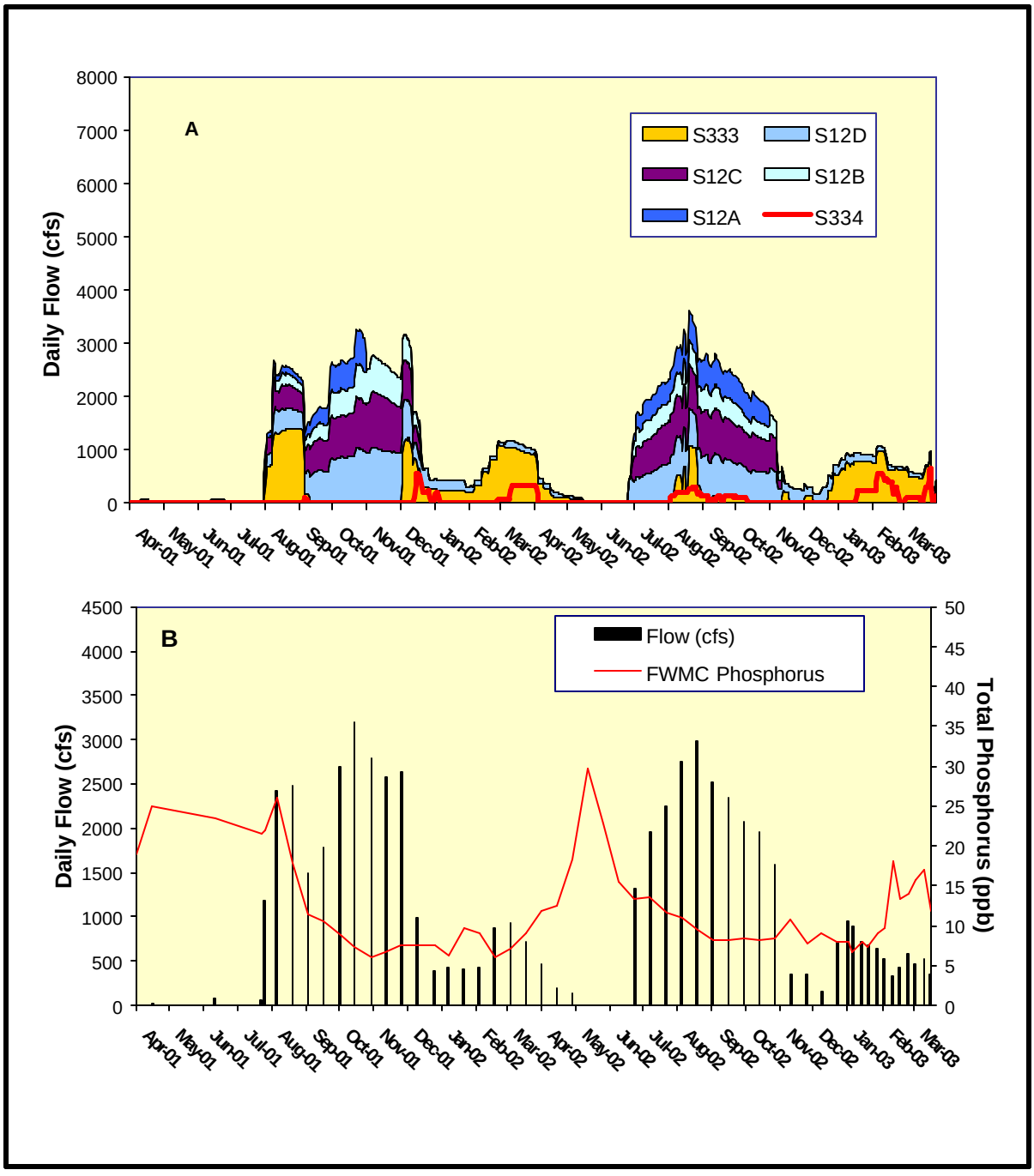

Figure 4. **A**. Daily flows into Shark River Slough by structure. **B**. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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 5**). The Flow Way Cell is the routine surface water 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. On July 31, 2002, the Florida Department of Environmental Protection (FDEP) issued Emergency Order #7 to allow the USACE to operate the new and existing facilities in accordance with the IOP.

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. As local sponsor, the District will eventually operate and maintain the project facilities. The USACE has implemented a monitoring plan that was 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. Discharges from Emergency Overflows EO1 and EO3 would discharge onto District property and eventually flow 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 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.

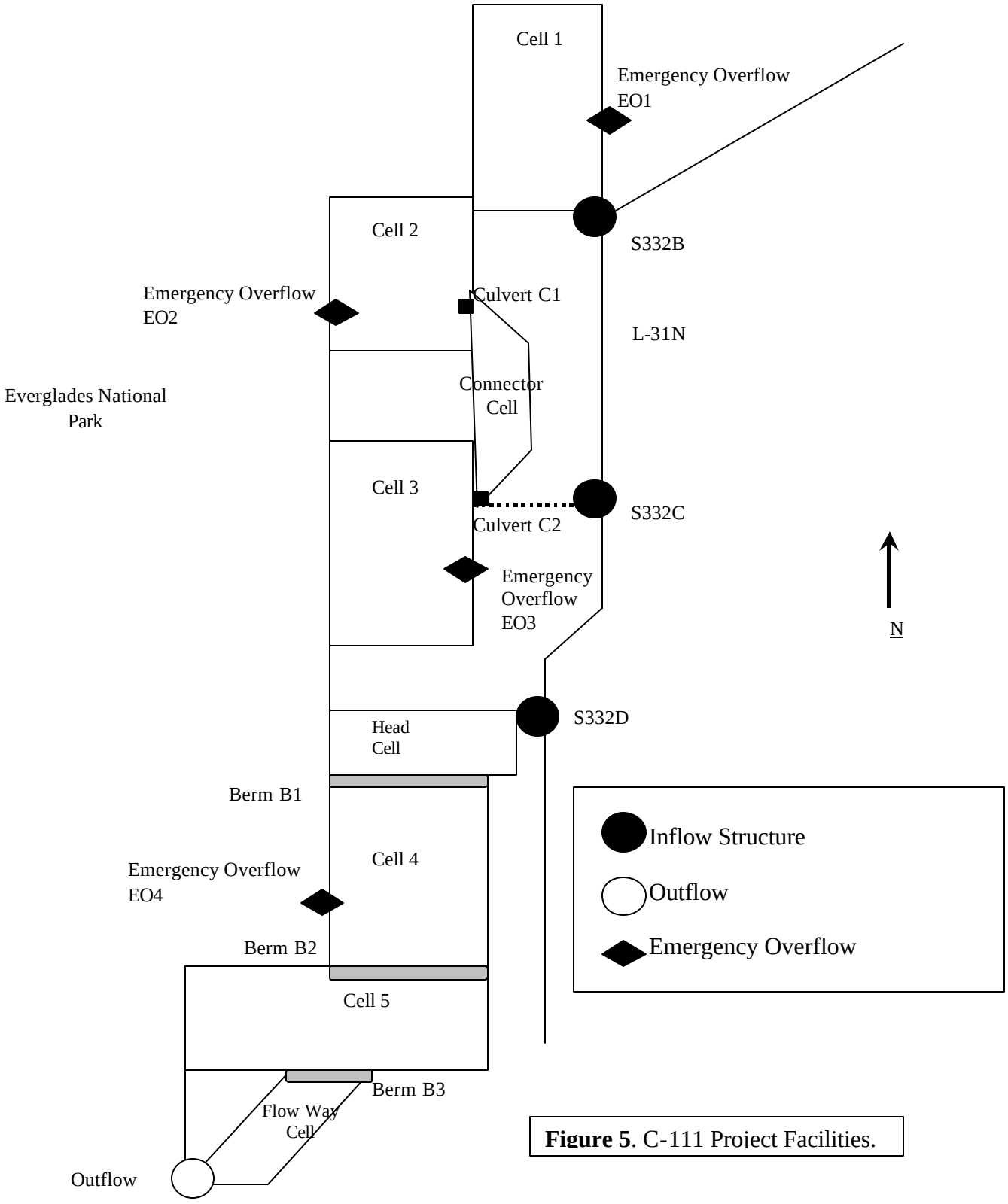

Figure 5. C-111 Project Facilities.

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 6a**). The bars in **Figure 6a** 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 2002 represent the new combination of structures. **Figure 6b** 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 change 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 data from S332D, S174 and S18C are utilized in **Figure 6b** and **Table 3**.

The 12-month flow-weighted mean concentrations for January, February and March 2003 were all 5.9 ppb due to the similarity of flows during these months (**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 5.3, 5.3 and 5.1 for the periods ending January, February and March 2003, respectively (**Table 3**), less than one-tenth the guideline.

The daily flows into Everglades National Park through S332D, S174 and S18C are presented in **Figure 7a**. **Figure 7b** 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 relationship between daily mean flow and flow-weighted mean total phosphorus concentrations at these structures.

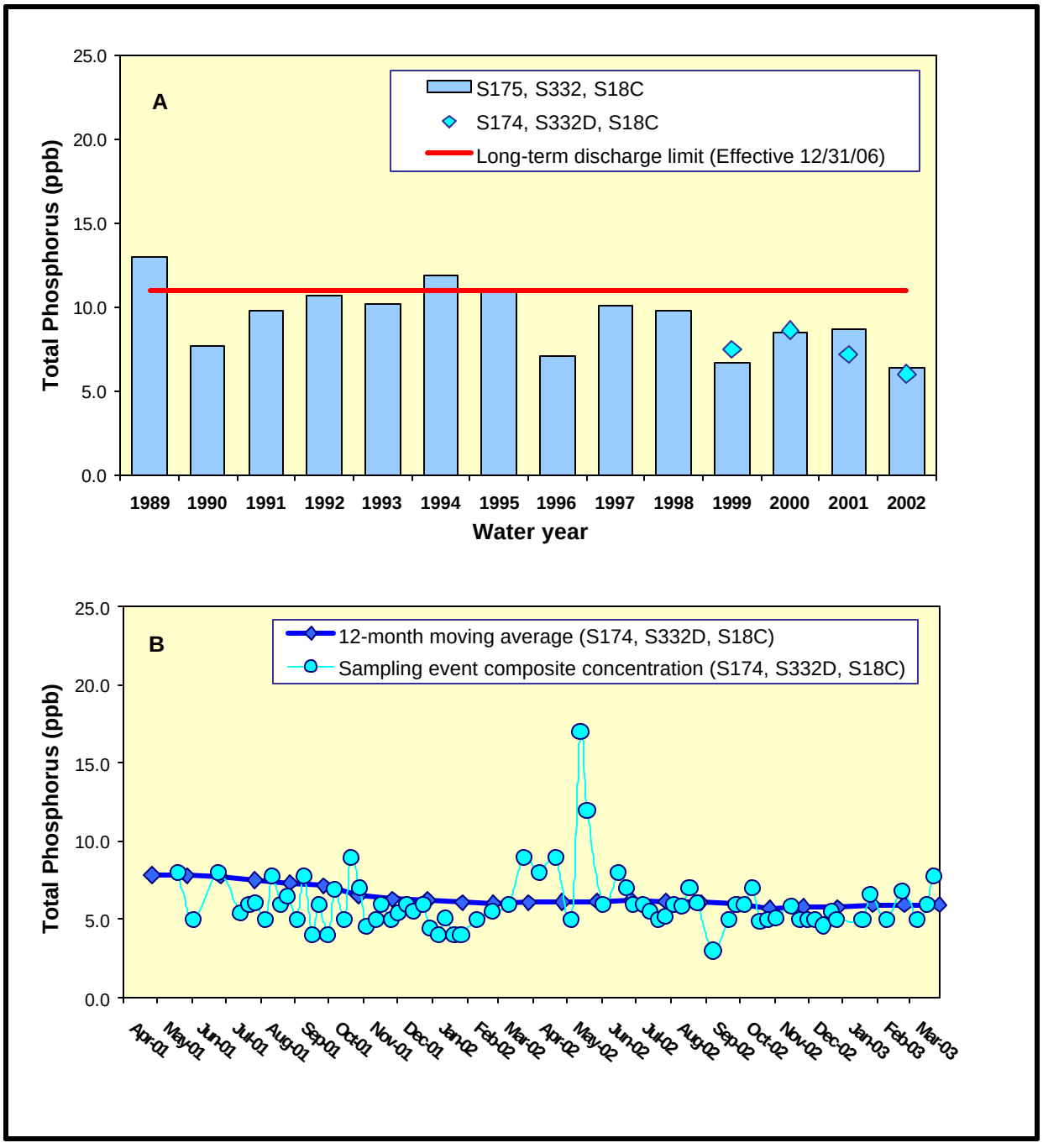

Figure 6. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins. **A.** The 12-month moving average fwmc at the end of each water year compared to the 11 ppb long-term total phosphorus limit. **B**. The 12-month moving average fwmc 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-01	260.1	7.9	11.0	53.1	20.6
31-May-01	254.1	7.8	11.0	53.1	12.9
30-Jun-01	249.0	7.8	11.0	53.1	10.0
31-Jul-01	243.0	7.5	11.0	53.1	10.7
31-Aug-01	237.1	7.3	11.0	53.1	11.5
30-Sep-01	235.1	7.2	11.0	53.1	11.5
31-Oct-01	235.2	6.5	11.0	53.1	8.0
30-Nov-01	269.7	6.3	11.0	53.1	7.4
31-Dec-01	296.5	6.2	11.0	53.1	6.7
31-Jan-02	316.0	6.1	11.0	53.1	5.9
28-Feb-02	320.6	6.1	11.0	53.1	0.0
31-Mar-02	325.9	6.1	11.0	53.1	0.0
30-Apr-02	331.1	6.1	11.0	53.1	0.0
31-May-02	336.4	6.1	11.0	53.1	5.0
30-Jun-02	364.3	6.2	11.0	53.1	4.9
31-Jul-02	392.1	6.1	11.0	53.1	4.7
31-Aug-02	388.3	6.1	11.0	53.1	4.7
30-Sep-02	357.1	6.0	11.0	53.1	4.9
31-Oct-02	301.2	5.7	11.0	53.1	4.8
30-Nov-02	256.9	5.8	11.0	53.1	5.0
31-Dec-02	235.1	5.8	11.0	53.1	4.9
31-Jan-03	219.5	5.9	11.0	53.1	5.3
28-Feb-03	215.2	5.9	11.0	53.1	5.3
31-Mar-03	215.8	5.9	11.0	53.1	5.1

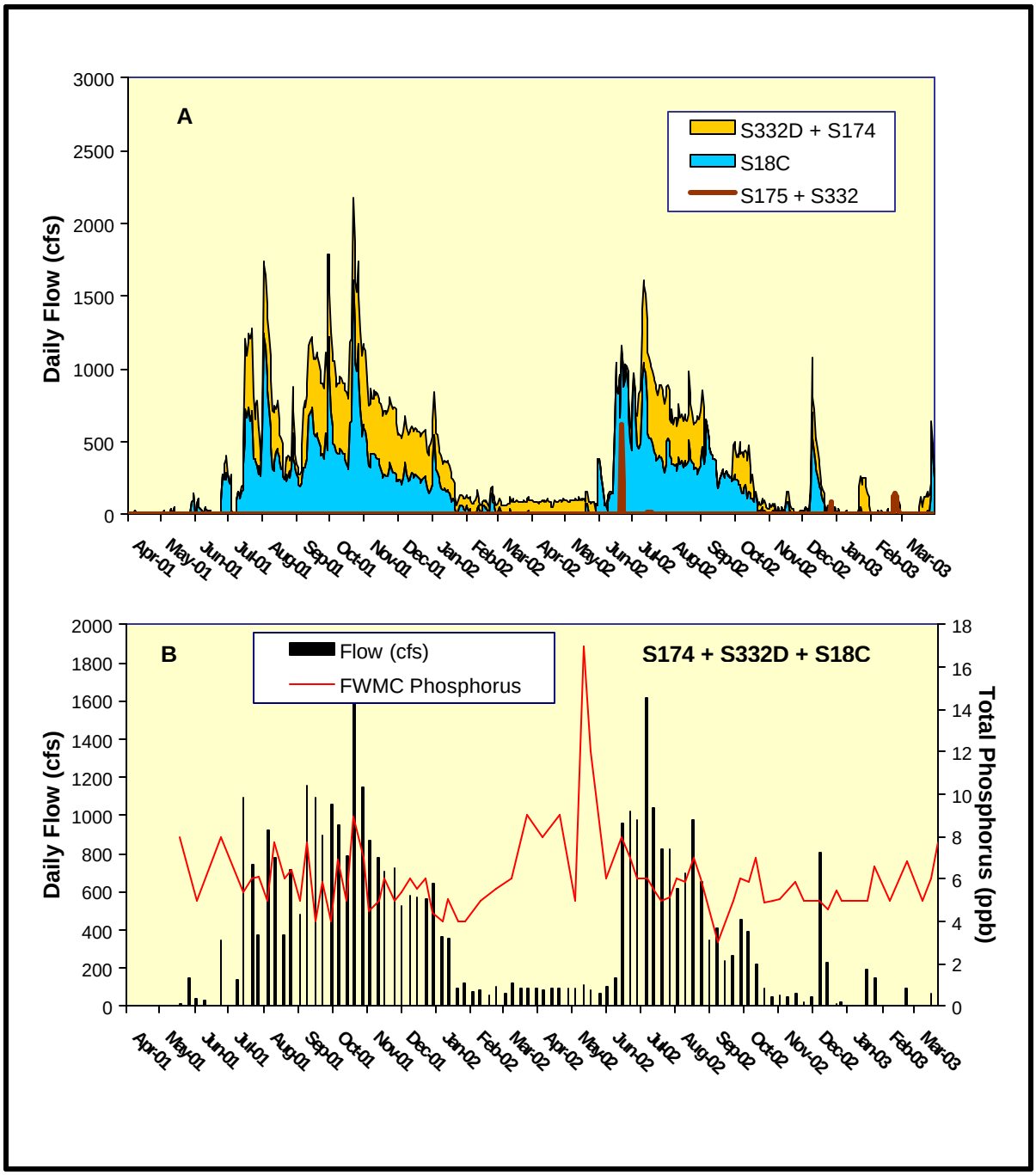

Figure 7. **A.** Daily flows into Everglades National Park through Taylor Slough and S18C. **B**. The relationship between daily flows at Taylor Slough structures and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
April-June 2003 Report

As of 11-18-2003, this report has been revised from the version that was originally posted on 10-28-2003

Prepared for the
Technical Oversight Committee
October 24, 2003

Prepared by:
Timothy J. Bechtel, Violeta Ciuca, Cheol Mo and Anna Reardon
Resource Assessment Division
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406

As of 11-18-2003, this report has been revised from the version that was originally posted on 10-28-2003

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 (mean sea level). 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 16.20, 15.72 and 16.06 feet in April, May and June 2003, respectively (**Figure 2, Table 1)**. The geometric means, calculated from total phosphorus concentrations measured in water samples collected in April, May and June were 7.6, 14.0 and 7.9 ppb, respectively. These values were less than the interim and long-term levels for April, May and June.

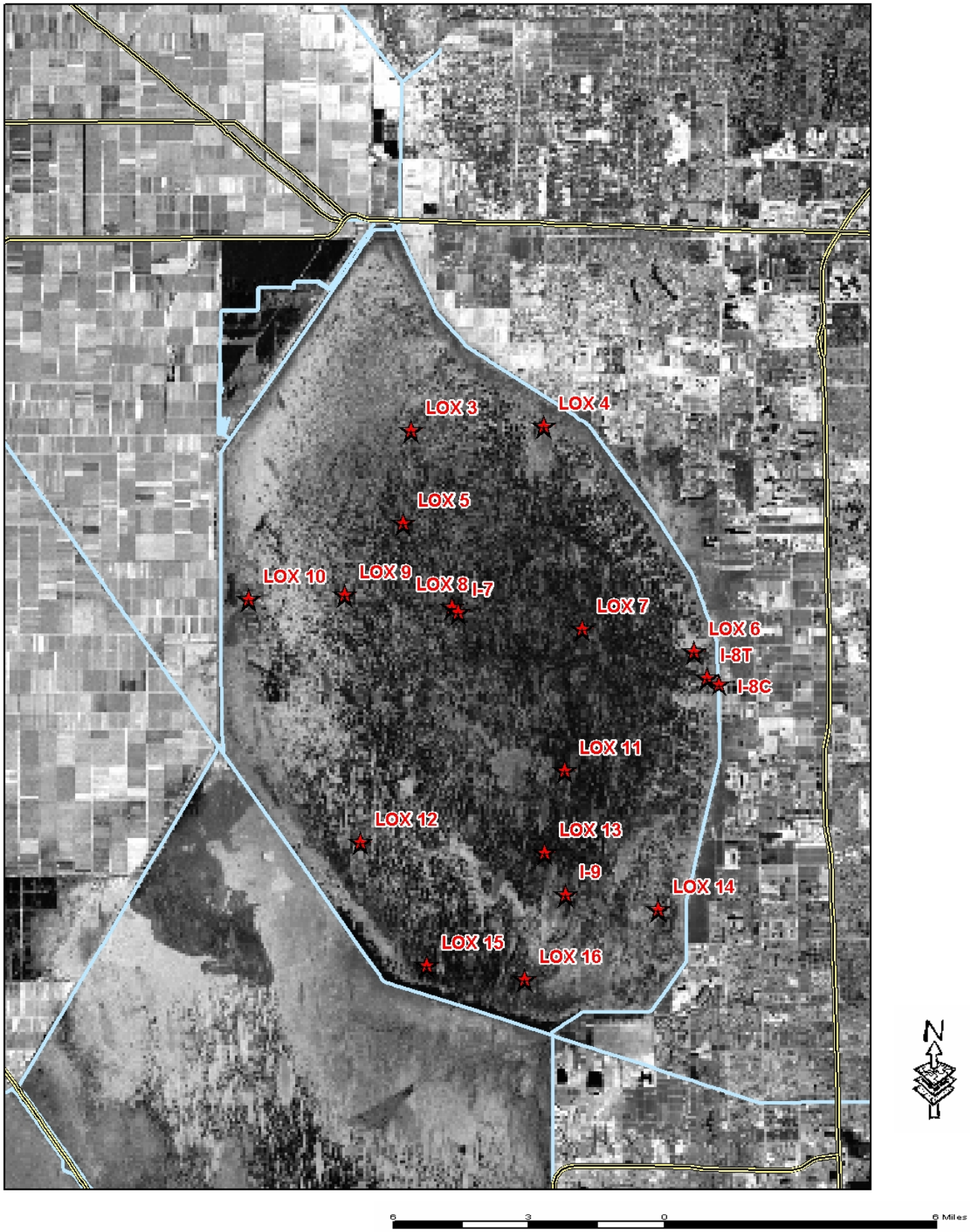

Figure 1. A.R.M. Loxahatchee Refuge Water Quality Sampling and Stage Measurement Sites

★ Station Location

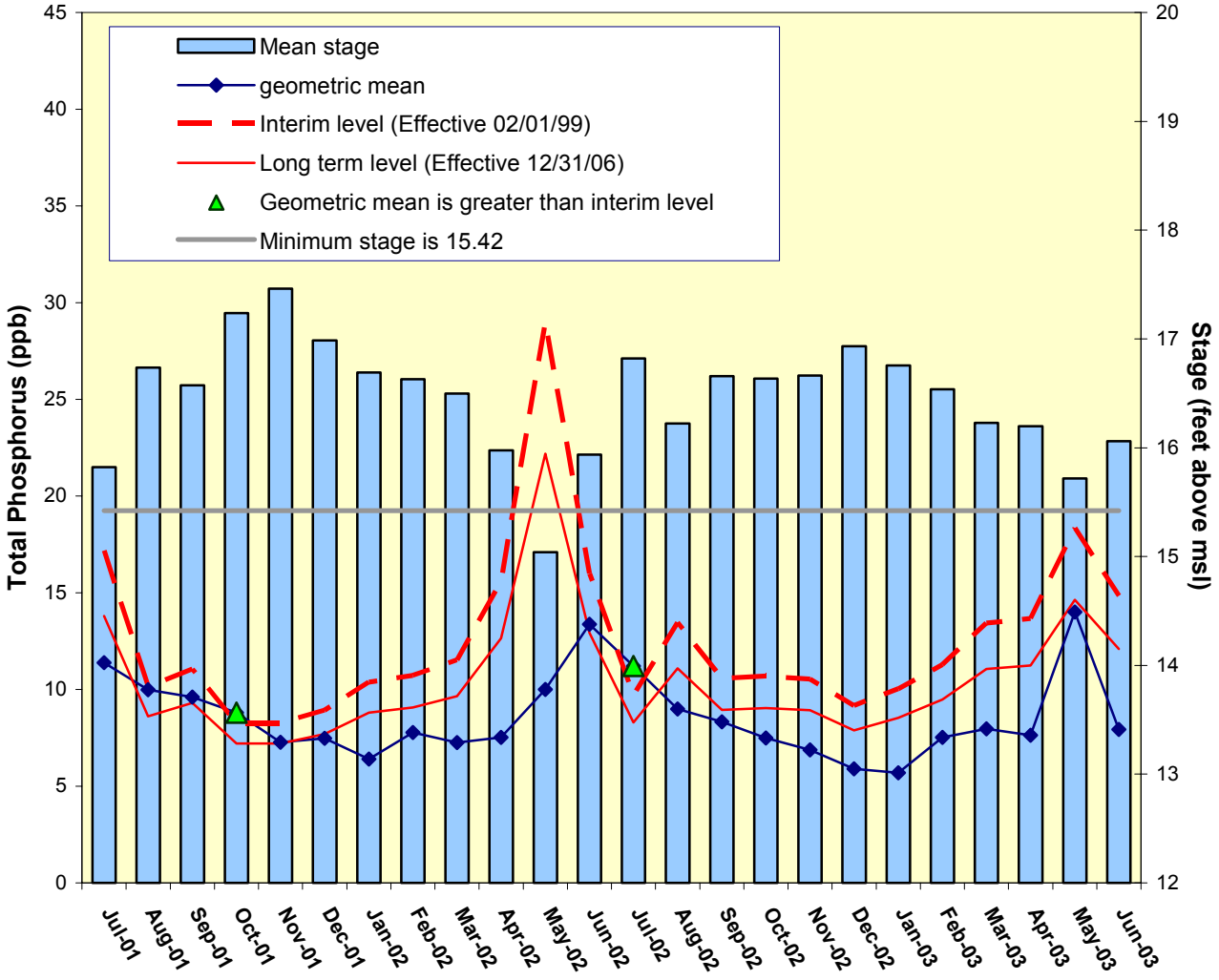

Figure 2. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

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

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft,NGVD)	Number of TP Samples	Number of Stage Measure-ments
Jul-2001	11.4	17.2	13.8	15.82	11	3
Aug-2001	10.0	10.1	8.6	16.74	14	3
Sep-2001	9.6	11.1	9.3	16.57	14	3
Oct-2001	8.8	8.3	7.2	17.24	14	3
Nov-2001	7.3	8.3	7.2	17.46	14	3
Dec-2001	7.5	8.9	7.7	16.99	14	3
Jan-2002	6.4	10.4	8.8	16.69	14	3
Feb-2002	7.8	10.7	9.1	16.63	14	3
Mar-2002	7.3	11.5	9.7	16.50	14	3
Apr-2002	7.5	15.6	12.7	15.98	11	3
May-2002	10.0	-	-	15.04	3	3
Jun-2002	13.4	16.0	12.9	15.94	10	3
Jul-2002	11.2	9.7	8.3	16.82	14	3
Aug-2002	9.0	13.5	11.1	16.22	12	3
Sep-2002	8.3	10.6	8.9	16.66	11	3
Oct-2002	7.5	10.7	9.0	16.64	12	3
Nov-2002	6.9	10.5	8.9	16.66	12	3
Dec-2002	5.9	9.2	7.9	16.93	14	3
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

Notes: *(1) Average Stage is calculated using stage elevations at three stations on the sampling date*
(2) Highlighted values indicate months when exceedances occurred

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 2002 (**Figure 3a**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2002 was 8.8 ppb. Corresponding interim and long-term limits were 9.6 and 7.9 ppb, respectively. For the nine-year period 1994 through 2002, the interim limit applicable to Shark River Slough has been met in seven times. The limit was exceeded in Water Years 2000 and 2001.

Table 2 presents the moving flow-weighted mean concentrations for each 12-month period beginning in January 2001 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 April, May and June 2003, the flow-weighted mean total phosphorus concentrations were 10.1, 10.2 and 10.5 ppb, respectively. The April and May concentrations were less than the interim limit while the June concentration exceeded the interim limit by 0.1 ppb. The long-term limits were exceeded in each of these recent months.

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 April, May and June 2003, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 48.4, 52.9 and 57.9, respectively. April, May and June observed percentages were greater than the guidelines (**Table 2**). The individual sampling events and the 12-month moving average are presented in **Figure 3b**.

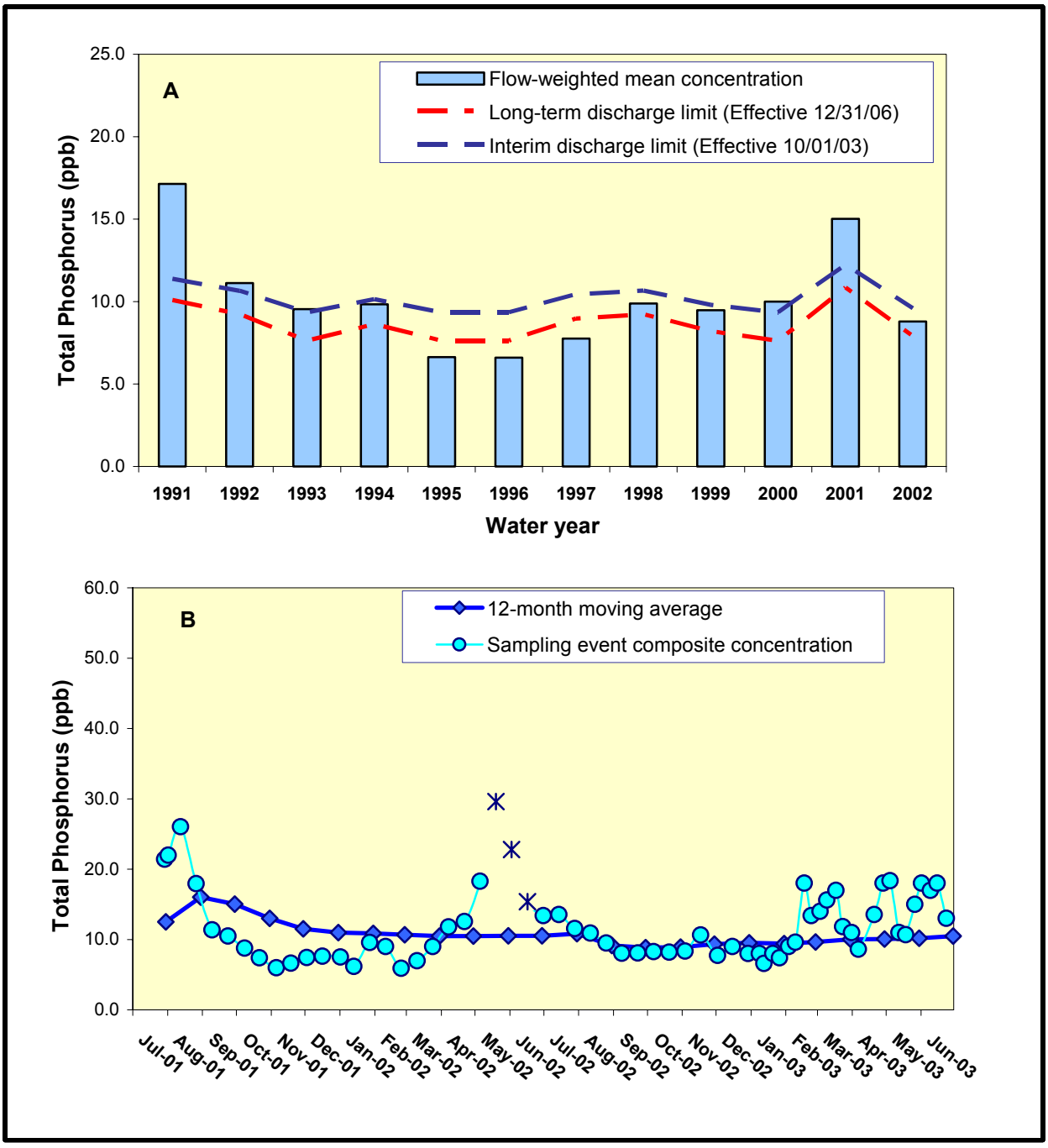

Figure 3. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough.
A. The 12-month moving average fwmc at the end of each water year compared to the total phosphorus interim and long-term limits.
B. The 12-month moving average fwmc at the end of each month and the composite total phosphorus concentration for each sampling event. *(star): denotes arithmetic average for biweekly samples in May and June 2002 as there was no flow on the sampling dates.

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	(%)	
	(Kac-ft)	(ppb)	10/1/2003	12/31/2006	Guideline	Observed
31-Jul-01	212.8	12.5	13.4	12.2	65.4	***78.9***
31-Aug-01	324.0	16.0	12.8	11.6	61.3	***78.9***
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31-Oct-01	502.4	13.0	11.8	10.5	55.2	***68.4***
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30-Jun-02	810.5	10.5	10.3	8.9	46.1	40.9
31-Jul-02	929.4	10.9	9.9	8.3	43.1	***45.8***
31-Aug-02	962.0	9.1	9.7	8.1	42.3	39.1
30-Sep-02	1001.9	8.8	9.6	7.9	41.4	30.4
31-Oct-02	951.4	8.9	9.8	8.2	42.6	30.4
30-Nov-02	836.0	9.4	10.2	8.7	45.4	34.8
31-Dec-02	762.7	9.6	10.5	9.1	47.4	33.3
31-Jan-03	786.8	9.4	10.4	9.0	46.7	32.0
28-Feb-03	781.1	9.7	10.5	9.0	46.9	37.0
31-Mar-03	755.2	10.1	10.6	9.1	47.6	***48.3***
30-Apr-03	756.2	10.1	10.6	9.1	47.5	***48.4***
31-May-03	775.4	10.2	10.5	9.0	47.0	***52.9***
30-Jun-03	800.3	10.5	10.4	8.9	46.4	***57.9***

Notes: *(1) Italicized values exceeded allowed percentage*
(2) Highlighted concentration indicates water year in which interim limit was exceeded

The daily flows through the individual Shark River Slough structures and S334 from July 2001 through June 2003 are presented in **Figure 4a**. 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 4b.** Values for Water Years 2001 and 2002 follow the strong inverse relationship between flow and total phosphorus concentration expected for waters entering the Park through Shark River Slough. However, during the un-seasonal rainfall conditions that occurred from February through June 2003, total phosphorus concentrations were greater and more variable, 9 to 18 ppb, than observed previously when flows were less than 500 cfs.

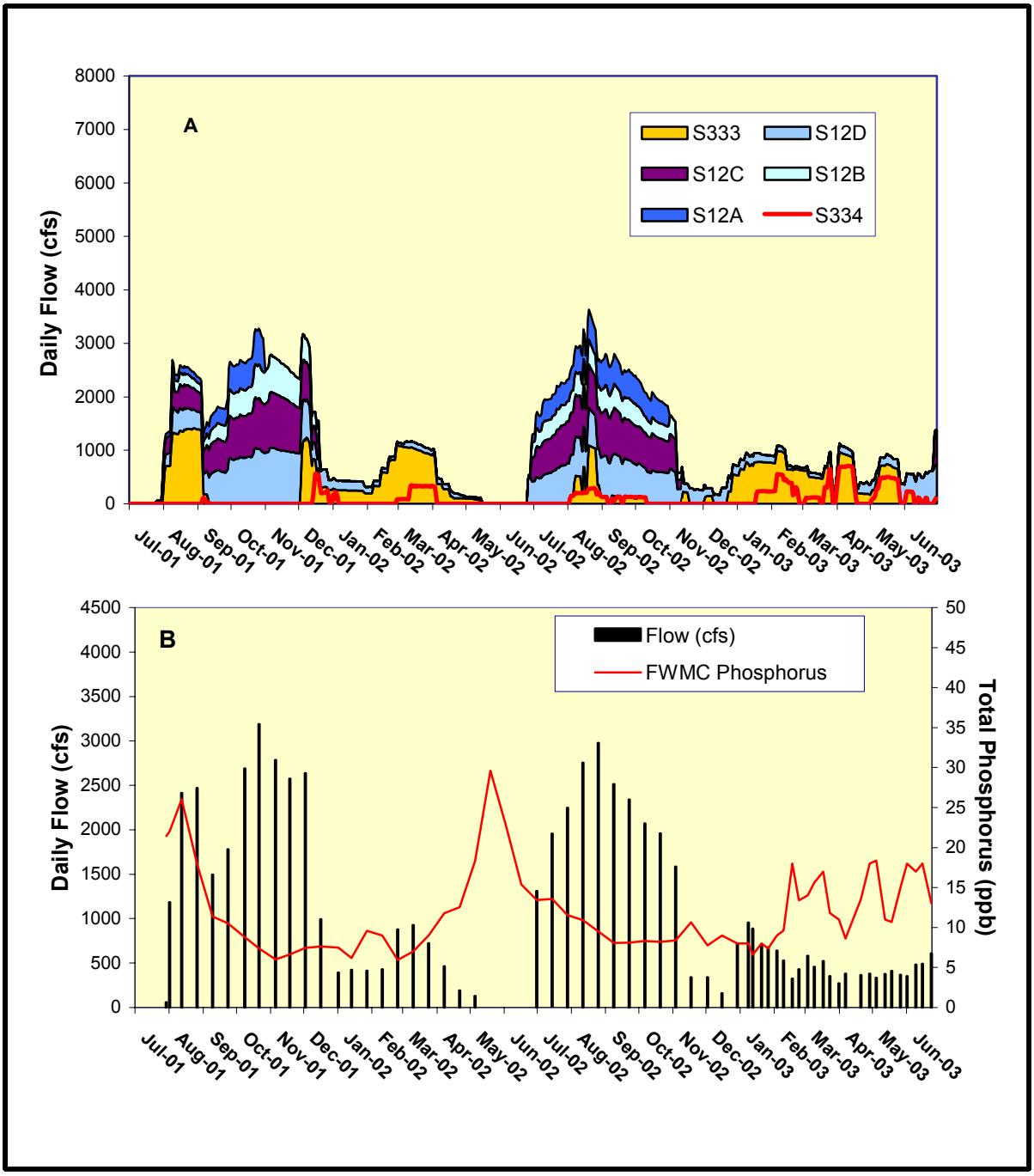

Figure 4. **A**. Daily flows into Shark River Slough by structure. **B**. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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 5**). 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 USACE has implemented 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 are presented graphically beginning on page 16 this report. 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 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.

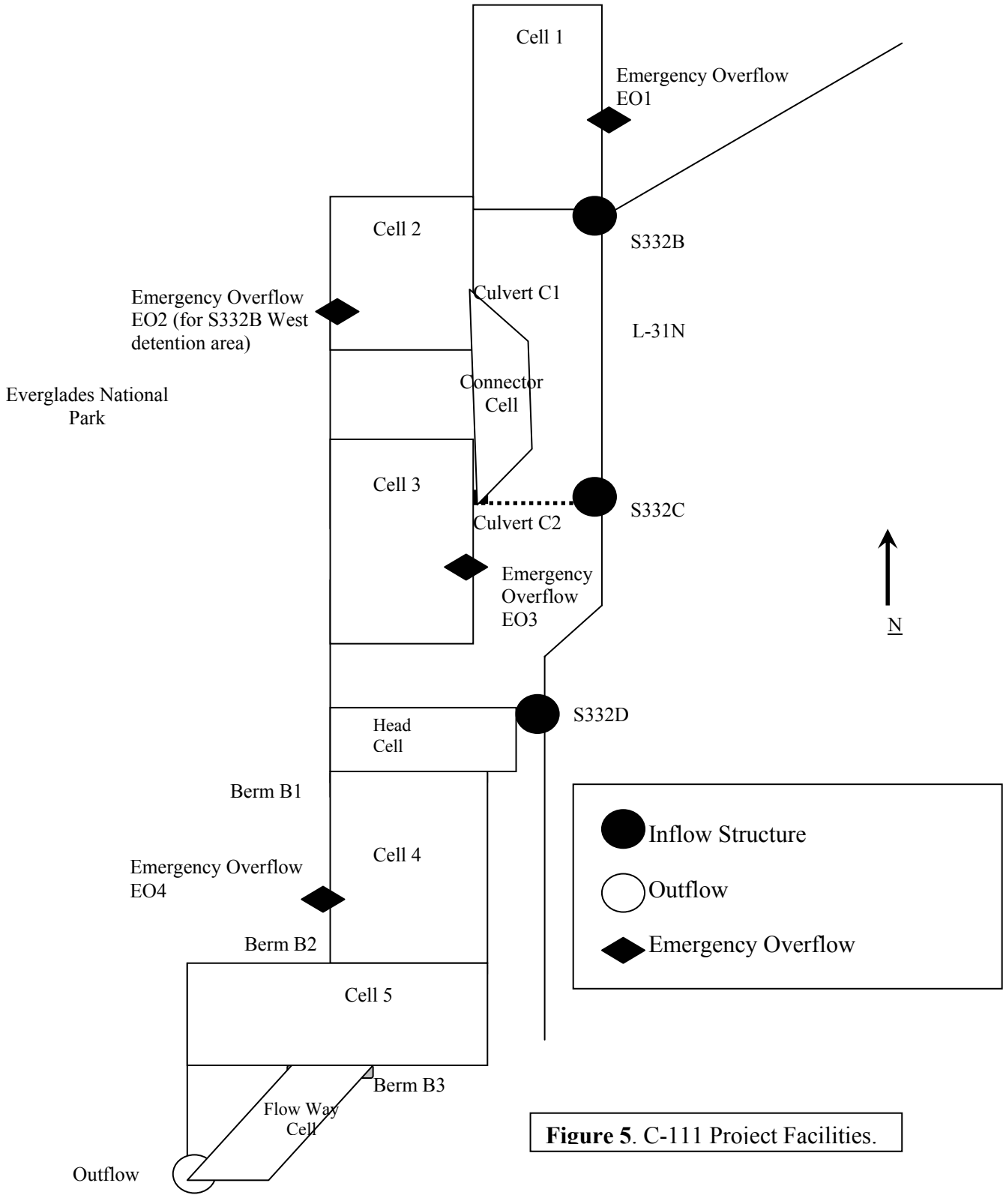

Figure 5. C-111 Project Facilities.

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 6a**). The bars in **Figure 6a** 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 2002 represent the new combination of structures. **Figure 6b** 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 6b**.

The 12-month flow-weighted mean concentrations for April, May and June 2003 were 5.8, 5.8 and 5.6 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 4.8, 0.0 and 0.0 for the periods ending April, May and June 2003.

The daily flows into Everglades National Park through S332D, S174 and S18C are presented in **Figure 7a**. **Figure 7b** 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.

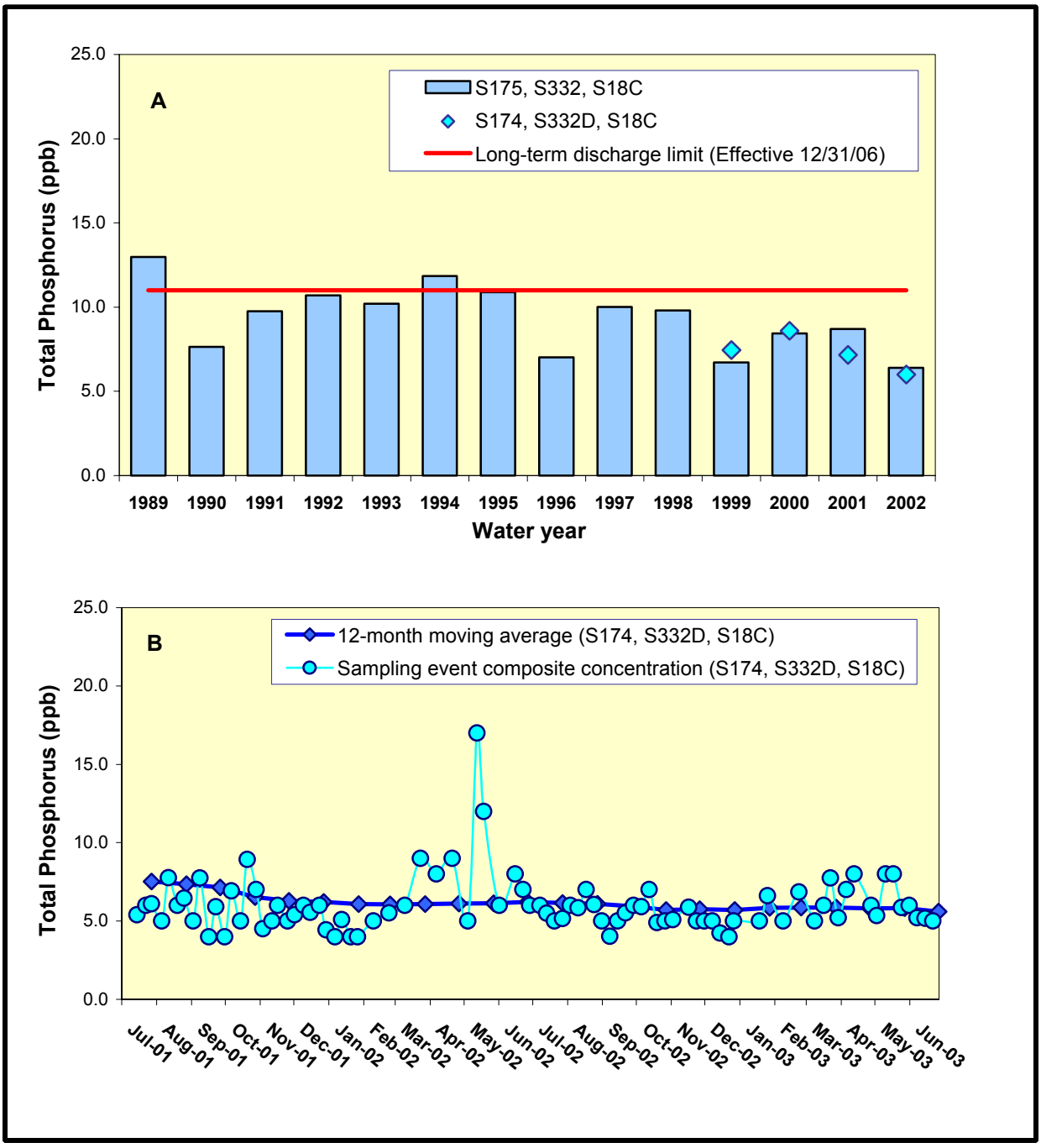

Figure 6. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins. **A.** The 12-month moving average fwmc at the end of each water year compared to the 11 ppb long-term total phosphorus limit. **B**. The 12-month moving average fwmc 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-Jul-01	243.0	7.5	11.0	53.1	10.7
31-Aug-01	237.1	7.3	11.0	53.1	11.5
30-Sep-01	235.1	7.2	11.0	53.1	11.5
31-Oct-01	235.2	6.5	11.0	53.1	8.0
30-Nov-01	269.7	6.3	11.0	53.1	7.4
31-Dec-01	296.5	6.2	11.0	53.1	6.7
31-Jan-02	316.0	6.1	11.0	53.1	5.9
28-Feb-02	320.6	6.1	11.0	53.1	0.0
31-Mar-02	325.9	6.1	11.0	53.1	0.0
30-Apr-02	331.1	6.1	11.0	53.1	0.0
31-May-02	336.4	6.1	11.0	53.1	5.0
30-Jun-02	364.3	6.2	11.0	53.1	4.9
31-Jul-02	392.1	6.1	11.0	53.1	4.7
31-Aug-02	388.3	6.1	11.0	53.1	4.7
30-Sep-02	371.8	6.0	11.0	53.1	4.7
31-Oct-02	316.0	5.7	11.0	53.1	4.5
30-Nov-02	271.6	5.8	11.0	53.1	4.8
31-Dec-02	249.8	5.7	11.0	53.1	4.7
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

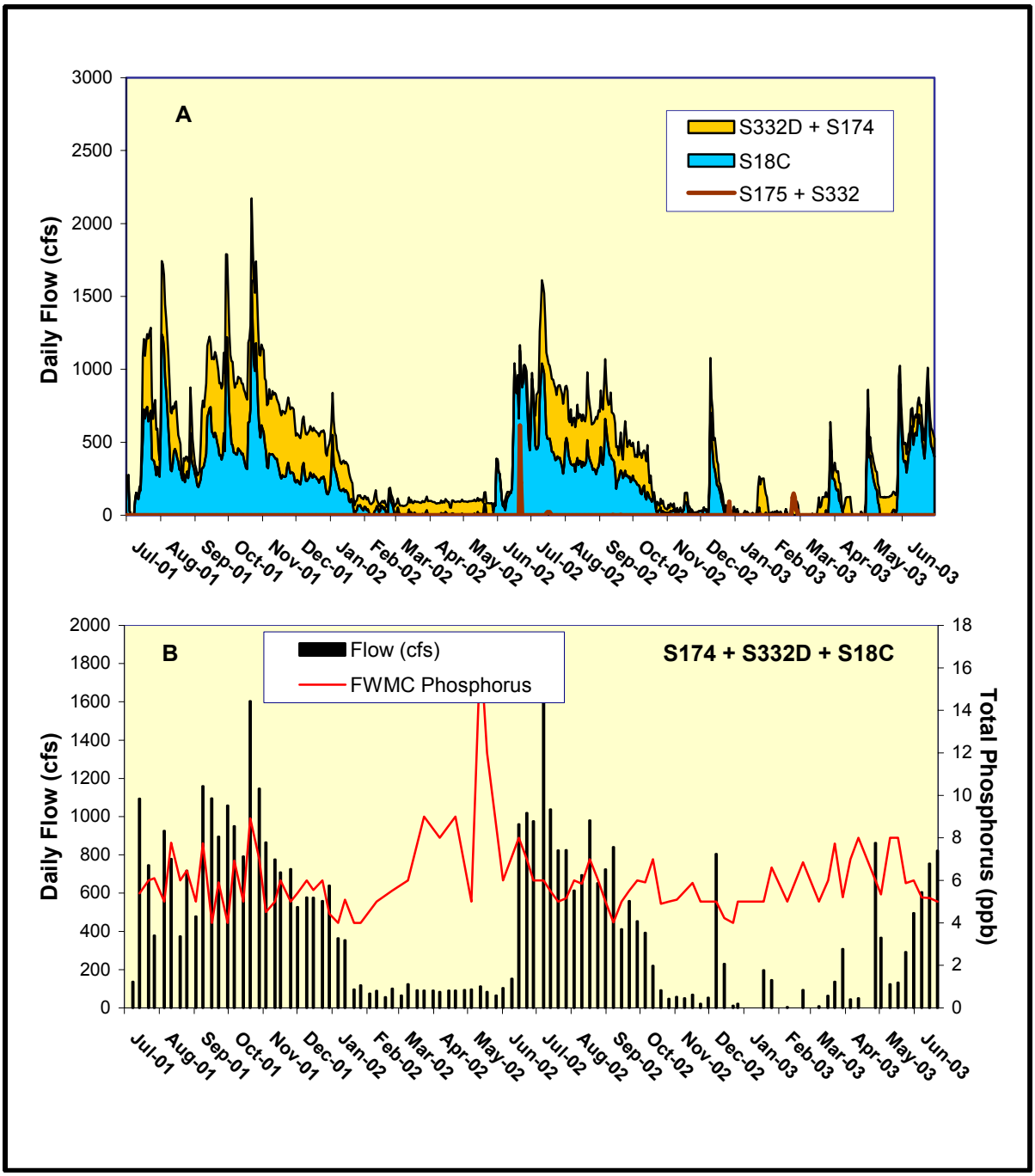

Figure 7. **A.** Daily flows into Everglades National Park through Taylor Slough and S18C. **B**. The relationship between daily flows at Taylor Slough structures and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Overflow Events 2000 – 2003 at S332B Weir

Note: Overflow data and total phosphorus data are from the USACE and have not undergone SFWMD QA/QC review. Flow data for S332B have been through the SFWMD's QA/QC review.

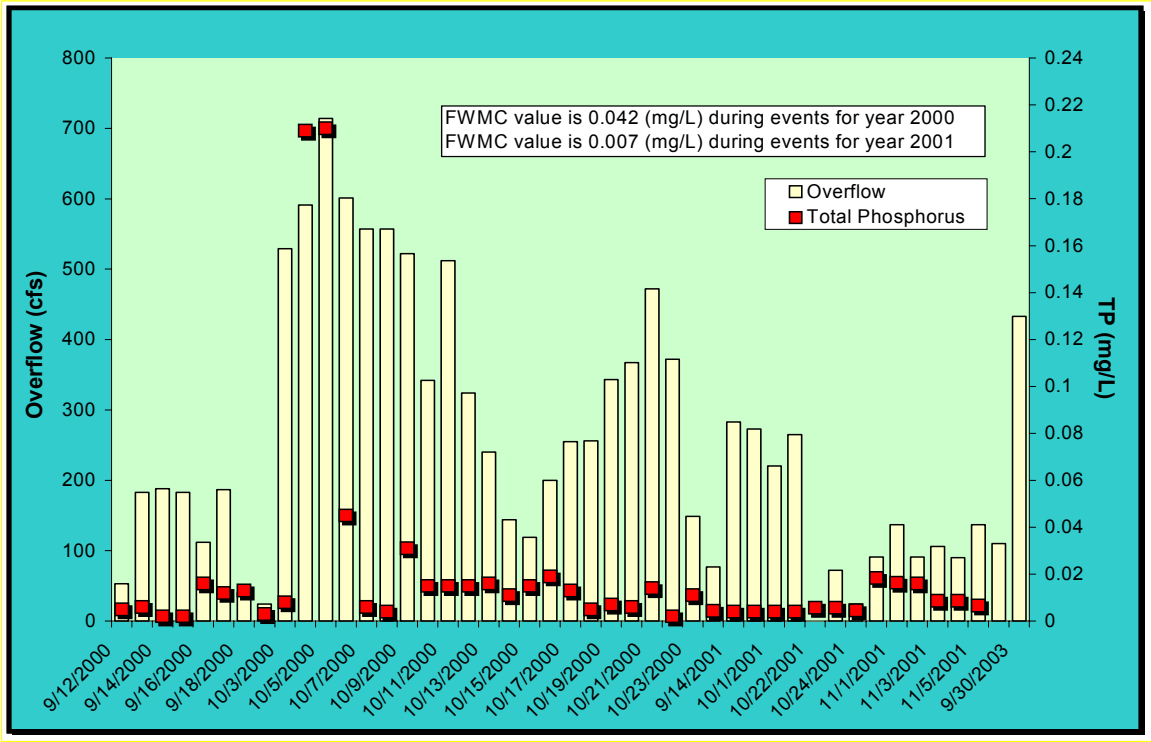

Figure 8. Total Phosphorus concentration for S-332B during overflow events (USACE data).

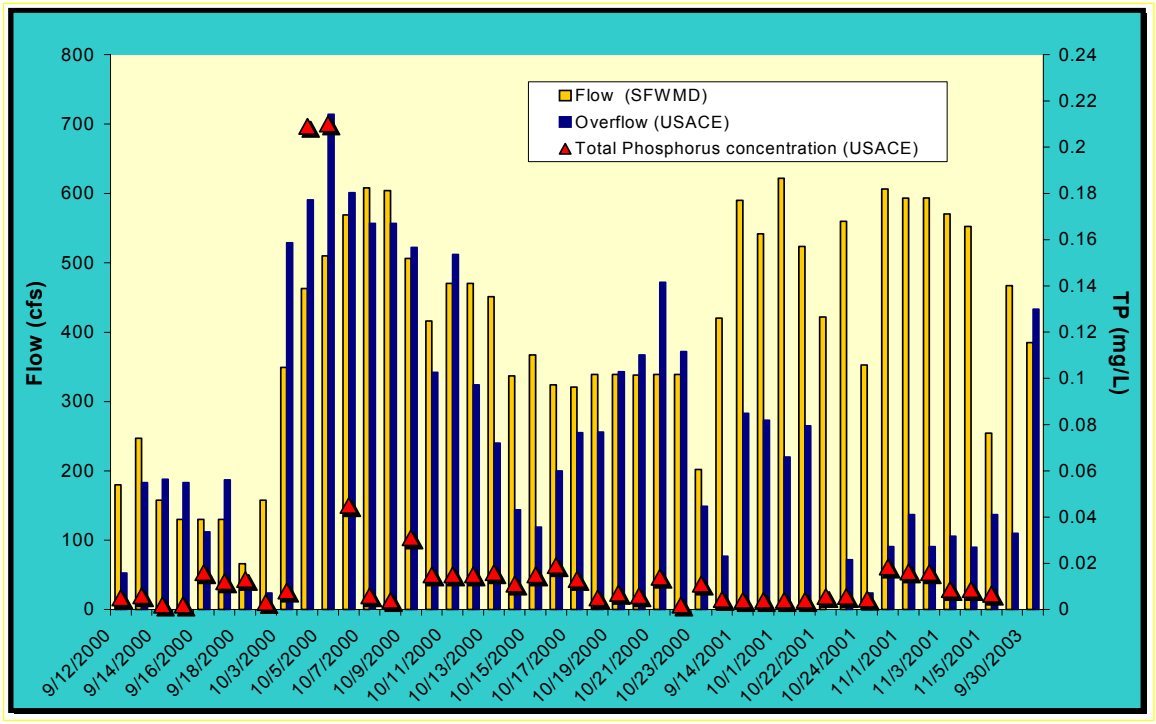

Figure 9. Pump S-332B during overflow events for 2000, 2001 and 2003.

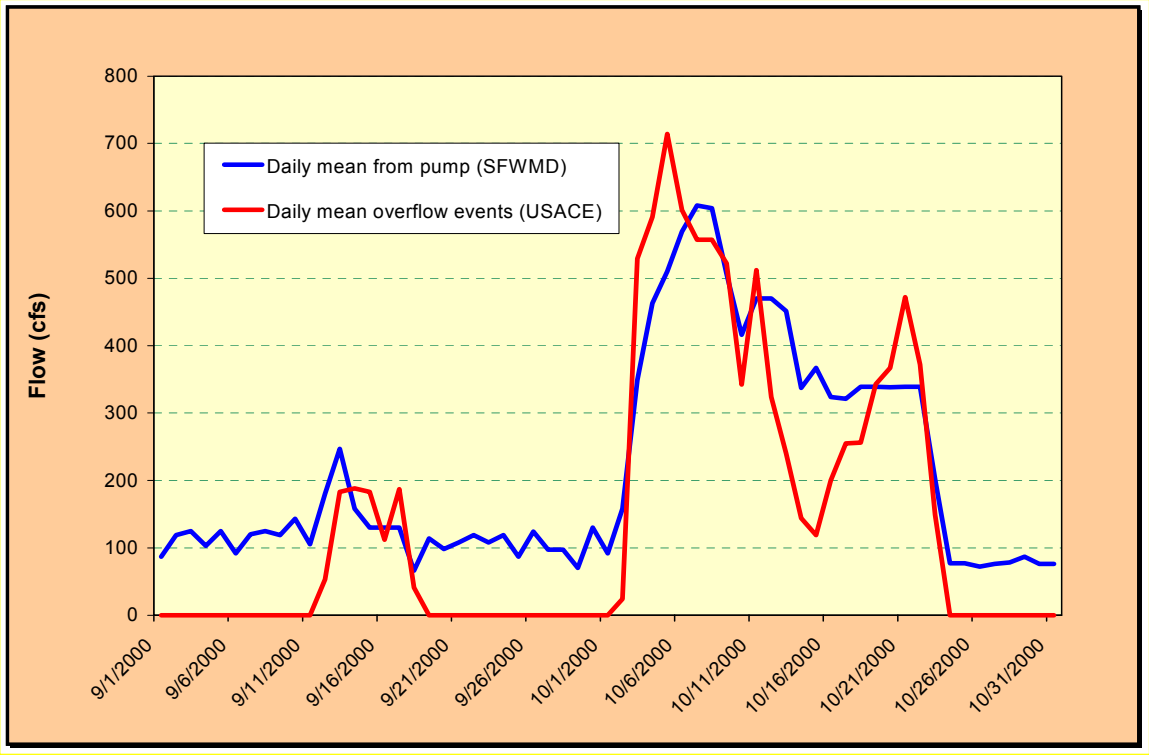

Figure 10. S-332B pump station flows and associated overflow events year 2000.

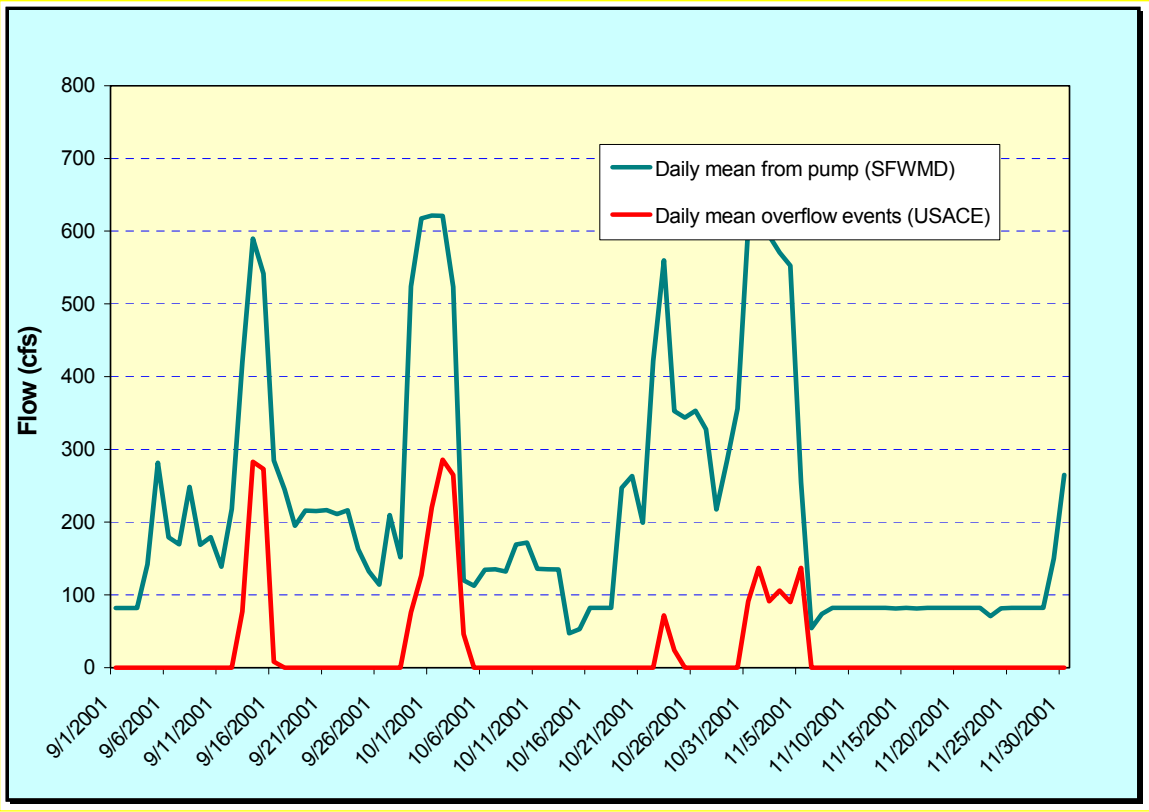

Figure 11. S-332B pump station flows and associated overflow events year 2001.

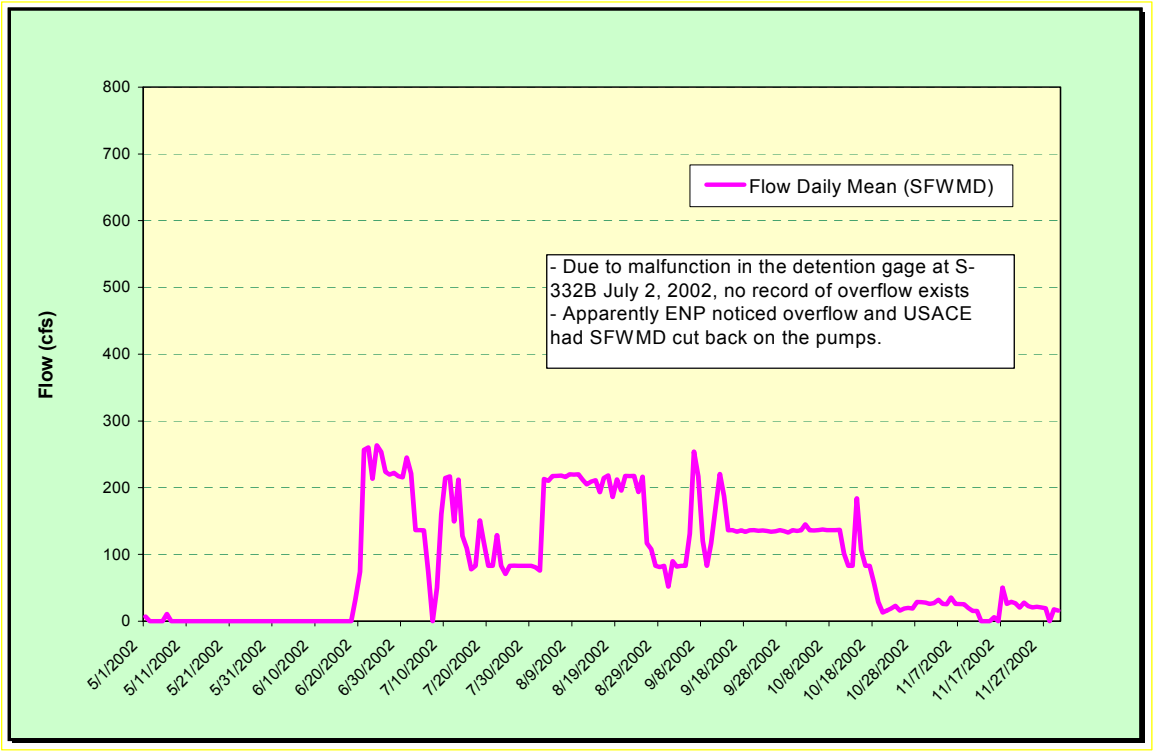

Figure 12. S-332B pump station year 2002.

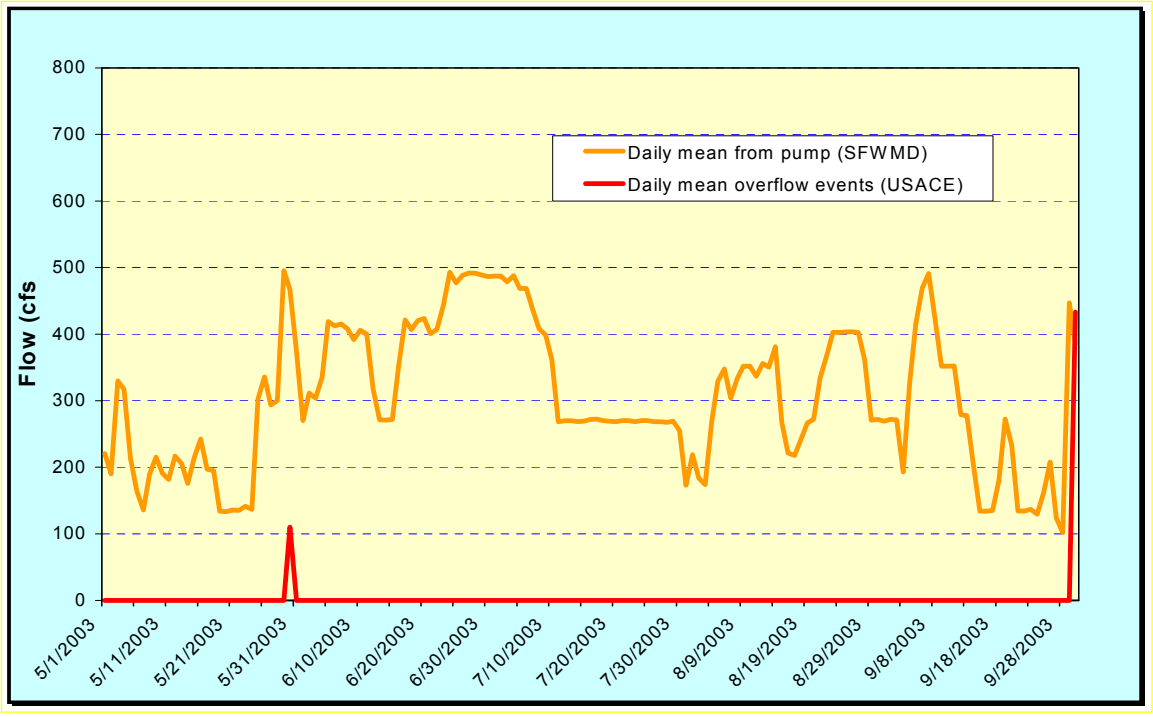

Figure 13. S-332B pump station flows and associated overflow events year 2003.

As of 11-18-2003, this report has been revised from the version that was originally posted on 10-28-2003
In the following pages, Figure 13, Table 4, Table 5 and corresponding text were modified with updated data.

WY2003 Phosphorus Loads to the Everglades Protection Area

(from Chapter 8A, Everglades Consolidated Report, 2004)

The Everglades Protection Area (EPA) is a complex system of marsh areas, canals, levees, and inflow and outflow water-control structures covering almost 2.5 million acres. In addition to rainfall inputs, surface water inflows regulated by water control structures from agricultural tributaries, such as the EAA and the C-139 basin, feed the EPA from the north and western boundaries. The EPA also receives surface water inflows originating from Lake Okeechobee to the north and from predominantly urbanized areas to the east. The timing and distribution of the surface inflows from the tributaries to the EPA are based on a complex set of operational decisions that account for natural and environmental system requirements, water supply for urbanized and natural areas, aquifer recharge, and flood control.

Each year the EPA receives amounts of surface water inflows based on hydrologic variability. These inflows, regulated according to previously mentioned operational decisions, also contribute a certain amount of TP loading to the EPA system. The load schematic presented in **Figure 13** depicts a generalized overview of surface water inflow sources and relative contributions of TP loading to the EPA for Water Year 2003 (WY2003). **Figure 13** also illustrates all connecting tributaries to the EPA: Lake Okeechobee, the EAA, the C-139 basin, other agricultural and urbanized areas, and the STAs. In some cases, surface water inflows represent a mixture of water from several sources as the water passes from one area to another before finally arriving in the EPA. For example, water discharged from Lake Okeechobee can pass through the EAA and then through an STA before arriving in the EPA. As another example, runoff from the C-139 basin can pass through STA-5 and then into the EAA before ultimately arriving in the EPA. The conveyance and delivery system is complex; however, the schematic in **Figure 13** attempts to identify the amount of TP load and its associated pathways to the EPA.

It is also recognized that a certain amount of TP loading to the EPA emanates from atmospheric deposition. **Figure 13** depicts a long-term average range of atmospheric deposition of TP between 107 and 143 tons as the total contribution to the Water Conservation Areas (WCAs). This range is based on data obtained from long-term monitoring that was evaluated and reported in 2002 in a District technical publication (Redfield, EMA-403, February 2002). The TP loads and the relative percent contribution to the region from each source, including and excluding the contribution of atmospheric deposition, are tabulated in **Table 4.** Detailed estimates of TP loads by structure are presented in **Table 5.**

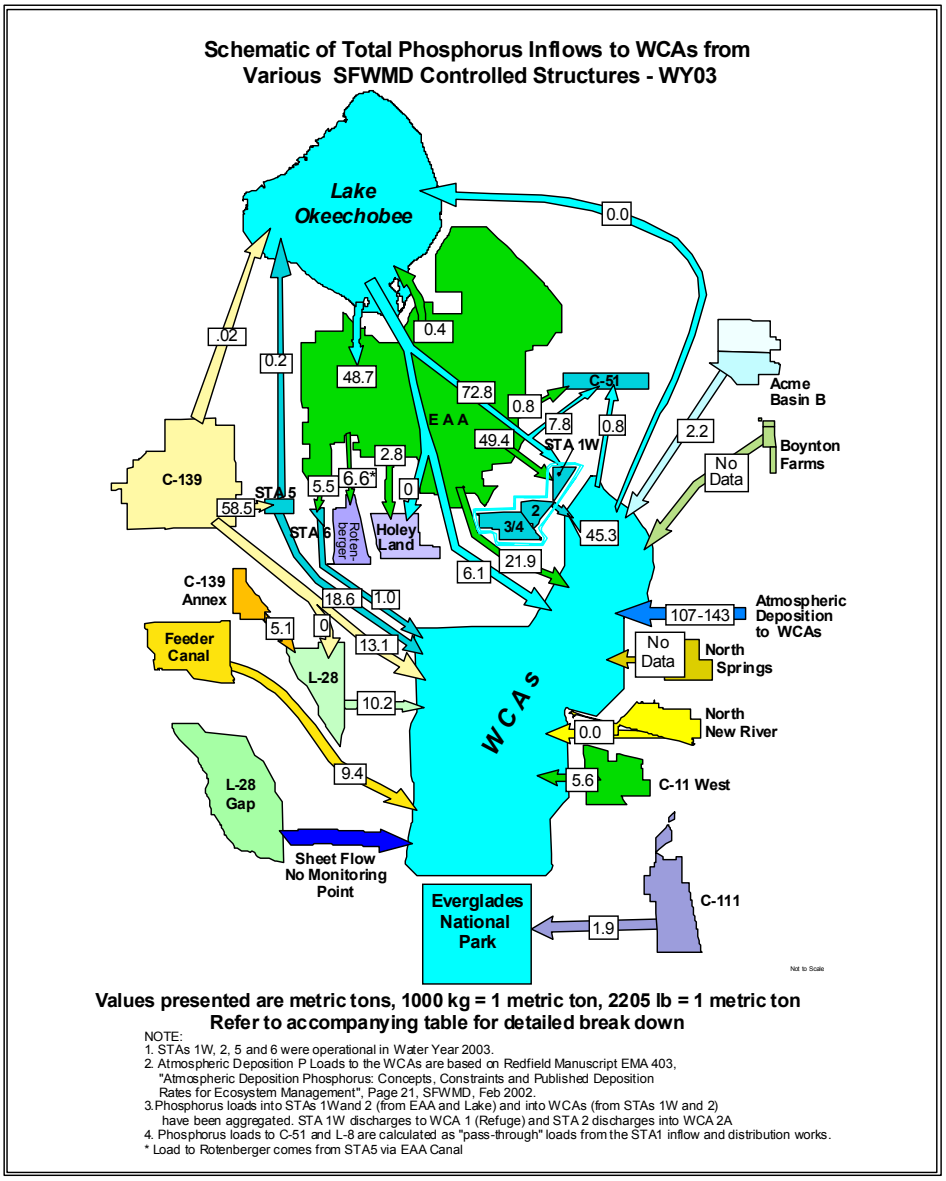

Figure 13. Overview of surface water inflow sources and relative contributions of phosphorus loading to the Everglades Protection Area for Water Year 2003.

Table 4. Water Year 2003 phosphorus loads to the EPA and other waters.

Data provided by Everglades Regulation Division

Source Water	Receiving Water	Phosphorus Load (metric tons)	Portion of Surface Inflows	Portion of Total Inflows
Lake Okeechobee	EPA (WCAs)	6.1	4.5%	1.9%
	EAA	48.7		
	STAs	72.8		
	C-51 Canal	7.8		
	Total from Lake O	**135**		
Everglades Agricultural Area	EPA (WCAs)	21.9	16.1%	6.7%
	Lake Okeechobee	0.4		
	STAs	54.9		
	Holey Land	2.8		
	C-51 West Basin	0.8		
	Total from EAA	**80.8**		
Stormwater Treatment Areas (STAs)	EPA (WCAs)	64.9	47.7%	19.7%
	Lake Okeechobee	0.2		
	Holey Land and Rotenberger	7.8		
	Total from STAs	**72.9**		
Rotenberger	EPA (WCAs)	0.8	0.6%	
C-51 West Basin	EAA	0.1		
	STAs	1.5		
	Total from C-51W Basin	**1.6**		
Acme Basin B	EPA (WCAs)	2.2	1.6%	0.7%
Boynton Farms	EPA (WCAs)	No data		
North Springs Improvement District	EPA (WCAs)	No data		
North New River Canal Basin	EPA (WCAs)	0.0	0.0%	0.0%
C-11 West Basin	EPA (WCAs)	5.6	4.1%	1.7%
C-111 Basin	EPA (ENP)	1.9	1.4%	0.6%
Feeder Canal Basin	EPA (WCAs)	9.4	6.9%	2.8%
L-28 Canal Basin	EPA (WCAs)	10.2	7.5%	3.1%
C-139 Basin	EPA (WCAs)	13.1	9.6%	4.0%
	STAs	58.5		
	Lake Okeechobee	0.02		
	Total C-139 Basin	**71.6**		
C-139 Annex	L-28 Canal	5.1		1.5%
L-28 Gap Basin	EPA (WCAs)	No data		
Total Surface Inflows	EPA (WCAs)	**136**	100%	41.3%
Atmospheric Deposition	WCA-1 (35 mg/m2/yr)	20.0		
	WCA-2 (35 mg/m2/yr)	18.8		
	WCA-3 (25 mg/m2/yr)	70.4		
	ENP (20 mg/m2/yr)	84.1		
	Total atmospheric deposition	**193**		58.7%
Total Loads to the EPA	**EPA (WCAs)**	**329**		100%
Loads From the EPA	STAs	*0.7*		
	Hillsboro Canal (S-39)	*7.7*		
	C-51 West Basin	*0.8*		
	Total loads from the EPA	**9.2**		

Notes on atmospheric deposition:
1: The Everglades National Park area is delineated by coastal line coverage and does not includes Florida Bay.
2: Estimates of areal deposition rates from "Atmospheric Deposition Phosphorus: Concepts, Constraints and Published Deposition Rates for Ecosystem Management", Page 21, SFWMD, Feb 2002. (EMA Report No. 403)

Table 5. Year 2003 Summary of Flow and Total Phosphorus by Structure.

Into WCA1

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
G300 & G301	10	2492	198
from EAA		*2086*	
from Lake O		*154*	
from East Beach		*252*	
from Inflow Basin		*0*	
G251 *(from STA-1W)*	97	5276	44
G310 *(from STA-1W)*	499	33415	54
ACME1 *(from Basin B)*	9	864	80
ACME2 *(from Basin B)*	9	1362	117
Total	**624**	**43409**	**56**

From WCA1

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S10A	121	5526	37
S10C	55	2591	38
S10D	67	4252	51
S10E	0	0	n/a
S39	207	7718	30
G300	8	979	103
G301	3	563	214
Total	**461**	**21628**	**38**

Into WCA2

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
G335 *(from STA-2)*	308	6634	17
S7	143	9624	55
from EAA		*4961*	
from Lake O		*4663*	
S10A *(from WCA1)*	121	5526	37
S10C *(from WCA1)*	55	2591	38
S10D *(from WCA1)*	67	4252	51
S10E *(from WCA1)*	0	0	n/a
N. Springs Improv. District	1	0	n/a
Total	**695**	**28626**	**33**

From WCA2

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S7	17	489	23
S11A	109	2565	19
S11B	58	792	11
S11C	134	4189	25
S38	34	1057	25
S34	114	3683	26
Total	**464**	**12774**	**22**

Into WCA3

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S140 *(from L28 Canal)*	136	10191	61
S190 *(from Feeder Canal)*	88	9358	86
L3 (G88+G155) *(from C139)*	32	8481	216
STA-6	33	1046	26
S8	292	29420	82
from EAA		*11039*	
from Lake O		*1251*	
from C-139		*4291*	
from STA-5		*12296*	
from Rotenberger		*543*	
S150 *(from EAA)*	69	4086	48
G204 *(from Holey Land)*	0	0	n/a
G404	93	6622	58
from EAA		*-241*	
from C-139		*351*	
from STA-5		*6300*	
from Rotenberger		*213*	
S11A *(from WCA2)*	109	2565	19
S11B (*from WCA2)*	58	792	11
S11C *(from WCA2)*	134	4189	25
G123 *(from N. New River)*	0	0	n/a
S9 *(from C-11 West)*	264	5580	17
Total	**1306**	**82329**	**51**

From WCA3

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S150	0	0	n/a
S8	0	0	n/a
G204	0	0	n/a
S31	0	0	n/a
S337	24	1415	49
S343A	16	155	8
S343B	18	174	8
S344	13	180	12
S12A	112	1191	9
S12B	98	847	7
S12C	188	2008	9
S12D	227	3354	12
S333	207	2979	12
S14	0	0	n/a
Total	**902**	**12303**	**11**

Into Everglades National Park (ENP)

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S12A *(from WCA3)*	112	1191	9
S12B *(from WCA3)*	98	847	7
S12C *(from WCA3)*	188	2008	9
S12D *(from WCA3)*	227	3354	12
S333 *(from WCA3)*	207	2979	12
S14 *(from WCA3)*	0	0	n/a
S174 *(from L-31W)*	6	66	8
S332D *(from L-31W)*	90	659	6
S18C *(from C-111 Canal)*	135	1200	7
Total	**1064**	**12303**	**9**

From ENP

Structure	Flow	Phosphorus	
	1000 ac-ft	Load (kg)	FWMC (ppb)
S334	76	1099	12
S197	16	128	6
Total	**92**	**1227**	**11**

FWMC = flow weighted mean concentration

Comparison of WY2003 Phosphorus Loads to 1979-1988 Baseline

This section reports phosphorus loading into the Everglades Protection Area for WY2003.

October 1978 through September 1988 has been identified as a comparative baseline period for various planning purposes, including the 1992 Everglades SWIM Plan, the design of the Everglades Construction Project, the 1991 Everglades Settlement Agreement and the Everglades Forever Act, as amended. During that 10-yr period, annual phosphorus loads in surface inflows to the EPA ranged from approximately 100 metric tons to over 350 metric tons, with an average of 270 metric tons (1992 Everglades SWIM Plan). Included in this 270 ton annual average was approximately 205 tons to the Water Conservation Areas (WCAs) from the EAA, Lake Okeechobee, L-8 and C-51W basins through the S-5A, S-6, S-7, S-150 and S-8 structures. This 205 ton annual average was the basis of design for the four original STAs of the Everglades Settlement Agreement. During that same 1979-1988 period, phosphorus loads in surface inflows to the Refuge ranged from approximately 40 metric tons to over 150 metric tons per year, with an average of about 110 metric tons (1992, Everglades SWIM Plan). Included in this 110 ton annual average was approximately 105 tons from the EAA, Lake Okeechobee, L-8 and C-51W basins through the S-5A and S-6 pump stations. This 105 ton annual average load to the Refuge was the basis of design for the original STA-1 and STA-2 of the Everglades Settlement Agreement.

As set forth in Appendix C of the Everglades Settlement Agreement, the Settling Parties assumed that if the STAs and BMPs performed as designed, there would be an approximate 80% reduction of stormwater-borne phosphorus loads to the WCAs from the EAA (i.e., excluding other sources such as Lake Okeechobee water supply releases). Using the loads that occurred during the baseline period (WY1979-88), and the Appendix C assumptions, the anticipated 10-year average load equating to this 80% reduction is approximately 40.2 metric tons from the EAA to the WCAs.

Similarly, the Settlement Agreement also envisions an approximate 85% reduction of phosphorus loads from the EAA to the Refuge if the STAs and BMPs achieve their design assumptions. Using the loads that occurred during the baseline period (WY1979-88), and the Appendix C assumptions, the anticipated 10-year average load equating to this 85% reduction is approximately 15.5 metric tons from the EAA to the Refuge.

In 2002 the Technical Oversight Committee (TOC) established, pursuant to the Settlement Agreement, a methodology developed by Walker (1996) for reviewing the load reductions based on annual phosphorus concentrations of water entering the WCAs and Refuge. That methodology assumes compliance with the reduction requirements unless the annual phosphorus inflow concentration to the WCAs (and Refuge) from the EAA and bypassed flows is greater than 76 ppb in any water year or is greater than 50 ppb in three or more consecutive water years (Walker 1996). Compliance will not be tested in water years when the EAA adjusted annual rainfall, as defined in SFWMD Rule 40E-63, is above 63.8 inches. Compliance will also not be tested in water years when the EAA adjusted rainfall is below 35.1 inches if sufficient water is not available to maintain wet conditions in the STAs. The following discussion of WY2003 loads does not substitute for the compliance review

activities of the TOC, but is simply a public presentation of relevant data as requested by the TOC.

Phosphorus loads to the EPA during WY2003 were significantly lower than the WY1979-1988 baseline period. As shown in Tables 8A-7 and 8A-8, loads to the EPA totaled approximately 136 metric tons, with a flow-weighted mean concentration of 48 ppb. It should be recognized that not all of this load came from the EAA. Phosphorus loads to the WCAs from the EAA were calculated as:

a proportion of STA-1W and STA-2 discharges, adjusted to reflect contributions from non-EAA sources [STA-1W (from EAA: 37%), STA-2 (from EAA: 79%)],

STA-6 discharges , and

direct EAA discharges from the S-7, S-8 and S-150 structures.

Phosphorus loads to the WCAs from the EAA during WY2003 totaled about 42.8 tons. This annual load is slightly higher than the 10-yr average expectation of 40.2 tons, however, it should be noted that the 42.8 tons is not a multiple year average value (as is the 10-yr average of 40.2 tons) and that compliance with the load reduction is not scheduled to begin until WY2004. The average of the WY2002 and WY2003 loads from the EAA to the WCAs was 36.2 tons, slightly below the anticipated 10-year average load of 40.2 tons. This relatively low average load is significant considering STA-1E and STA-3/4 were not operational during WY2003.

Phosphorus loads from all sources to the Refuge during WY2003 totaled approximately 43.4 tons, the majority resulting from regulatory releases from Lake Okeechobee. The phosphorus load to the Refuge from the EAA during WY2003 was approximately 16.6 tons, slightly above the anticipated 10-year average load of 15.5 tons. This small degree of overage is significant in that STA-1 East was not yet operational. The average of the WY2002 and WY2003 loads from the EAA to the Refuge was 14.6 tons, slightly below the anticipated 10-year average load of 15.5 tons. The flow-weighted mean phosphorus concentration entering the Refuge from the EAA and bypass flows during WY2003 was 55 ppb, which is below the annual maximum of 76 ppb established by the TOC methodology, and slightly higher than the 49 ppb observed during WY2002.

Settlement Agreement
July - September 2003 Report

Following the Feb 3, 2004 TOC Meeting, the column showing the Guideline for Percent of Sampling Events Greater than 10 ppb in Table 2 was recalculated and updated. The method for calculating these guidelines was changed to eliminate the subtraction of S334 flow from S333 flow. These revisions affected values in that column by 0.3 - 3.1%.

Prepared for the
Technical Oversight Committee
January 27, 2004

Prepared by:
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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 (mean sea level). 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 16.02, 16.74 and 17.23 feet in July, August and September 2003, respectively (**Figure 2, Table 1)**. The geometric means, calculated from total phosphorus concentrations measured in water samples collected in July, August and September were 7.7, 8.0 and 8.78 ppb, respectively. These values were less than the interim and long-term levels for July and August. In September the geometric mean exceeded the interim and the long-term levels (8.3 and 7.2, respectively). It had been 13 months since the interim and long-term limits were exceeded.

Only 9 stations were sampled in July. LOX stations 3, 4, 5, 9 and 10 all had total water depths less than 10 cm which precludes sample collection. In September, LOX 13 was not sampled due to a total water level less than 10 cm.

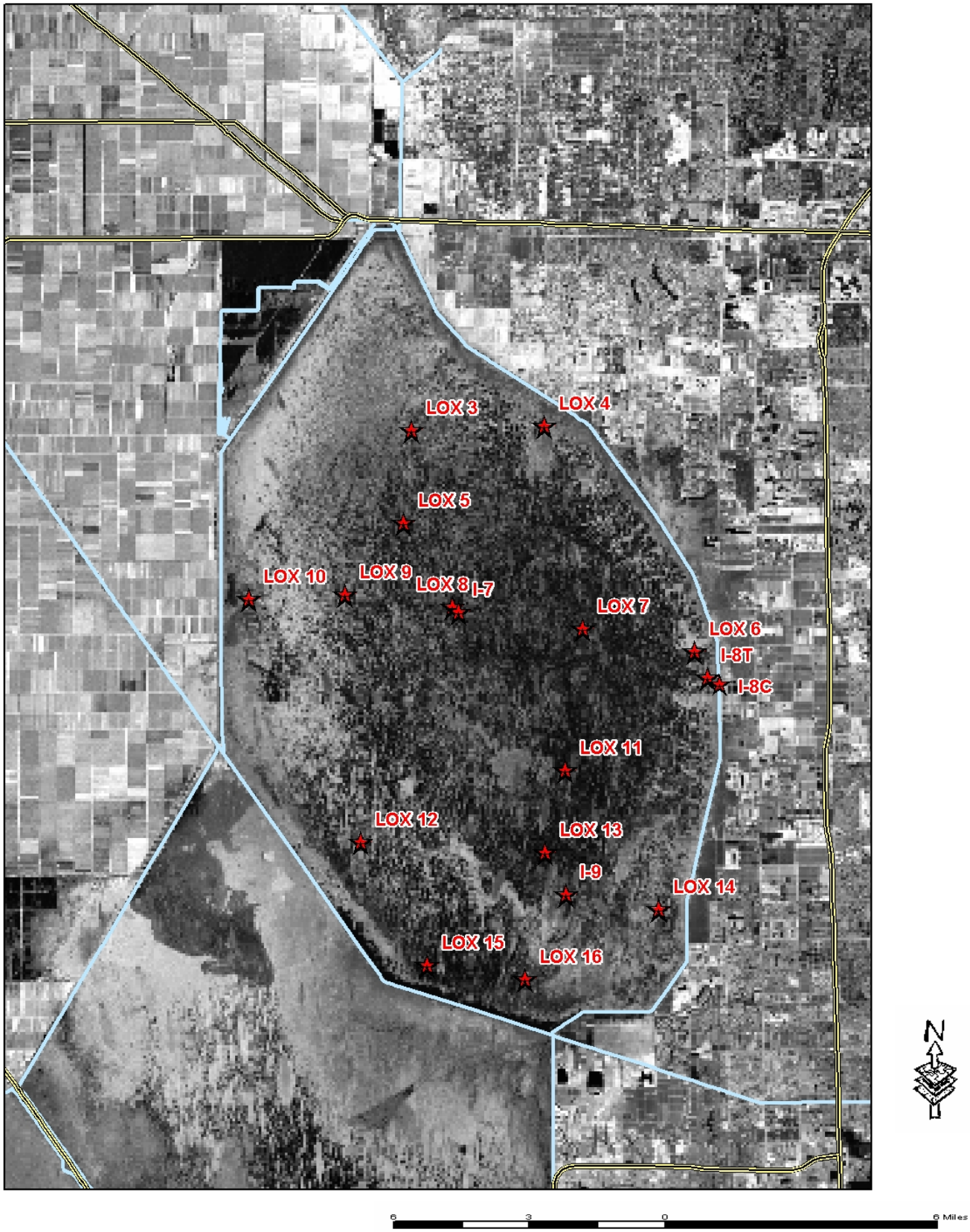

Figure 1. A.R.M. Loxahatchee Refuge Water Quality Sampling and Stage Measurement Sites

★ Station Location

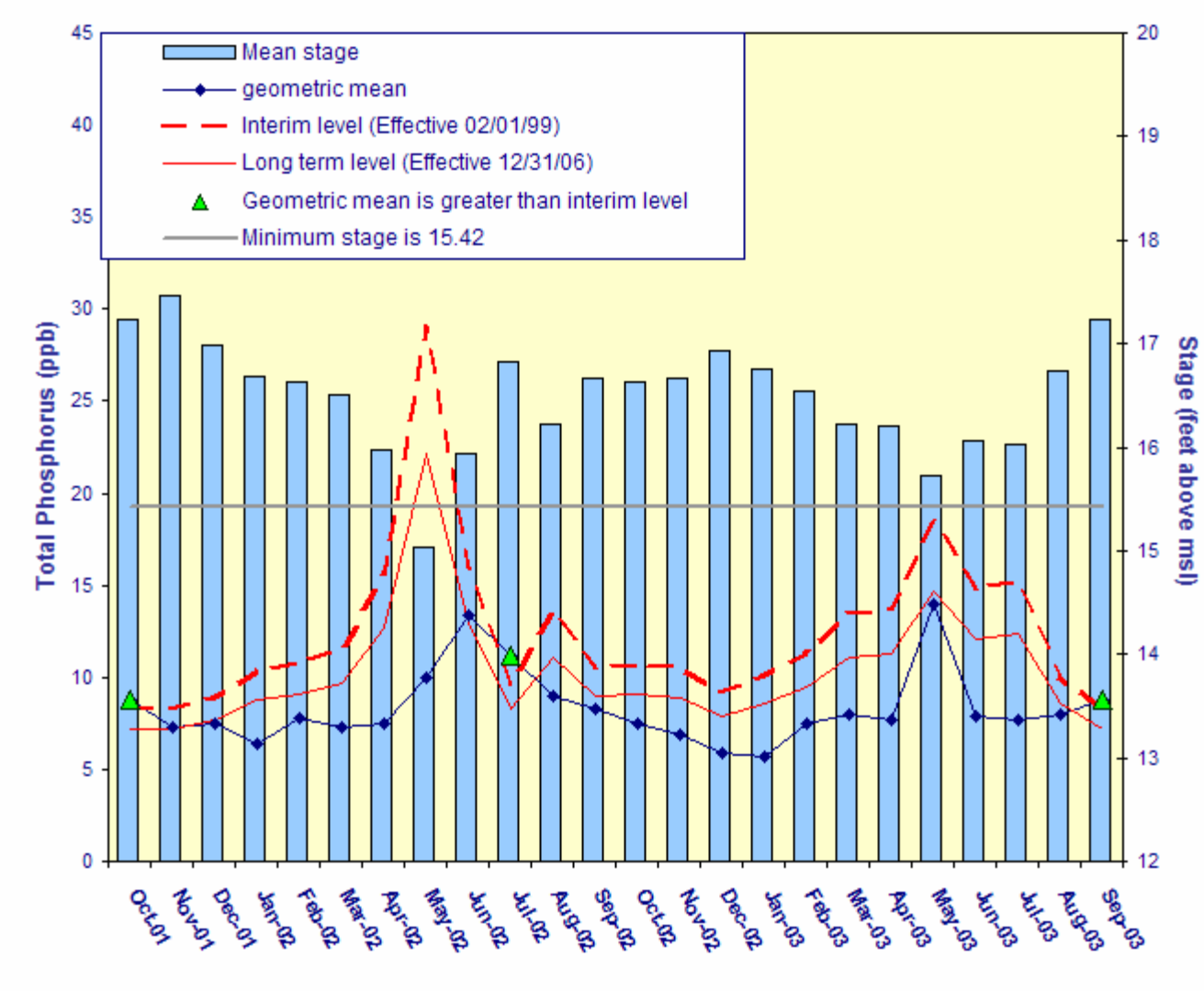

Figure 2. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

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

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft,NGVD)	Number of TP Samples	Number of Stage Measure-ments
Oct-2001	8.8	8.3	7.2	17.24	14	3
Nov-2001	7.3	8.3	7.2	17.46	14	3
Dec-2001	7.5	8.9	7.7	16.99	14	3
Jan-2002	6.4	10.4	8.8	16.69	14	3
Feb-2002	7.8	10.7	9.1	16.63	14	3
Mar-2002	7.3	11.5	9.7	16.50	14	3
Apr-2002	7.5	15.6	12.7	15.98	11	3
May-2002	10.0	0.0	0.0	15.04	3	3
Jun-2002	13.4	16.0	12.9	15.94	10	3
Jul-2002	11.2	9.7	8.3	16.82	14	3
Aug-2002	9.0	13.5	11.1	16.22	12	3
Sep-2002	8.3	10.6	8.9	16.66	11	3
Oct-2002	7.5	10.7	9.0	16.64	12	3
Nov-2002	6.9	10.5	8.9	16.66	12	3
Dec-2002	5.9	9.2	7.9	16.93	14	3
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

Notes: *(1) Average Stage is calculated using stage elevations at three stations on the sampling date*
(2) Highlighted values indicate months when exceedances occurred

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 2003 (**Figure 3a**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2003 was 10.0 ppb. Corresponding interim and long-term limits were 10.2 and 8.7 ppb, respectively. For the ten-year period 1994 through 2003, the interim limit applicable to Shark River Slough has been met eight times. The limit was exceeded in Water Years 2000 and 2001.

Table 2 presents the moving flow-weighted mean concentrations for each 12-month period beginning in October 2001 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 July, August and September 2003, the flow-weighted mean total phosphorus concentrations were 9.8, 9.9 and 10.0 ppb, respectively. The July, August and September concentrations were less than the interim limit, but the long-term limits were exceeded in each of these months.

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 July, August and September 2003, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 50.0, 50.0 and 50.0, respectively. July, August and September observed percentages were greater than the guidelines (**Table 2**). The individual sampling events and the 12-month moving average are presented in **Figure 3b**.

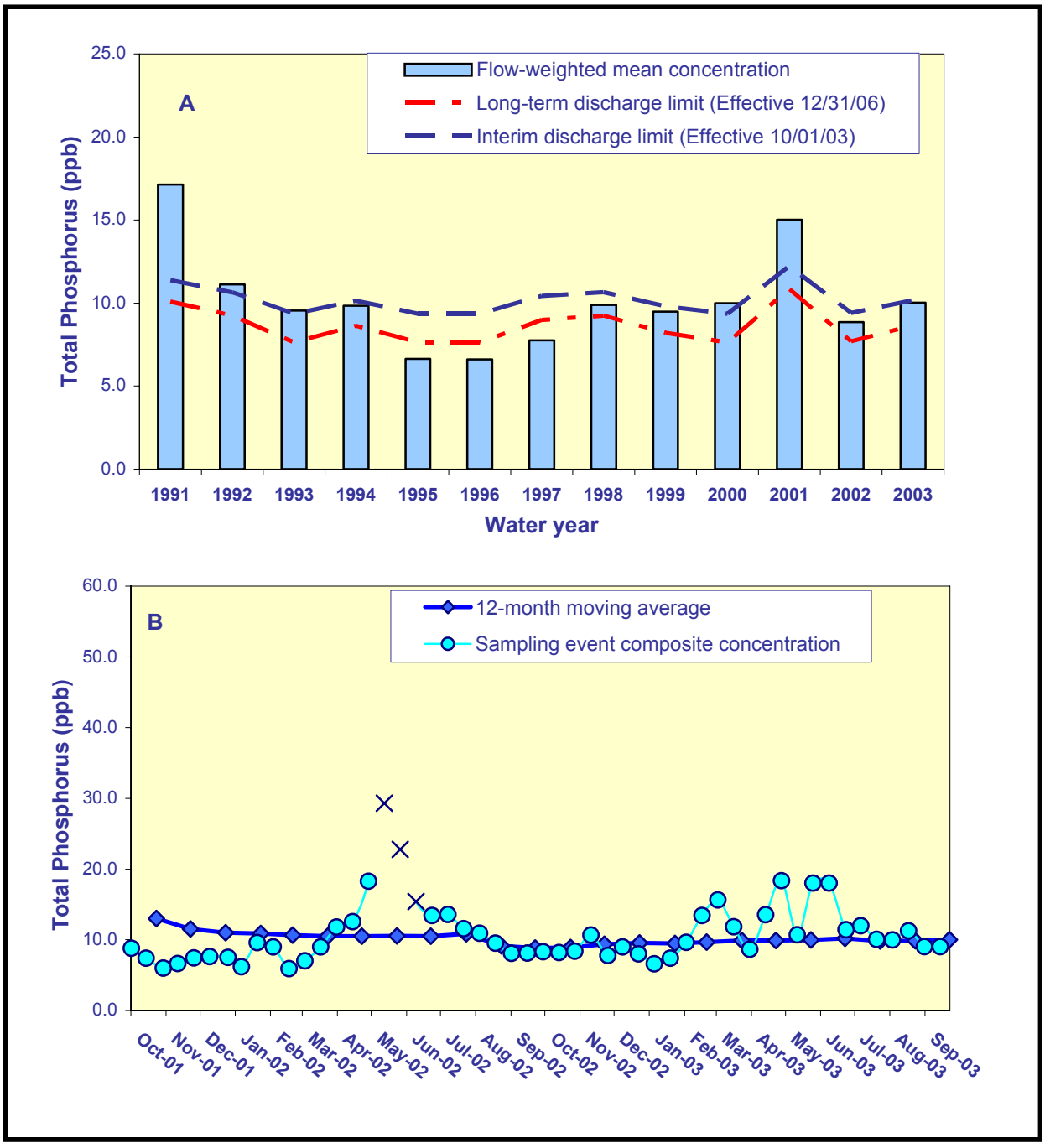

Figure 3. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough.
A. The 12-month moving average fwmc at the end of each water year compared to the total phosphorus interim and long-term limits.
B. The 12-month moving average fwmc at the end of each month and the composite total phosphorus concentration for each sampling event. *(star): denotes arithmetic average for biweekly samples in May and June 2002 as there was no flow on the sampling dates.

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	(%)	
	(Kac-ft)	(ppb)	10/1/2003	12/31/2006	Guideline	Observed
31-Oct-01	503.2	13.0	11.8	10.5	55.2	***68.4***
30-Nov-01	600.0	11.5	11.3	10.0	52.1	***57.9***
31-Dec-01	688.8	11.0	10.9	9.5	49.4	***52.6***
31-Jan-02	707.8	10.9	10.8	9.4	48.9	***52.6***
28-Feb-02	741.3	10.7	10.6	9.2	48.0	45.0
31-Mar-02	809.5	10.5	10.3	8.9	46.1	40.9
30-Apr-02	829.9	10.5	10.3	8.8	45.6	40.9
31-May-02	833.5	10.5	10.2	8.7	45.5	43.5
30-Jun-02	839.6	10.5	10.2	8.7	45.3	40.9
31-Jul-02	958.5	10.9	9.7	8.1	42.4	***45.8***
31-Aug-02	1003.2	9.1	9.6	7.9	41.4	39.1
30-Sep-02	1048.1	8.8	9.4	7.7	40.4	30.4
31-Oct-02	999.9	8.9	9.6	7.9	41.5	30.4
30-Nov-02	884.5	9.4	10.0	8.5	44.2	34.8
31-Dec-02	802.2	9.6	10.4	8.9	46.3	33.3
31-Jan-03	831.1	9.5	10.3	8.8	45.6	34.8
28-Feb-03	843.6	9.7	10.2	8.7	45.2	39.1
31-Mar-03	812.1	9.9	10.3	8.9	46.1	***47.8***
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***

Notes: *Italicized values exceeded allowed percentage*

The daily flows through the individual Shark River Slough structures and S334 from October 2001 through September 2003 are presented in **Figure 4a**. 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 4b.** Values for Water Years 2002 and 2003 follow the strong inverse relationship between flow and total phosphorus concentration expected for waters entering the Park through Shark River Slough. However, during the unseasonable rainfall conditions that occurred from February through May 2003, total phosphorus concentrations were greater and more variable, 9 to 18 ppb, than observed previously when flows were less than 500 cfs. From June through September 2003, increasing flows resulted in gradually decreasing total phosphorus concentrations from 12 ppb to 9 ppb.

At the October 30, 2003 TOC meeting a discussion between Tim Bechtel and Bill Walker via telephone indicated that the District had been subtracting flows through S334 from the total flow of the S12 structures plus S333 for before calculating the flow-weighted mean total phosphorus concentration of samples collected at the S12s and S333. This was a modification of the calculations specified in the Settlement Agreement that was approved by the TOC in 2000. Bill Walker argued that S334 flows were also being subtracted from the combined S12 plus S333 inflows used to determine the interim and long-term limits and that this procedure was incorrect. After the meeting District staff checked the calculations and agreed with Bill Walker. The flow files were corrected by eliminating the S334 flow data from the computation spreadsheets for the entire period the incorrect inflows had been calculated.

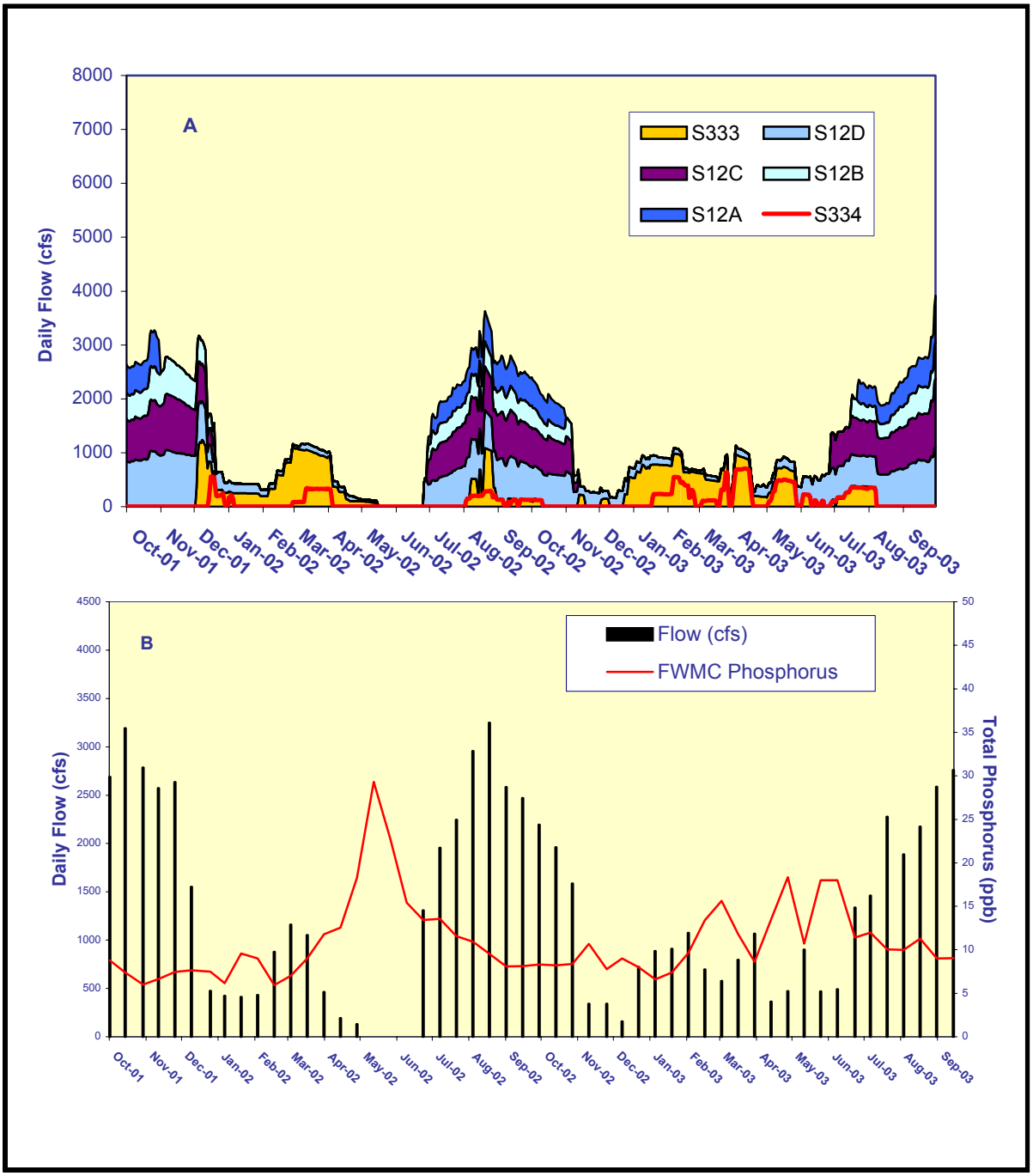

Figure 4. **A**. Daily flows into Shark River Slough by structure. **B**. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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 5**). 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 USACE has implemented 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 are presented graphically beginning on page 16 this report. 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 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.

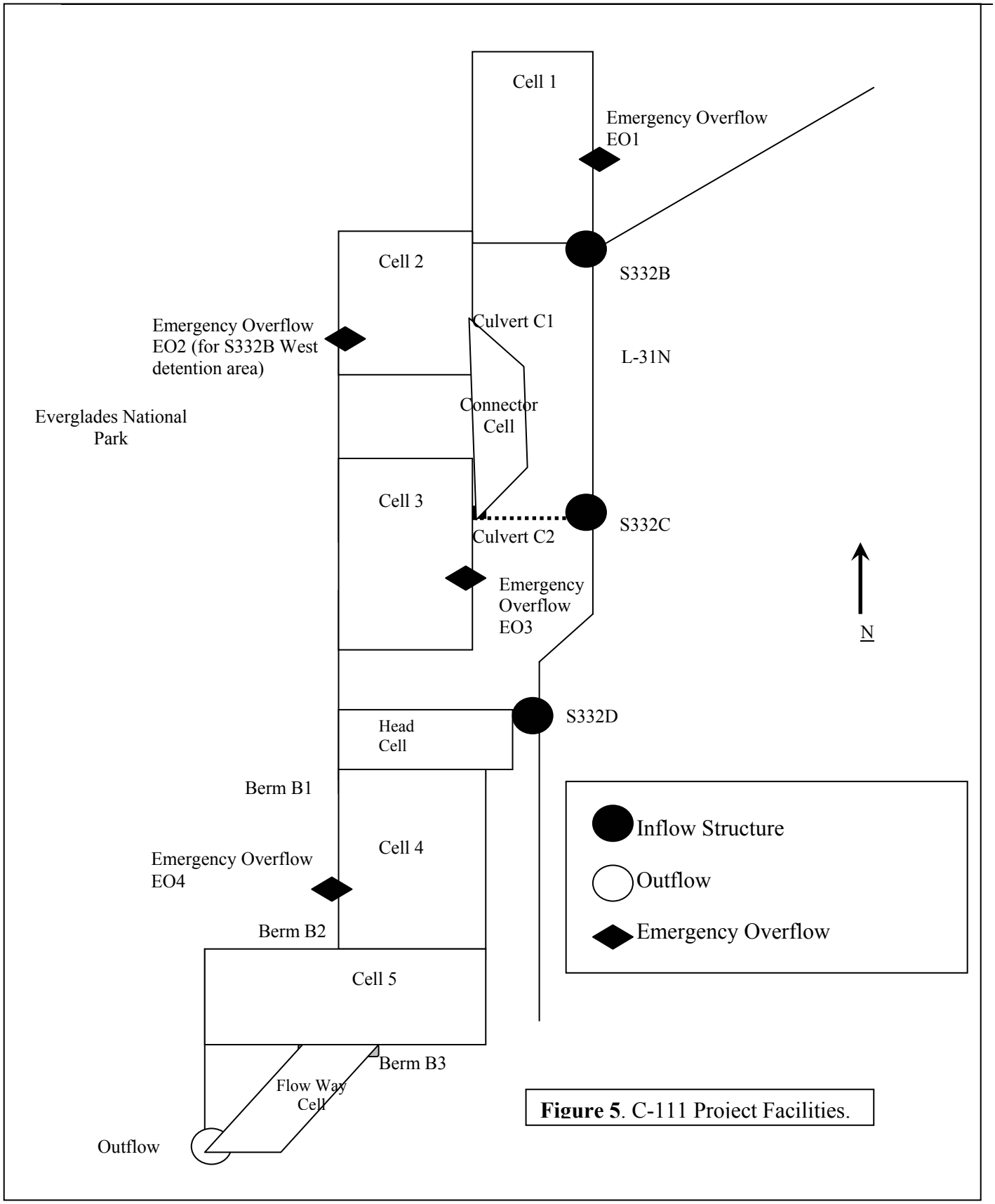

Figure 5. C-111 Project Facilities.

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 water years from 1999 through 2002 using data from both the old (S175, S332, S18C) and new (S174, S332D, S18C) combinations of structures (**Figure 6a**). The bars in **Figure 6a** represent the flow-weighted mean total phosphorus concentrations from S332, S175 and S18C for water years 1989 through 2002. In water year 2003, flows through S332 and S175 were intermittent. Flow through S332 totaled 97.64 cfs with 92.2 cfs pumped in December 2002. Flow through S175 totaled 467.8 cfs with 464.13 cfs passing through the structure in February 2003. Consequently, no flow-weighted mean total phosphorus was calculated for Water Year 2003 using the S332, S175 and S18C structures. The diamond point values for water years 1999 through 2003 represent the flow-weighted mean total phosphorus concentrations for S174, S332D and S18C. **Figure 6b** presents the 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at the S174, S332D and S18C structures.

The 12-month flow-weighted mean concentrations for July, August and September 2003 were 5.6, 5.3 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 0.0 for the periods ending July, August and September 2003.

The daily flows into Everglades National Park through S332D, S174 and S18C are presented in **Figure 7a**. **Figure 7b** 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 clear linear relationship between daily mean flow and flow-weighted mean total phosphorus concentrations at these structures.

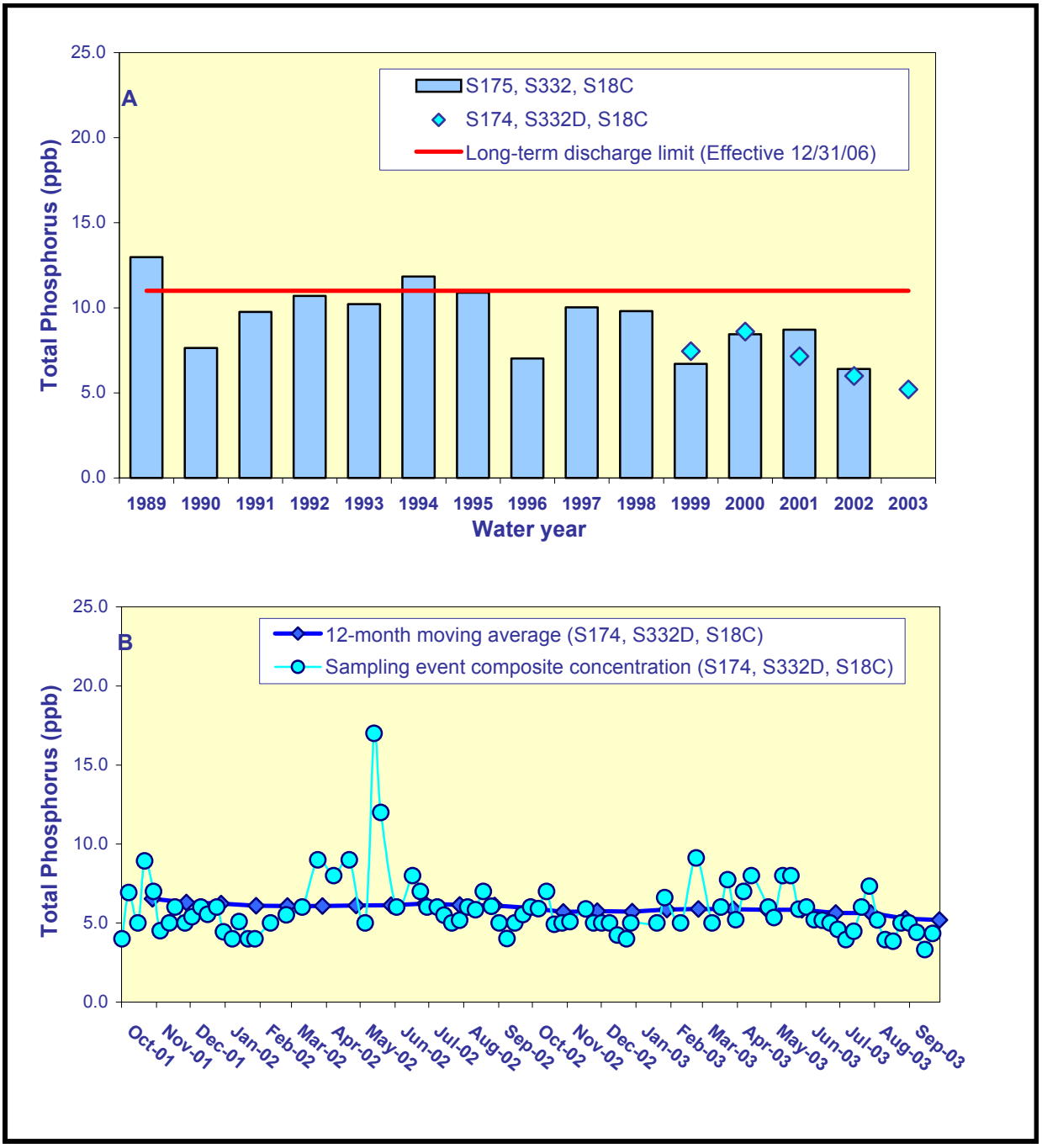

Figure 6. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins. **A.** The 12-month moving average fwmc at the end of each water year compared to the 11 ppb long-term total phosphorus limit. **B**. The 12-month moving average fwmc 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-Oct-01	235.2	6.5	11.0	53.1	8.0
30-Nov-01	269.7	6.3	11.0	53.1	7.4
31-Dec-01	296.5	6.2	11.0	53.1	6.7
31-Jan-02	316.0	6.1	11.0	53.1	5.9
28-Feb-02	320.6	6.1	11.0	53.1	0.0
31-Mar-02	325.9	6.1	11.0	53.1	0.0
30-Apr-02	331.1	6.1	11.0	53.1	0.0
31-May-02	336.4	6.1	11.0	53.1	5.0
30-Jun-02	364.3	6.2	11.0	53.1	4.9
31-Jul-02	392.1	6.1	11.0	53.1	4.7
31-Aug-02	388.3	6.1	11.0	53.1	4.7
30-Sep-02	371.8	6.0	11.0	53.1	4.7
31-Oct-02	316.0	5.7	11.0	53.1	4.5
30-Nov-02	271.6	5.8	11.0	53.1	4.8
31-Dec-02	249.8	5.7	11.0	53.1	4.7
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

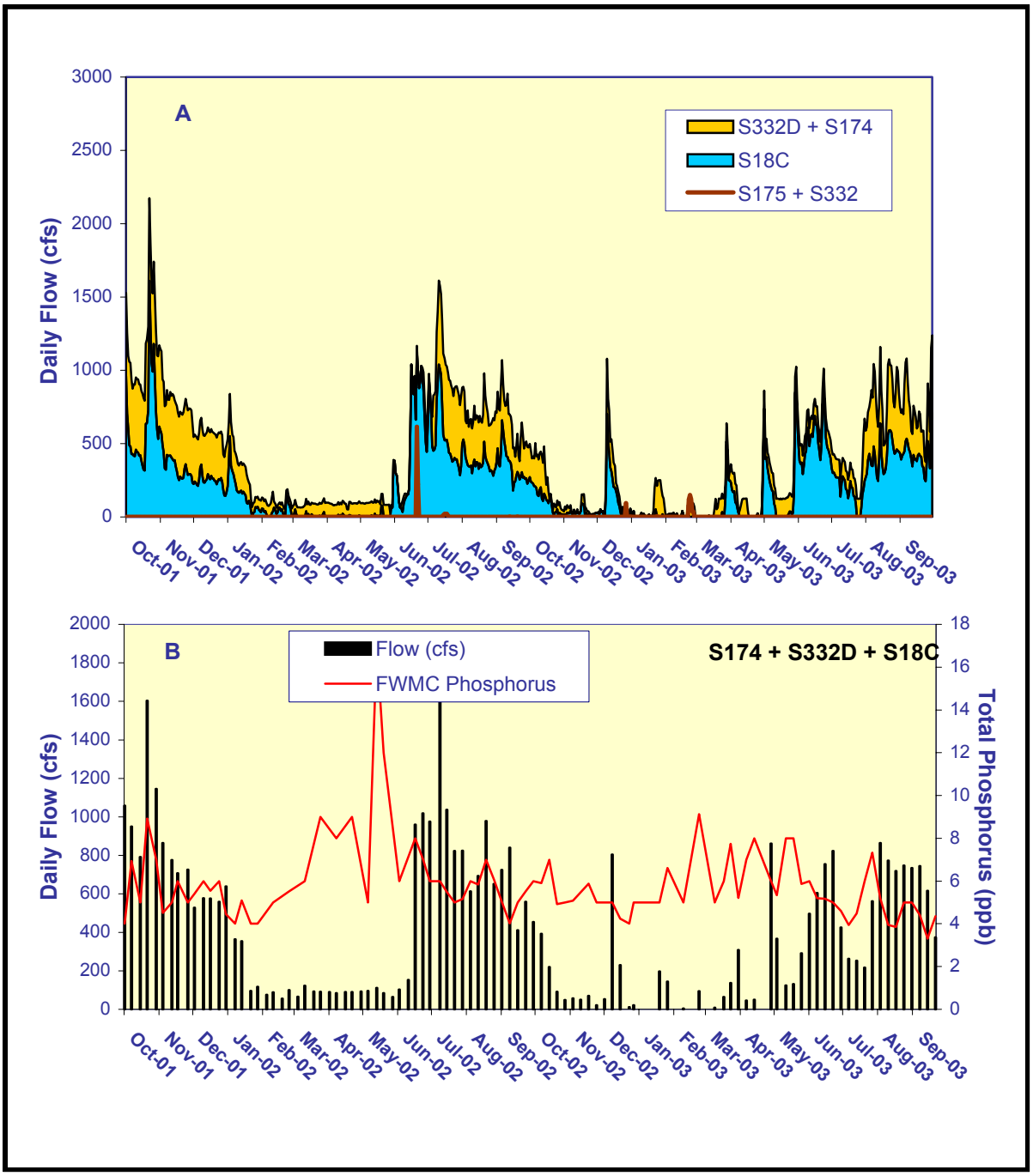

Figure 7. **A.** Daily flows into Everglades National Park through Taylor Slough and S18C. **B**. The relationship between daily flows at Taylor Slough structures and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Overflow Events 2000 – 2003 at S332B Weir

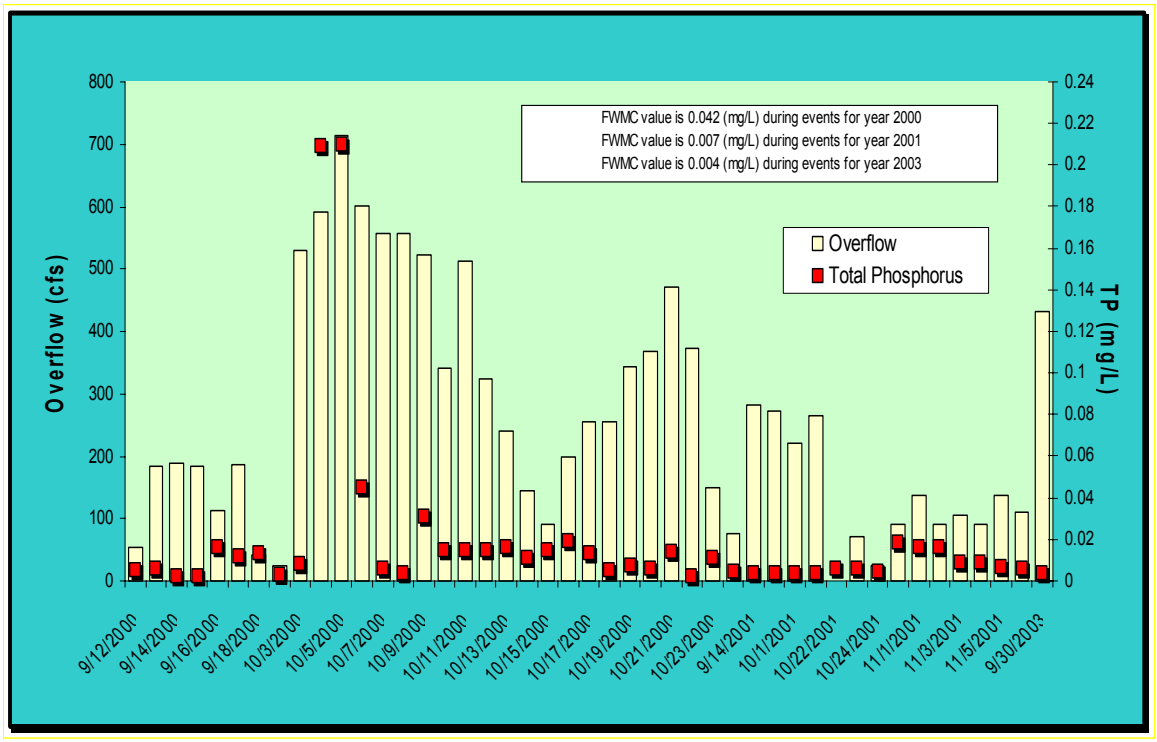

Figure 8. Total phosphorus concentration for S-332B during overflow events.

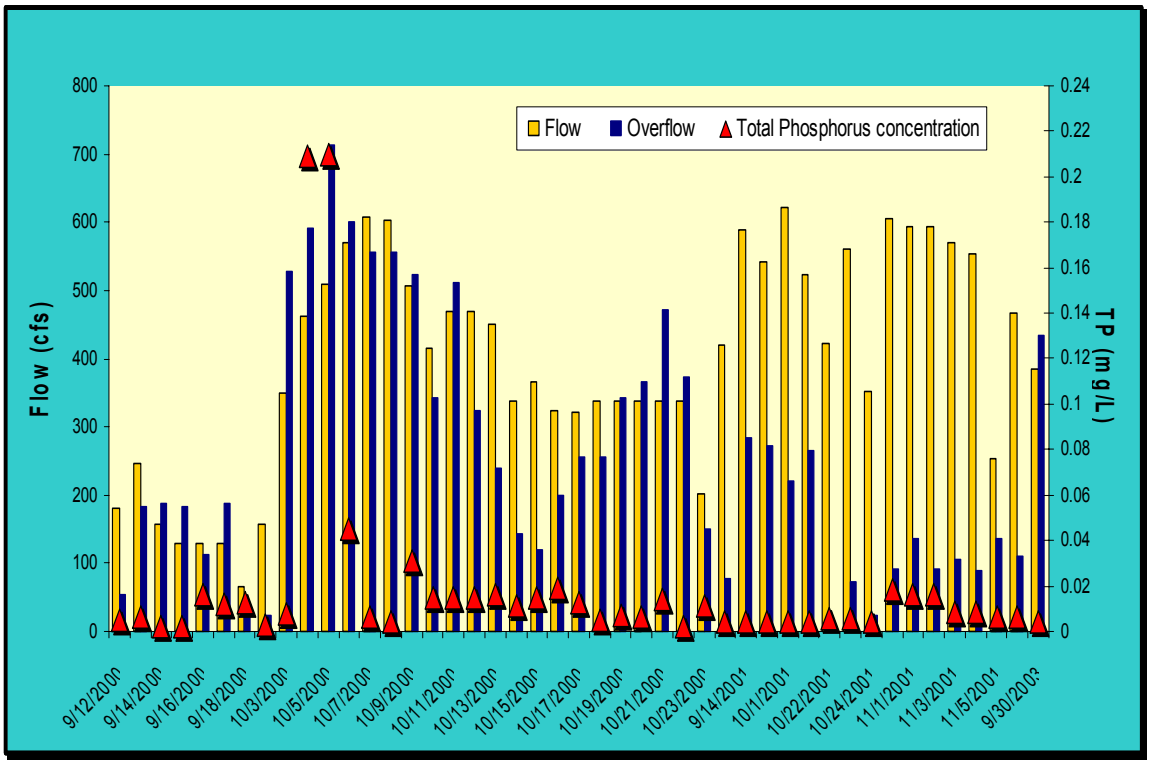

Figure 9. Pump S-332B during overflow events for 2000, 2001 and 2003.

Settlement Agreement
October - December 2003 Report

Prepared for the
Technical Oversight Committee
May 25, 2004

Prepared by:
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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. According to the Settlement Agreement, the stage range within which the interim and long-term concentration levels are applicable is 15.42 to 17.14 feet (mean sea level). 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 geometric mean concentration is calculated and compared to the interim and long-term concentration levels.

Average stages in the Refuge were 17.15, 16.98 and 16.91 feet in October, November and December 2003, respectively (Please see **Figure 2** and **Table 1)**. The geometric means, calculated from total phosphorus concentrations measured in water samples collected in October, November and December were 7.0, 7.5 and 7.6 ppb, respectively. These values were less than the interim and long-term levels for October, November, and December.

Only 11 stations were sampled in November. LOX stations 3, 5 and 9 had total water depths less than 10 cm which precluded sample collection.

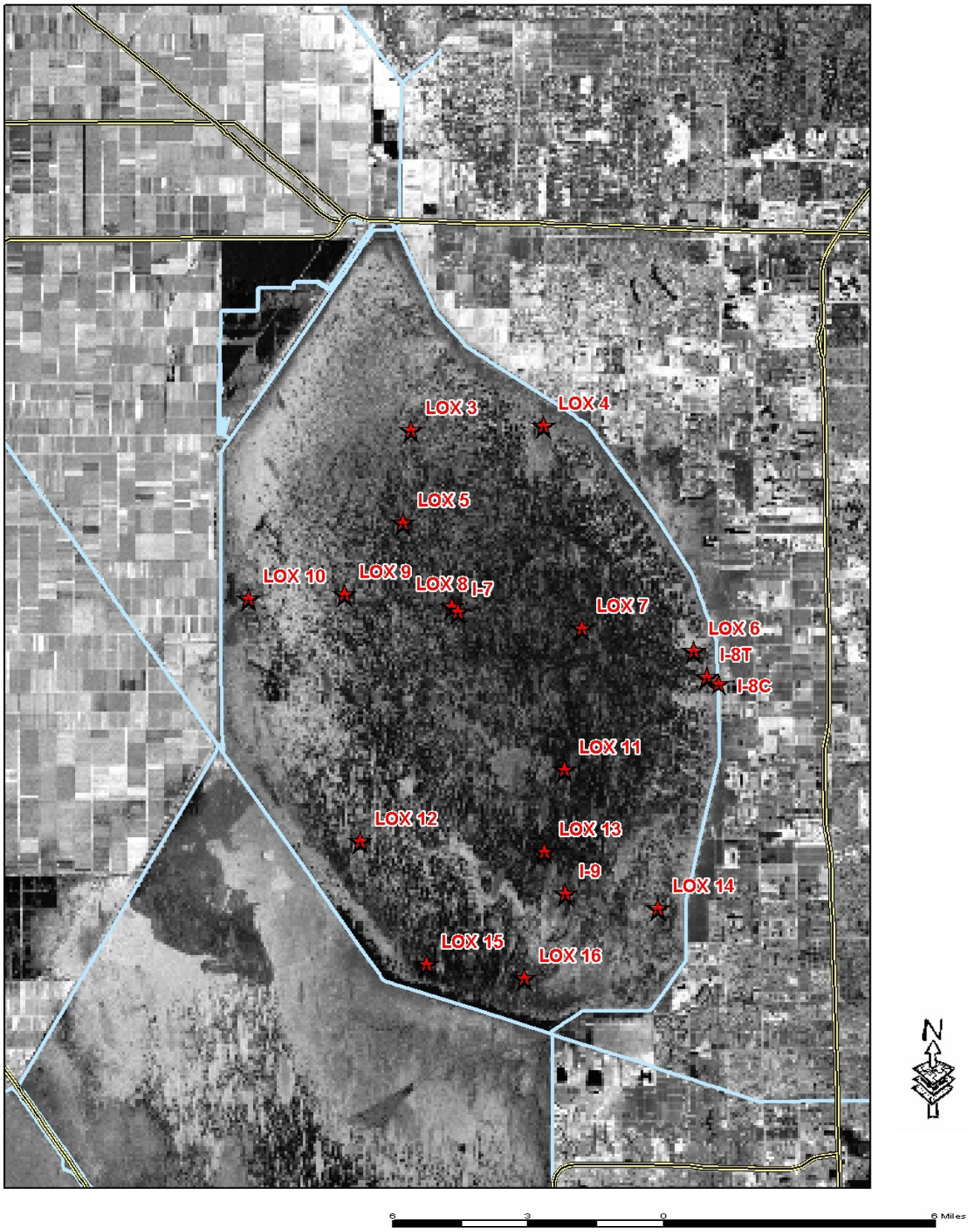

Figure 1. A.R.M. Loxahatchee Refuge Water Quality Sampling and Stage Measurement Sites

★ Station Location

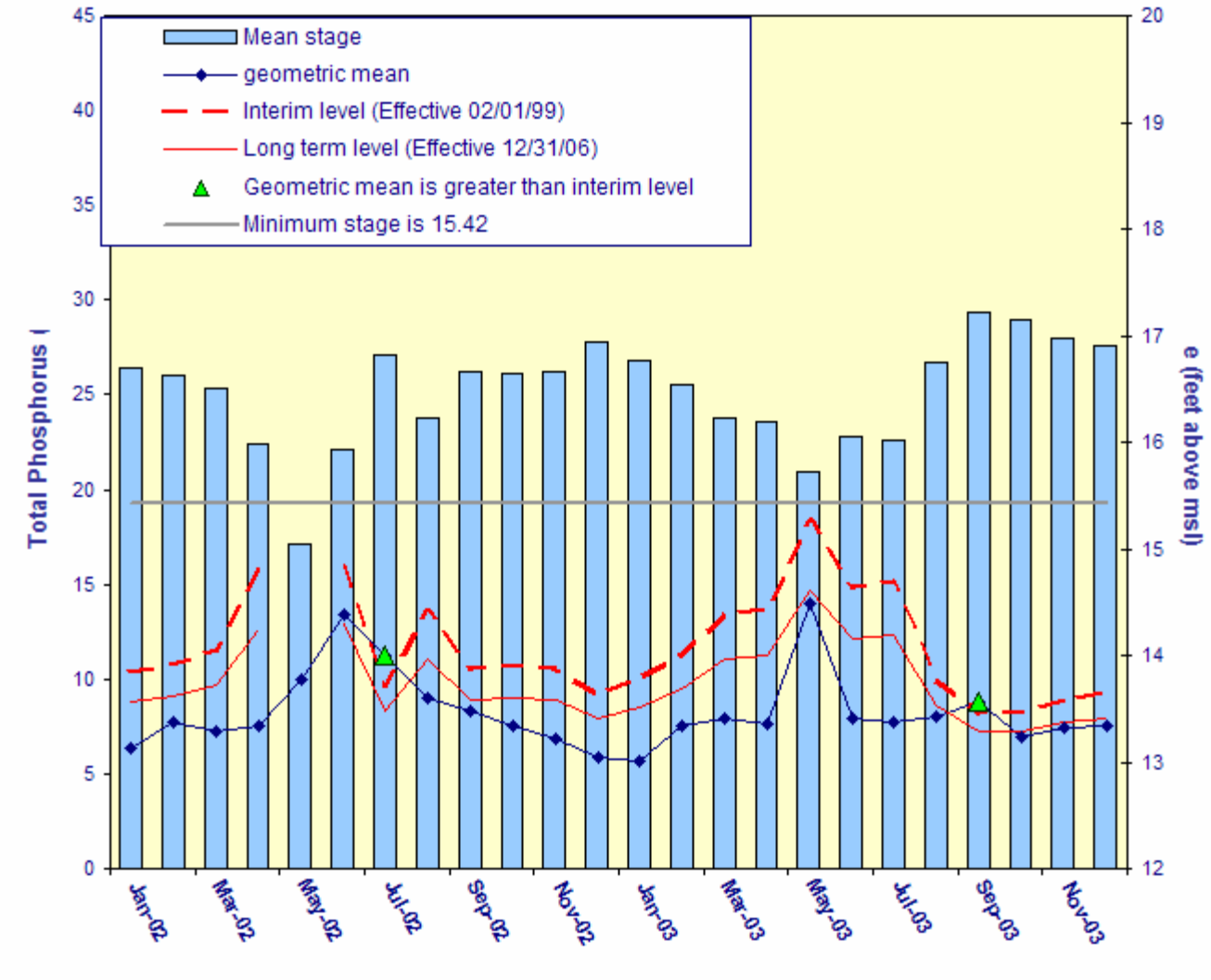

Figure 2. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. Interim and long-term concentration levels are not applicable if the stage is less than 15.42 ft. The calculated levels are adjusted for fluctuations in stage.

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

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft,NGVD)	Number of TP Samples	Number of Stage Measure-ments
Jan-2002	6.4	10.4	8.8	16.69	14	3
Feb-2002	7.8	10.7	9.1	16.63	14	3
Mar-2002	7.3	11.5	9.7	16.50	14	3
Apr-2002	7.5	15.6	12.7	15.98	11	3
May-2002	10.0	N/A	N/A	15.04	3	3
Jun-2002	13.4	16.0	12.9	15.94	10	3
Jul-2002	11.2	9.7	8.3	16.82	14	3
Aug-2002	9.0	13.5	11.1	16.22	12	3
Sep-2002	8.3	10.6	8.9	16.66	11	3
Oct-2002	7.5	10.7	9.0	16.64	12	3
Nov-2002	6.9	10.5	8.9	16.66	12	3
Dec-2002	5.9	9.2	7.9	16.93	14	3
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

Notes:
(1) Average Stage is calculated using stage elevations at three stations on the sampling date
(2) Highlighted rows indicate months when excursions occurred
(3) N/A denotes that the concentration levels 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 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 2003 (**Figure 3A**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2003 was 9.2 ppb. Corresponding interim and long-term limits were 9.4 and 7.6 ppb, respectively. For the ten-year period 1994 through 2003, the interim limit applicable to Shark River Slough has been met eight times. The limit was exceeded in Water Years 2000 and 2001.

Table 2 presents the moving flow-weighted mean concentrations for each 12-month period beginning in October 2001 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 2003, the flow-weighted mean total phosphorus concentrations were 9.7, 9.5 and 9.2 ppb, respectively. The October, November and December concentrations were less than the interim limit, but the long-term limits were exceeded in each of these months.

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 2003, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 50.0, 46.2 and 46.2, respectively. October, November and December observed percentages were greater than the guidelines (**Table 2**). The individual sampling events and the 12-month moving average are presented in **Figure 3B**.

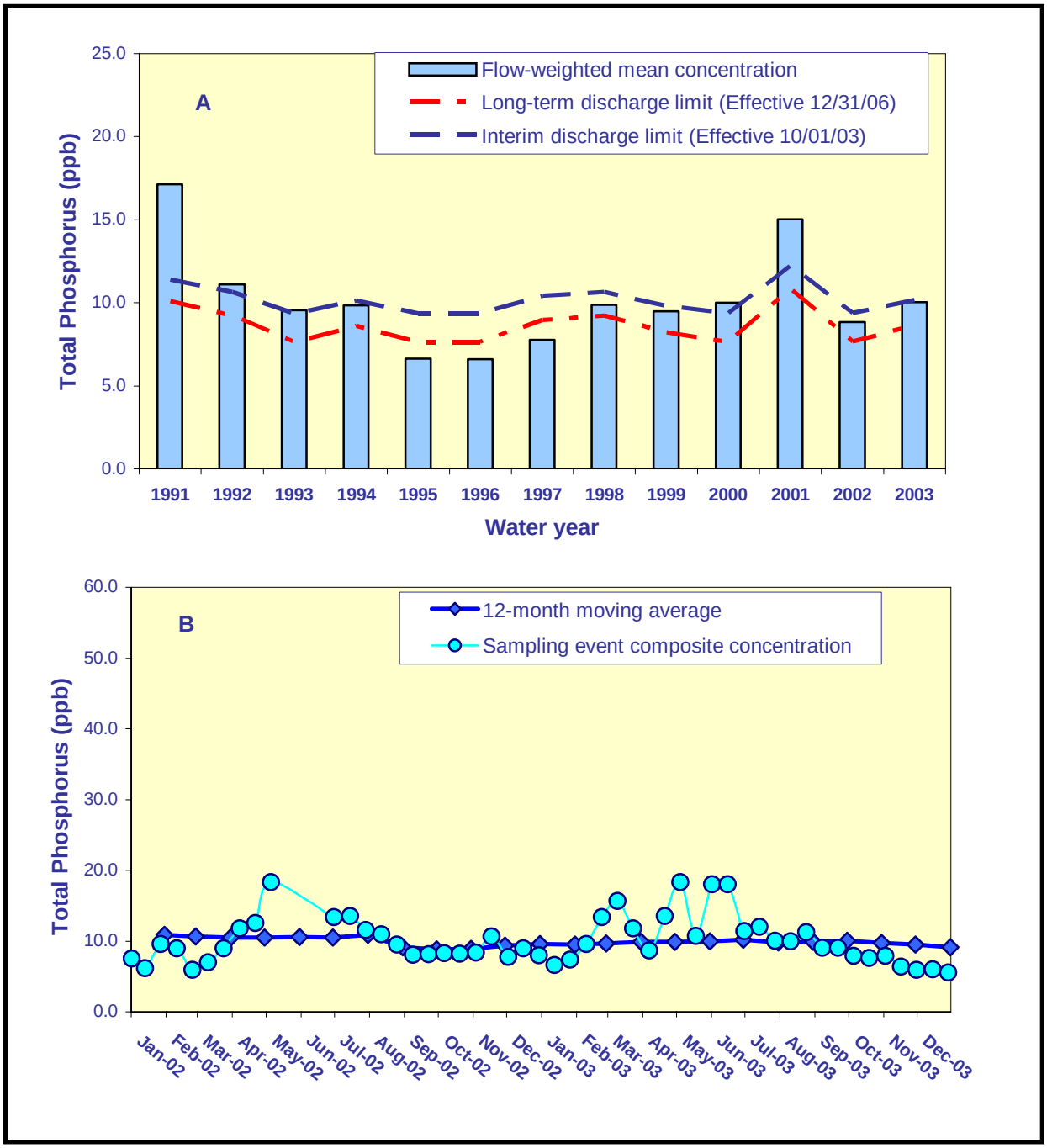

Figure 3. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough.
A. The 12-month moving average fwmc at the end of each water year compared to the total phosphorus interim and long-term limits.
B. The 12-month moving average fwmc at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

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	(%)	
	(Kac-ft)	(ppb)	10/1/2003	12/31/2006	Guideline	Observed
31-Jan-02	707.8	10.9	10.8	9.4	48.9	***52.6***
28-Feb-02	741.3	10.7	10.6	9.2	48.0	45.0
31-Mar-02	809.5	10.5	10.3	8.9	46.1	40.9
30-Apr-02	829.9	10.5	10.3	8.8	45.6	40.9
31-May-02	833.5	10.5	10.2	8.7	45.5	43.5
30-Jun-02	839.6	10.5	10.2	8.7	45.3	40.9
31-Jul-02	958.5	10.9	9.7	8.1	42.4	***45.8***
31-Aug-02	1003.2	9.1	9.6	7.9	41.4	39.1
30-Sep-02	1048.1	8.8	9.4	7.7	40.4	30.4
31-Oct-02	999.9	8.9	9.6	7.9	41.5	30.4
30-Nov-02	884.5	9.4	10.0	8.5	44.2	34.8
31-Dec-02	802.2	9.6	10.4	8.9	46.3	33.3
31-Jan-03	831.1	9.5	10.3	8.8	45.6	34.8
28-Feb-03	843.6	9.7	10.2	8.7	45.2	39.1
31-Mar-03	812.1	9.9	10.3	8.9	46.1	***47.8***
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	9.2	9.4	7.6	40.1	***46.2***

Notes: ***Bold italicized values exceeded guideline percentage***

The daily flows through the individual Shark River Slough structures and S334 from October 2001 through December 2003 are presented in **Figure 4A**. 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 4B.** Values for Water Years 2002 and 2003 follow the strong inverse relationship between flow and total phosphorus concentration expected for waters entering the Park through Shark River Slough. However, during the unseasonable rainfall conditions that occurred from February through May 2003, total phosphorus concentrations were greater and more variable, 9 to 18 ppb, than observed previously when flows were less than 500 cfs. From June through September 2003, increasing flows resulted in gradually decreasing total phosphorus concentrations from 18 ppb to 9 ppb. The concentration continued to decrease to 5.5 ppb by the end of December 2003.

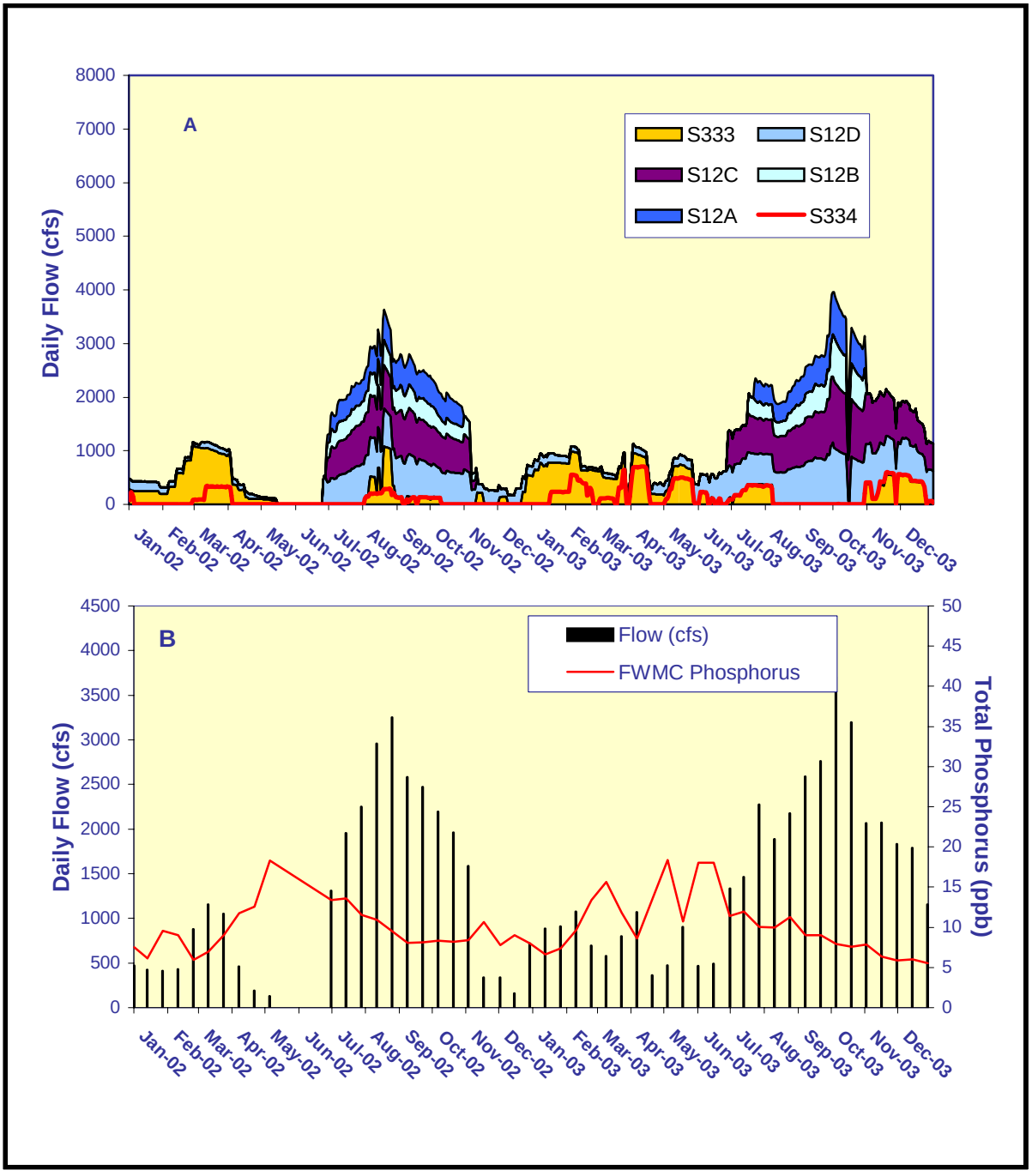

Figure 4. **A**. Daily flows into Shark River Slough (through S12 structures and S333) and flow through S334. **B**. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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 5**). 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 USACE has implemented 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 during the period between September 2001 and September 2003. There were no overflows during the period from October 2003 to December 2003. Data from the overflows will be presented graphically in this report when they occur. 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 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.

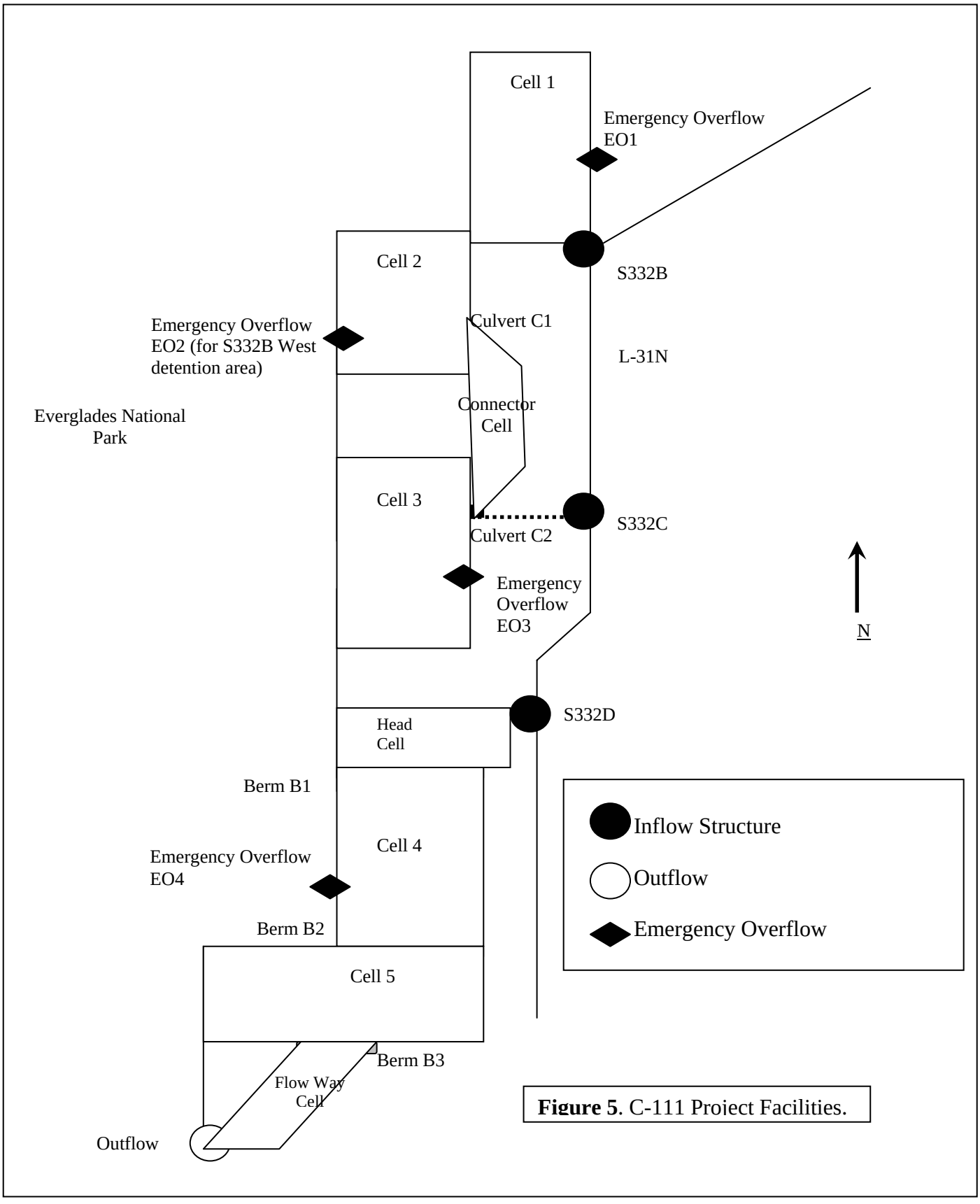

Figure 5. C-111 Project Facilities.

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 water years from 1999 through 2002 using data from both the old (S175, S332, S18C) and new (S174, S332D, S18C) combinations of structures (**Figure 6A**). The bars in **Figure 6A** represent the flow-weighted mean total phosphorus concentrations from S332, S175 and S18C for water years 1989 through 2002. In water year 2003, flows through S332 and S175 were intermittent. Flow through S332 totaled 97.64 cfs with 92.2 cfs pumped in December 2002. Flow through S175 totaled 467.8 cfs with 464.13 cfs passing through the structure in February 2003. Consequently, no flow-weighted mean total phosphorus was calculated for Water Year 2003 using the S332, S175 and S18C structures. The diamond point values for water years 1999 through 2003 represent the flow-weighted mean total phosphorus concentrations for S174, S332D and S18C. **Figure 6B** presents the 12-month moving average and individual sampling event flow-weighted mean total phosphorus concentrations at the S174, S332D and S18C structures.

The 12-month flow-weighted mean concentrations for October, November and December 2003 were 5.0, 5.1 and 5.0 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 0.0 for the periods ending October, November and December 2003.

The daily flows into Everglades National Park through S332D, S174 and S18C are presented in **Figure 7A**. **Figure 7B** 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 clear linear relationship between daily mean flow and flow-weighted mean total phosphorus concentrations at these structures.

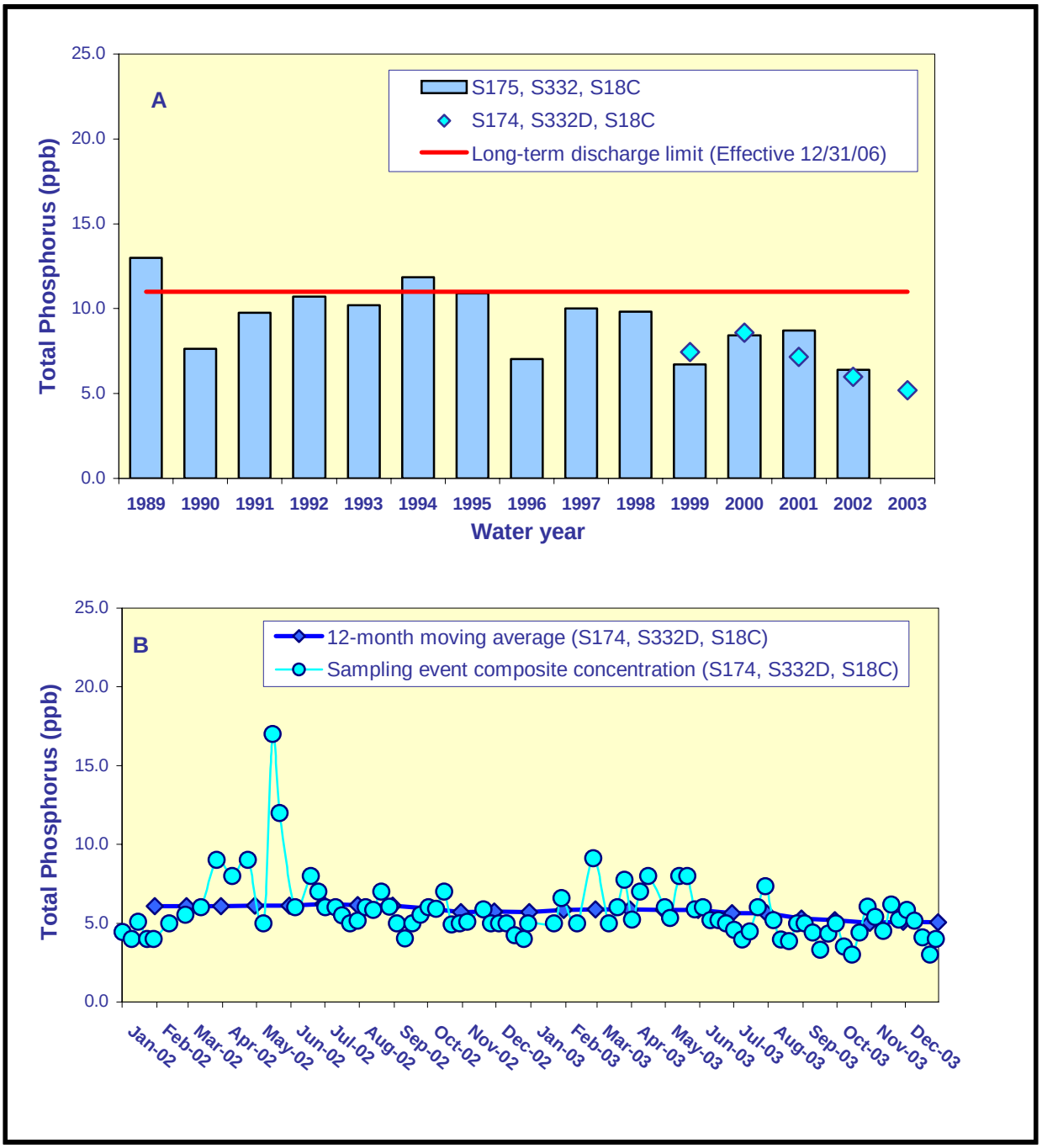

Figure 6. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins. **A.** The 12-month moving average fwmc at the end of each water year compared to the 11 ppb long-term total phosphorus limit. **B**. The 12-month moving average fwmc 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-02	316.0	6.1	11.0	53.1	5.9
28-Feb-02	320.6	6.1	11.0	53.1	0.0
31-Mar-02	325.9	6.1	11.0	53.1	0.0
30-Apr-02	331.1	6.1	11.0	53.1	0.0
31-May-02	336.4	6.1	11.0	53.1	5.0
30-Jun-02	364.3	6.2	11.0	53.1	4.9
31-Jul-02	392.1	6.1	11.0	53.1	4.7
31-Aug-02	388.3	6.1	11.0	53.1	4.7
30-Sep-02	371.8	6.0	11.0	53.1	4.7
31-Oct-02	316.0	5.7	11.0	53.1	4.5
30-Nov-02	271.6	5.8	11.0	53.1	4.8
31-Dec-02	249.8	5.7	11.0	53.1	4.7
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

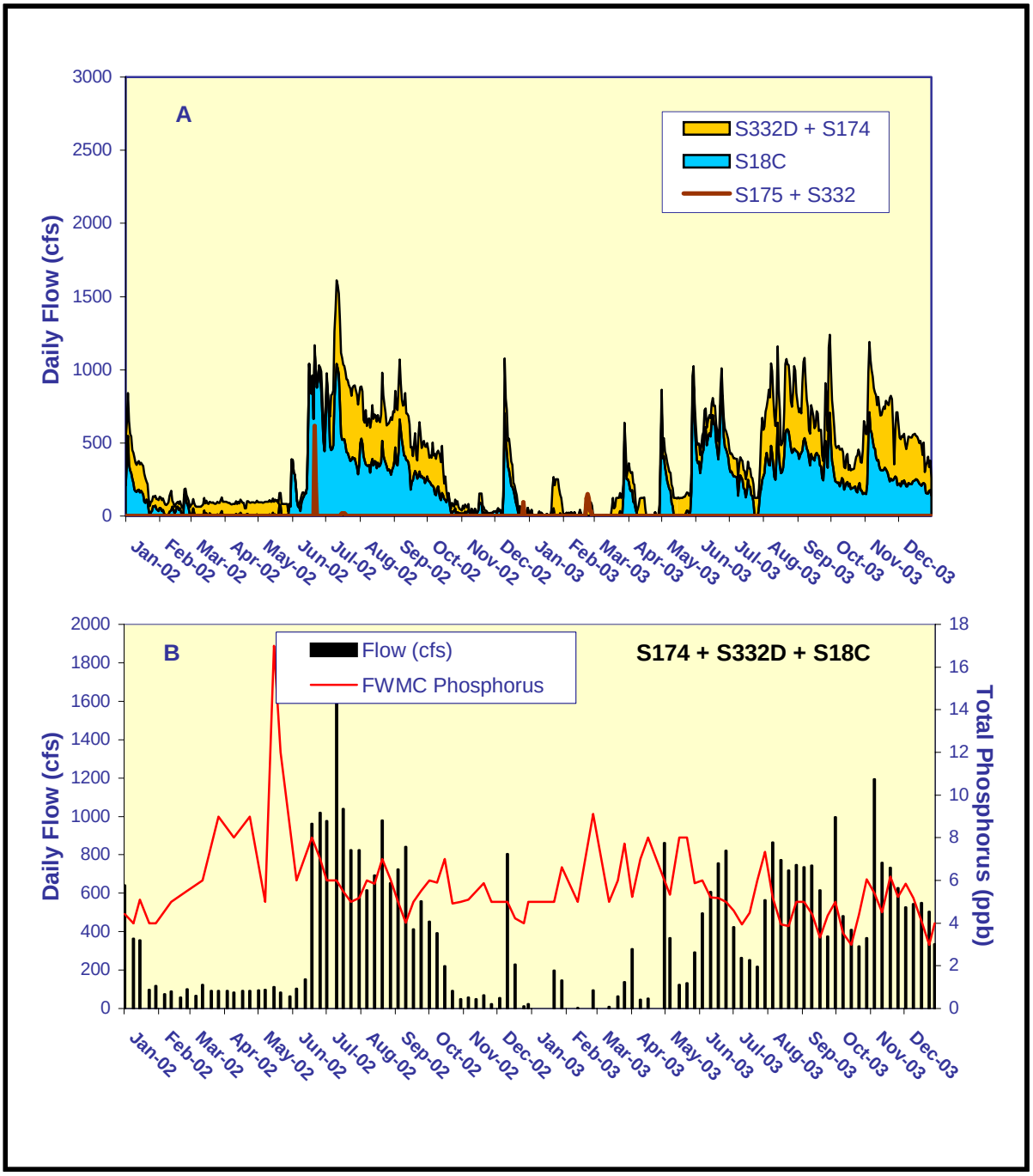

Figure 7. **A.** Daily flows through compliance structures into Everglades National Park through Taylor Slough and S18C. Flow through the original compliance structures is shown as a red line. **B**. The relationship between daily flows at Taylor Slough structures and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
January - March 2004 Report

Update, October 1, 2004: In Table 2, the guideline for percent of sampling events greater than 10 ppb was recalculated and updated.

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 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 interim and long-term concentration levels are applicable when the average stage is between 15.42 and 17.14 feet (NGVD). If the average stage is less than 15.42 feet (NGVD), the concentration levels are not applicable. If the average stage is more than 17.14 feet (NGVD), 17.14 feet is used for the level calculations. 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 16.71, 16.71 and 16.46 feet in January, February and March 2004, respectively (**Figure 2, Table 1)**. The geometric means, calculated from total phosphorus concentrations measured in water samples collected in January, February and March were 7.4, 8.2 and 9.0 ppb, respectively. These values were less than the interim and long-term levels for January, February and March.

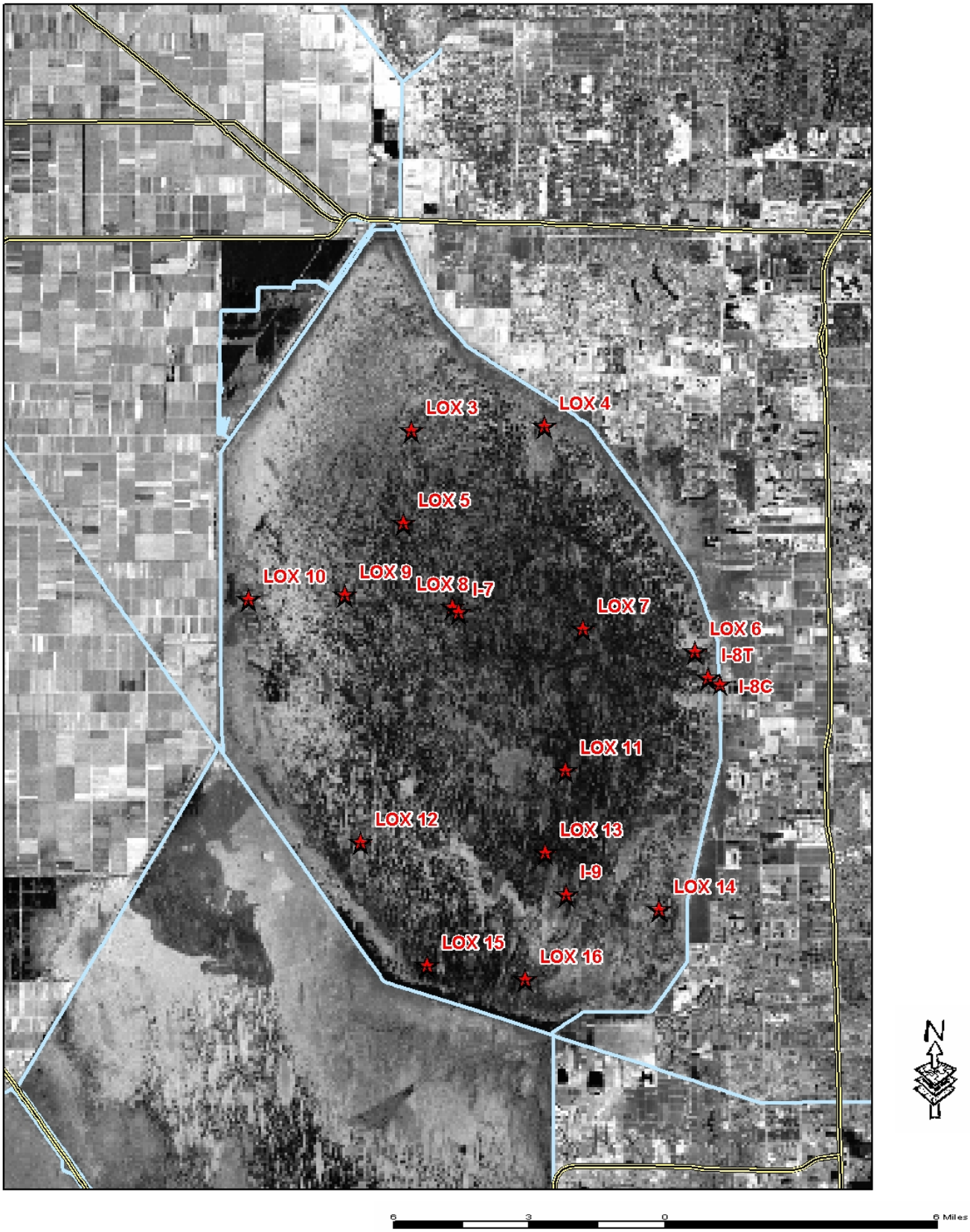


Figure 1. A.R.M. Loxahatchee Refuge Water Quality Sampling and Stage Measurement Sites

★ Station Location

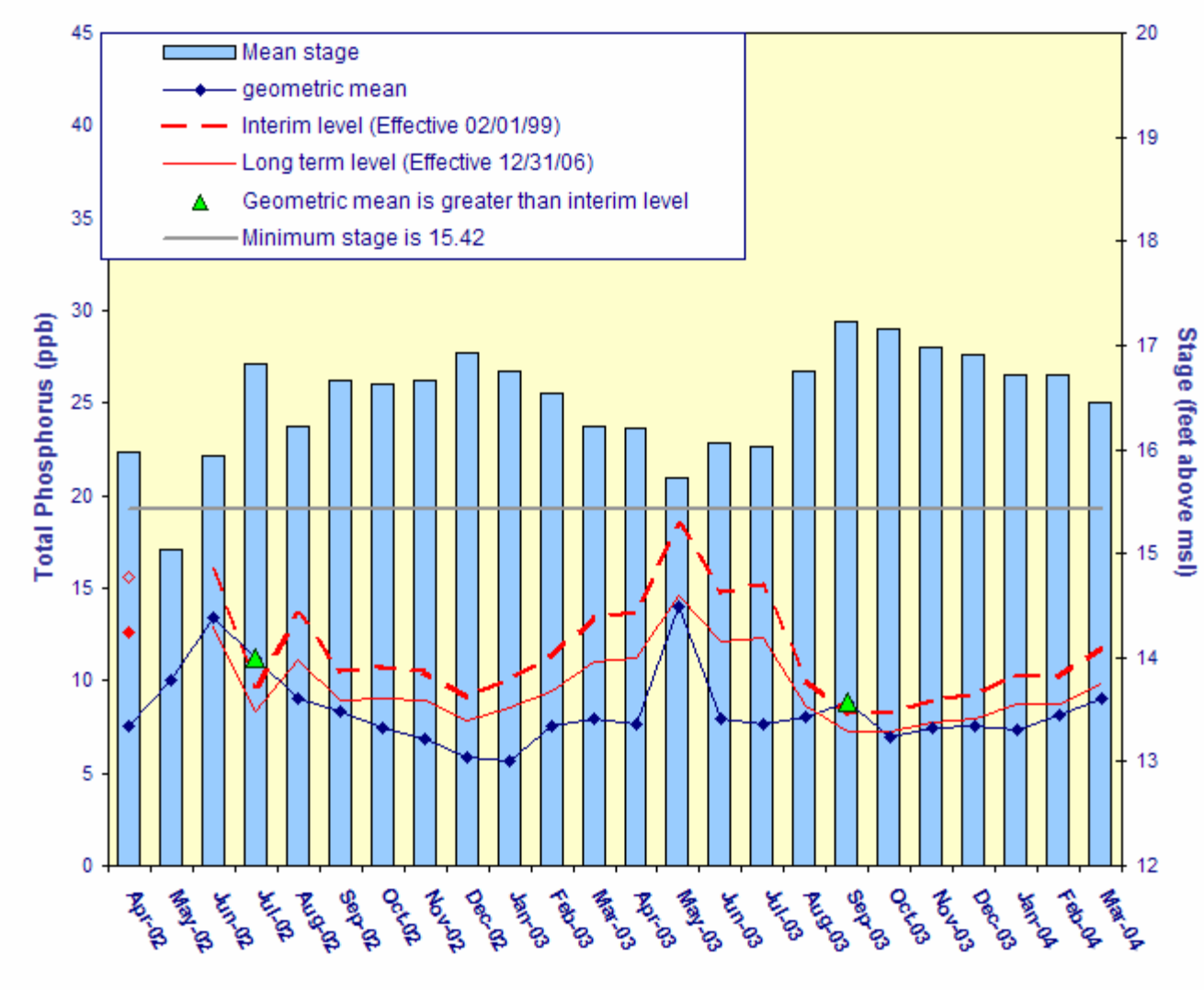


Figure 2. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. Interim and long-term levels are not applicable if the average stage is less than 15.42 ft. The calculated levels are adjusted for fluctuations in stage.

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

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft,NGVD)	Number of TP Samples	Number of Stage Measure-ments
Apr-2002	7.5	15.6	12.7	15.98	11	3
May-2002	10.0	N/A	N/A	15.04	3	3
Jun-2002	13.4	16.0	12.9	15.94	10	3
Jul-2002	11.2	9.7	8.3	16.82	14	3
Aug-2002	9.0	13.5	11.1	16.22	12	3
Sep-2002	8.3	10.6	8.9	16.66	11	3
Oct-2002	7.5	10.7	9.0	16.64	12	3
Nov-2002	6.9	10.5	8.9	16.66	12	3
Dec-2002	5.9	9.2	7.9	16.93	14	3
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

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.

EVERGLADES NATIONAL PARK

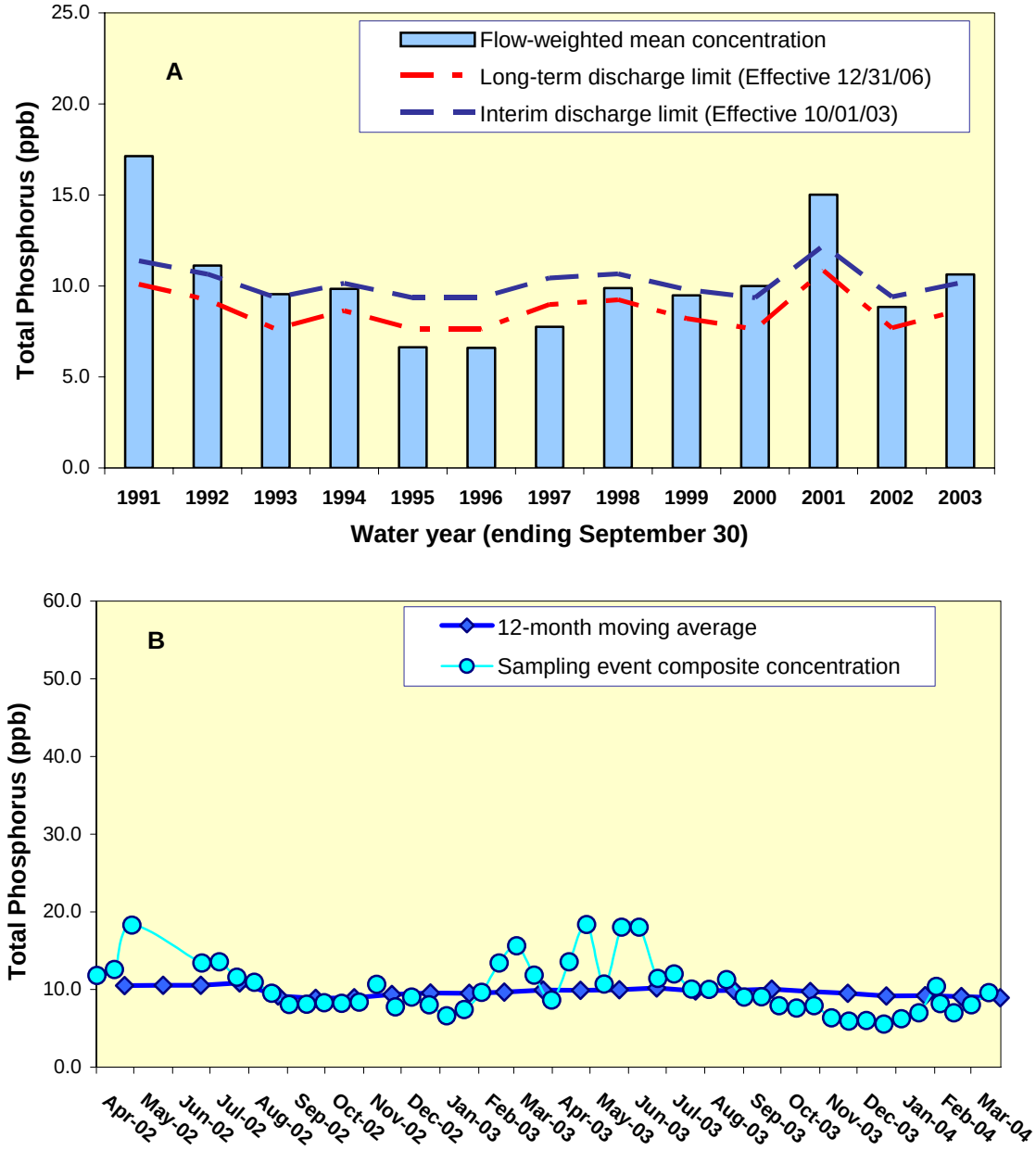
Shark River Slough

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 2003 (**Figure 3A**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 30, 2003 was 8.9 ppb. Corresponding interim and long-term limits were 9.4 and 7.7 ppb, respectively. For the ten-year period 1994 through 2003, the interim limit applicable to Shark River Slough has been met eighteen times. The limit was exceeded in Water Years 2000 and 2001.

Table 2 presents the moving flow-weighted mean concentrations for each 12-month period beginning in October 2001 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 2004, the flow-weighted mean total phosphorus concentrations were 9.2, 9.1 and 8.9 ppb, respectively. The January, February and March concentrations were less than the interim limits. The long-term limits were exceeded in each of these recent months.

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 2004, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 46.2, 44.4 and 37.0, respectively. January and February observed percentages were greater than the guidelines (**Table 2**). The individual sampling events and the 12-month moving average are presented in **Figure 3B**.



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A. The 12-month moving average fwmc at the end of each water year compared to the total phosphorus interim and long-term limits.
B. The 12-month moving average fwmc at the end of each month and the composite total phosphorus concentration for each sampling event.

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	(%)	
	(Kac-ft)	(ppb)	10/1/2003	12/31/2006	Guideline	Observed
30-Apr-02	829.9	10.5	10.3	8.8	45.6	40.9
31-May-02	833.5	10.5	10.2	8.7	45.5	43.5
30-Jun-02	839.6	10.5	10.2	8.7	45.3	40.9
31-Jul-02	958.5	10.9	9.7	8.1	42.4	***45.8***
31-Aug-02	1003.2	9.1	9.6	7.9	41.4	39.1
30-Sep-02	1048.1	8.8	9.4	7.7	40.4	30.4
31-Oct-02	999.9	8.9	9.6	7.9	41.5	30.4
30-Nov-02	884.5	9.4	10.0	8.5	44.2	34.8
31-Dec-02	802.2	9.6	10.4	8.9	46.3	33.3
31-Jan-03	831.1	9.5	10.3	8.8	45.6	34.8
28-Feb-03	843.6	9.7	10.2	8.7	45.2	39.1
31-Mar-03	812.1	9.9	10.3	8.9	46.1	***47.8***
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

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

The daily flows through the individual Shark River Slough structures and S334 from October 2001 through March 2004 are presented in **Figure 4A**. 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 2003.

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 4B.** Values for Water Years 2001 and 2002 follow the strong inverse relationship between flow and total phosphorus concentration expected for waters entering the Park through Shark River Slough. However, during the un-seasonal rainfall conditions that occurred from February through June 2003, total phosphorus concentrations were greater and more variable, 9 to 18 ppb, than observed previously when flows were less than 500 cfs. From June through September 2003, increasing flows resulted in gradually decreasing total phosphorus concentrations from 18 ppb to 9 ppb. The concentration continued to decrease to 5.5 ppb by the end of December 2003, but shows an increasing trend with the reduced flows experienced during the first quarter of 2004.

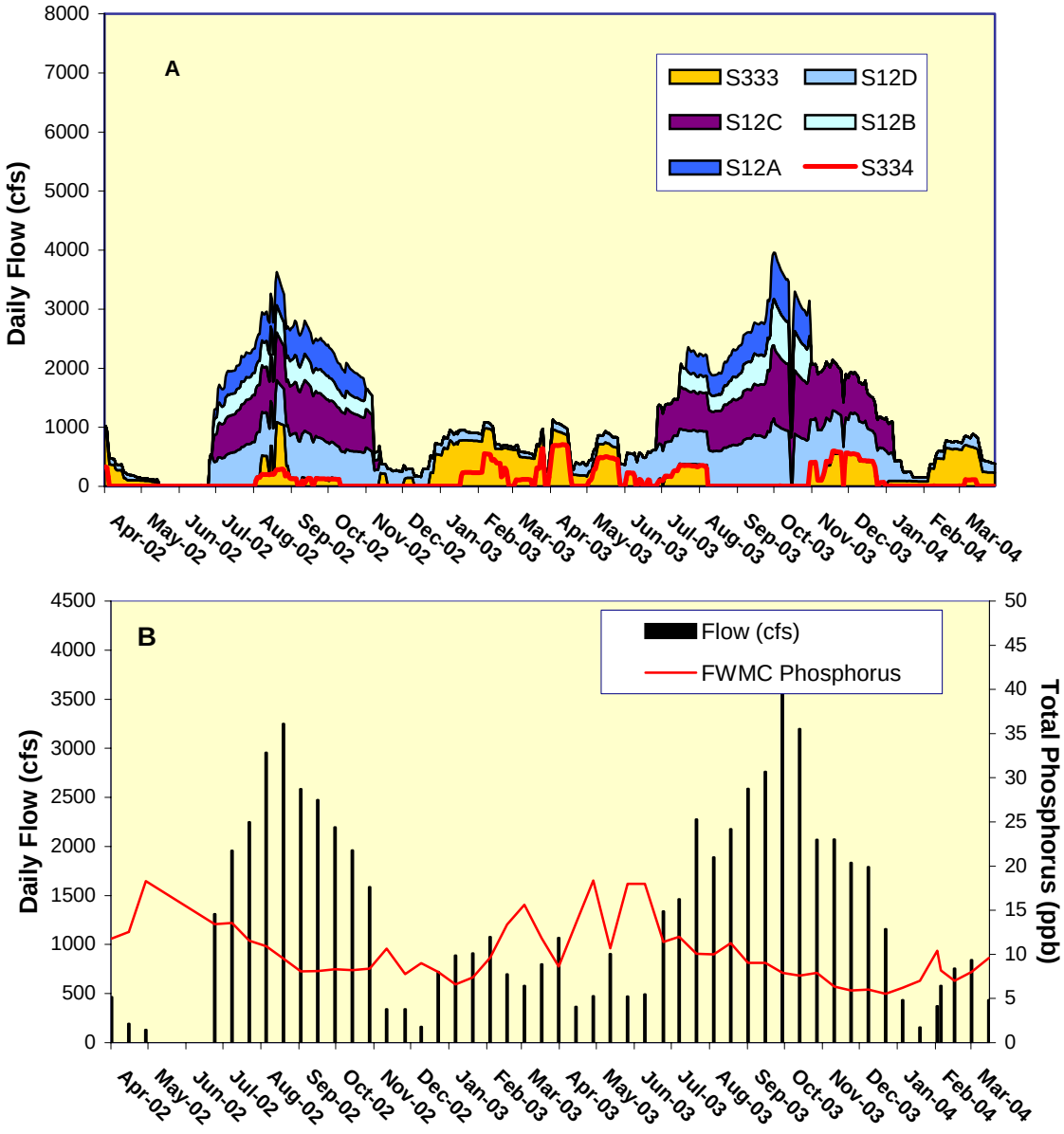

Figure 4. **A**. Daily flows into Shark River Slough (through S12 structures and S333) and flow through S334. **B**. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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 5**). The Flow Way Cell is the only location where surface water routinely discharges 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 USACE has implemented 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. **There were no overflows during the period from October 2003 through March 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 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.

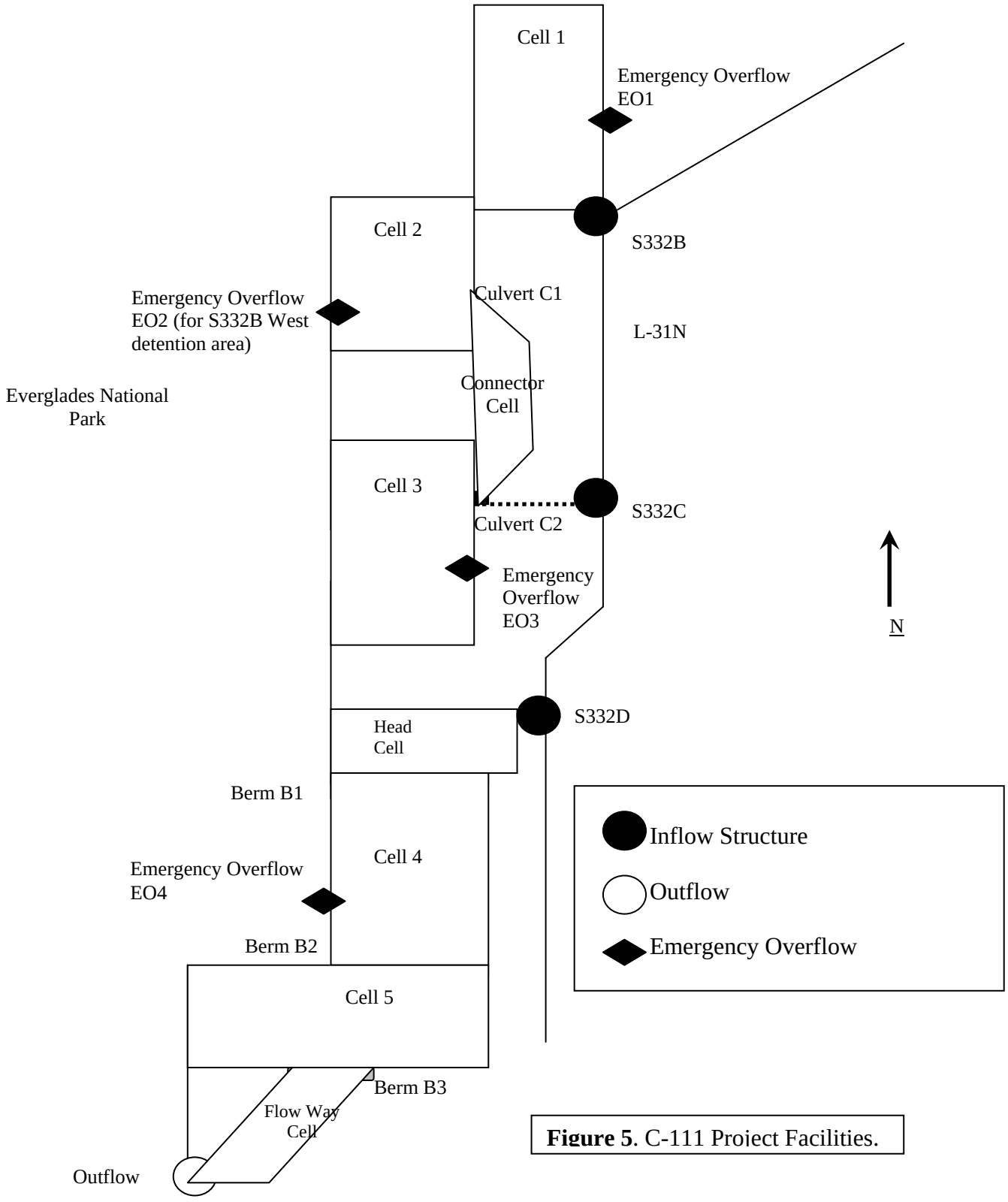

Figure 5. C-111 Project Facilities.

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 6A**). The bars in **Figure 6A** 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 2002 represent the new combination of structures. **Figure 6B** 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 6B**.

The 12-month flow-weighted mean concentrations for January, February and March 2004 were 5.1, 5.0 and 5.0 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 0.0, 0.0 and 0.0 for the periods ending January, February and March 2004.

The daily flows into Everglades National Park through S332D, S174 and S18C are presented in **Figure 7A**. **Figure 7B** 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.

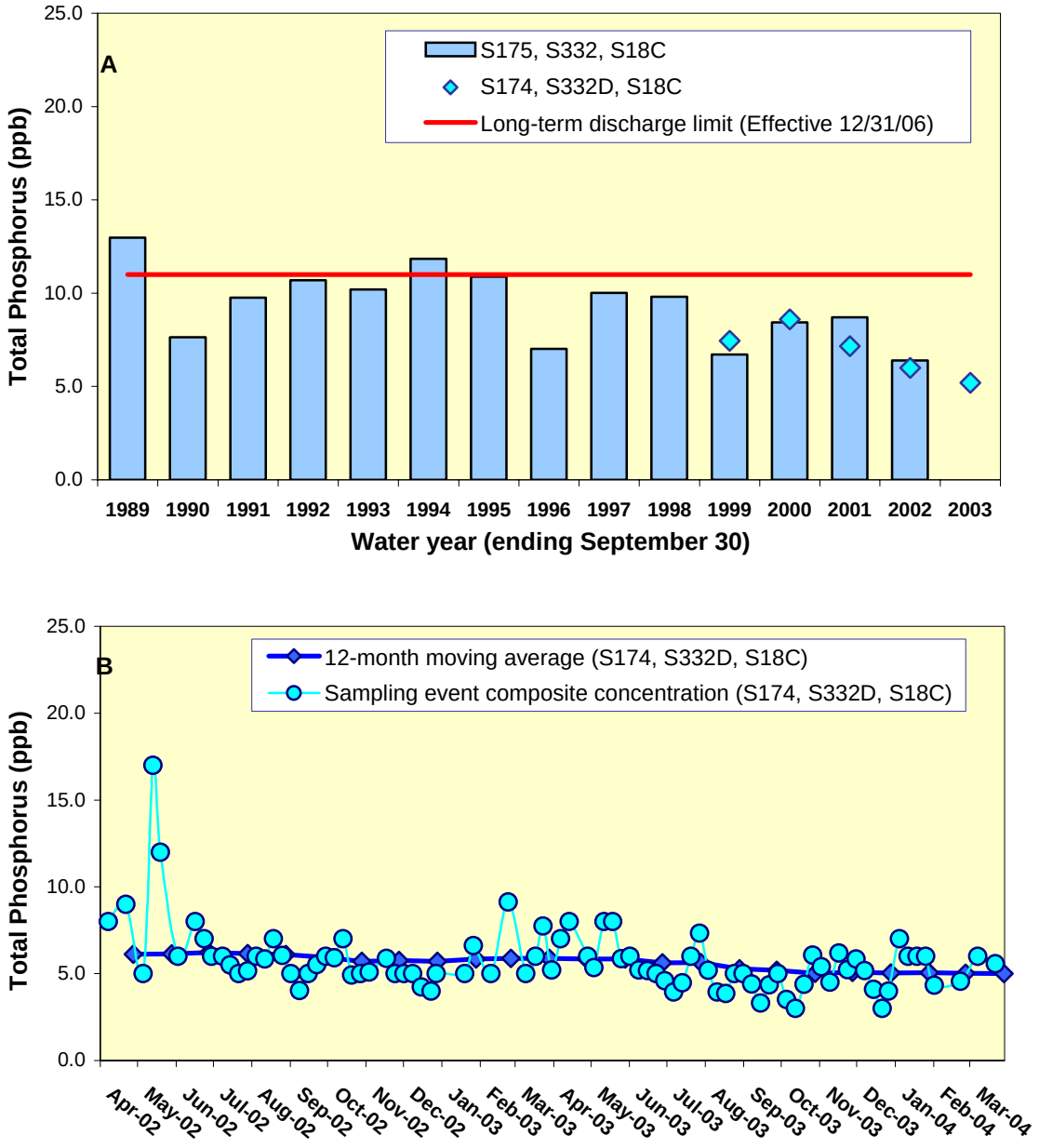

Figure 6. Total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins. **A.** The 12-month moving average fwmc at the end of each water year compared to the 11 ppb long-term total phosphorus limit. **B**. The 12-month moving average fwmc 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-02	331.1	6.1	11.0	53.1	0.0
31-May-02	336.4	6.1	11.0	53.1	5.0
30-Jun-02	364.3	6.2	11.0	53.1	4.9
31-Jul-02	392.1	6.1	11.0	53.1	4.7
31-Aug-02	388.3	6.1	11.0	53.1	4.7
30-Sep-02	371.8	6.0	11.0	53.1	4.7
31-Oct-02	316.0	5.7	11.0	53.1	4.5
30-Nov-02	271.6	5.8	11.0	53.1	4.8
31-Dec-02	249.8	5.7	11.0	53.1	4.7
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

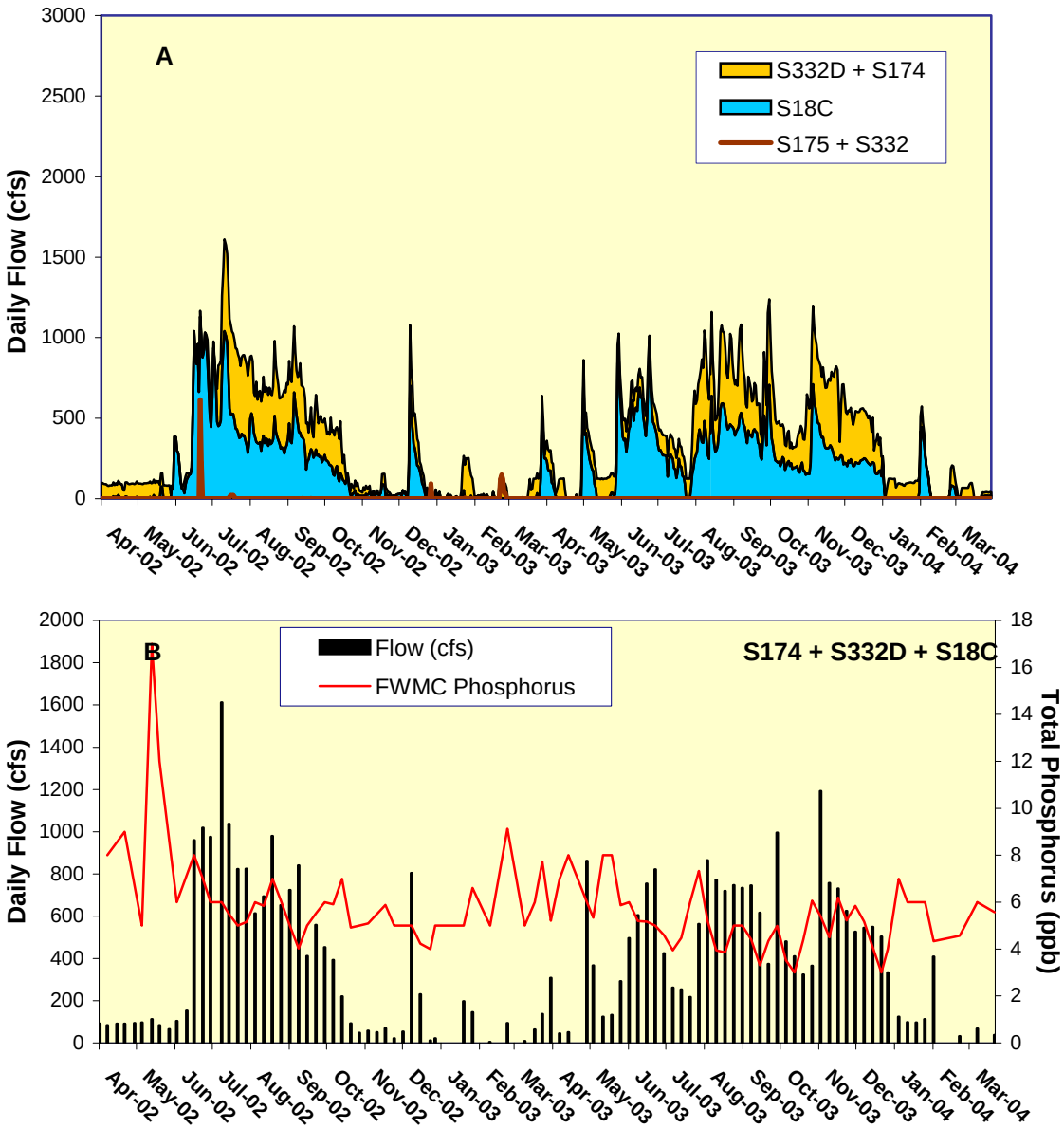

Figure 7. **A.** Daily flows into Everglades National Park through Taylor Slough and S18C. **B**. The relationship between daily flows at Taylor Slough structures and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
April - June 2004 Report

Prepared for the
Technical Oversight Committee
November 19, 2004

Prepared by:
Julianne LaRock, Cheol Mo and Violeta Ciuca
Water Quality Assessment Division
South Florida Water Management District
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West Palm Beach, FL 33406

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.

Average stages in the Refuge were 15.91, 15.37 and 15.22 feet in April, May and June 2004, respectively (**Figure 2** and **Table 1)**. The geometric means, calculated from total phosphorus concentrations measured in water samples collected in April, May and June 2004 were 9.6, 12.4 and 40.0 ppb, respectively. The interim and long-term limits for April 2004 were 16.3 and 131.1 ppb respectively. The interim and long-term limits for May and June were not calculated because the average stages for these months were below 15.42 feet NGVD. The geometric mean for April was below both the interim and long-term levels.

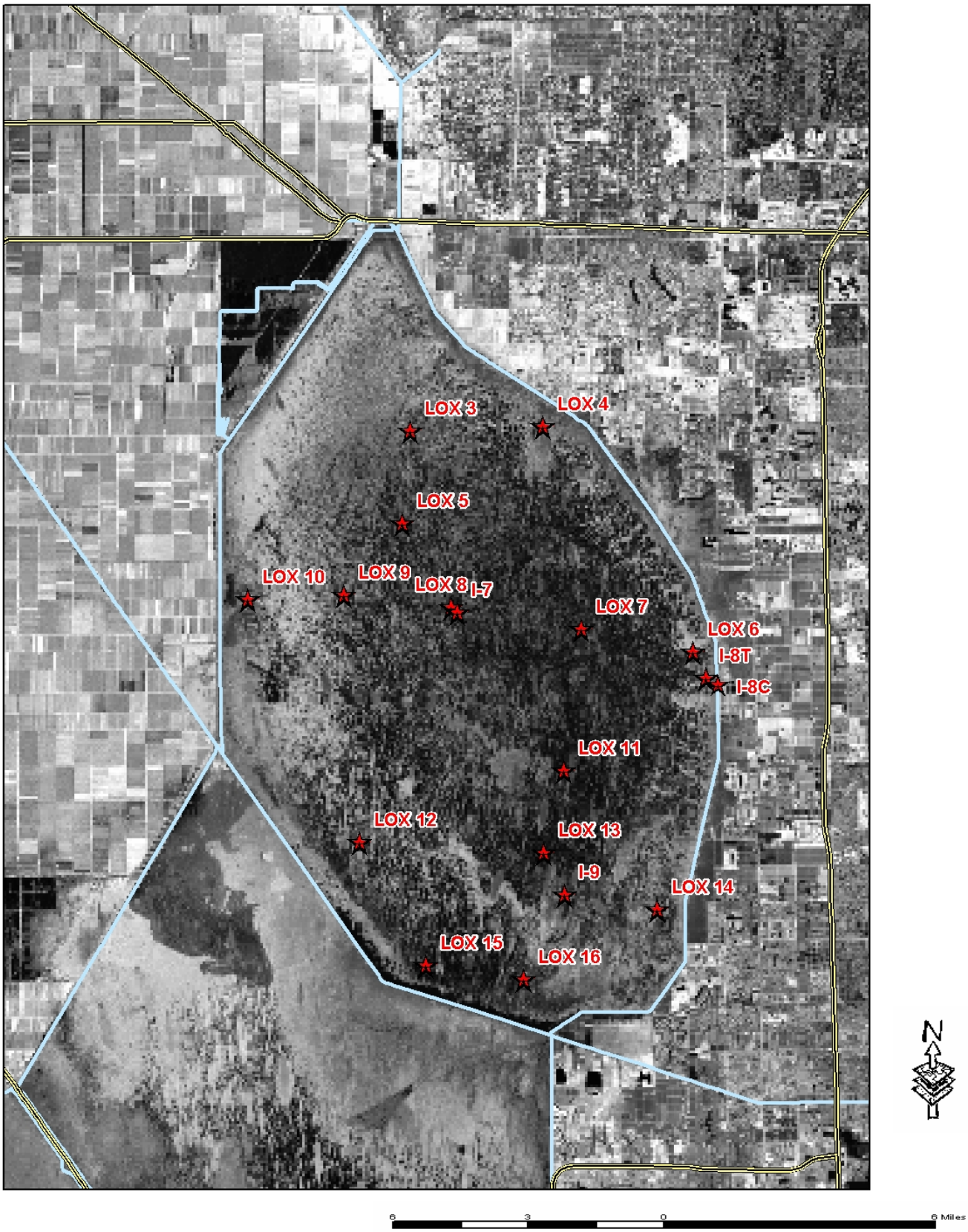

Figure 1. A.R.M. Loxahatchee Refuge Water Quality Sampling and Stage Measurement Sites

★ Station Location

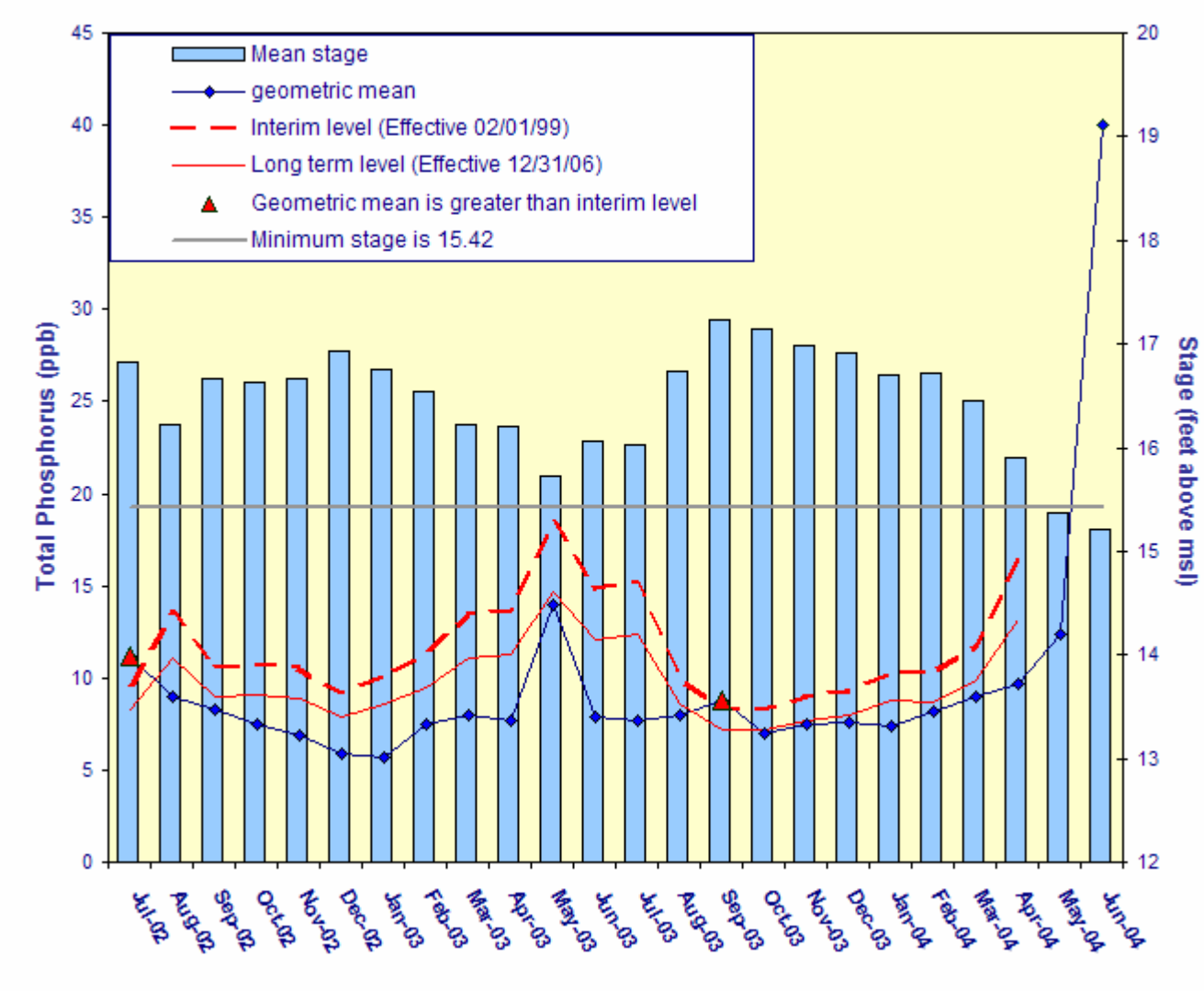

Figure 2. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

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

Month - Year	Geometric Mean Concentratio (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft,NGVD)	Number of TP Samples	Number of Stage Measure-ments
Jul-2002	11.2	9.7	8.3	16.82	14	3
Aug-2002	9.0	13.5	11.1	16.22	12	3
Sep-2002	8.3	10.6	8.9	16.66	11	3
Oct-2002	7.5	10.7	9.0	16.64	12	3
Nov-2002	6.9	10.5	8.9	16.66	12	3
Dec-2002	5.9	9.2	7.9	16.93	14	3
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

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.

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 2003 (**Figure 3**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2003 was 10.0 ppb. Corresponding interim and long-term limits were 10.2 and 8.7 ppb, respectively. For the ten-year period 1994 through 2003, the interim limit applicable to Shark River Slough has been met eight times. The limit was exceeded in Water Years 2000 and 2001.

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 April, May and June 2004, the flow-weighted mean total phosphorus concentrations were 9.0, 9.0 and 8.7 ppb, respectively. The interim limits were 9.5, 9.7 and 9.8 ppb, respectively. The long-term limits were 7.9, 8.0 and 8.2 ppb, respectively. The April, May and June 2004 concentrations were less than the interim limit. The long-term limits were exceeded in each of these recent months.

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 April, May and June 2004, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 40.7, 40.7 and 36.0, respectively. April , May and June observed percentages were less than the guidelines (**Table 2**). The individual sampling events and the 12-month moving average are presented in **Figure 4**.

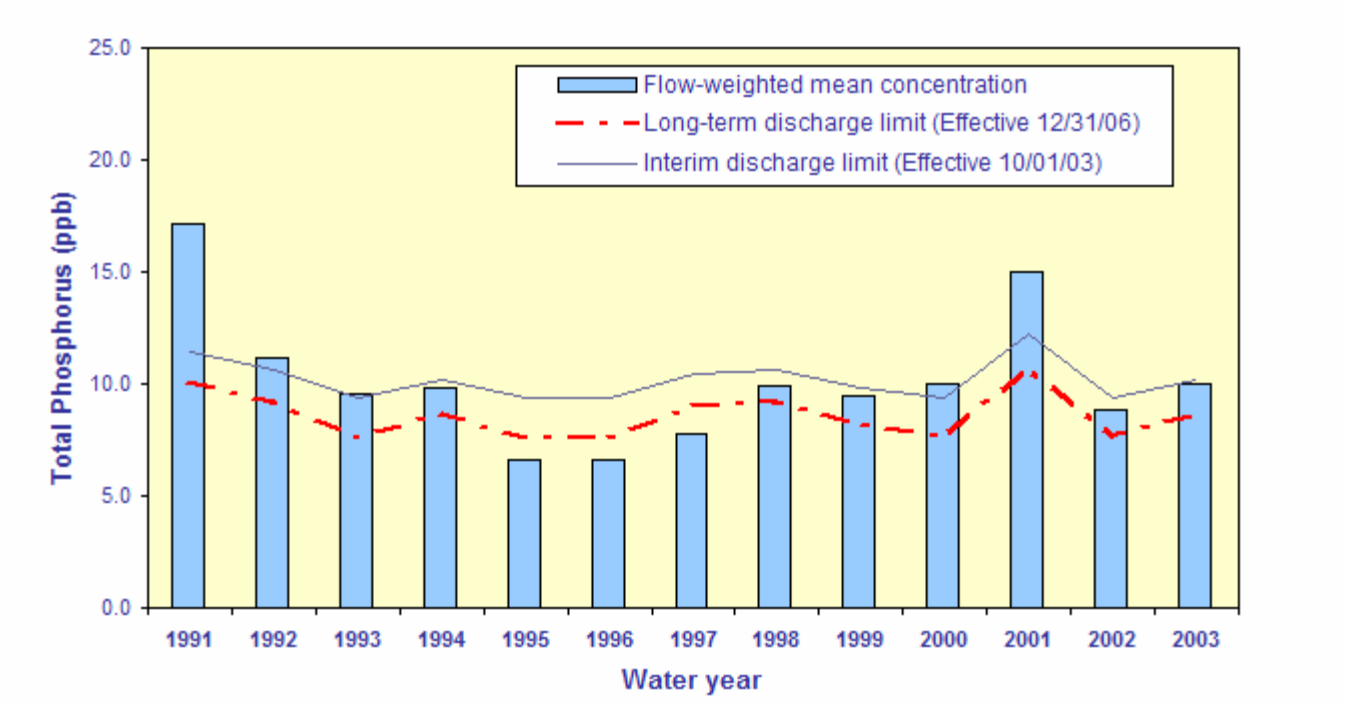

Figure 3. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the total phosphorus interim and long-term limits.

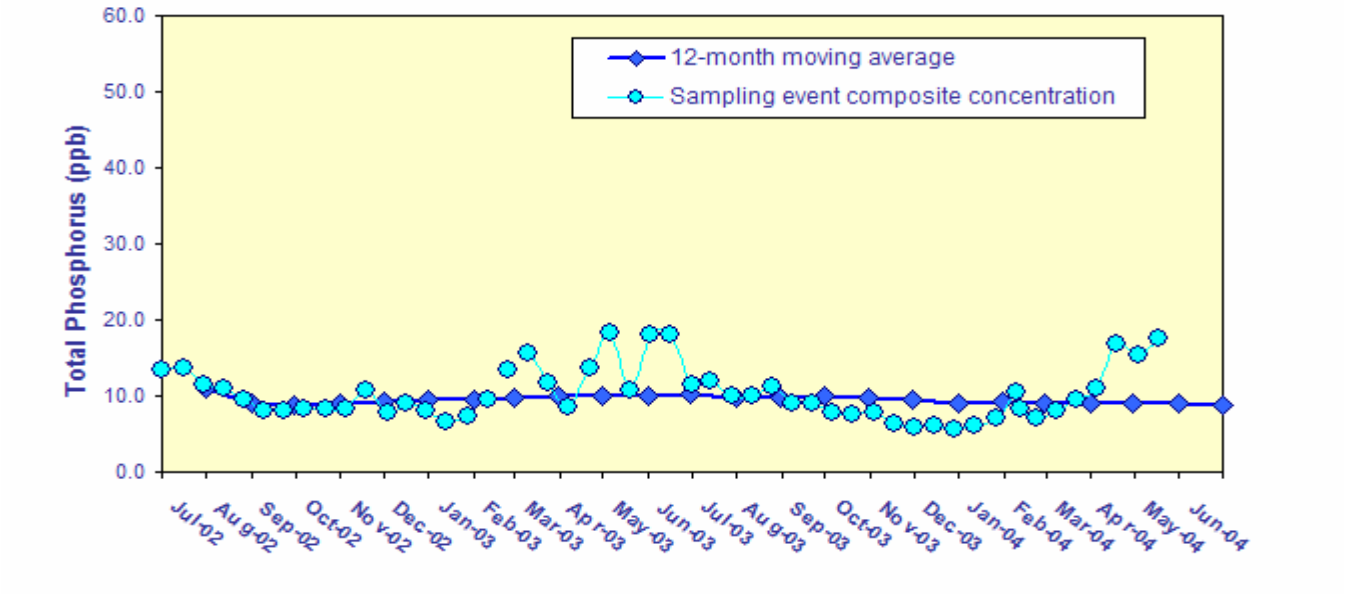

Figure 4. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each month and the composite total phosphorus concentration for each sampling event. There are no sampling event values for June,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

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	(%)	
	(Kac-ft)	(ppb)	10/1/2003	12/31/2006	Guideline	Observed
31-Jul-02	958.5	10.9	9.7	8.1	42.4	***45.8***
31-Aug-02	1003.2	9.1	9.6	7.9	41.4	39.1
30-Sep-02	1048.1	8.8	9.4	7.7	40.4	30.4
31-Oct-02	999.9	8.9	9.6	7.9	41.5	30.4
30-Nov-02	884.5	9.4	10.0	8.5	44.2	34.8
31-Dec-02	802.2	9.6	10.4	8.9	46.3	33.3
31-Jan-03	831.1	9.5	10.3	8.8	45.6	34.8
28-Feb-03	843.6	9.7	10.2	8.7	45.2	39.1
31-Mar-03	812.1	9.9	10.3	8.9	46.1	***47.8***
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***
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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

Notes: Bold italicized values exceeded the guideline percentages.

The daily flows through the individual Shark River Slough structures from July 2002 through June 2004 are presented in **Figure 5**.

The total inflow to Shark River Slough during the reporting quarter, April 2004 through June 2004 was 28,500 acre-feet. Almost all of that flow was through S333 and S12D only. The total flow was relatively small compared to the previous 10 year average, 101,700 acre-feet for the same quarter, April through 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 Park through Shark River Slough. The current quarter sampling event flow-weighted mean concentrations ranged from 11.0 to 17.6 ppb.

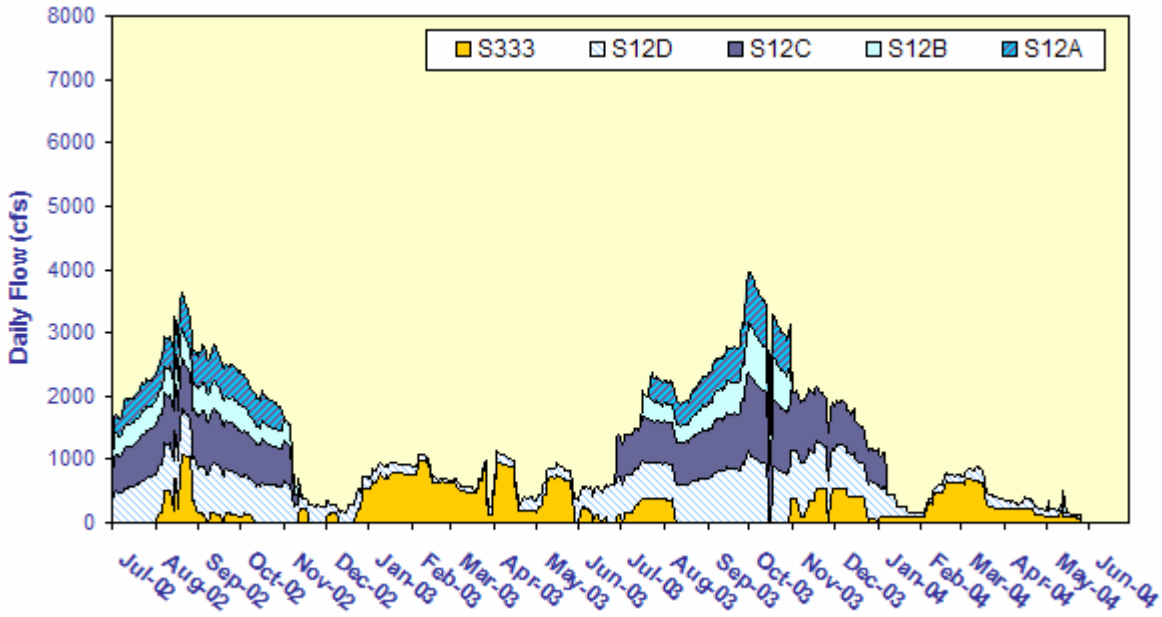

Figure 5. Daily flows into Shark River Slough by structure.

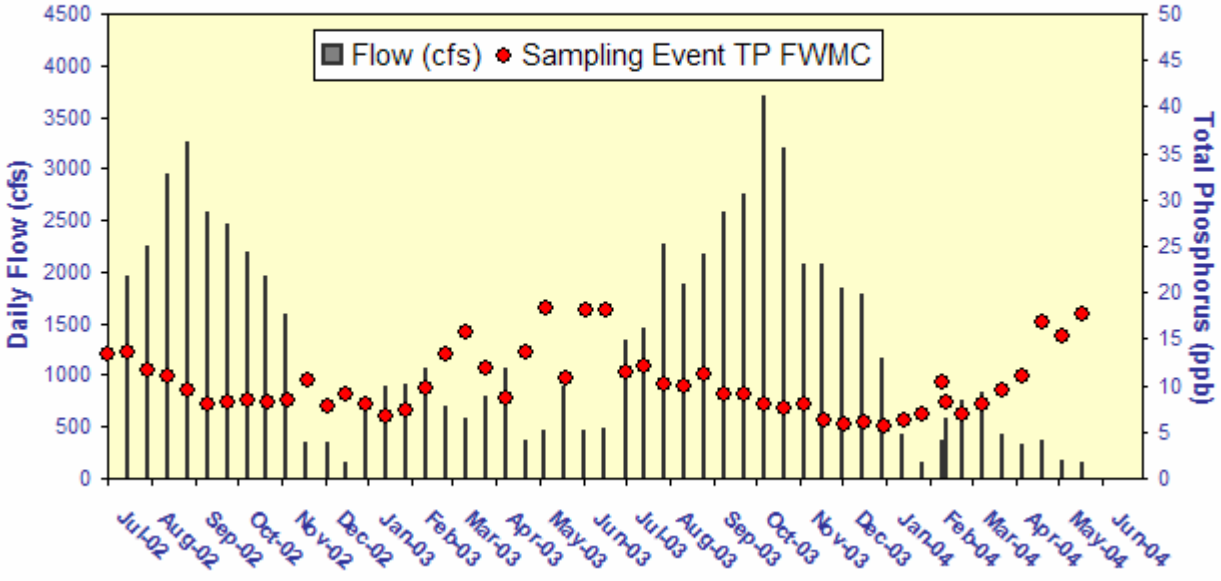

Figure 6. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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 June 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 District will continue to report

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

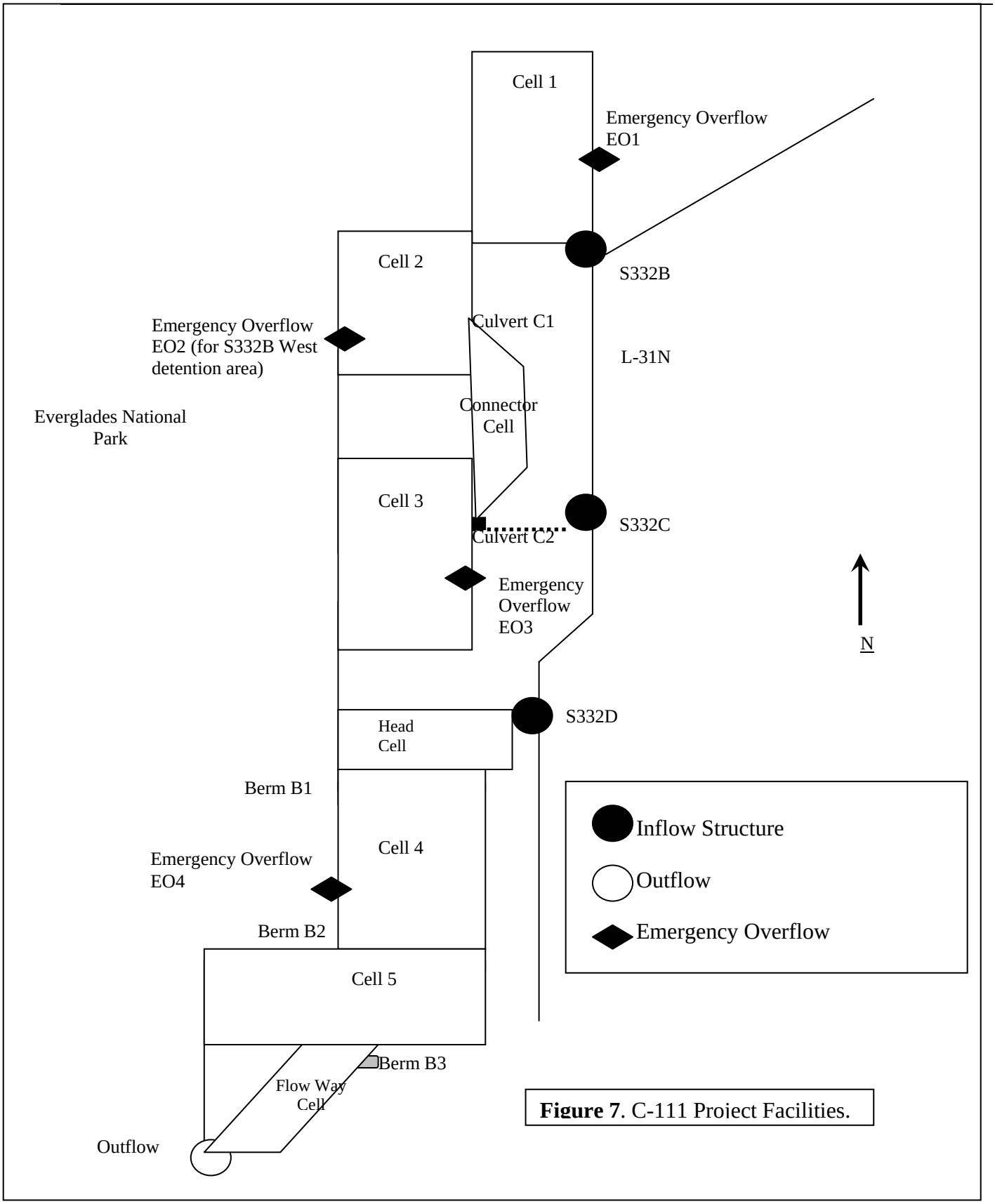

Figure 7. C-111 Project Facilities.

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 April, May and June 2004 were 5.0, 4.9 and 4.9 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 0.0, 2.2 and 6.8 ppb for the periods ending April, May and June 2004.

The daily flows into Everglades National Park through S332D, S174 and S18C are presented in **Figure 10**.

There was very little flow through the system during the reporting quarter, April 2004 through June 2004. The flow during the quarter into Taylor Slough through S174 and S332D and into the Coastal Basins through S18C during the quarter was 3,860 acre-feet. This was much smaller than the previous 10 year average – 48,260 acre-feet – for the same quarter.

Figure 11 shows the relationship between the daily inflows and the corresponding flow-weighted mean total phosphorus concentrations for each sampling event. There had been no observable relationship between daily mean flow and total phosphorus concentrations at these structures. Sampling event flow-weighted mean total phosphorus concentrations were highly variable, ranging from 5.0 ppb to 14.0 ppb.

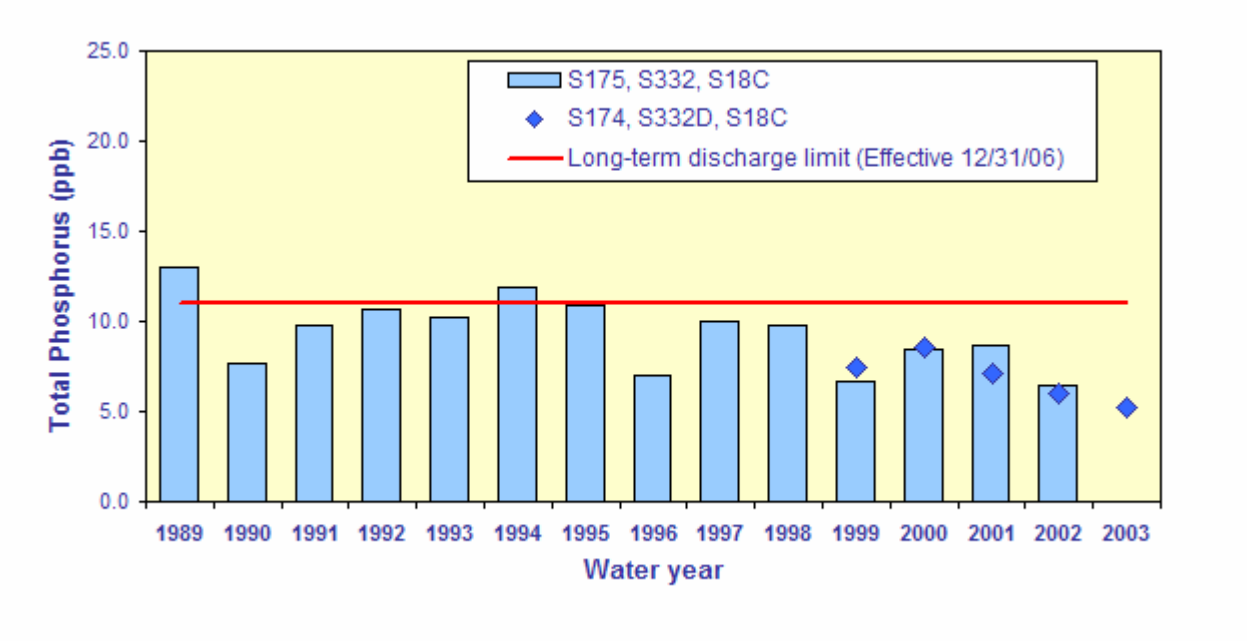

Figure 8. **A.** The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term total phosphorus limit.

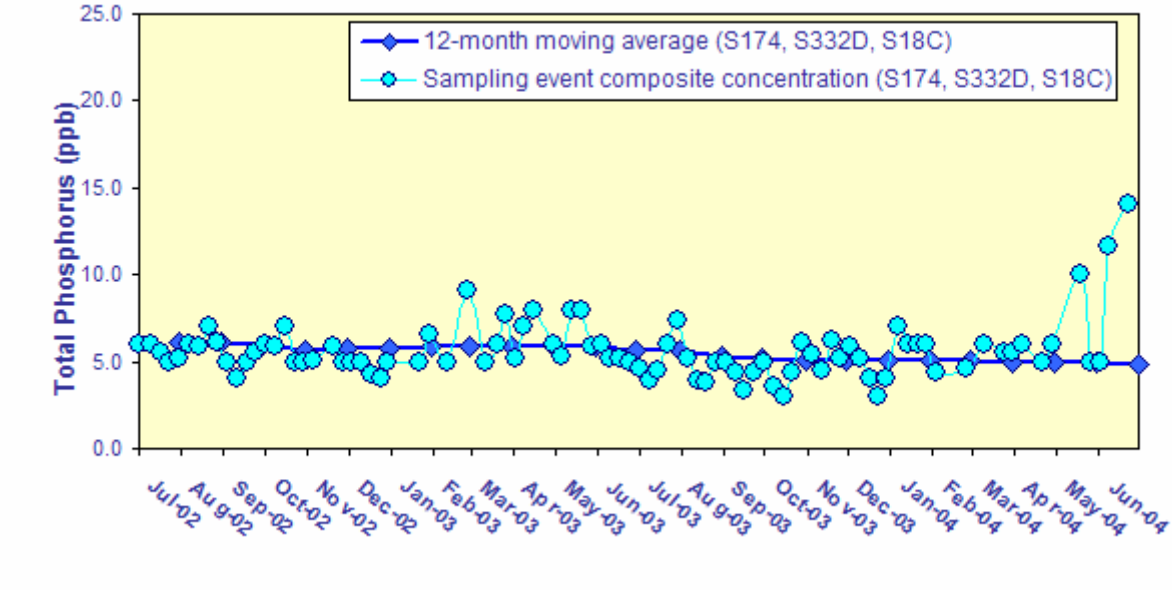

Figure 9. 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the composite total phosphorus concentration for each sampling event.

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-Jul-02	392.1	6.1	11.0	53.1	4.7
31-Aug-02	388.3	6.1	11.0	53.1	4.7
30-Sep-02	371.8	6.0	11.0	53.1	4.7
31-Oct-02	316.0	5.7	11.0	53.1	4.5
30-Nov-02	271.6	5.8	11.0	53.1	4.8
31-Dec-02	249.8	5.7	11.0	53.1	4.7
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	6.8

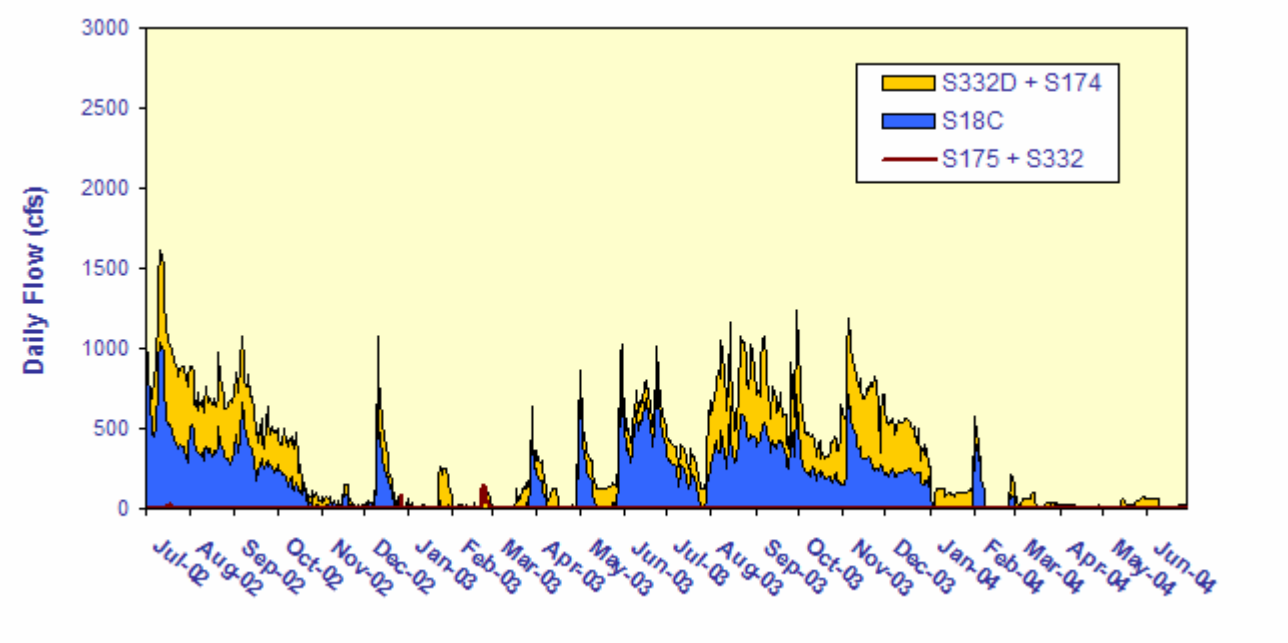

Figure 10. Daily flows into Everglades National Park through Taylor Slough and S18C.

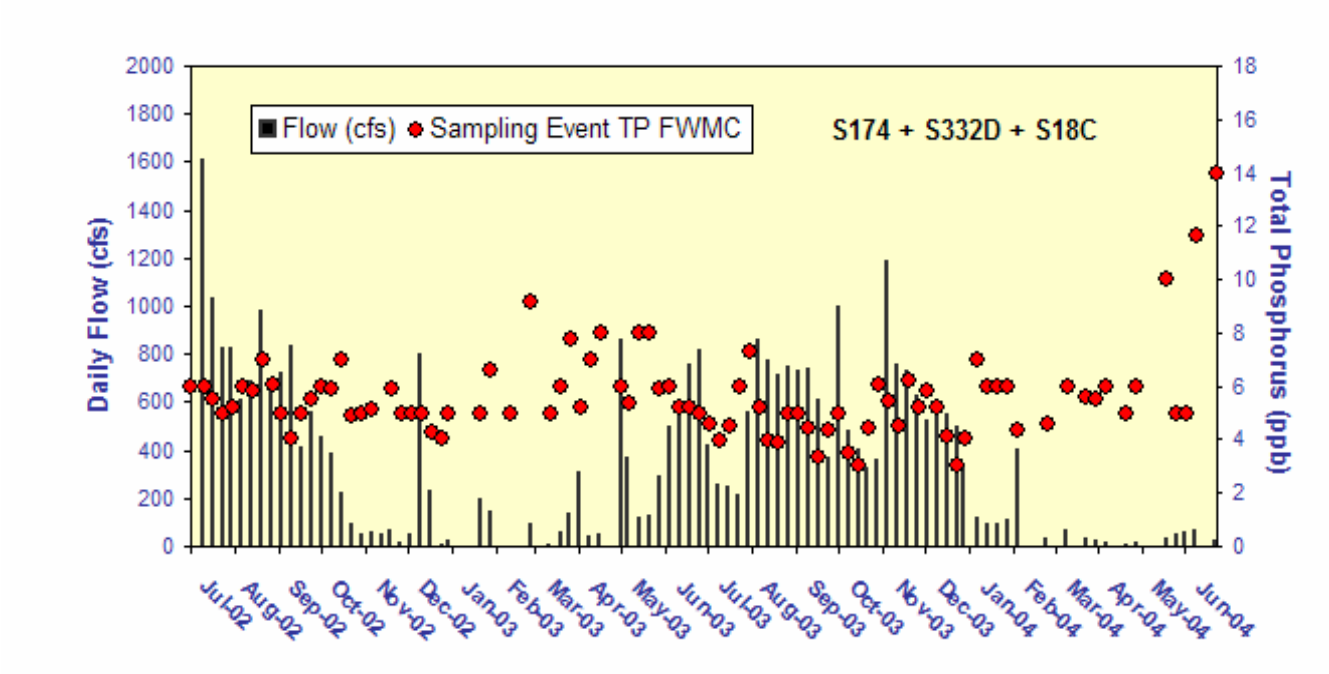

Figure 11. The relationship between daily flows at Taylor Slough structures and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
July - September 2004 Report

Update, February 28, 2005: On page 1, the text was revised to show the correct date (November 8, 2004) of the special meeting held in November

Prepared for the
Technical Oversight Committee
February 24, 2005

Prepared by:
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Water Quality Assessment Division
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406

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.

Average stages in the Refuge were 15.00, 16.00 and 16.79 feet in July, August and September 2004, respectively (**Figure 2** and **Table 1)**. Only one sample (LOX12) was collected in July because of the low stage at the other stations. During August, samples were not collected at LOX3 and LOX5 because of low stages. The geometric means, calculated from total phosphorus concentrations measured in water samples collected in July, August and September 2004 were 21.0, 17.5 and 8.5 ppb, respectively. Interim and long term limits are not applicable when the average stage is less than 15.42 feet, which was the case in July 2004. The interim limits for August and September were 15.4 and 9.9 ppb, respectively. The long-term limits were 12.5 and 8.4 ppb, respectively. The interim and long term limits were exceeded in August 2004. This was the subject of two (2) Special Technical Oversight Committee (TOC) meetings held November 8, 2004 and January 25, 2005, and a progress report on actions being taken to resolve exceedances is being prepared for the Principals to the Consent Decree.

Several hurricanes impacted Florida during this quarter. Hurricane Frances, on September 4 through 8 2004, disabled the satellite data collection platform at 1-8C. Possible alternates for this data include manual readings recorded by Refuge staff or readings from 1-8T or G-94C. Use of the manual readings was deemed most appropriate and resulted in the average stage of 16.79 for September. Had the values from 1-8T or G-94C been used, the average stage would have been 16.74 or 16.75 respectively and the limits would have been slightly higher. The platform at 1-8C was repaired on December 2, 2004. Manual readings will continue to be used for the months of October and November in determining compliance.

The long term level for September 2004 was exceeded slightly, but the geometric mean concentration was below the Interim level.

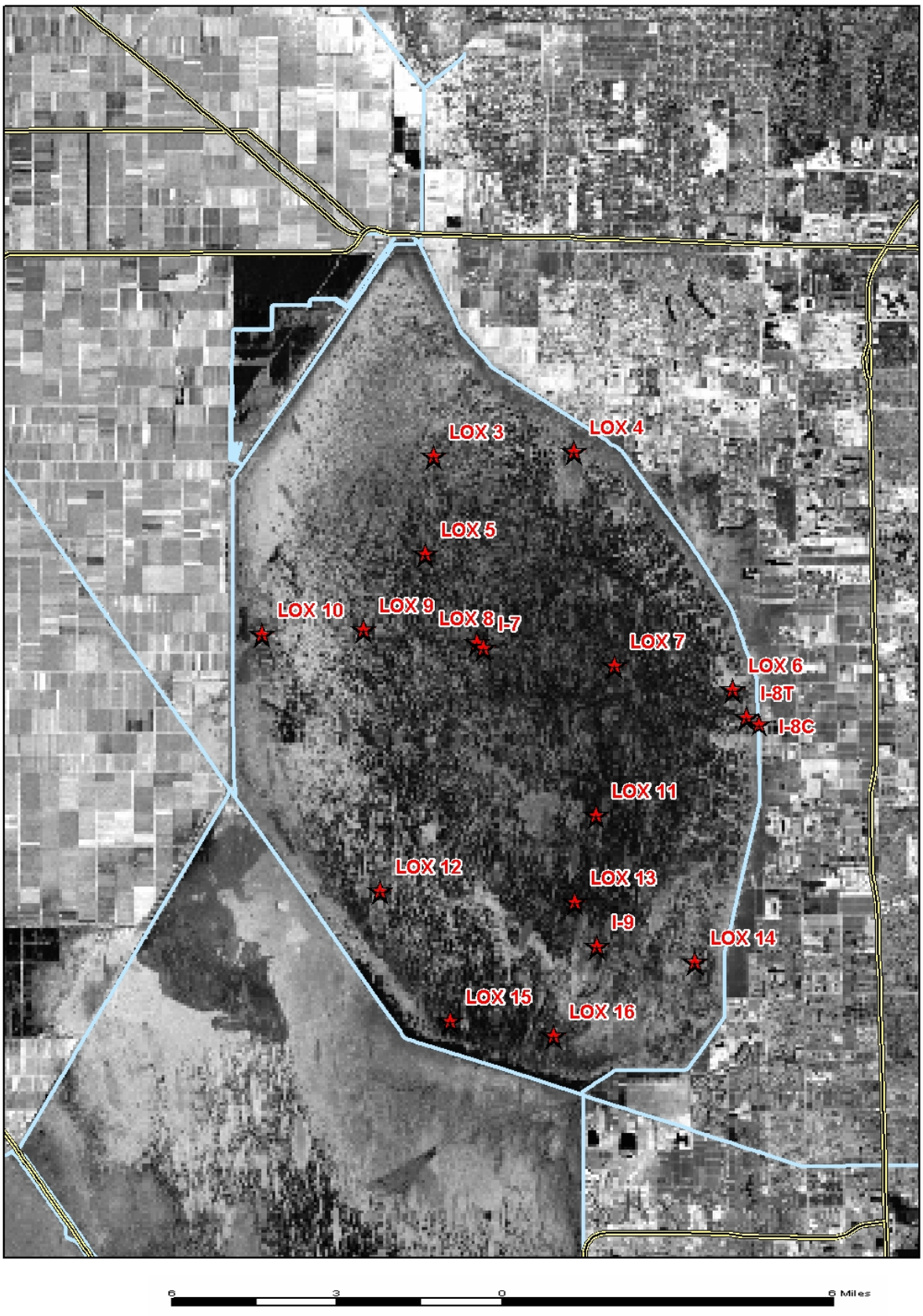

Figure 1. A.R.M. Loxahatchee Refuge Water Quality Sampling and Stage Measurement Sites

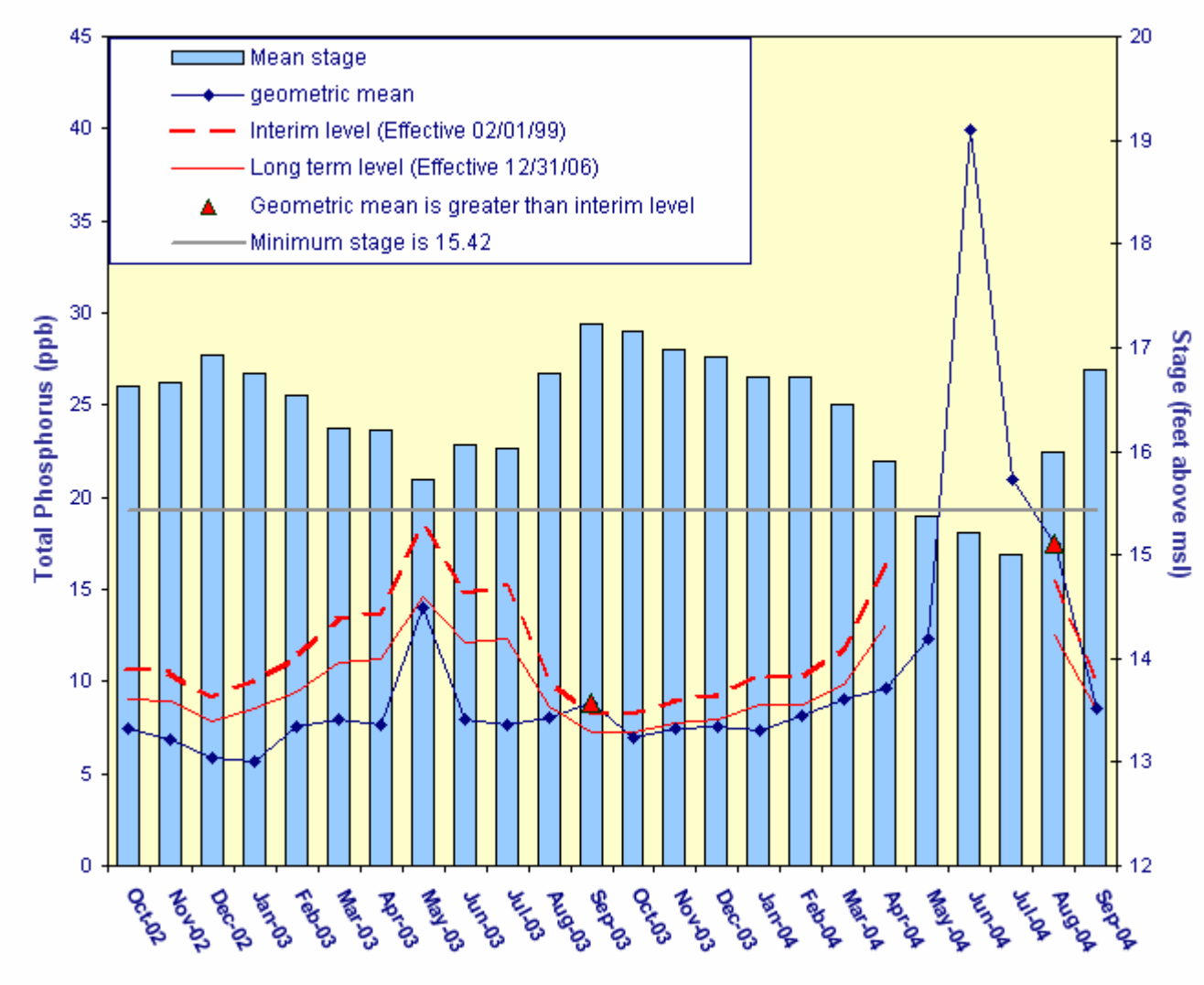

Figure 2. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

Note: 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 Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft,NGVD)	Number of TP Samples	Number of Stage Measure-ments
Oct-2002	7.5	10.7	9.0	16.64	12	3
Nov-2002	6.9	10.5	8.9	16.66	12	3
Dec-2002	5.9	9.2	7.9	16.93	14	3
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

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.

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 is 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 October 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 July, August and September 2004, the flow-weighted mean total phosphorus concentrations were 8.4, 8.2 and 8.4 ppb, respectively. The interim limits were 10.2, 10.7 and 10.8 ppb, respectively. The long-term limits were 8.8, 9.3 and 9.4 ppb, respectively. The July, August and September 2004 concentrations were less than the interim limits 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 July, August and September 2004, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 27.3, 28.6 and 35.0, respectively. July, August and September observed percentages were less than the guidelines (**Table 2**). The individual sampling events and the 12-month moving average are presented in **Figure 4**.

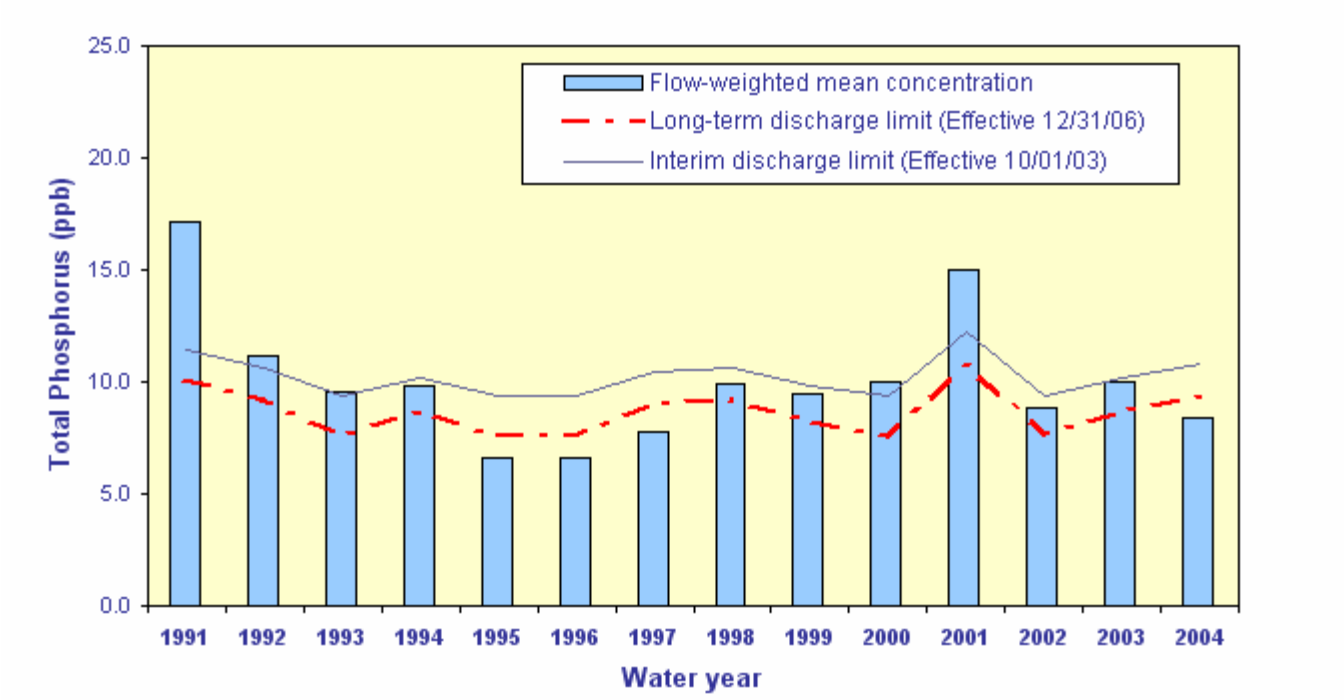

Figure 3. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the total phosphorus interim and long-term limits.

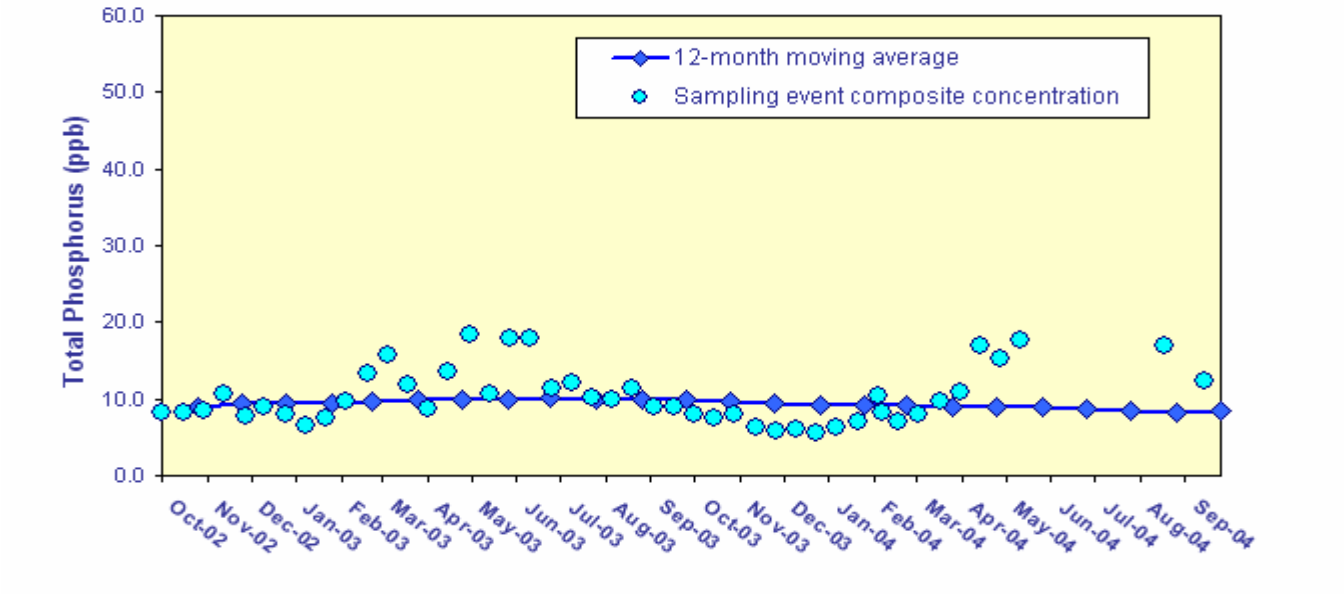

Figure 4. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each month and the composite total phosphorus concentration for each sampling event. There are no sampling event values for June 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	(%)	
	(Kac-ft)	(ppb)	10/1/2003	12/31/2006	Guideline	Observed
31-Oct-02	999.9	8.9	9.6	7.9	41.5	30.4
30-Nov-02	884.5	9.4	10.0	8.5	44.2	34.8
31-Dec-02	802.2	9.6	10.4	8.9	46.3	33.3
31-Jan-03	831.1	9.5	10.3	8.8	45.6	34.8
28-Feb-03	843.6	9.7	10.2	8.7	45.2	39.1
31-Mar-03	812.1	9.9	10.3	8.9	46.1	***47.8***
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

Notes: Bold italicized values exceeded the guideline percentages.

The daily flows through the individual Shark River Slough structures from October 2002 through September 2004 are presented in **Figure 5**. During dry periods inflows to Shark River Slough have been through S333 and S12D.

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.

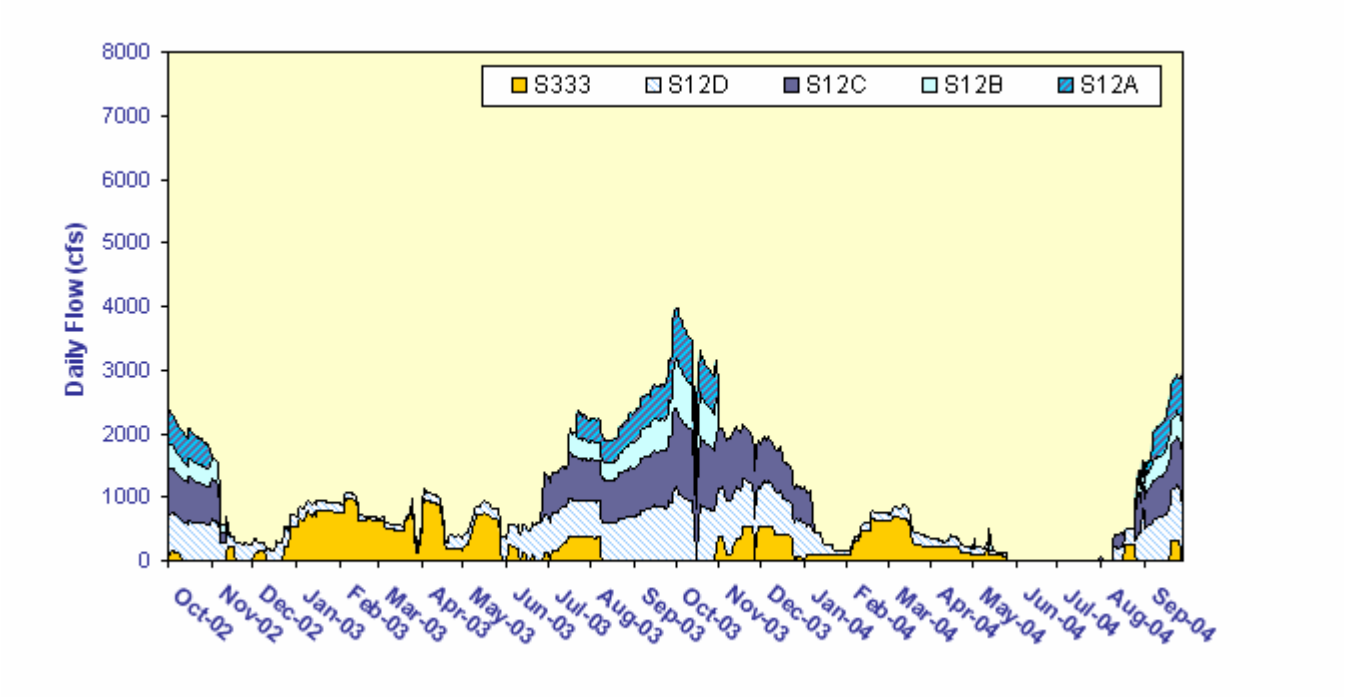

Figure 5. Daily flows into Shark River Slough by structure.

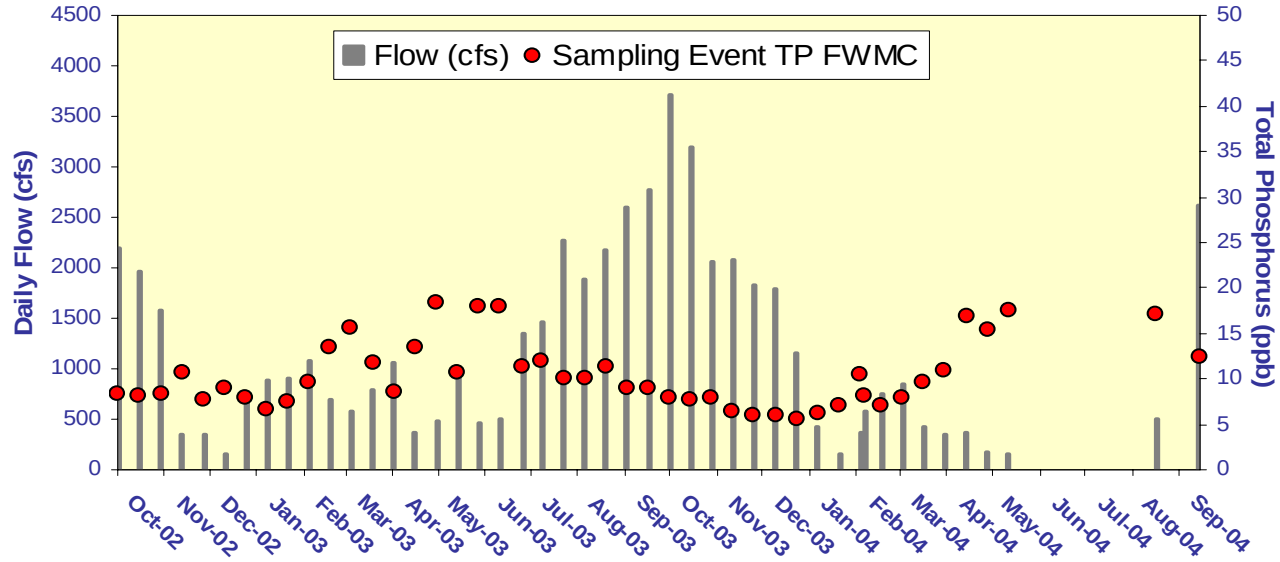

Figure 6. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Note: There was no sampling event flow weighted mean concentration for the months of June and July 2004 because no flow.

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.

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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).

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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 8** represent the flow-weighted mean total phosphorus concentrations from S332, S175 and S18C for water years 1989 through 2004. 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 July, August and September 2004 were 5.0, 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 11.4 ppb for each of the periods ending July, August and September 2004.

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.

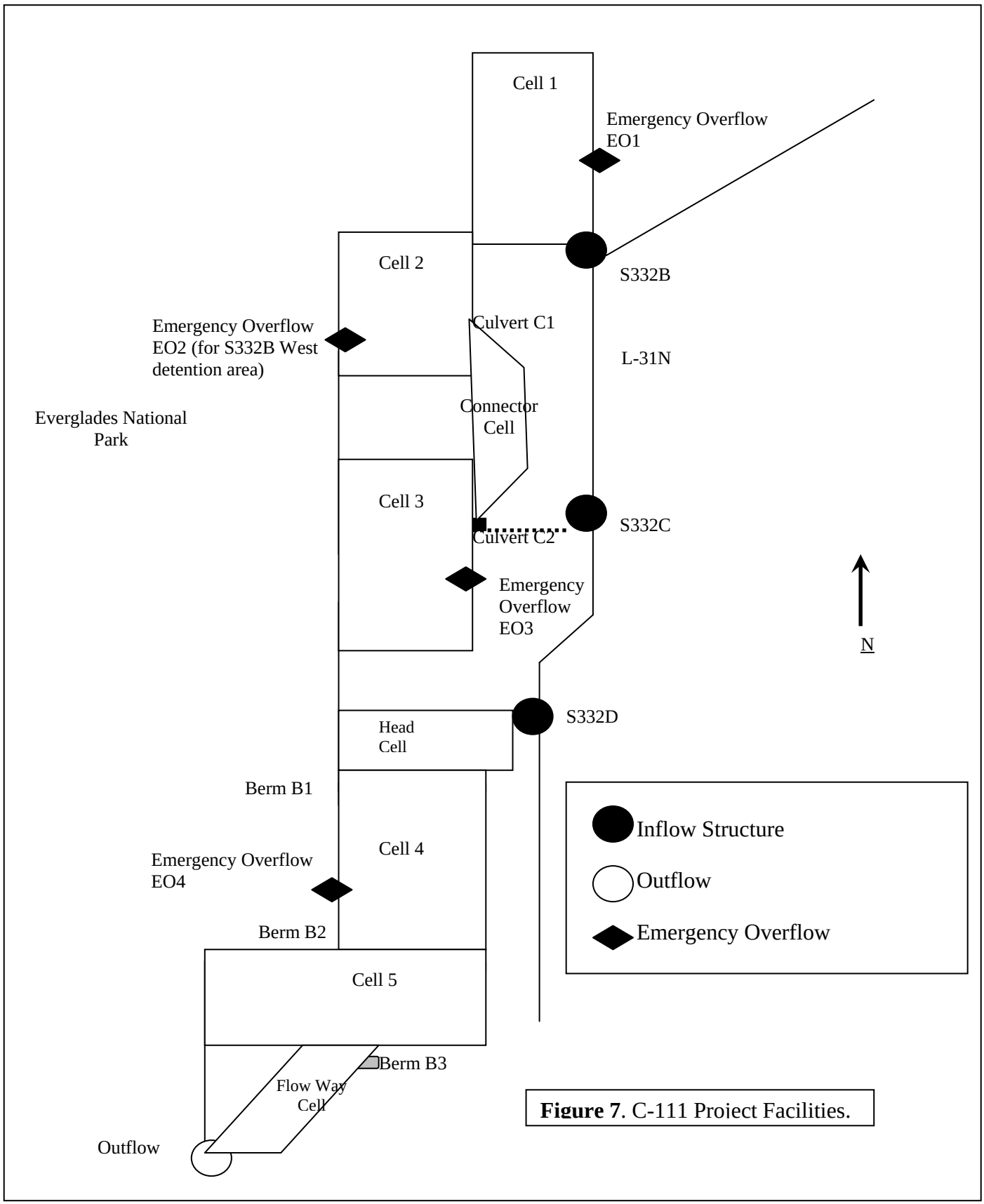

Figure 7. C-111 Project Facilities.

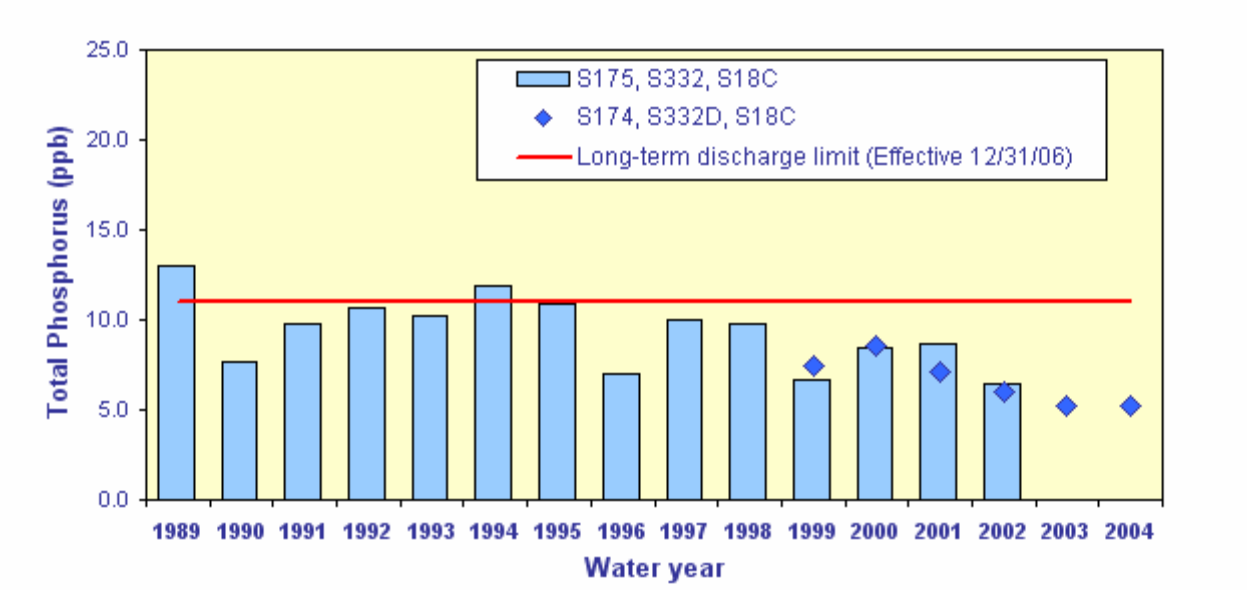

Figure 8. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year ending September 30th, compared to the 11 ppb long-term total phosphorus limit.

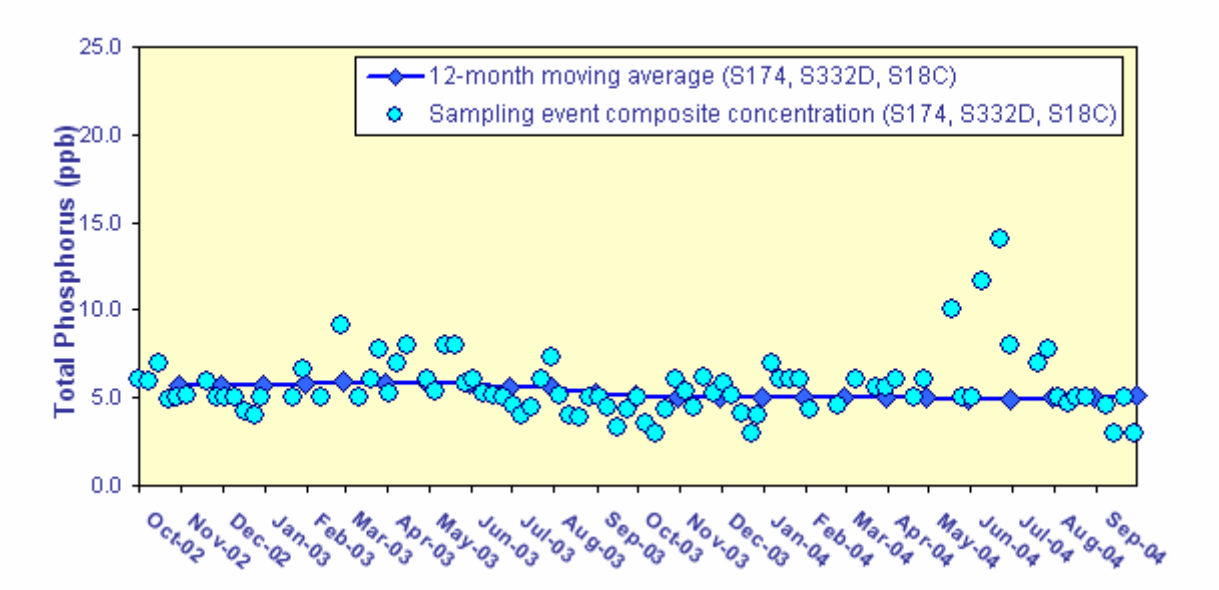

Figure 9. 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the composite total phosphorus concentration for each sampling event.

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-Oct-02	316.0	5.7	11.0	53.1	4.5
30-Nov-02	271.6	5.8	11.0	53.1	4.8
31-Dec-02	249.8	5.7	11.0	53.1	4.7
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

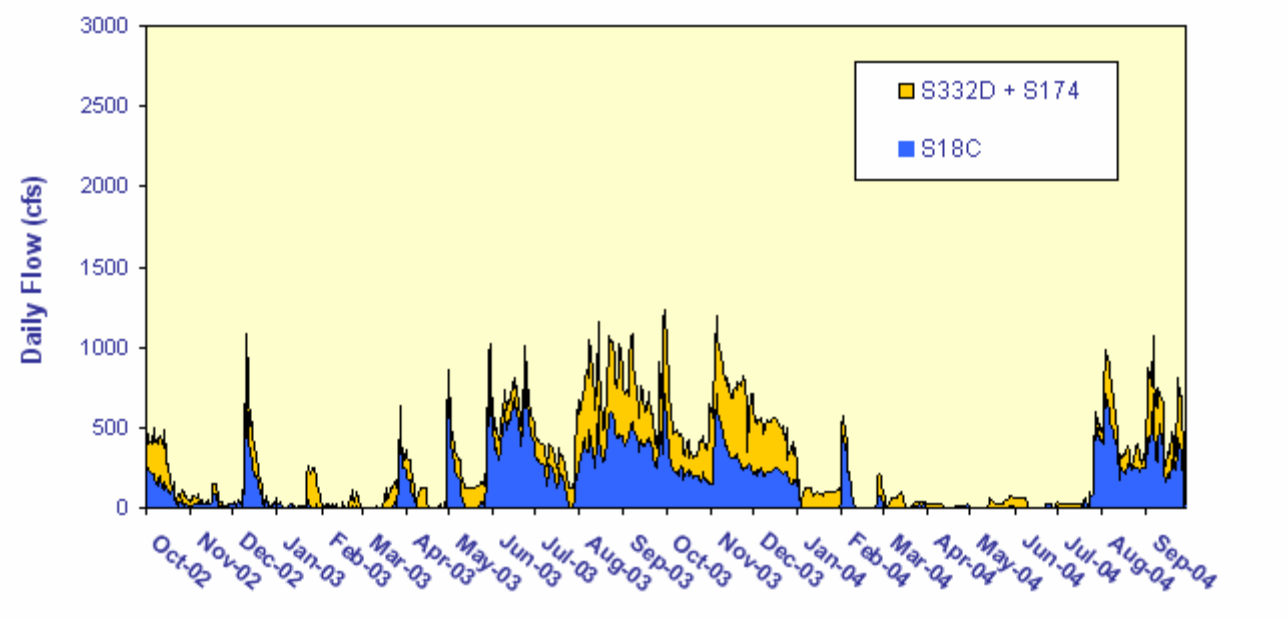

Figure 10. Daily flows into Everglades National Park through Taylor Slough and S18C.

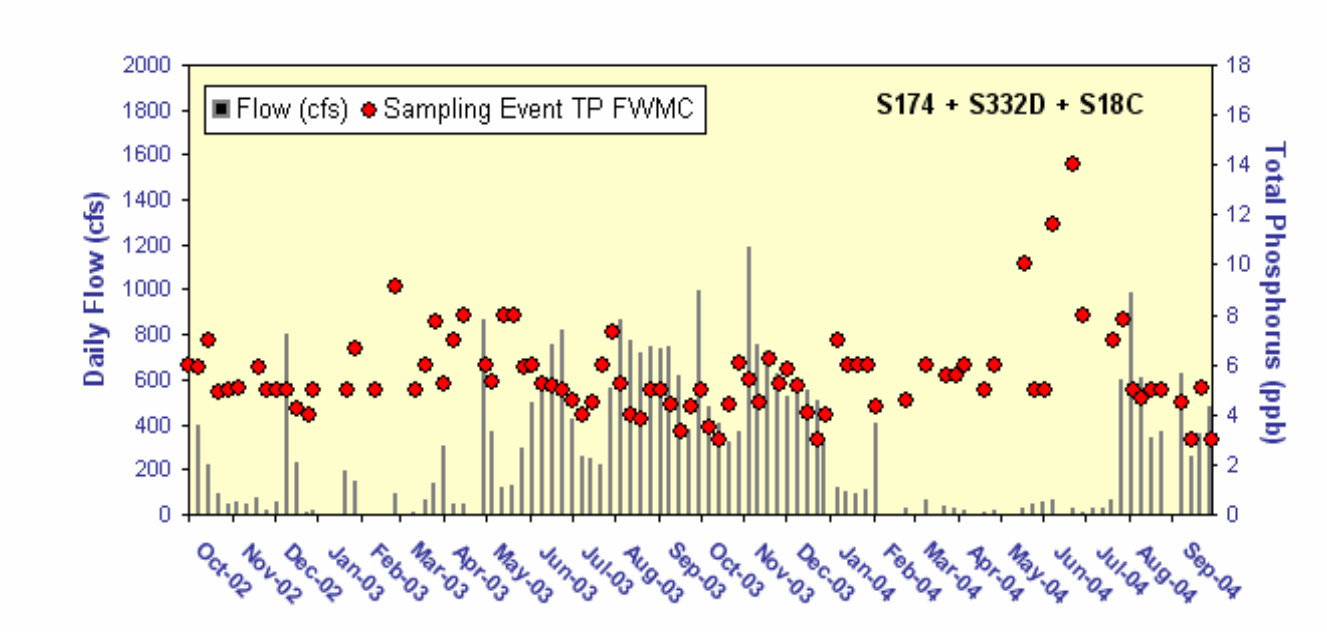

Figure 11. The relationship between daily flows at Taylor Slough structures and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
October - December 2004 Report

Prepared for the
Technical Oversight Committee
April 29, 2005

Prepared by:
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West Palm Beach, FL 33406

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.

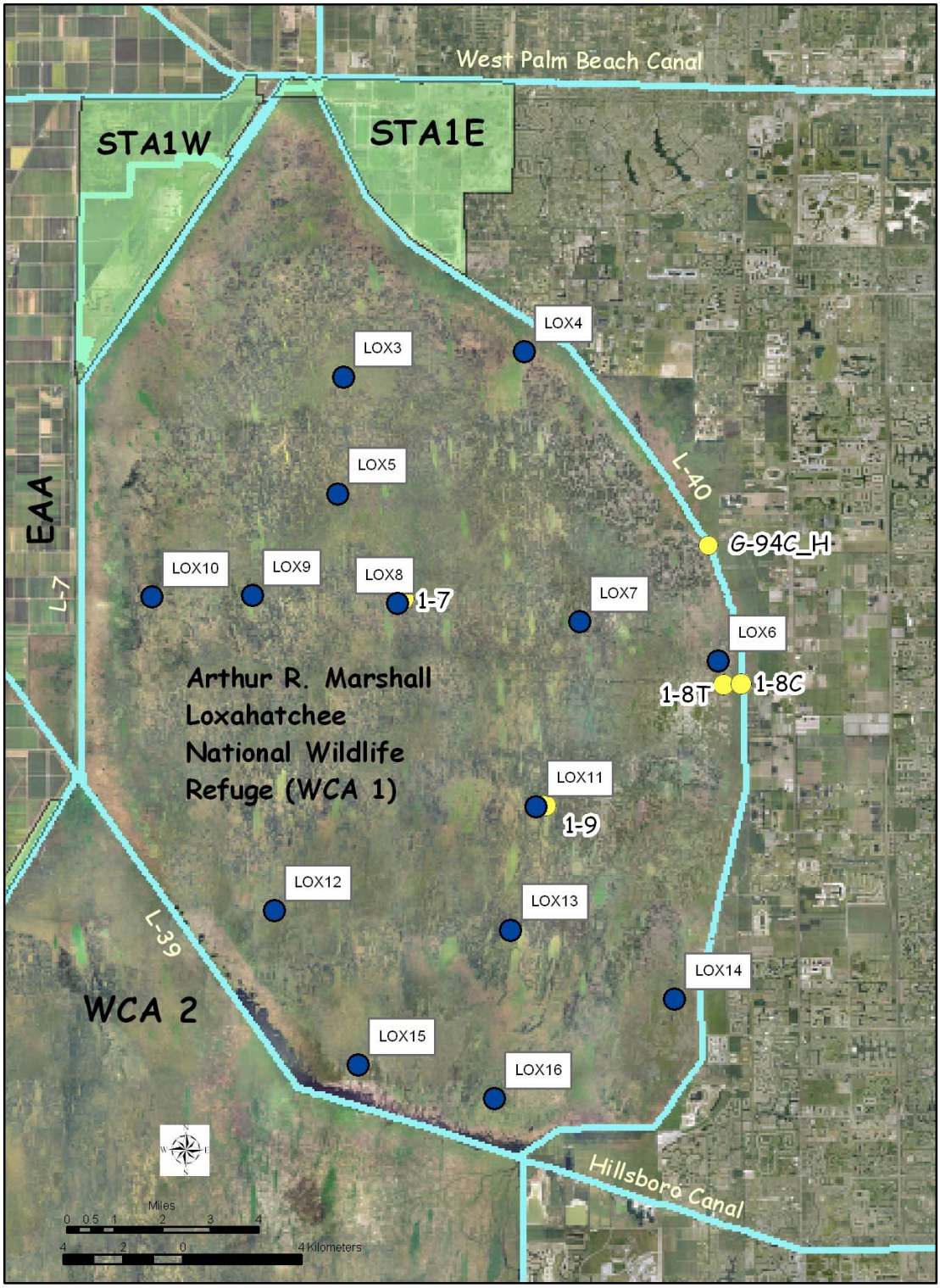

Figure 1. A.R.M. Loxahatchee Refuge Water Quality Sampling and Stage Measurement Sites

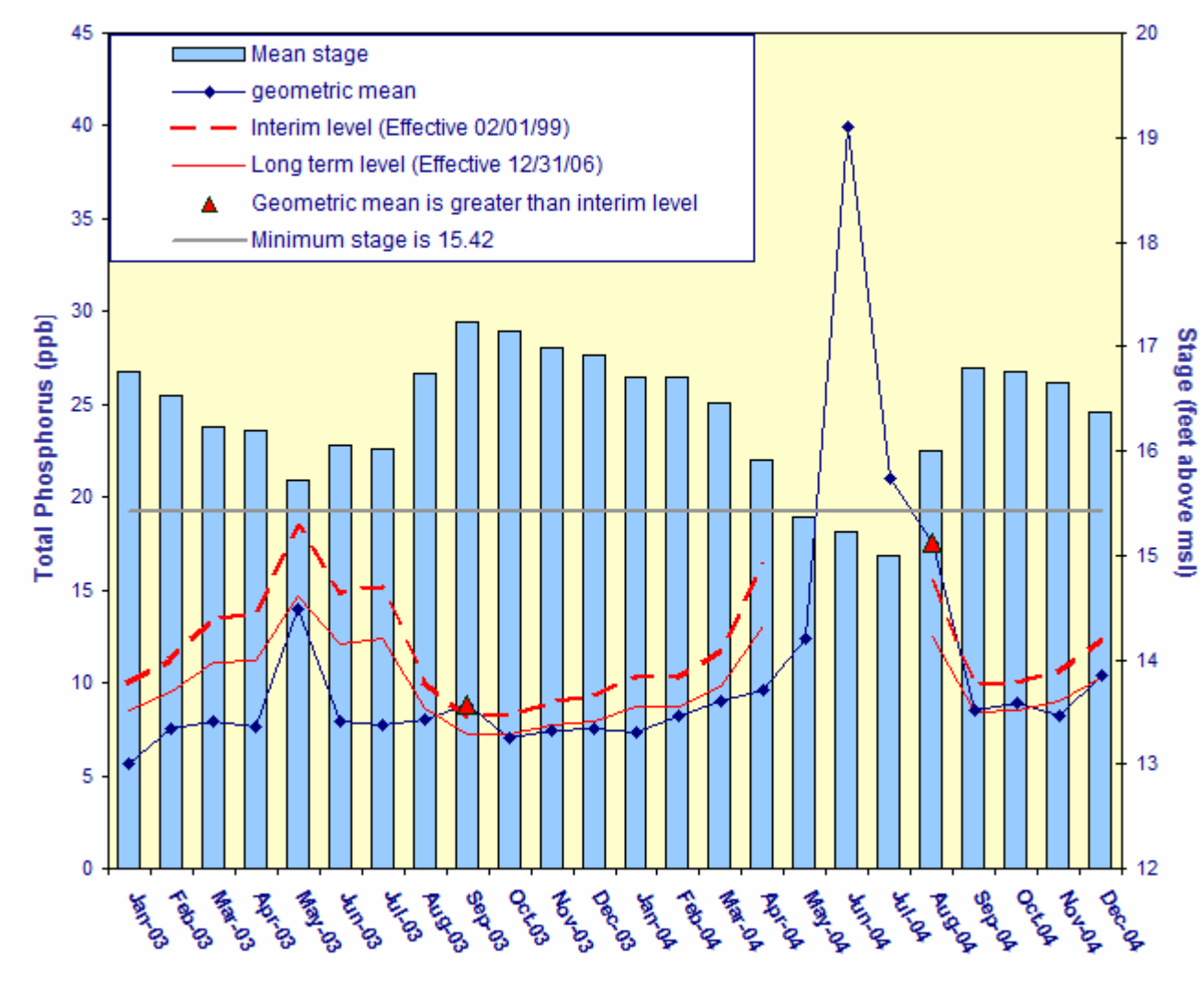

Figure 2. Monthly total phosphorus geometric mean concentrations for the A.R.M. Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage. Interim and Long-term limits are not shown for May – July 2004 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 (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft,NGVD)	Number of TP Samples	Number of Stage Measure-ments
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.

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**.

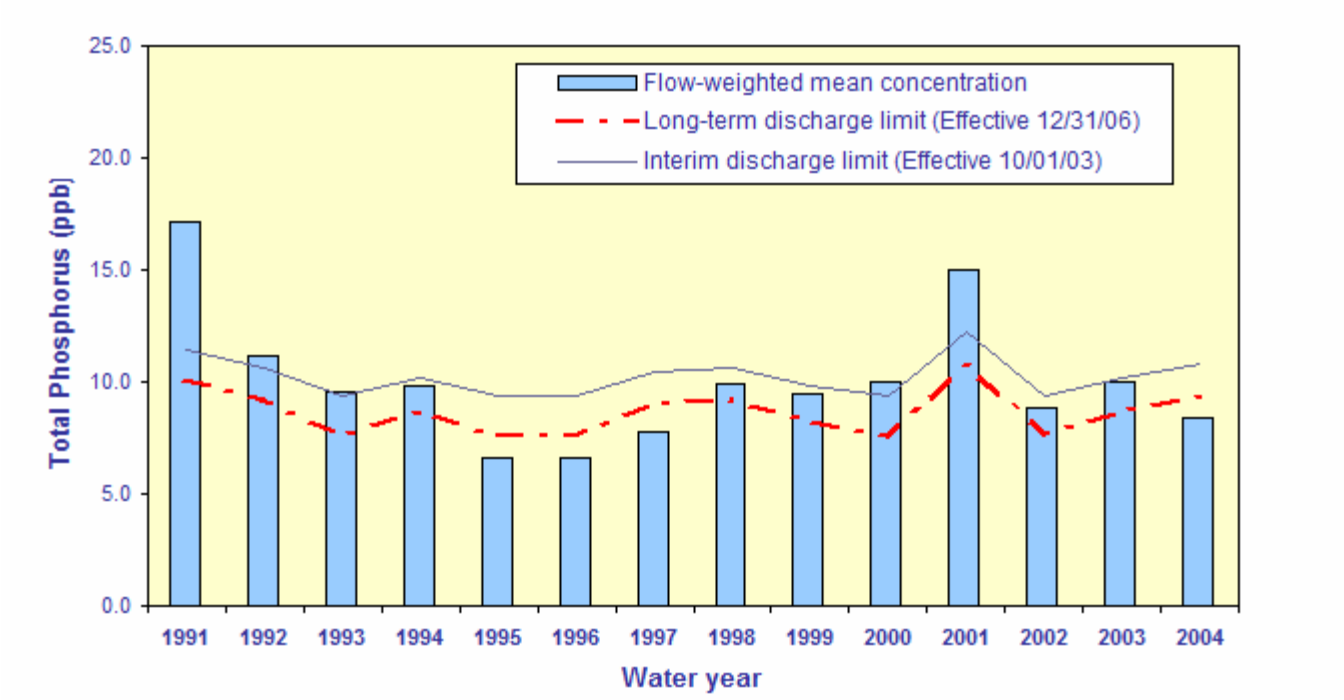

Figure 3. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the total phosphorus interim and long-term limits.

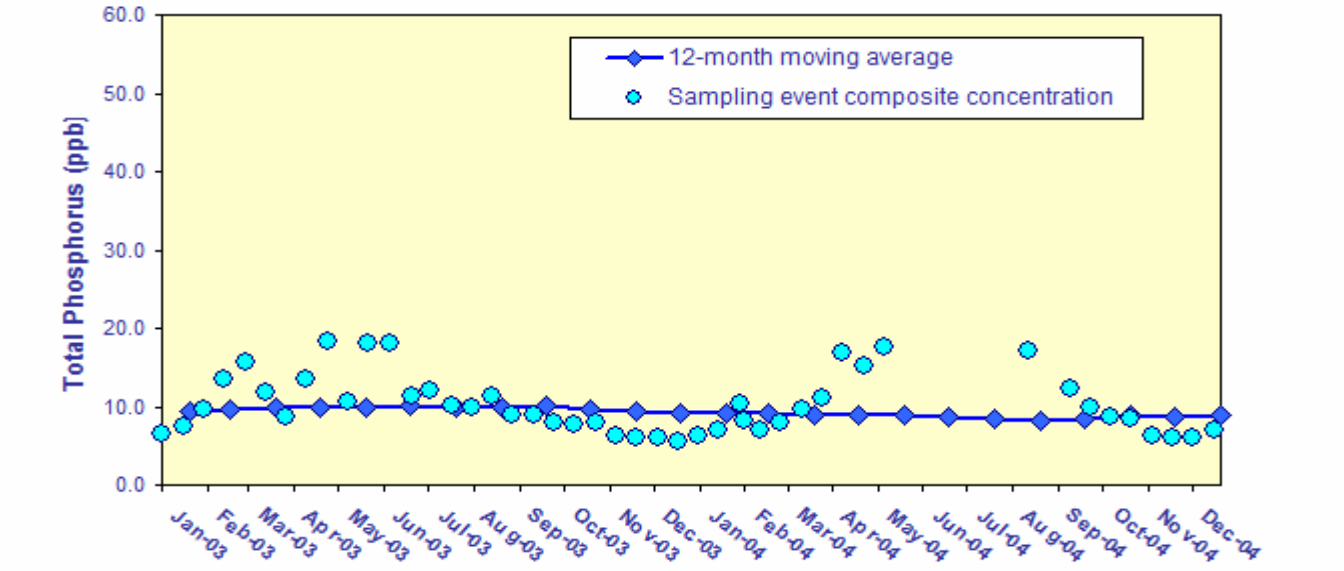

Figure 4. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each month and the composite total phosphorus concentration for each sampling event. There are no sampling event values for June 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	(%)	
	(Kac-ft)	(ppb)	10/1/2003	12/31/2006	Guideline	Observed
31-Jan-03	831.1	9.5	10.3	8.8	45.6	34.8
28-Feb-03	843.6	9.7	10.2	8.7	45.2	39.1
31-Mar-03	812.1	9.9	10.3	8.9	46.1	***47.8***
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

Notes: Bold italicized values exceeded the guideline percentages.

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.

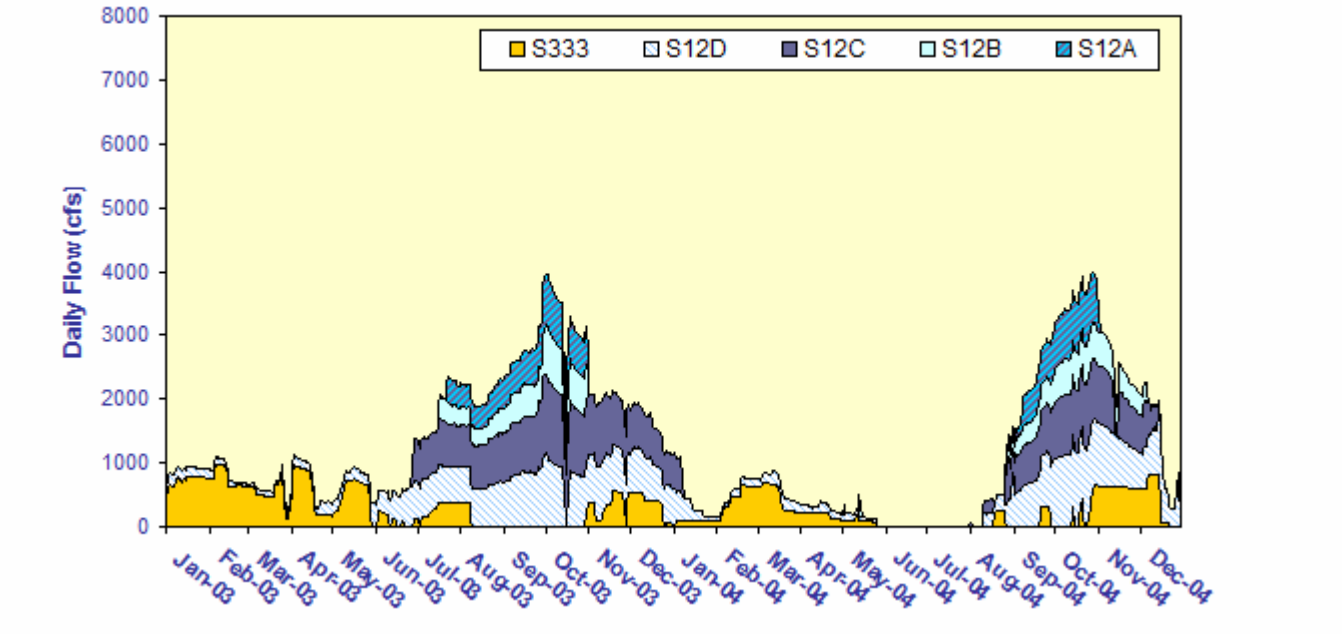

Figure 5. Daily flows into Shark River Slough by structure.

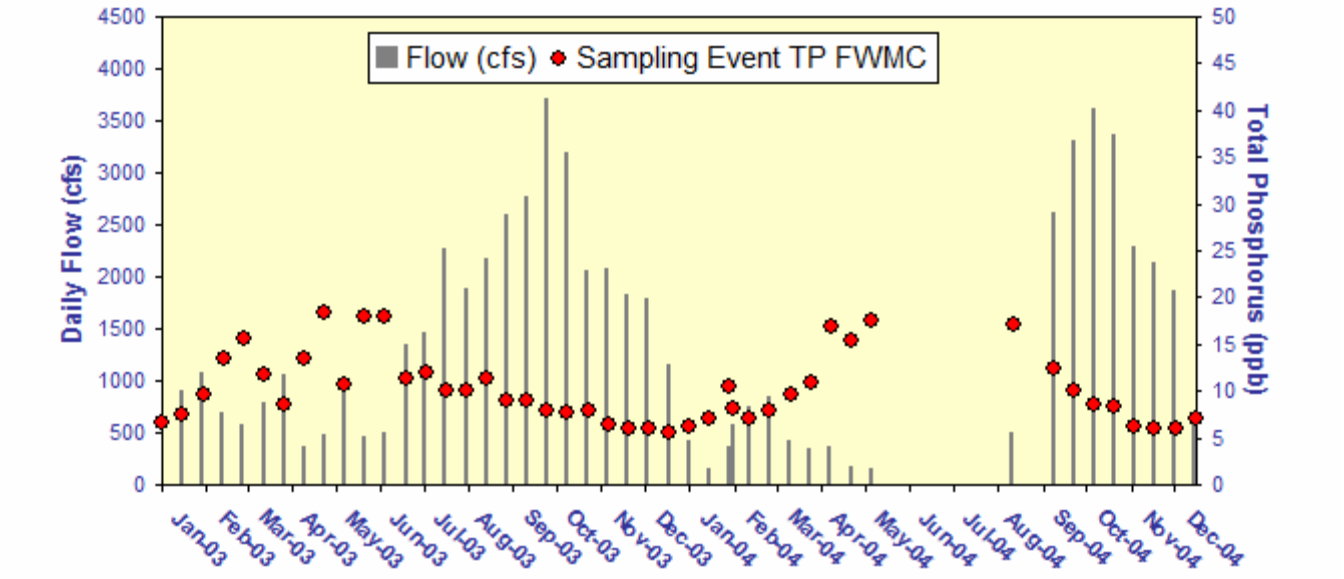

Figure 6. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events. There was no sampling event flow weighted mean concentration for the months of June and July 2004 because there was no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

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

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.

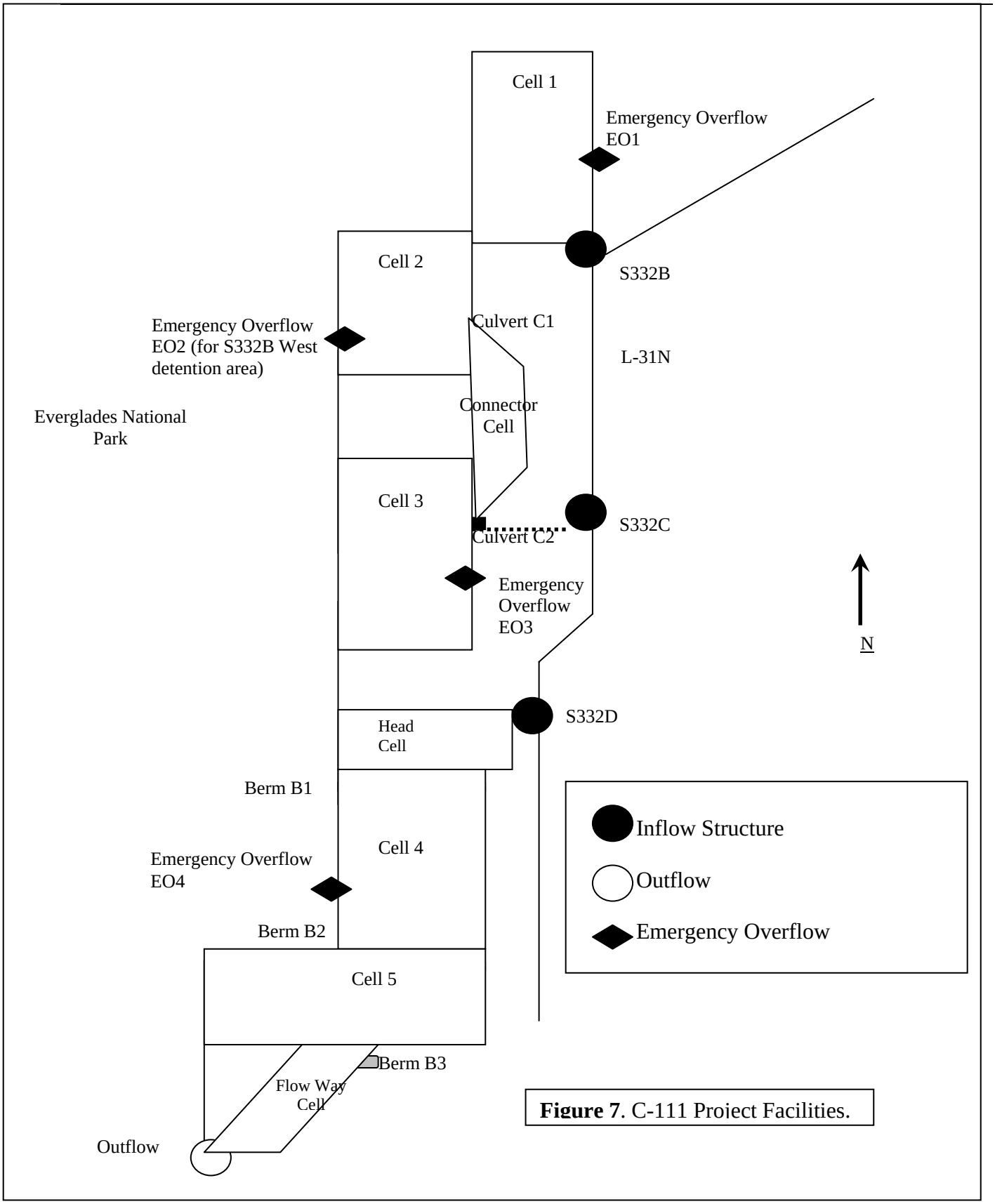

Figure 7. C-111 Project Facilities.

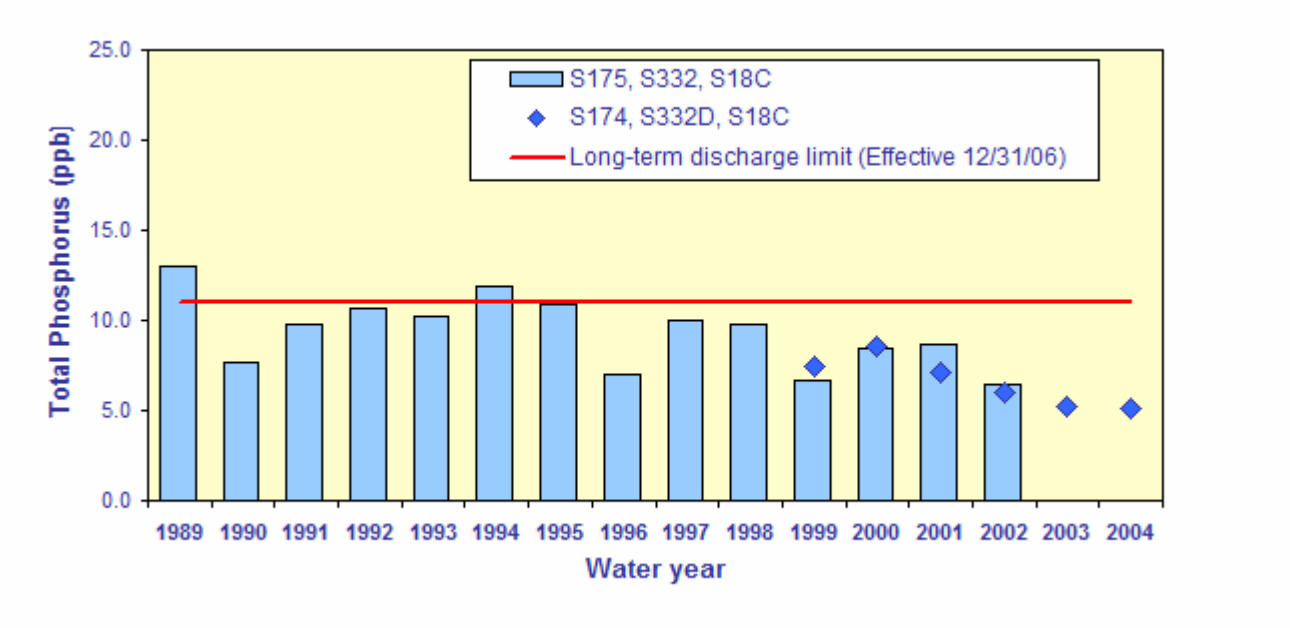

Figure 8. **A.** The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term total phosphorus limit.

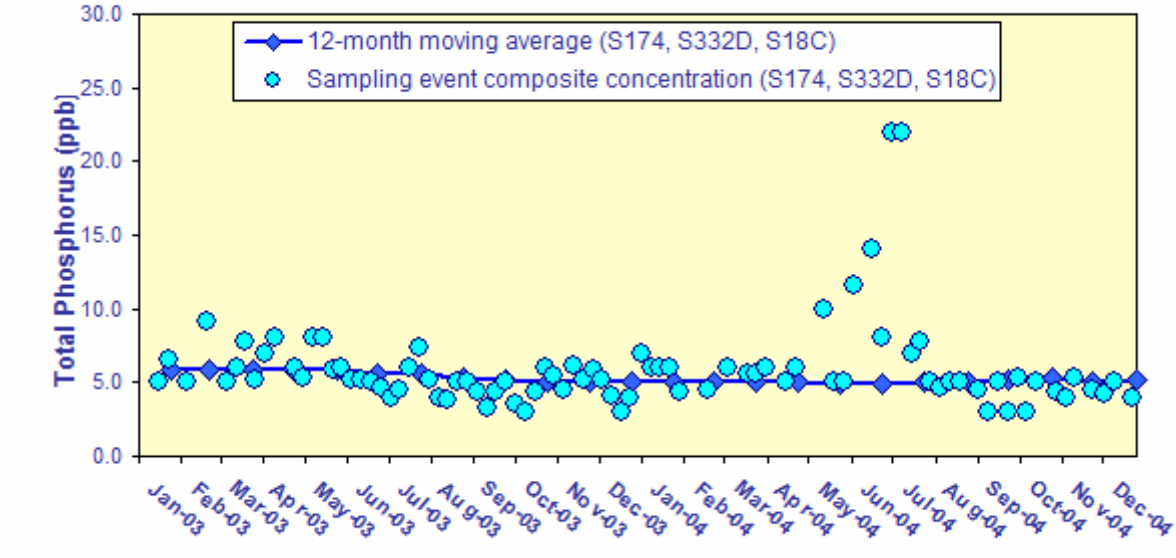

Figure 9. 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the composite total phosphorus concentration for each sampling event.

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
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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

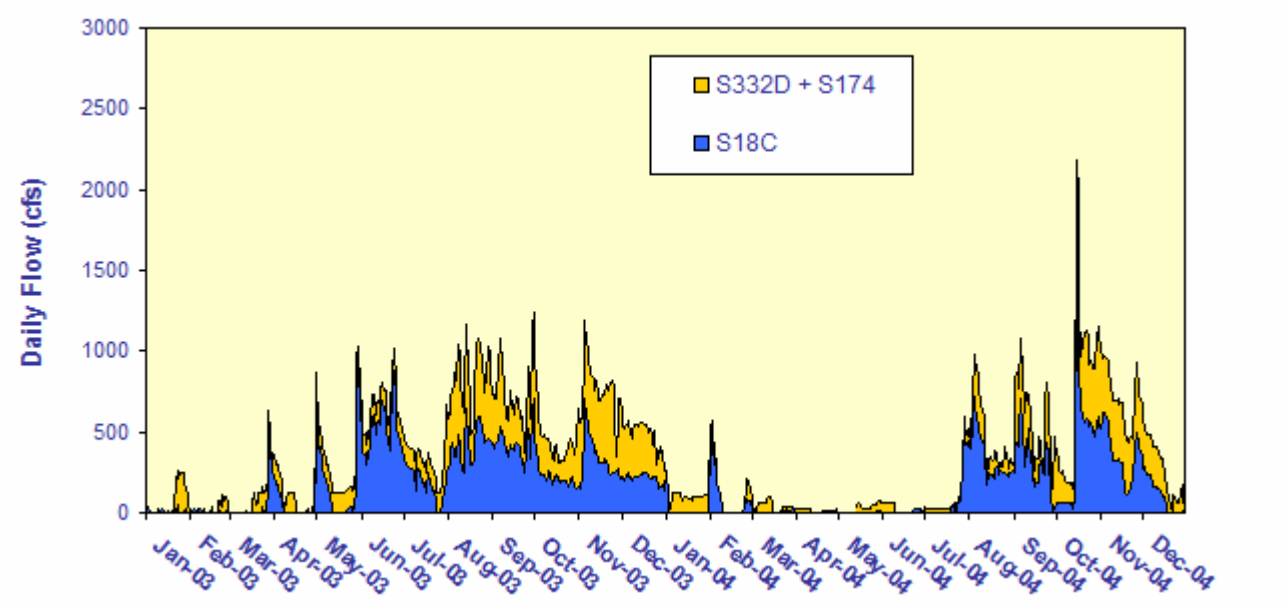

Figure 10. Daily flows into Everglades National Park through Taylor Slough and S18C.

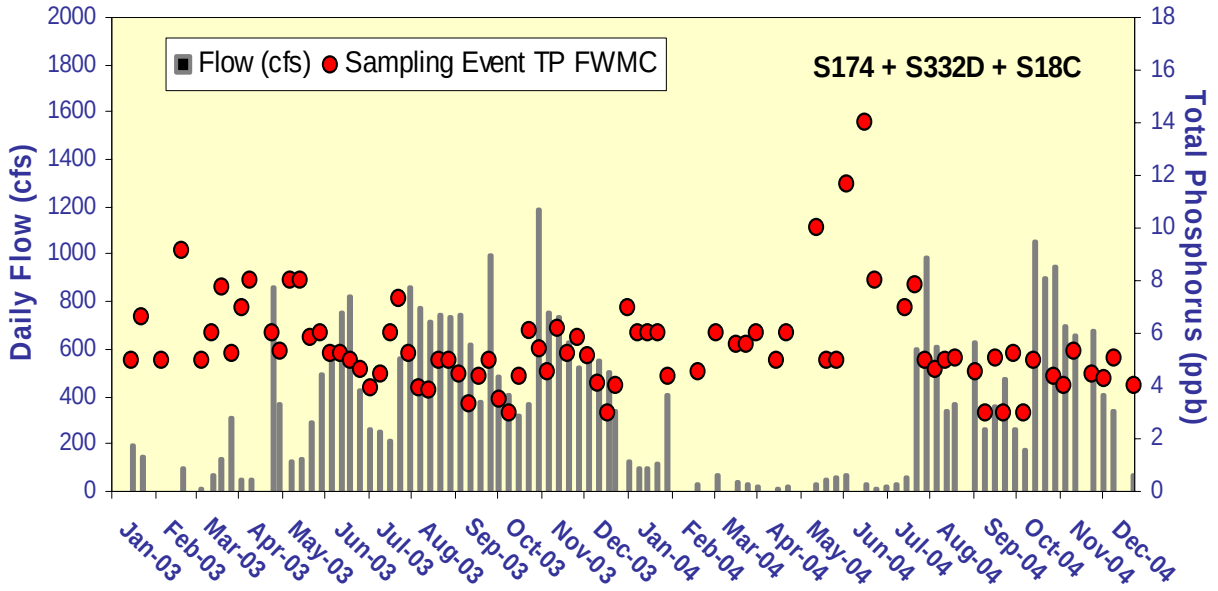

Figure 11. The relationship between daily flows at Taylor Slough structures and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
January - March 2005 Report

Prepared for the
Technical Oversight Committee
June 22, 2005

Prepared by:
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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.

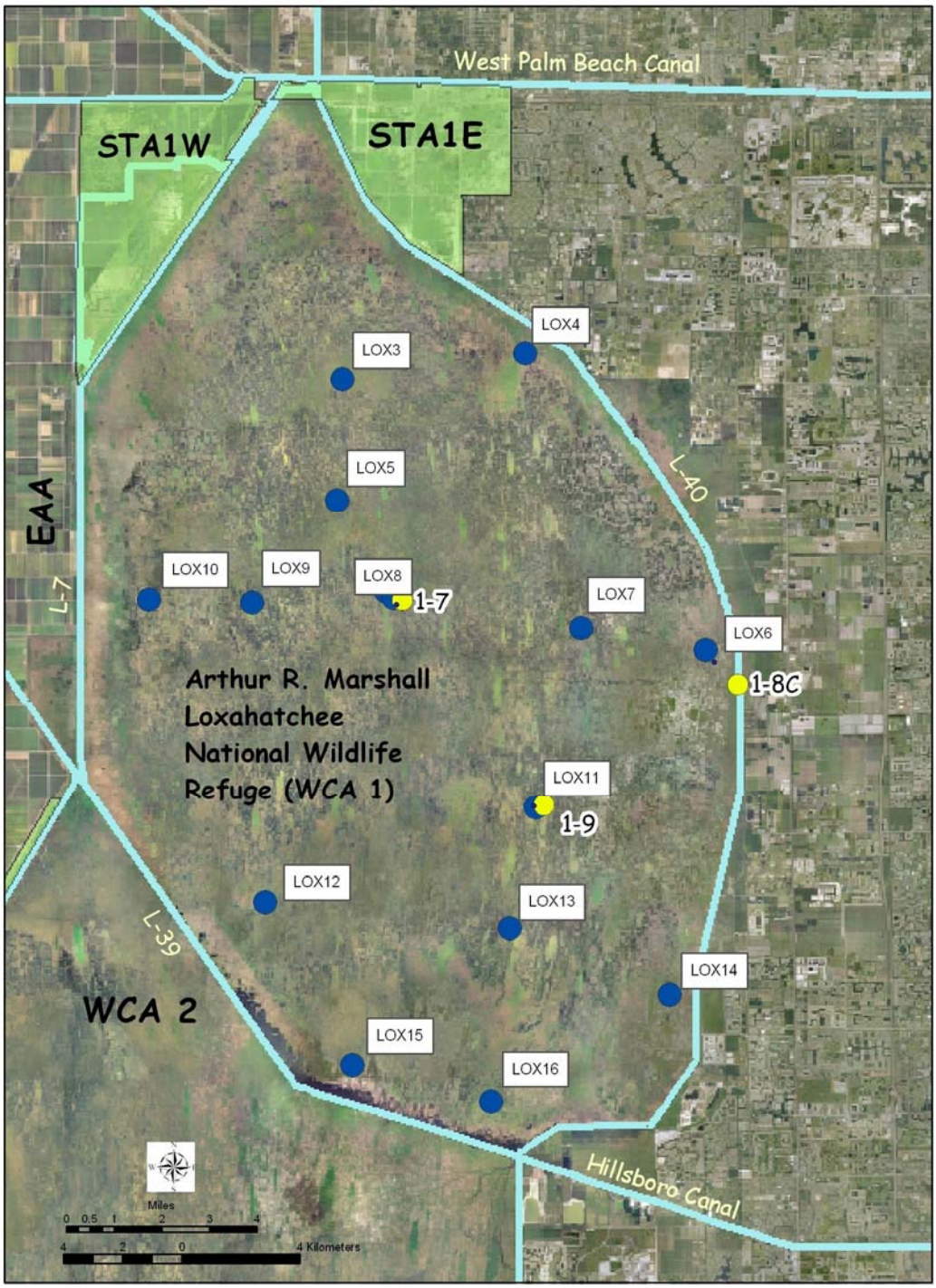

Figure 1. A.R.M. Loxahatchee Refuge Water Quality Sampling and Stage Measurement Sites

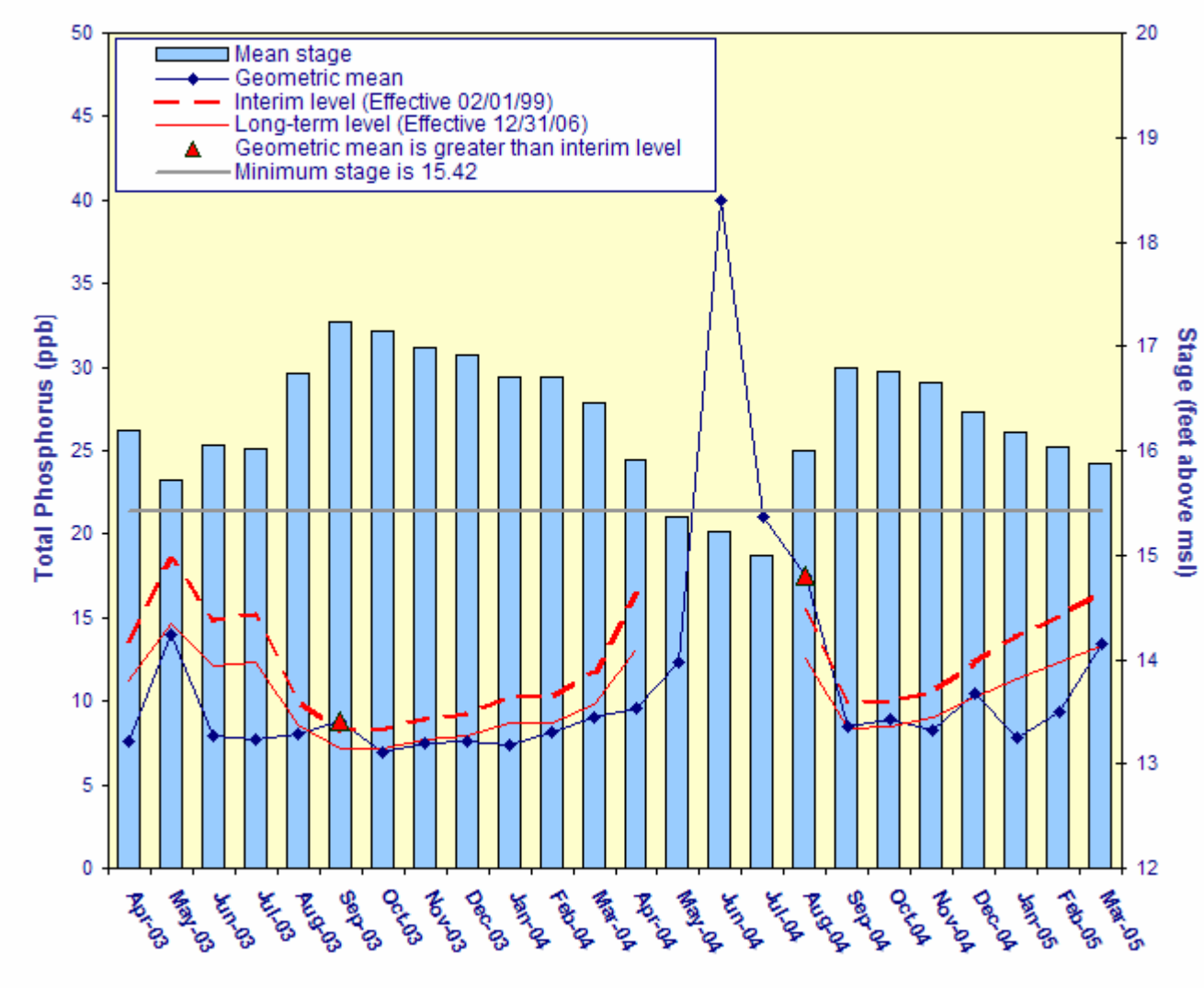

Figure 2. Monthly total phosphorus geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage. Interim and Long-term limits are not shown for May 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 (ppb)	Interim Level (ppb) Effective 2/1/99	Long-Term Level (ppb) Effective 12/31/06	Average Stage (ft, NGVD)	Number of TP Samples	Number of Stage Measure-ments
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**.

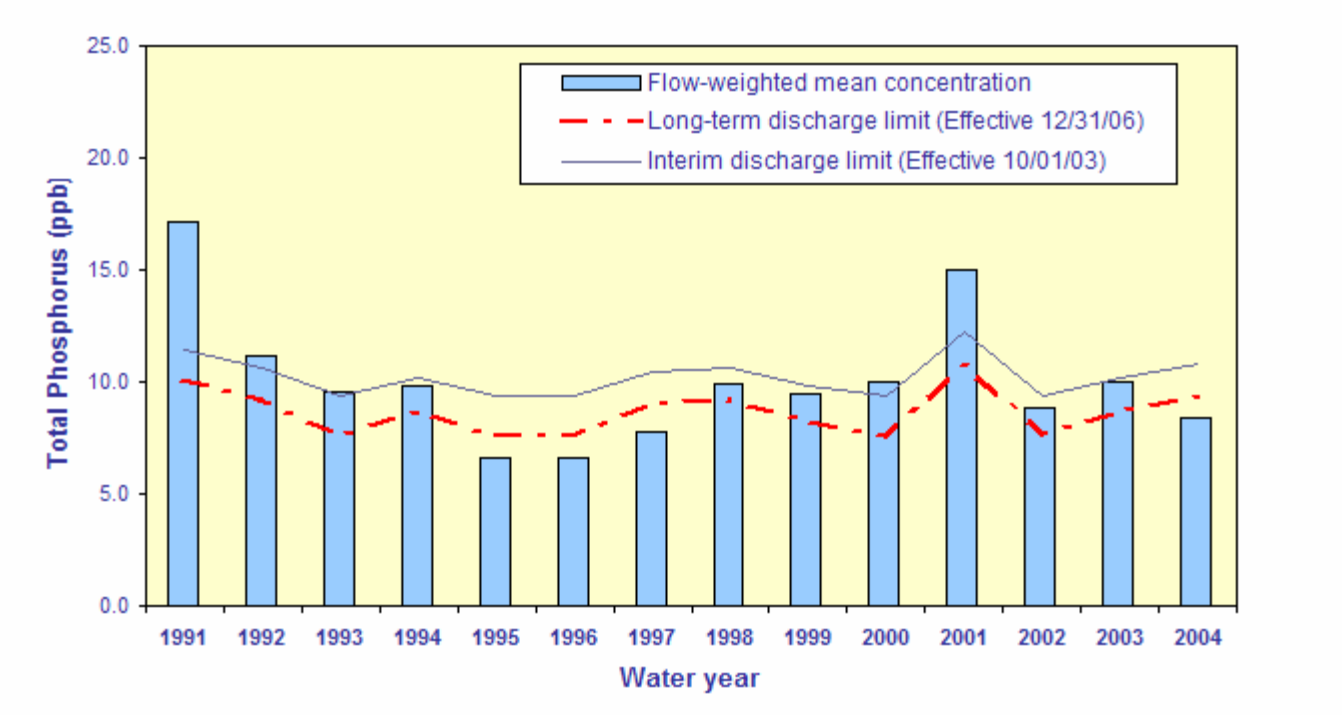

Figure 3. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the total phosphorus interim and long-term limits.

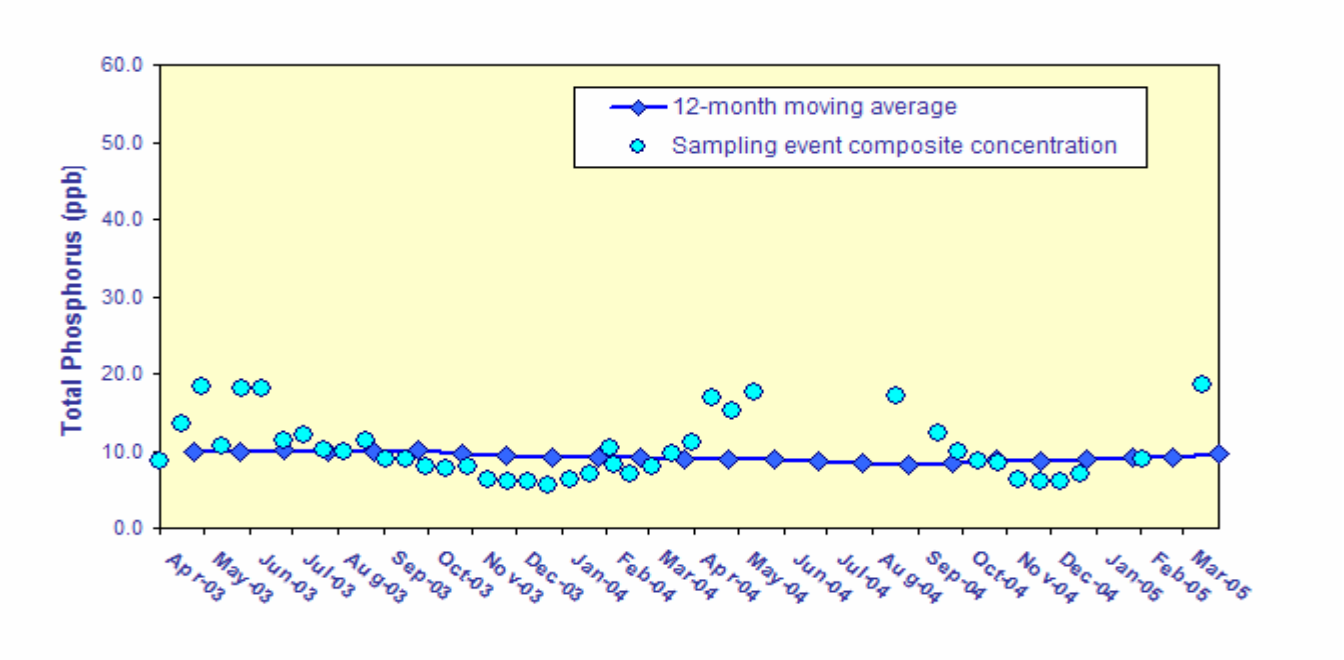

Figure 4. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each month and the composite total phosphorus concentration for each sampling event. There are no sampling event values for June, 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	Effective	(%)	
	(Kac-ft)	(ppb)	10/1/2003	12/31/2006	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.

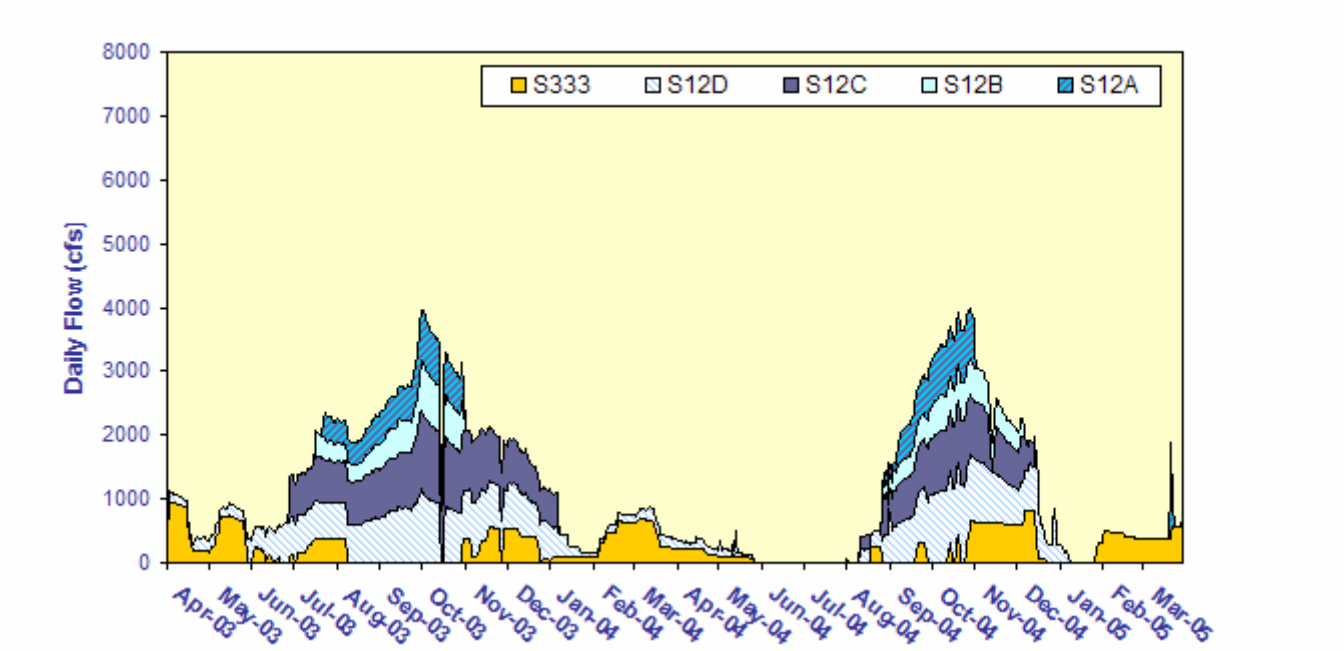

Figure 5. Daily flows into Shark River Slough by structure. On January, 2005 there was flow through structures S12D and S333. S333 was the only structure with flow for the month of February 2005. There was flow through structures S12A, S12D, and S333 in March 2005.

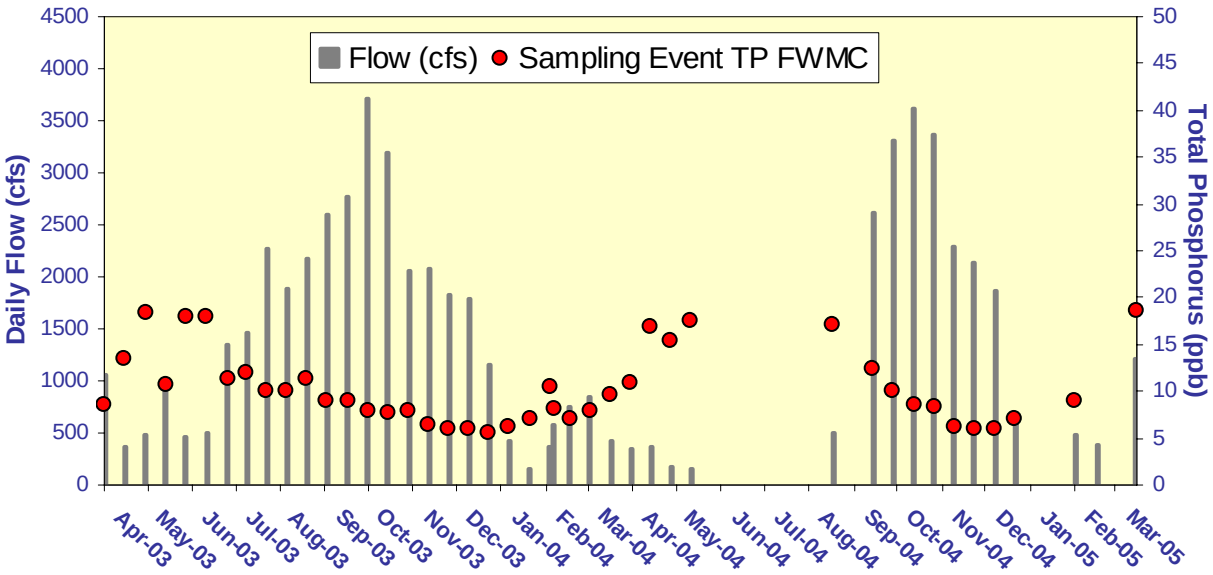

Figure 6. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events. There was no sampling event flow weighted mean concentration for the months of June through July 2004 and January 2005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

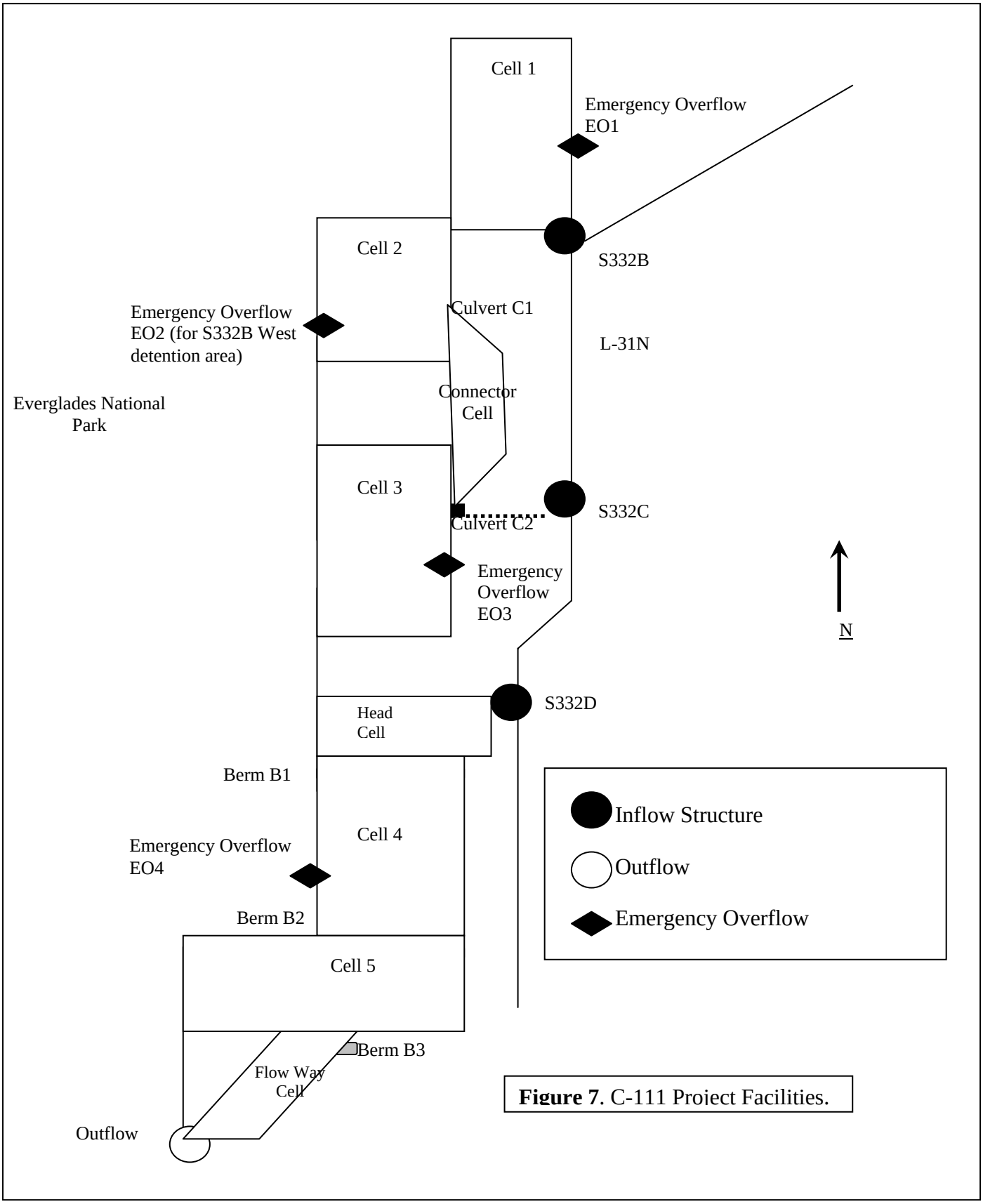

Figure 7. C-111 Project Facilities.

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.

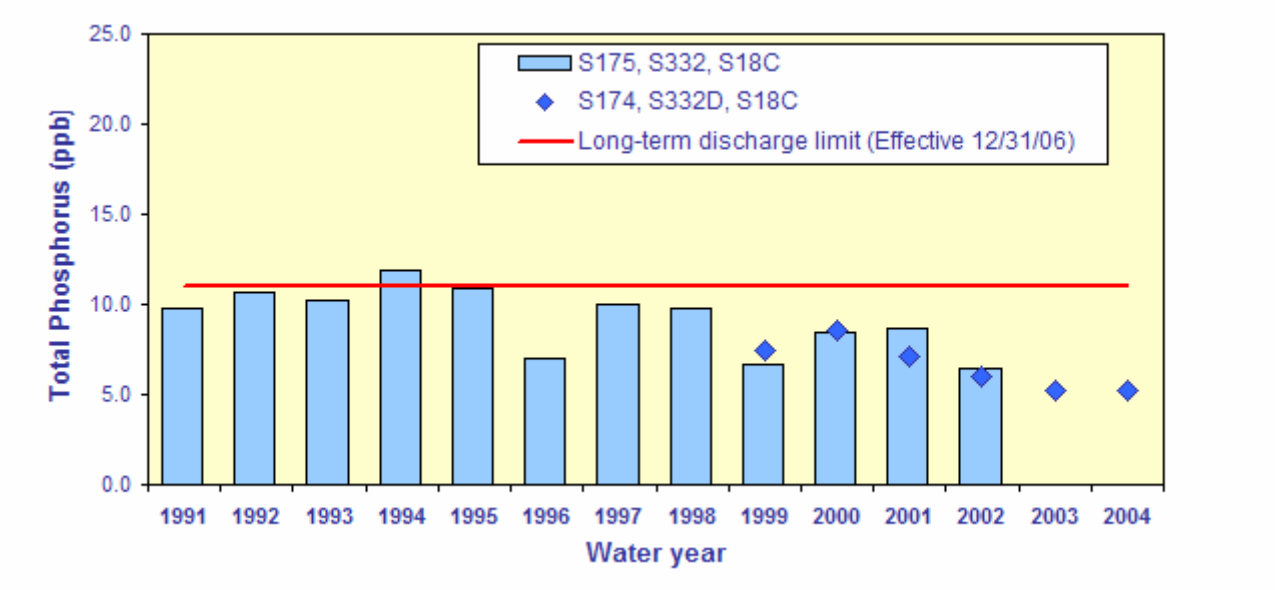

Figure 8. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term total phosphorus limit.

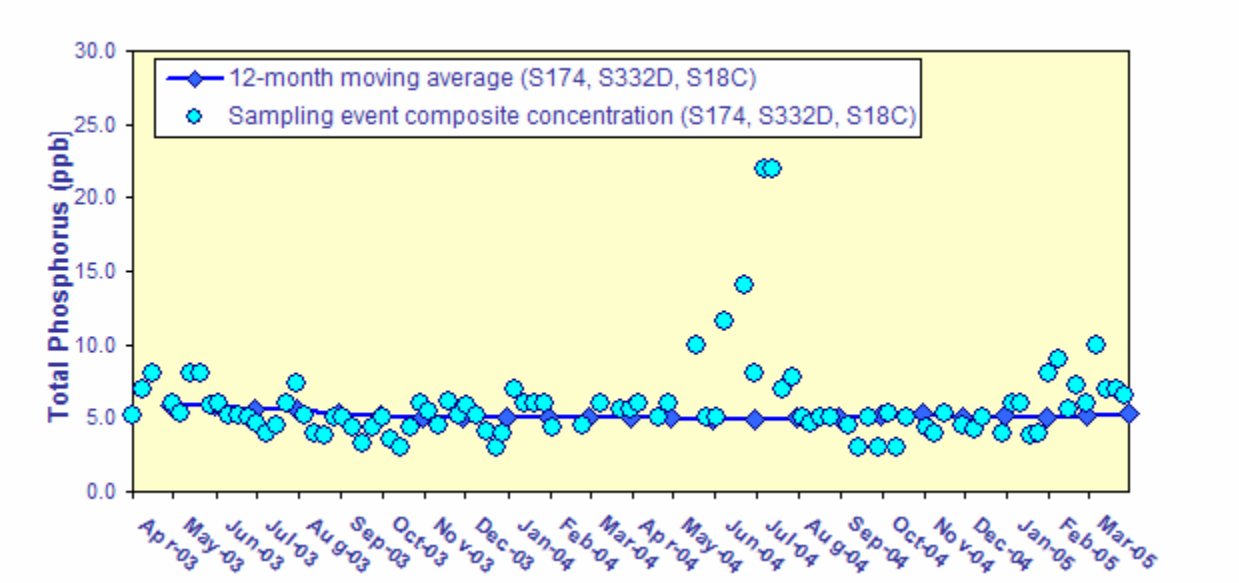

Figure 9. 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the composite total phosphorus concentration for each sampling event.

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
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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

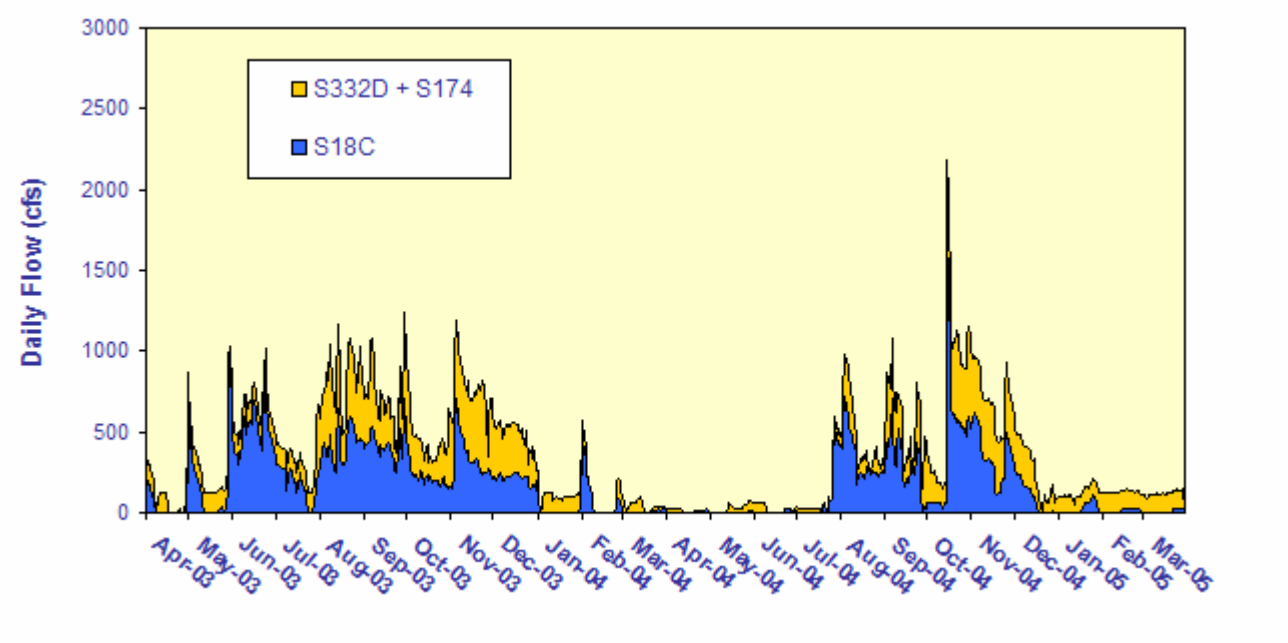

Figure 10. Daily flows into Everglades National Park through Taylor Slough (S332D + S174) and S18C.

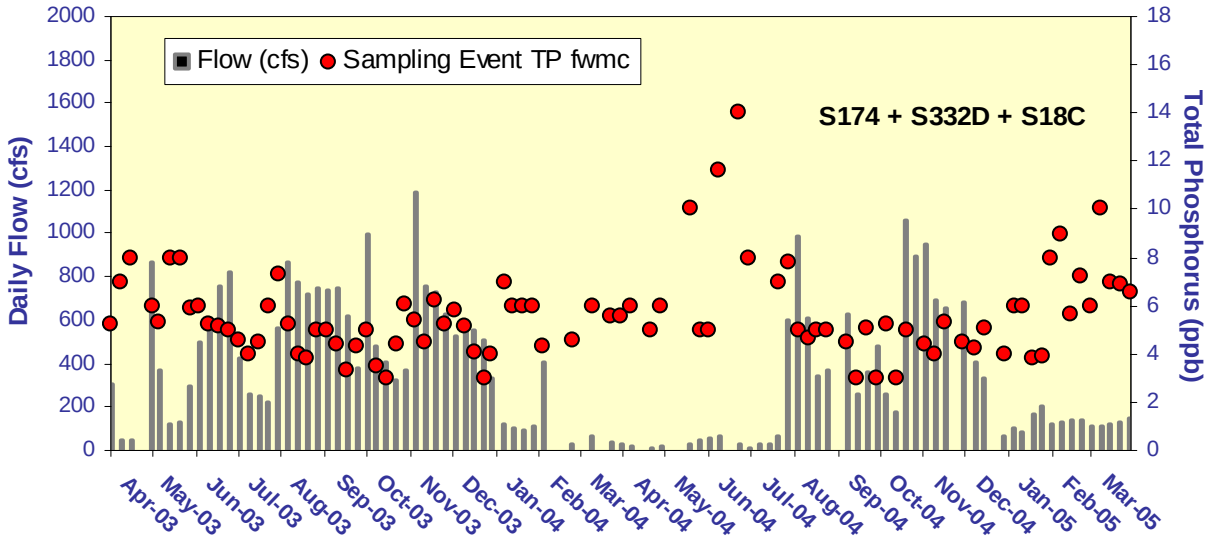

Figure 11. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
April–June 2005 Report

Prepared for the
Technical Oversight Committee
August 15, 2005

(Revised August 17, 2005)

Prepared by:
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West Palm Beach, FL 33406

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, LOX3 through LOX16 (**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.

The interim levels for April, May, and June 2005 were 13.9, 17.7 and 13.9 ppb, respectively. The long-term limits were 11.4, 14.1 and 11.4 ppb, respectively. The geometric mean was less than the interim and long-term levels for April 2005. Because the total depth was less than 0.1 meter (m), no water samples were collected at stations LOX3, LOX5, and LOX9 for April 2005 and stations LOX3, LOX5, LOX9, and LOX10 for May 2005.

Average stages in the Refuge were 16.17, 15.78 and 16.17 feet in April, May and June 2005 respectively (**Figure 2** and **Table 1)**. The geometric mean, calculated from total phosphorus concentrations measured in water samples collected in April was 8.6 parts per billion (ppb). The entire water quality dataset for May and June 2005 was qualified by the District QA Officer (http://www.sfwmd.gov/org/ema/toc/archives/2005_08_16/evpa_samp_rpt_2005-08-15.pdf). As a result, compliance with the interim and long-term levels is not calculated.

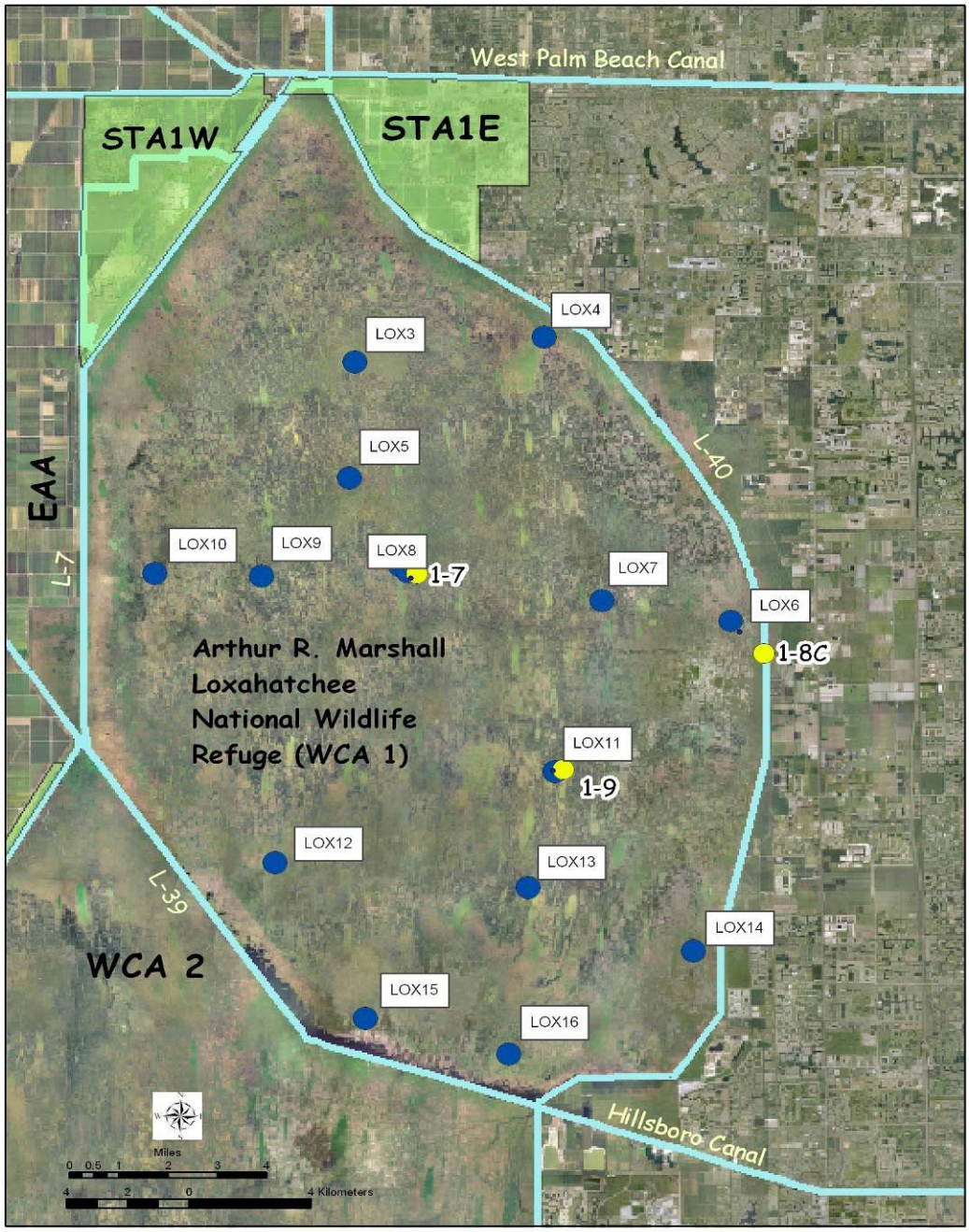

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Stations

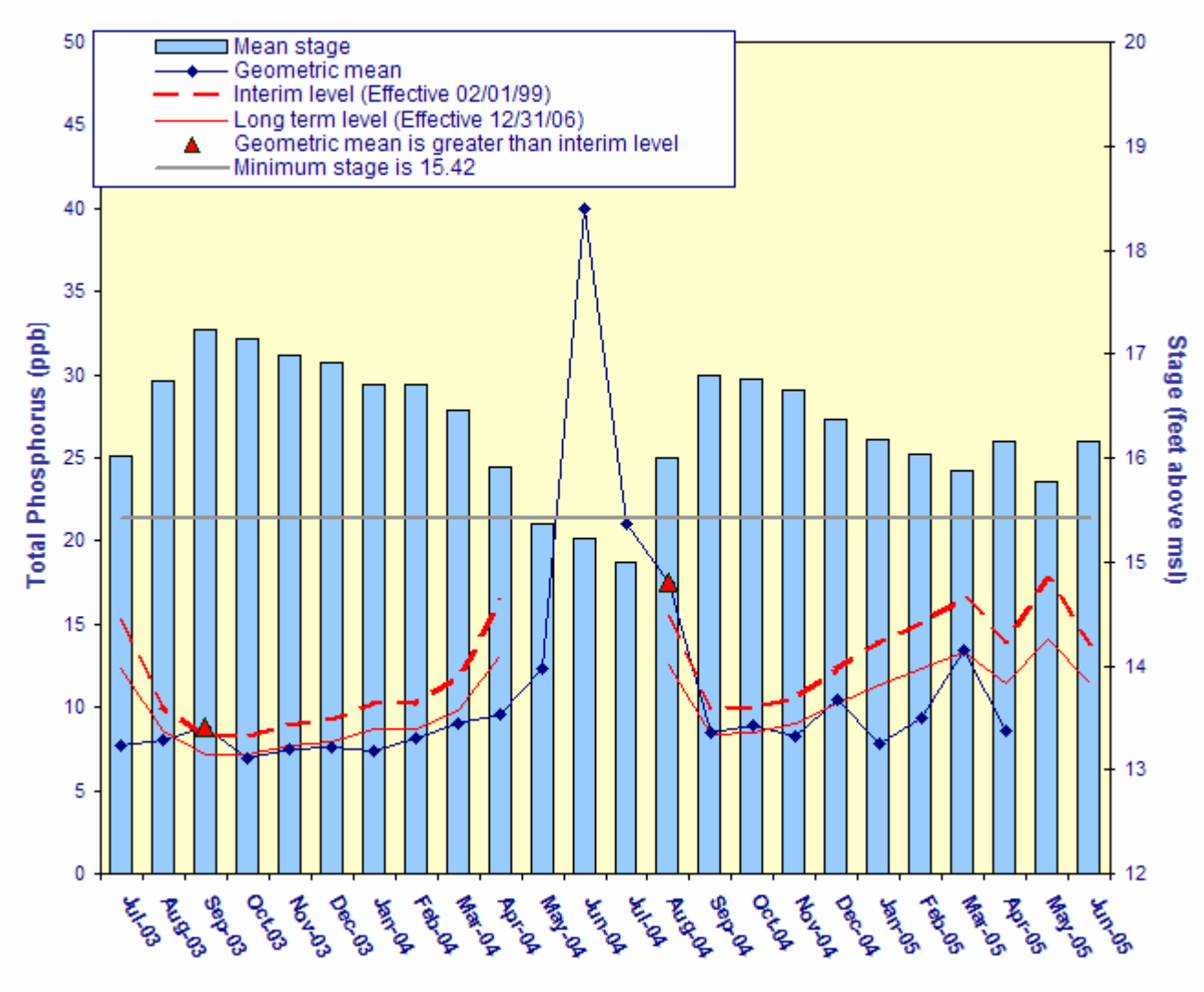

Figure 2. Monthly total phosphorus geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage. Interim and Long-term levels are not shown for May 2004 – July 2004 because the mean stage was less than 15.42 ft. Total phosphorus geometric mean concentrations are not shown for May and June 2005 because the water quality data were qualified.

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

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
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
Apr-2005	8.6	13.9	11.4	16.17	11	3
May-2005	Data Qualified	17.7	14.1	15.78	10	3
Jun-2005	Data Qualified	13.9	11.4	16.17	14	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 ft.

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 (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.

Table 2 presents the moving flow-weighted mean concentrations for each 12-month period beginning in July 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 April, May and June 2005, the flow-weighted mean total phosphorus concentrations were 9.5, 10.3 and 10.4 ppb, respectively. The interim limits were 10.7, 10.5 and 10.2 ppb, respectively. The long-term limits were 9.2, 9.1 and 8.7 ppb, respectively. The April and May 2005 concentrations were less than the interim limits, and the June 2005 concentration was above the interim limit.

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 April, May and June 2005, the percent of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 46.7, 50.0 and 52.9, respectively. The observed percentage of flow-weighted mean total phosphorus concentrations greater than 10 ppb were less than the guideline for the month of April 2005 and higher than the guidelines for May and June 2005 (**Table 2**). The individual sampling events and the 12-month moving average are presented in **Figure 4**.

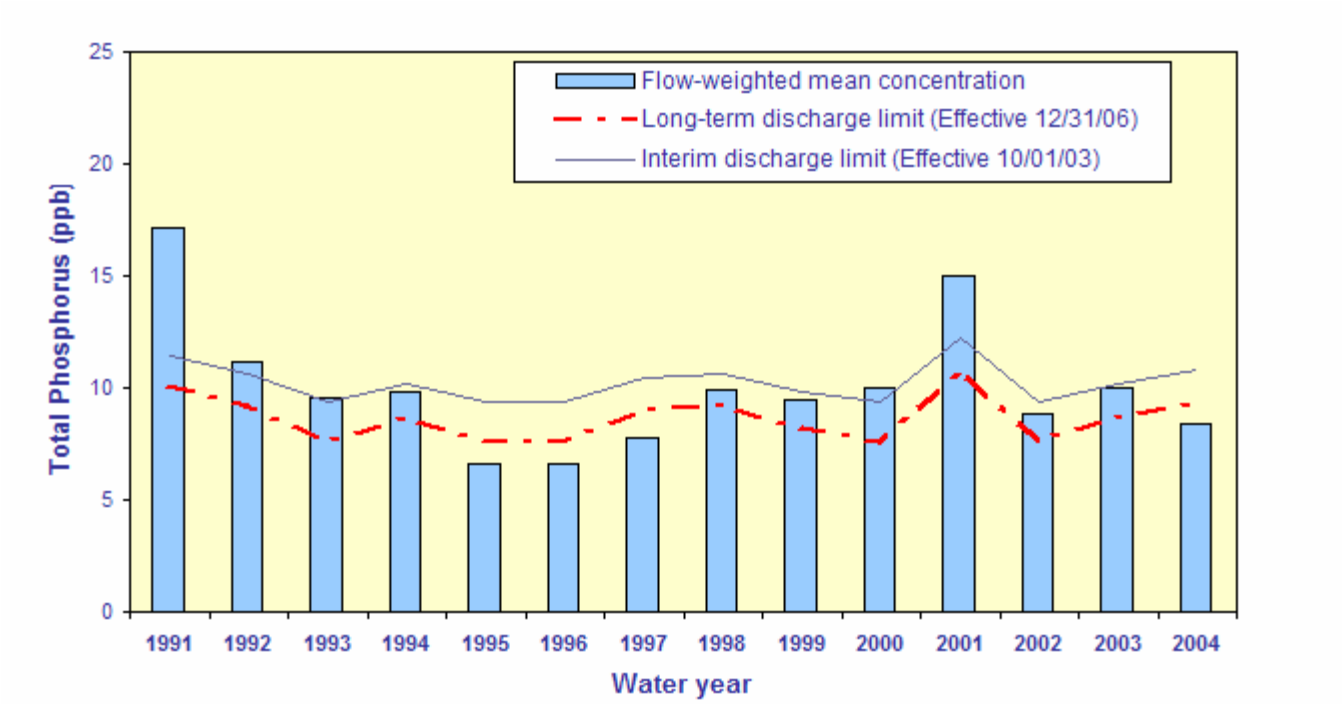

Figure 3. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the total phosphorus interim and long-term limits.

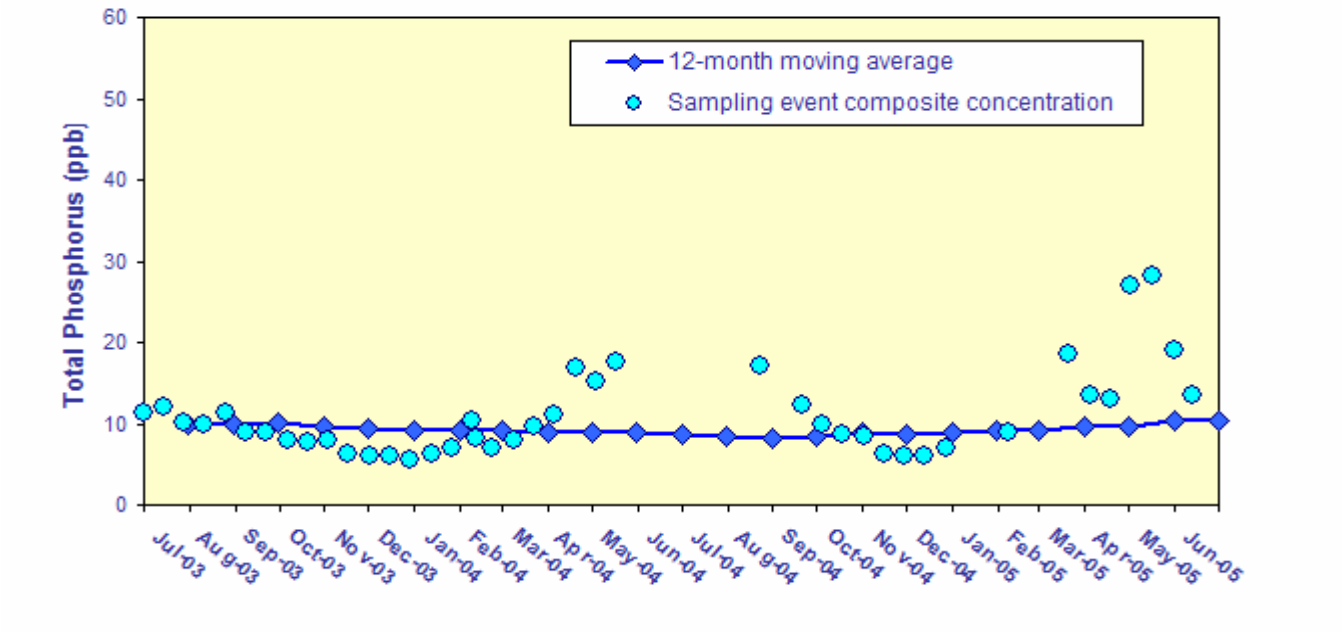

Figure 4. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each month and the composite total phosphorus concentration for each sampling event. There are no sampling event values for June, July 2004 and January 2005 because there was no flow in those periods.

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

12-Month Period Ending On	Total Period Flow (Kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Interim Limit (ppb) Effective 10/1/2003	Long Term Limit (ppb) Effective 12/31/2006	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
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
30-Apr-05	737.8	9.5	10.7	9.2	48.1	46.7
31-May-05	772.2	10.3	10.5	9.1	47.1	***50.0***
30-Jun-05	841.2	10.4	10.2	8.7	45.3	***52.9***

Notes: Bold italicized values exceeded the guideline percentages.

The daily flows through the individual Shark River Slough structures from July 2003 through June 2005 are presented in **Figure 5**. Since mid-December 2004 inflows to Shark River Slough have been through mostly S333 and S12D. A large proportion of this water in the L29 Canal entered through S333 and was released from the system through S334. This condition lasted until mid-June. Structures S12A, S12B and S12C were closed, except S12A on March 21 through 23, 2005, until June 22, 2005 in accordance with Interim Operational Plan (IOP) for protection of the Cape Sable Seaside Sparrow.

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.

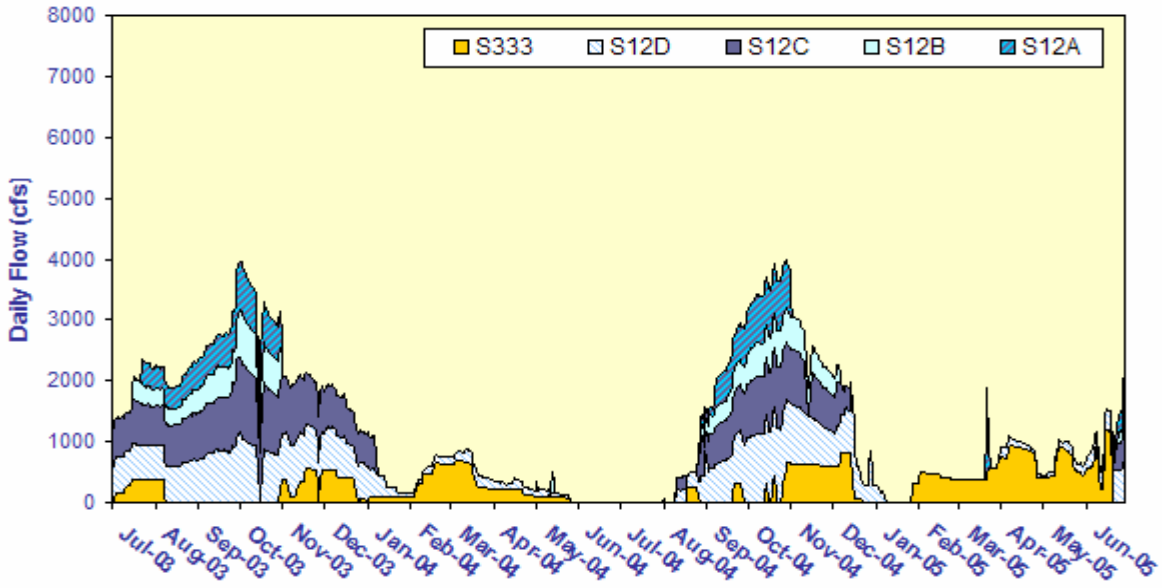

Figure 5. Daily flows into Shark River Slough by structure.

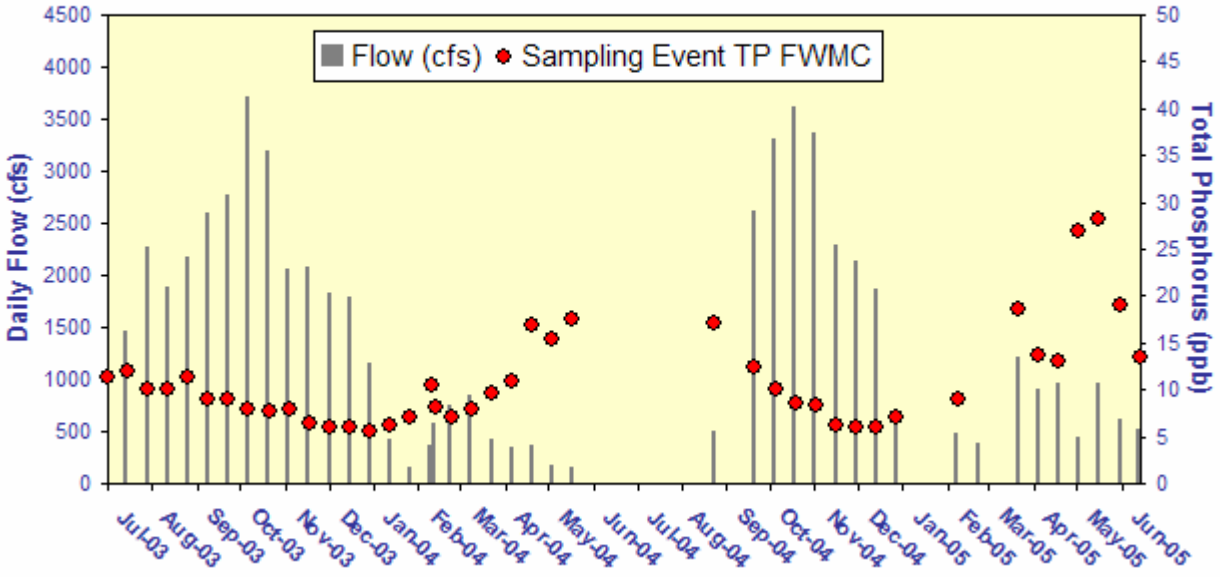

Figure 6. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events. There was no sampling event flow weighted mean concentration for the months of June through July 2004 and January 2005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

Taylor Slough and the Coastal Basins

Under the Consent Decree, a single long-term total phosphorus 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 location to routinely discharge surface water into 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 June 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.

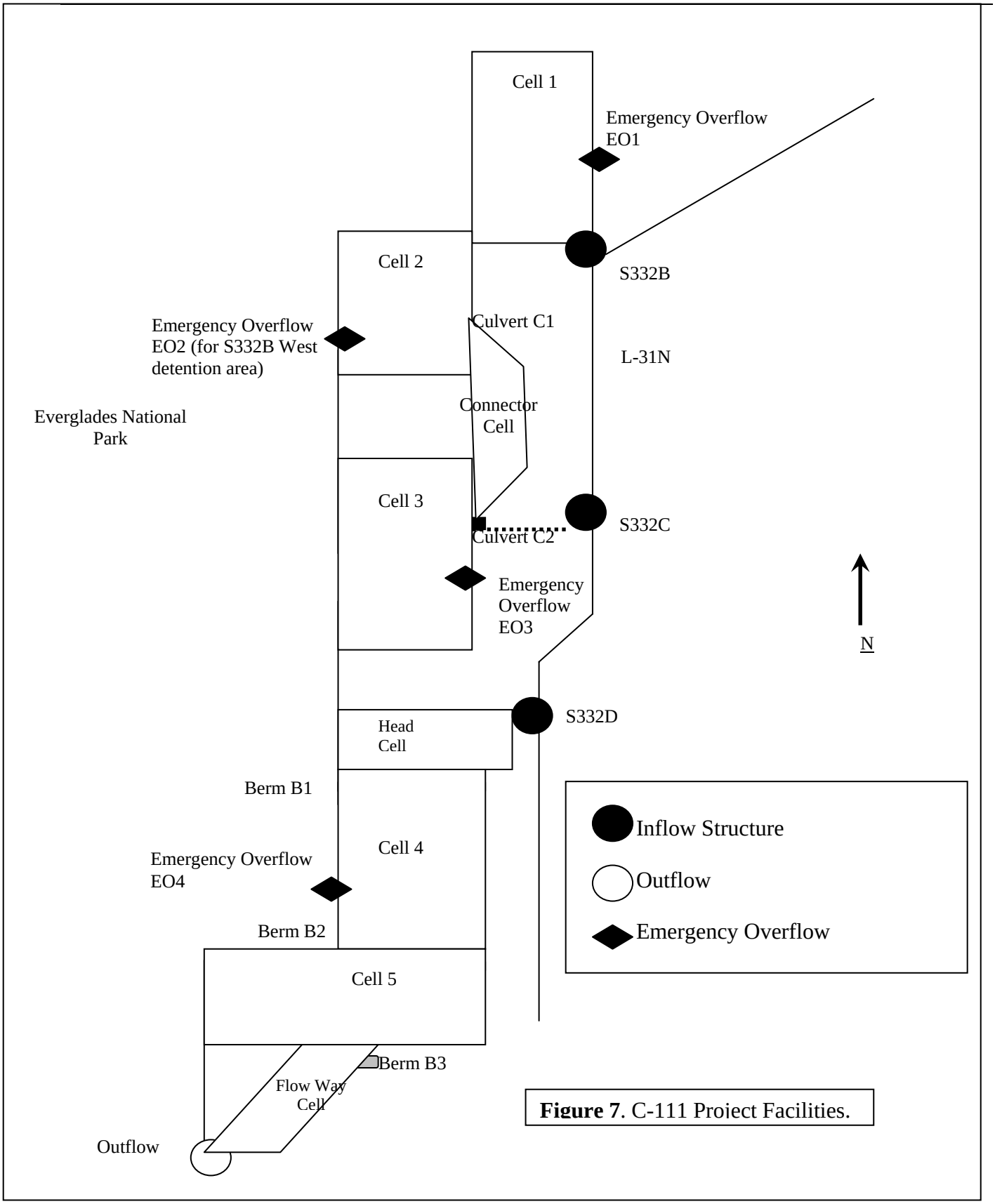

Figure 7. C-111 Project Facilities.

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 April, May and June 2005 were 5.6, 5.9 and 5.5 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 13.3, 18.8 and 14.6 ppb for the periods ending April, May and June 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. Historically, there has been no observable relationship between daily mean flow and flow-weighted mean total phosphorus concentrations at S332, S175 and S18C structures. However, the data for July 2003 through June 2005 at S332D, S174 and S18C structures indicate that all of the higher flow-weighted mean concentrations occurred on lower flow days. The average daily flow was 98 cfs-day on the days with flow-weighted mean concentrations of 8 ppb or greater, while the average daily flow was 428 cfs-day for days with a flow-weighted mean concentration below 8 ppb.

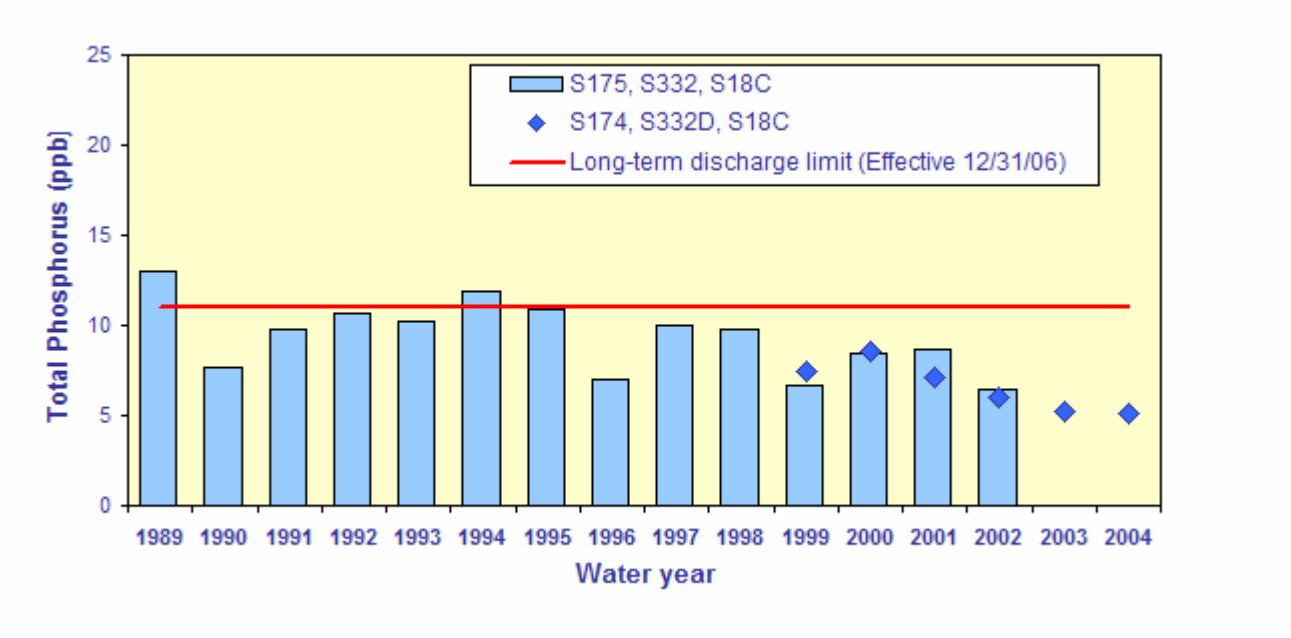

Figure 8. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term total phosphorus limit.

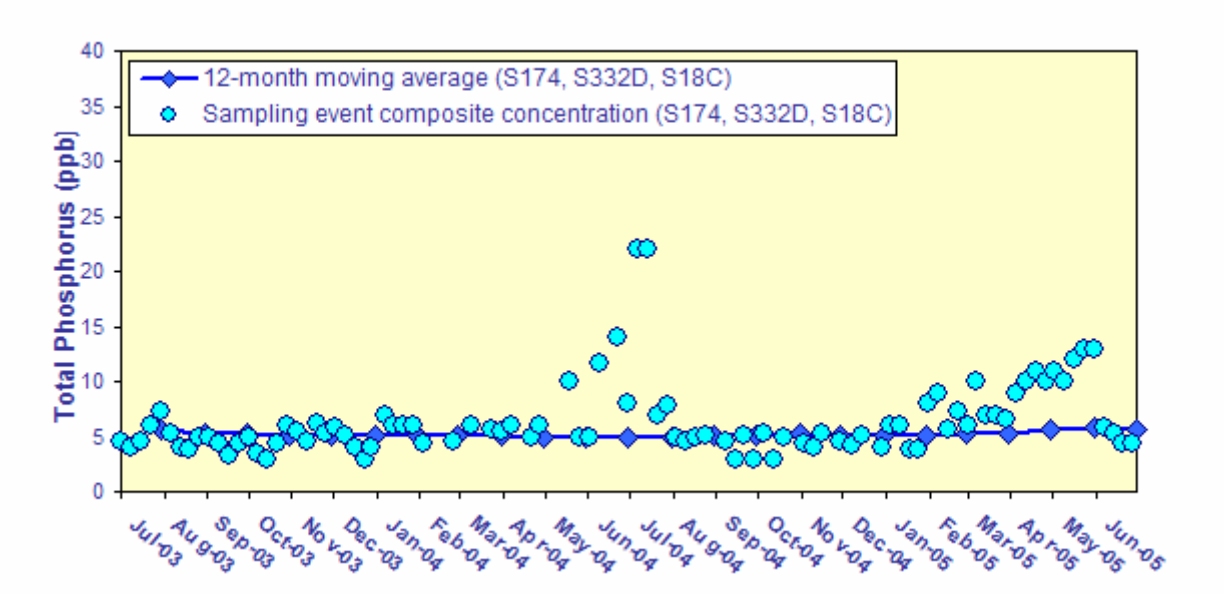

Figure 9. 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the composite total phosphorus concentration for each sampling event.

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

12-Month Period Ending On	Total Period Flow (Kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Long Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
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	6.8
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
30-Apr-05	207.2	5.6	11.0	53.1	13.3
31-May-05	214.1	5.9	11.0	53.1	18.8
30-Jun-05	261.0	5.5	11.0	53.1	14.6

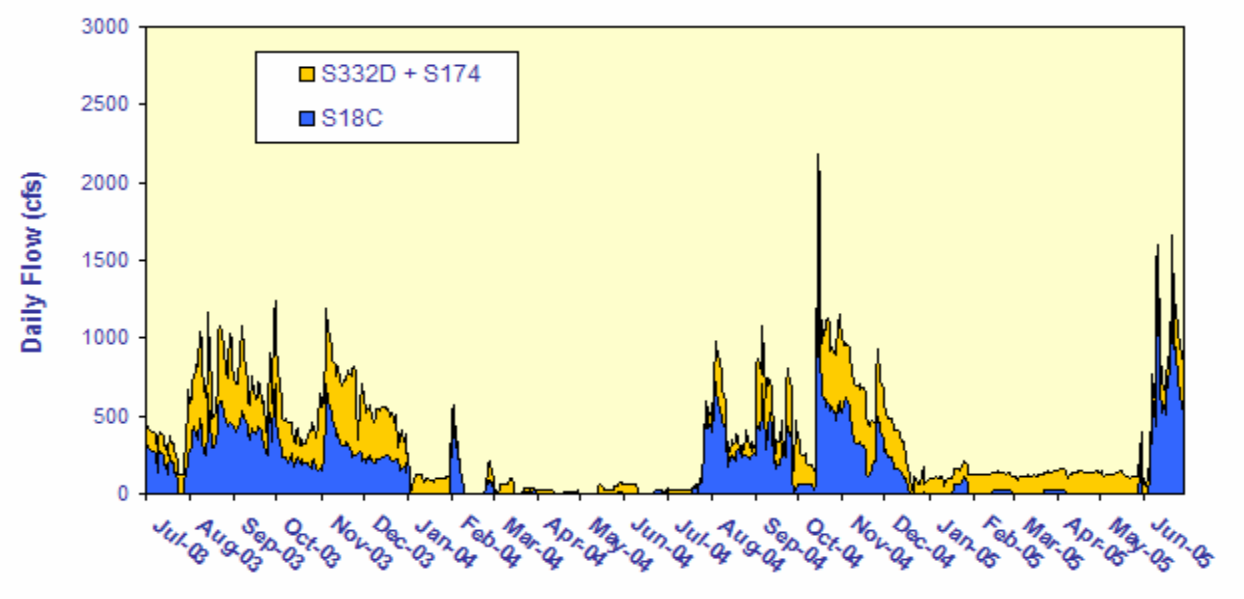

Figure 10. Daily flows into Everglades National Park through Taylor Slough (S332D + S174) and S18C.

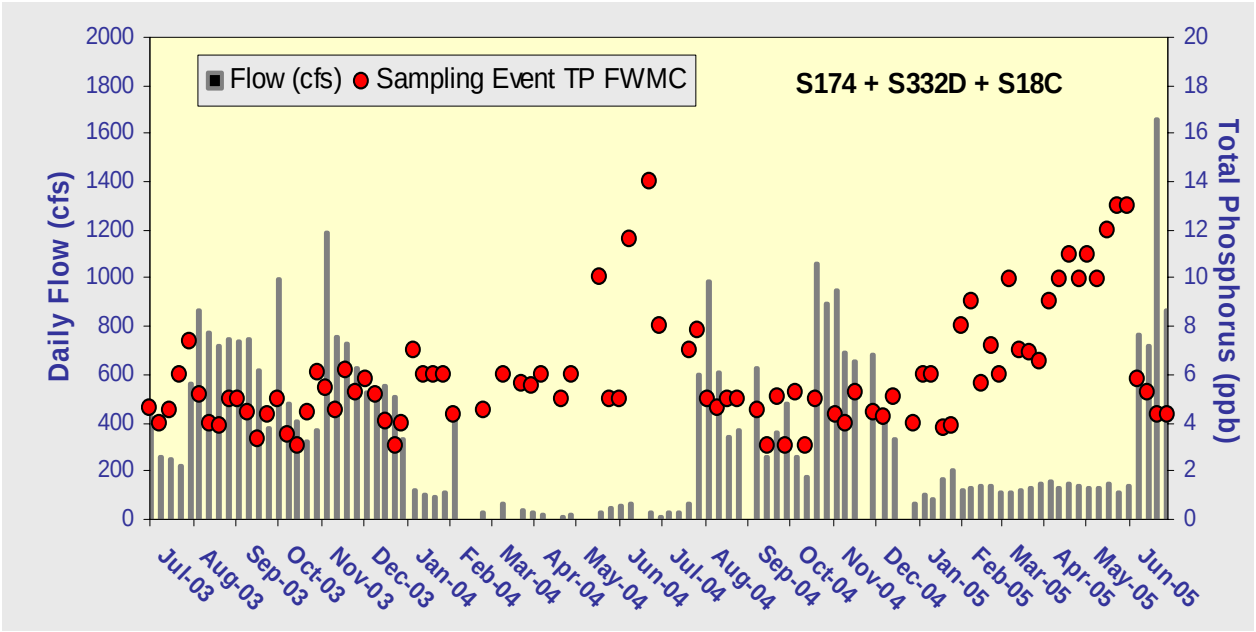

Figure 11. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
July - September 2005 Report

Update, November 30, 2005
On page 11, text was added to explain water quality sampling results for the overflow event at EO2 on August 30, 2005. On page 14, Figure 9 was modified to include TP results for the August overflow event.

Update, December 29, 2005
Figure 2 (page 3) and Table 1 (page 4) are modified to show May and June 2005 TP geometric mean concentration values.

Update, February 16, 2006
Table 1 (page 4) for September 2005: number of TP samples was changed from 10 to 11;
interim level was changed from 13.1 to 13.0 due to the update in stage data;
geometric mean concentration and long term level were not affected.

Prepared for the
Technical Oversight Committee
November 23, 2005

Prepared by:
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Water Quality Assessment Division
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406

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, LOX3 through LOX16 (**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.

The interim levels for July, August and September 2005 were 14.9, 13.9 and 13.1 parts per billion (ppb), respectively. The long-term levels were 12.2, 11.4 and 10.8 (ppb), respectively. Because the total depth was less than 0.1 meter (m), no water samples were collected at stations LOX3 and LOX10 for August 2005 and stations LOX3, LOX5 and LOX13 for September 2005.

Average stages in the Refuge were 16.05, 16.17 and 16.28 feet in July, August and September 2005 (**Figure 2** and **Table 1**). The geometric means, calculated from total phosphorus concentrations measured in water samples collected in July, August and September 2005, were 7.4, 6.5 and 7.5 ppb, respectively. The interim levels were 14.9, 13.9 and 13.1 ppb respectively. The geometric means were less than the interim and long-term levels for July, August and September 2005.

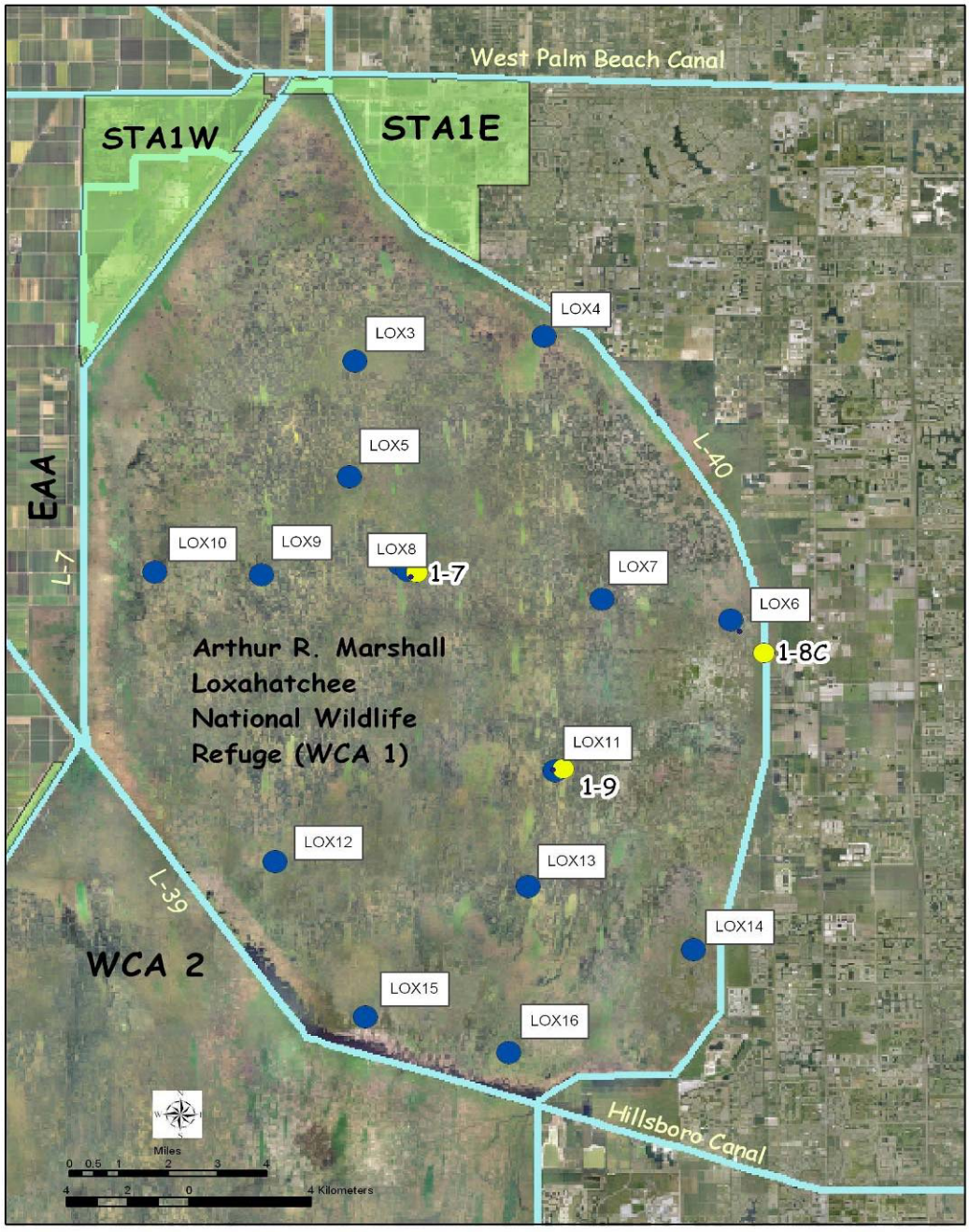

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

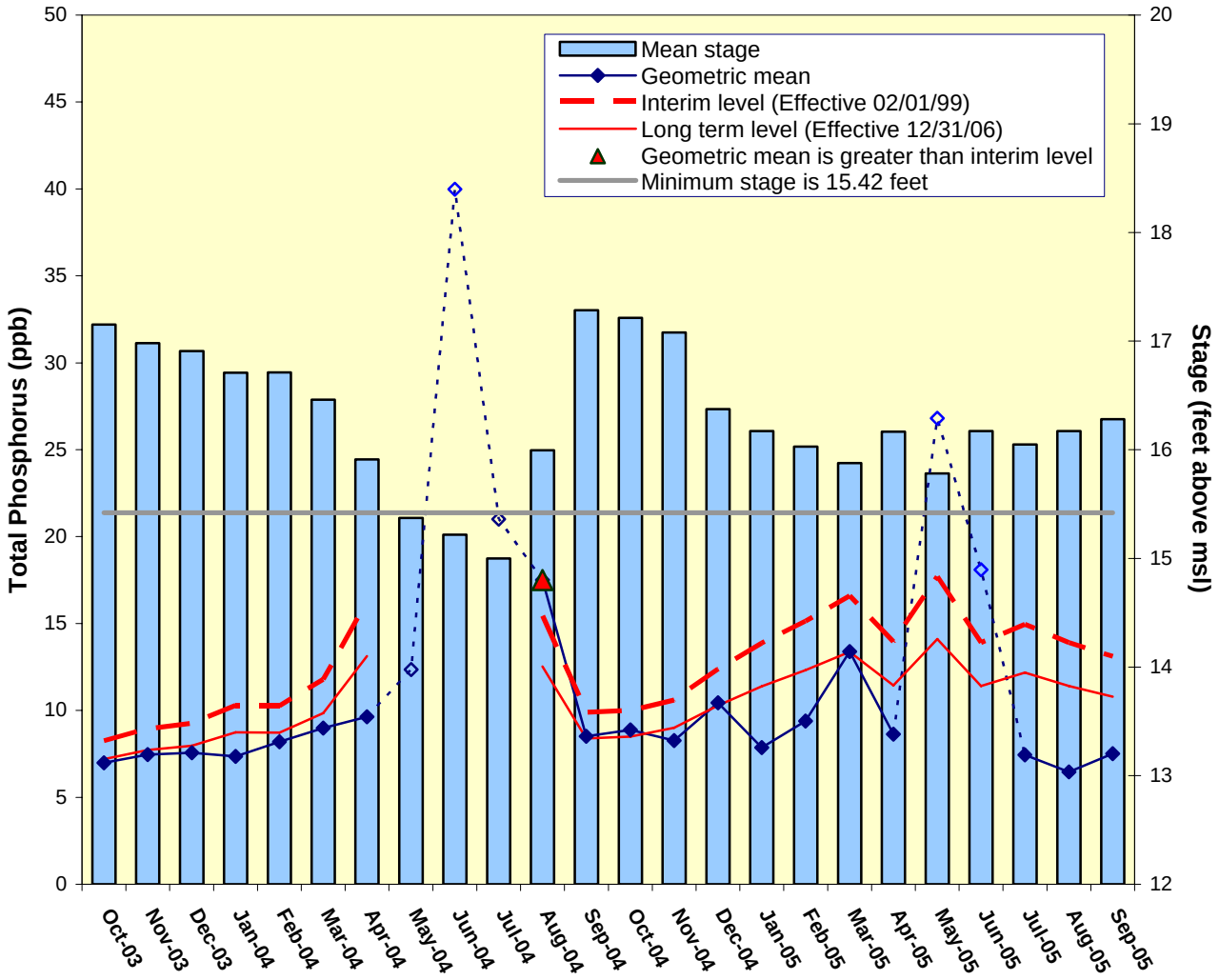

Figure 2. Monthly total phosphorus geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

Interim and Long-term levels are not shown for May 2004 – July 2004 because the levels do not apply when the mean stage is less than 15.42 feet.

The TP data from May and June, 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used. Geometric means for May and June 2005 are shown for reference only and were not considered for compliance purposes.

Table 1. Loxahatchee National Wildlife Refuge Total Phosphorus Compliance Tracking

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
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
Apr-2005	8.6	13.9	11.4	16.17	11	3
May-2005*	26.8*	17.7	14.1	15.78	10*	3
June-2005*	18.1*	13.9	11.4	16.17	14*	3
Jul-2005	7.4	14.9	12.2	16.05	14	3
Aug-2005	6.5	13.9	11.4	16.17	12	3
Sep-2005	7.5	13.0	10.8	16.28	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 occurred.
(3) N/A denotes that the concentration values were not applicable because the average stage was less than 15.42 feet.
** The TP data from May and June, 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used.*

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) (**Figure 3**) 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 (October 1st through September 30th) from 1991 to 2005 (**Figure 4**). The 12-month moving flow-weighted mean total phosphorus concentration ending September 2005 was 9.4 ppb. Corresponding interim and long-term limits were 9.4 and 7.6 ppb, respectively.

Table 2 presents the moving flow-weighted mean concentrations for each 12-month period beginning in October 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 July, August and September 2005, the flow-weighted mean total phosphorus concentrations were 10.5, 9.8 and 9.4 ppb, respectively. The interim limit was 9.4 ppb for July, August and September 2005. The long-term limits were 7.7 ppb for July and 7.6 ppb for August and September. The July and August 2005 12-month flow-weighted mean concentrations were greater than the interim 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 July, August and September 2005, the observed percentage of flow-weighted mean total phosphorus concentrations greater than 10 ppb were 55.0, 47.6 and 42.9 percent, respectively. The observed percentage of flow-weighted mean total phosphorus concentrations greater than 10 ppb were less than the guideline for the entire period March 2004 to April 2005 and higher than the guidelines from May to September 2005 (**Table 2**). The individual sampling events and the 12-month moving average are presented in **Figure 5**.

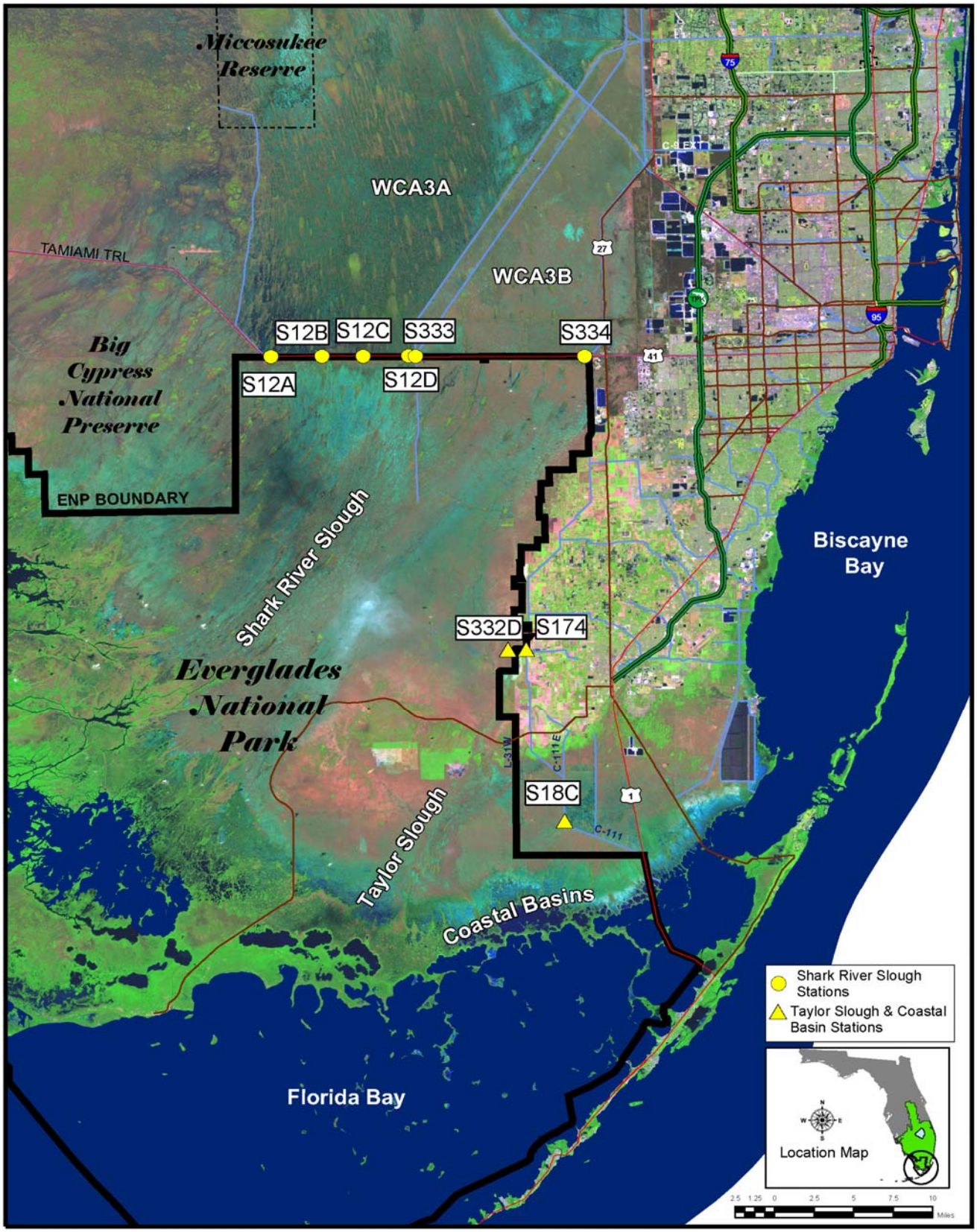

Figure 3. Everglades National Park flow structures

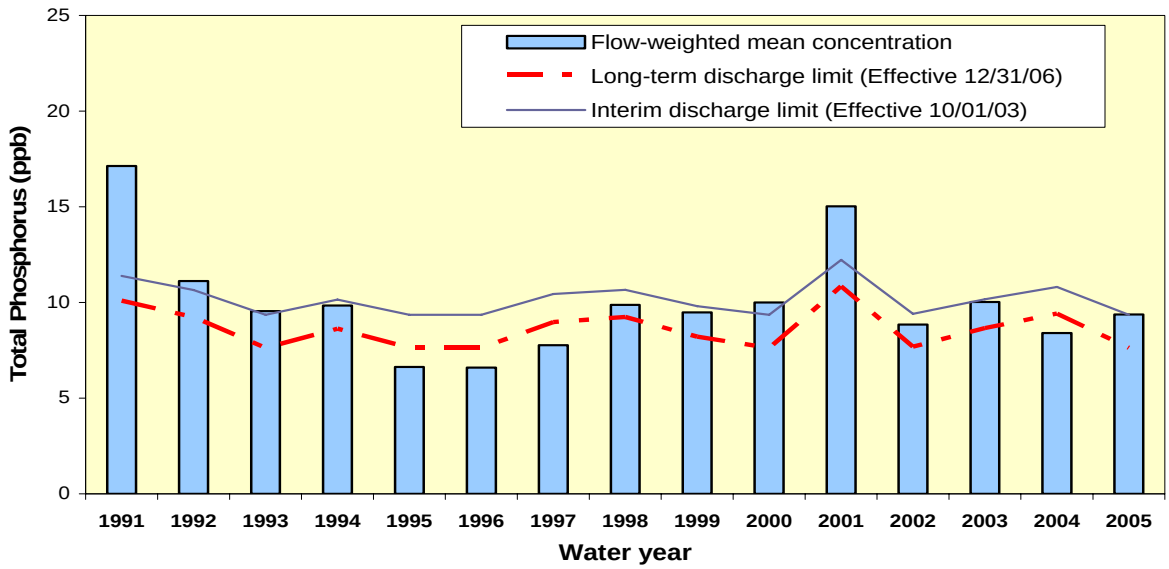

Figure 4. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the total phosphorus interim and long-term limits. For the second consecutive compliance year, the 12-month fwmc was within the interim limits, which became effective on October 1, 2003.

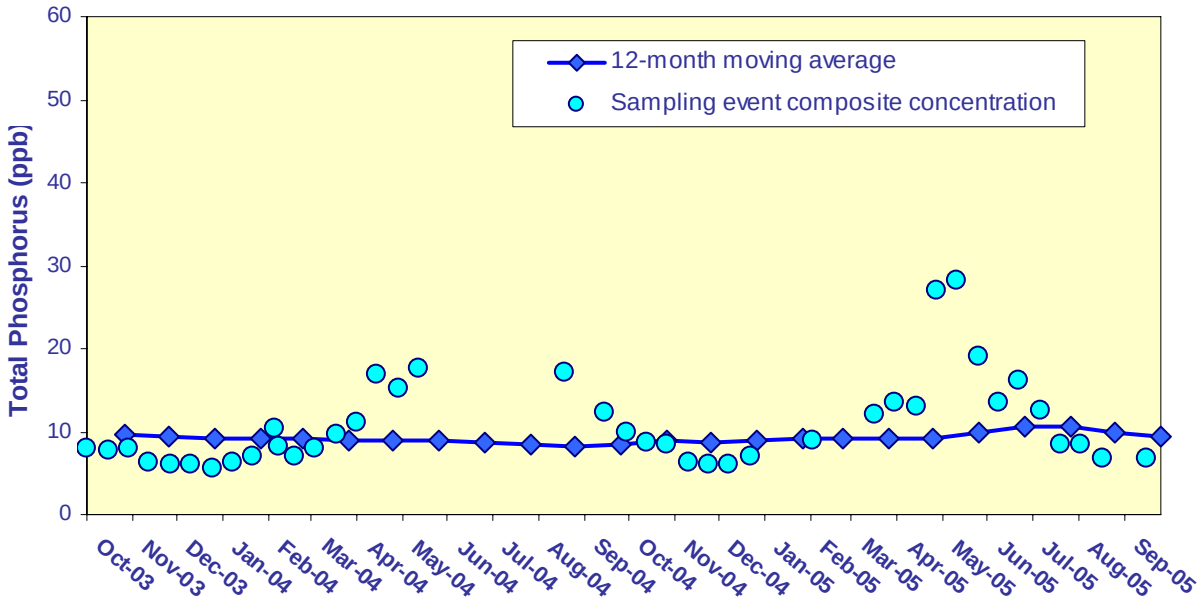

Figure 5. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Shark River Slough at the end of each month and the composite total phosphorus concentration for each sampling event. There are no sampling event values for June, July 2004 and January 2005 because there was no flow in those periods.

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

12-Month Period Ending On	Total Period Flow (Kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Interim Limit (ppb) Effective 10/1/2003	Long Term Limit (ppb) Effective 12/31/2006	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
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**	698.3	9.2	10.8	9.4	49.2	46.7
30-Apr-05	732.6	9.1	10.7	9.3	48.2	46.7
31-May-05	767.1	10.0	10.5	9.1	47.3	***50.0***
30-Jun-05	836.0	10.5	10.2	8.7	45.4	***55.6***
31-Jul-05	1054.7	10.5	9.4	7.7	40.3	***55.0***
31-Aug-05	1269.2	9.8	9.4	7.6	40.1	***47.6***
30-Sep-05*	1345.9	9.4	9.4	7.6	40.1	***42.9***

Notes: 1) Highlighted rows indicate the end of the water year (Oct 1st to Sept 30th)

2) Bold italicized values exceeded the guideline percentages.

3) When the total flow for Shark River Slough exceeds 1061 Kac-ft/yr, a flow of 1061 Kac-ft/yr is used in calculating the discharge limits.

** September compliance points.*

***Flow data at structure S12A from March 21 to March 23, 2005 were corrected. This affected previously-published Total Period Flow and flow- weighted mean TP values for March-June 2005.*

The daily flows through the individual Shark River Slough structures from October 2003 through September 2005 are presented in **Figure 6**. From mid-December 2004 through June 2005, inflows to Shark River Slough were through S333 and S12D. A large proportion of the flow in the L29 Canal entered through S333 and was released from the system through S334. This condition lasted until mid-June 2005. Structures S12A, S12B and S12C were closed in accordance with Interim Operational Plan (IOP) for protection of the Cape Sable Seaside Sparrow. The S12s are operated to meet target discharges per the Shark River Slough Rainfall Plan which has been in effect since July 1985.

For additional information on the S12s and S333 structures, please visit: http://www.sfwmd.gov/org/ema/reports/sharkriver/index.html.

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 7.** Values follow the strong inverse relationship between flow and total phosphorus concentration expected for waters entering the ENP through Shark River Slough.

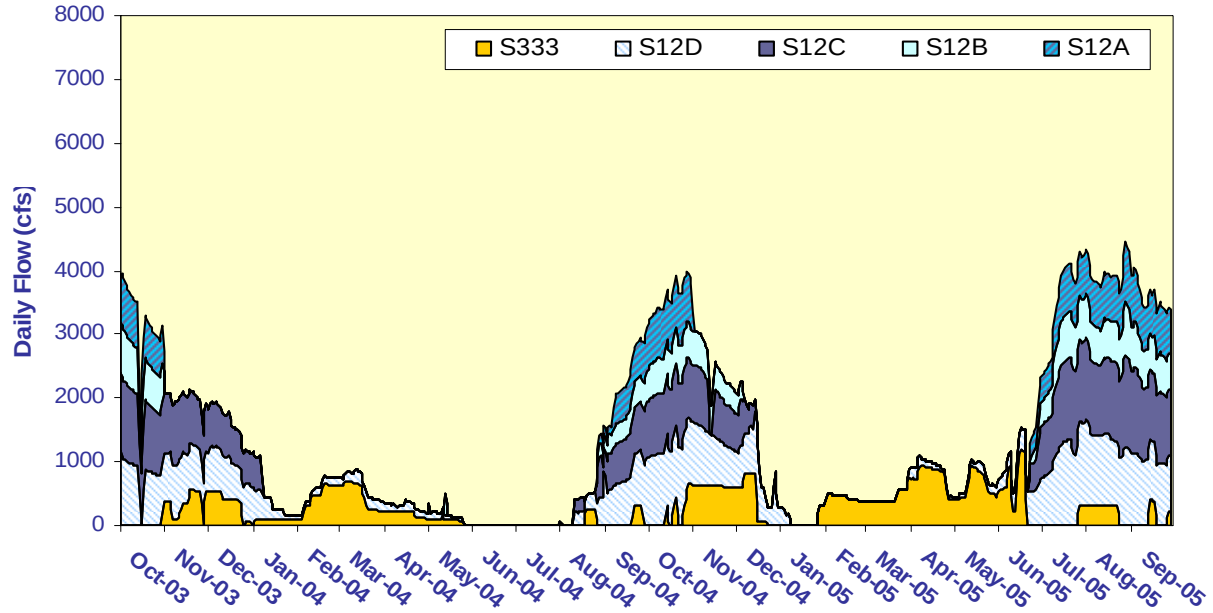

Figure 6. Daily flows into Shark River Slough by structure.

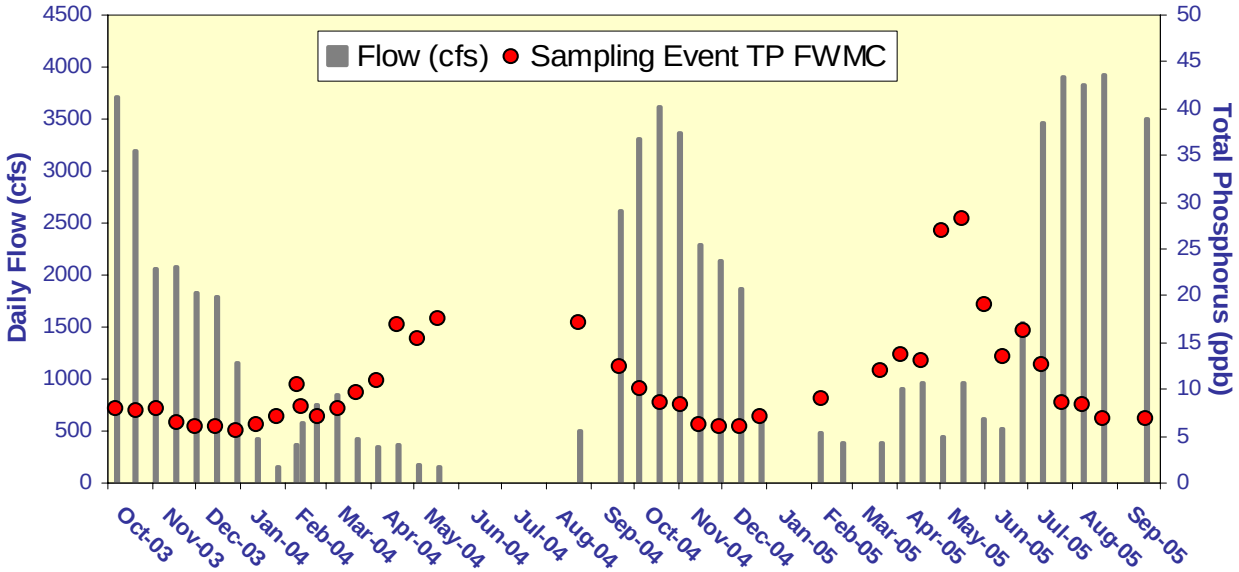

Figure 7. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events. There was no sampling event flow-weighted mean concentration for the months of June through July 2004 and January 2005 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. For the Water Year ending September 2005, the total phosphorus value was much lower than the long-term limit.

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 8**). The Flow Way Cell is the only location to routinely discharge surface water into 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 District started the routine sampling in September 2003.

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 June 2005. After this period, overflow events occured at the S332B west detention area for: three days in July 2005 (7/1-7/2 and 7/10), seven days in August 2005 (8/25-8/31), and eight days in September 2005 (9/1-9/6) and 9/20-9/21). Water Quality sample was collected on August 30, 2005 during the overflow event. The TP concentration of the August 30, 2005 sample was 14 ppb

(Figure 9). 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.

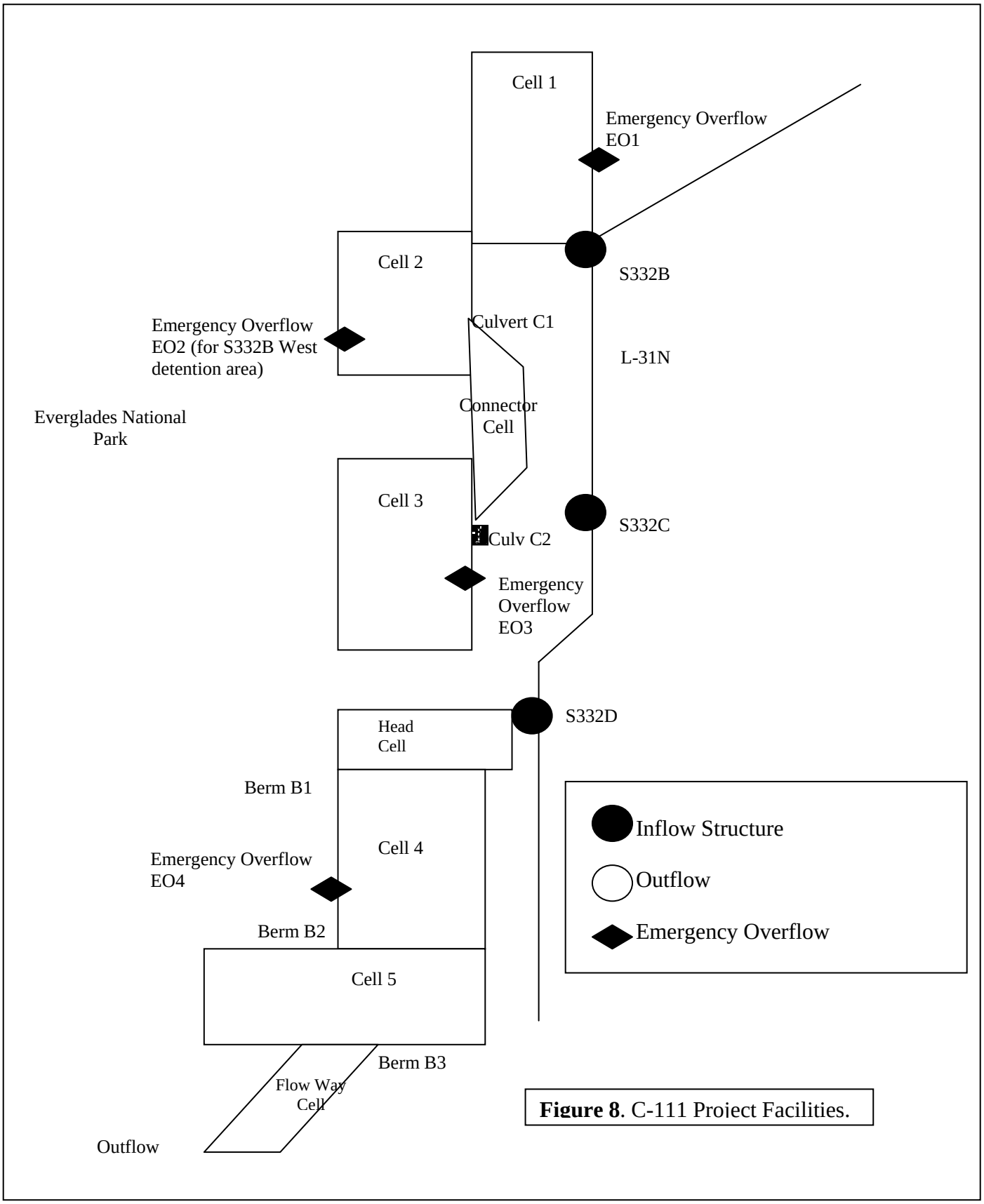

Figure 8. C-111 Project Facilities.

Overflow Events 2005 at S332B Pump

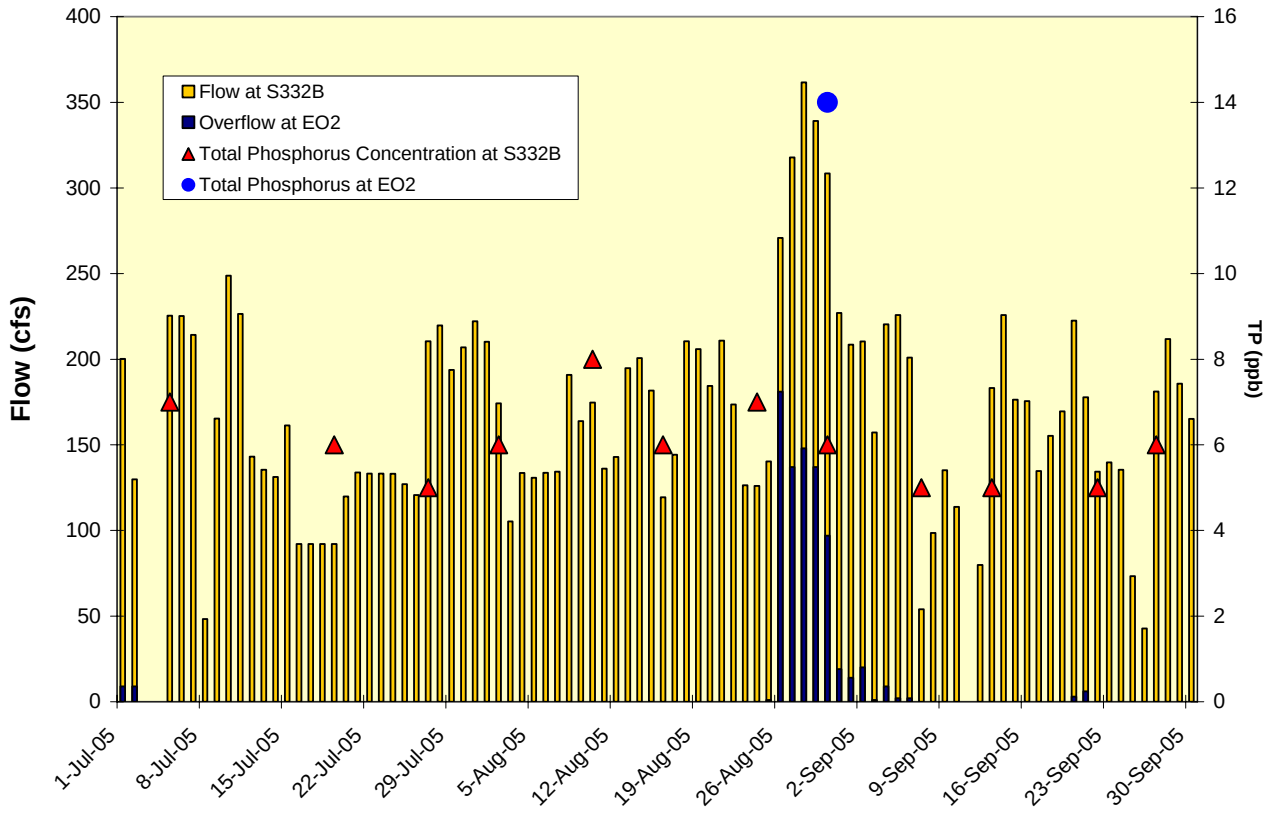

Figure 9. Flows through pump S332B and total phosphorus concentrations during overflow events at EO2 west pond.

Compliance with Consent Decree

Inflow concentrations of total phosphorus to the ENP 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 10)**. The bars in **Figure 10** 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 2005 represent the new combination of structures. S175, located on the Levee 31W borrow canal, is closed under IOP. It was opened briefly on August 26 and 27, 2005 for the flood protection of the area after Hurricane Katrina (total flow: 2,066 acre-feet; TP concentration: 6 ppb; TP load: 15 kg). However, flow through S175 is not considered an input to the ENP but a flow within it.

Figure 11 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 S175, S332 to S174, 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 11**.

The 12-month flow-weighted mean concentrations for July, August and September 2005 were 5.4, 6.4 and 6.3 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 observed percentage of flow-weighted mean total phosphorus concentrations greater than 10 ppb for the combined flow through S174, S332D and S18C was 10.4, 12.2 and 12.2 percent for the periods ending July, August and September 2005.

The daily flows into ENP through S332D, S174 and S18C are presented in **Figure 12**. **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean total phosphorus concentrations for each sampling event. There used to be no observable relationship between daily mean flow and flow-weighted mean total phosphorus concentrations at S332, S175 and S18C structures. However, the data for October 2003 through September 2005 at S332D, S174 and S18C structures indicate that all of the higher flow-weighted mean concentrations occurred on lower flow days except for August 2005.

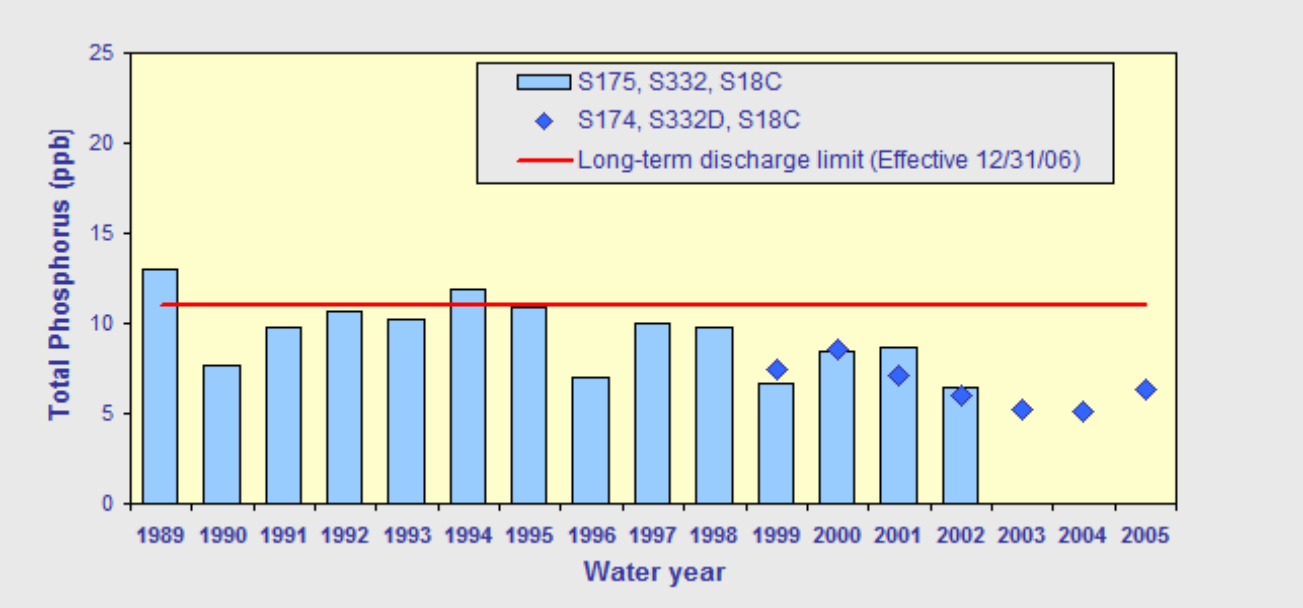

Figure 10. The 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term total phosphorus limit.

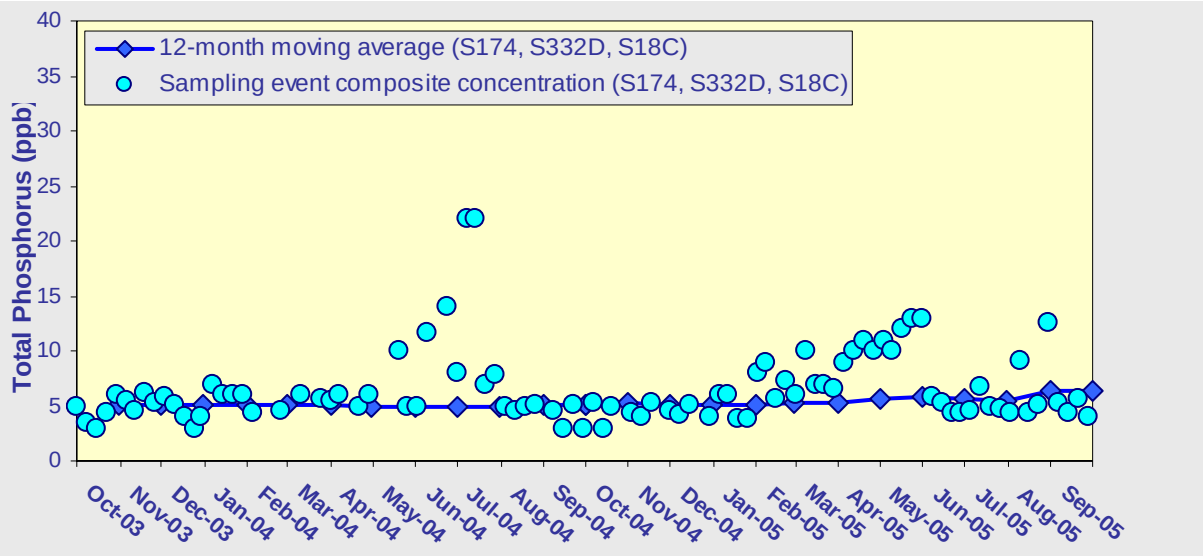

Figure 11. 12-month moving average total phosphorus flow-weighted mean concentrations (fwmc) in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the composite total phosphorus concentration for each sampling event.

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

12-Month Period Ending On	Total Period Flow (Kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Long Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
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	6.8
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
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
30-Apr-05	207.2	5.6	11.0	53.1	13.3
31-May-05	214.1	5.9	11.0	53.1	18.8
30-Jun-05	261.0	5.5	11.0	53.1	14.6
31-Jul-05	304.6	5.4	11.0	53.1	10.4
31-Aug-05	357.1	6.4	11.0	53.1	12.2
30-Sep-05	380.0	6.3	11.0	53.1	12.2

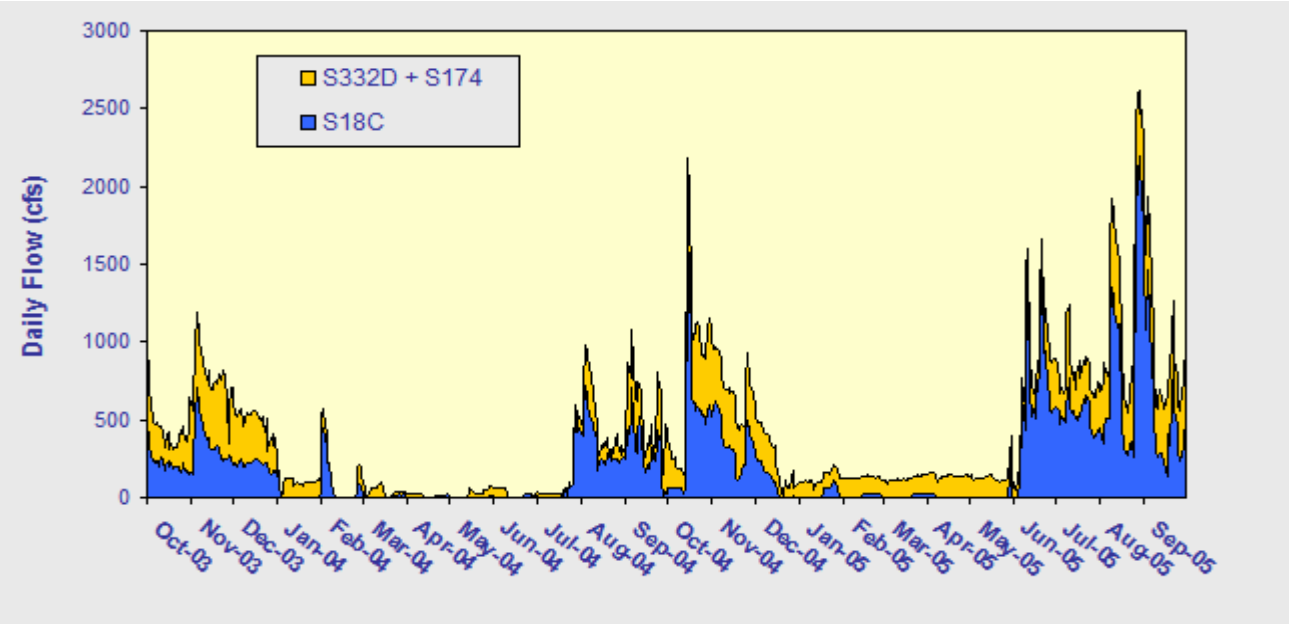

Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C.

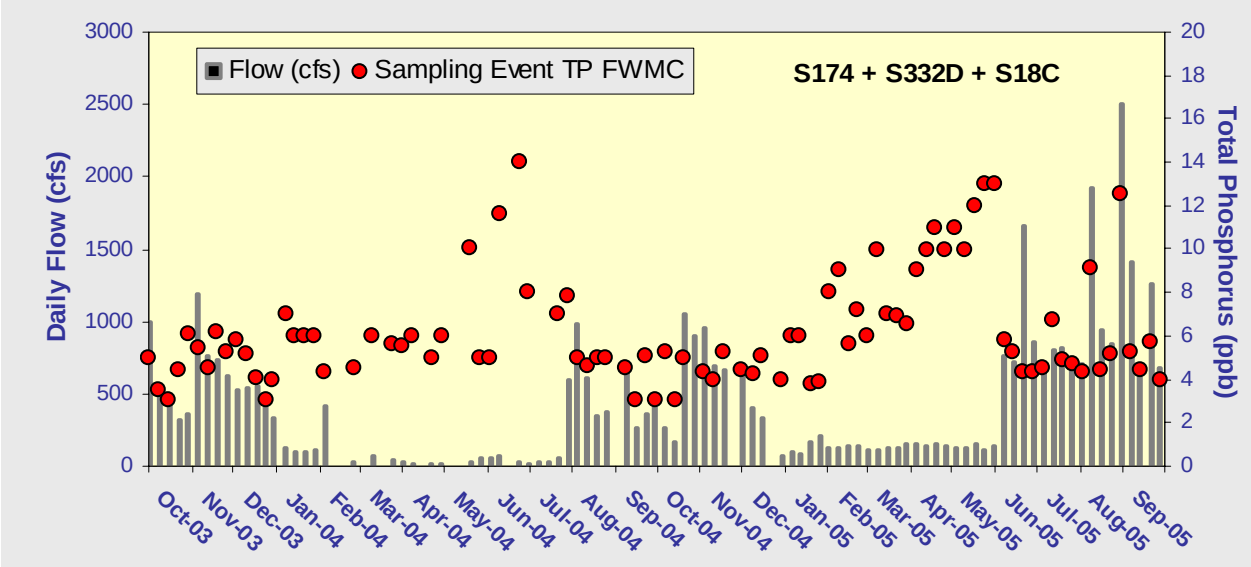

Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
October - December 2005 Report

Update, February 16, 2006
Table 1 (page 4) for September 2005: number of TP samples was changed from 10 to 11; interim level was changed from 13.1 to 13.0 due to the update in stage data; geometric mean concentration and long term level were not affected.

Prepared for the
Technical Oversight Committee
February 10, 2006

Prepared by:
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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, LOX3 through LOX16 (**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.

The interim levels for October, November and December 2005 were 11.4, 9.8 and 9.6 parts per billion (ppb), respectively. The long-term levels were 9.6, 8.4 and 8.2, respectively. Because the total depth was less than 0.1 meter (m), no water samples were collected at station LOX13 in October 2005.

Average stages in the Refuge were 16.52, 16.79 and 16.85 feet in October, November and December 2005 (**Figure 2** and **Table 1**). The geometric means, calculated from total phosphorus concentrations measured in water samples collected in October, November and December 2005, were 6.5, 7.8 and 7.6 ppb, respectively. The geometric means were less than the interim and long-term levels for October, November and December 2005.

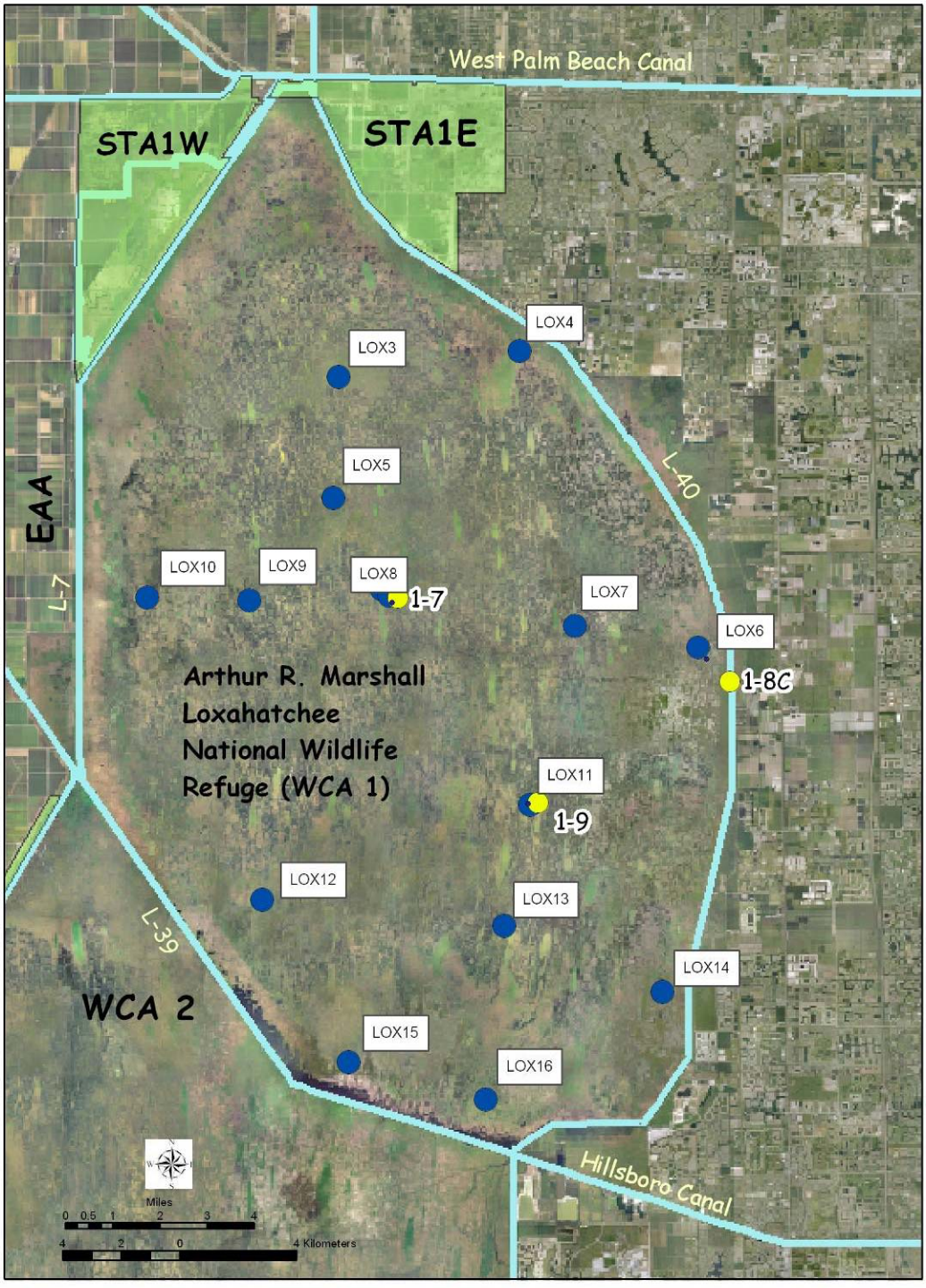

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

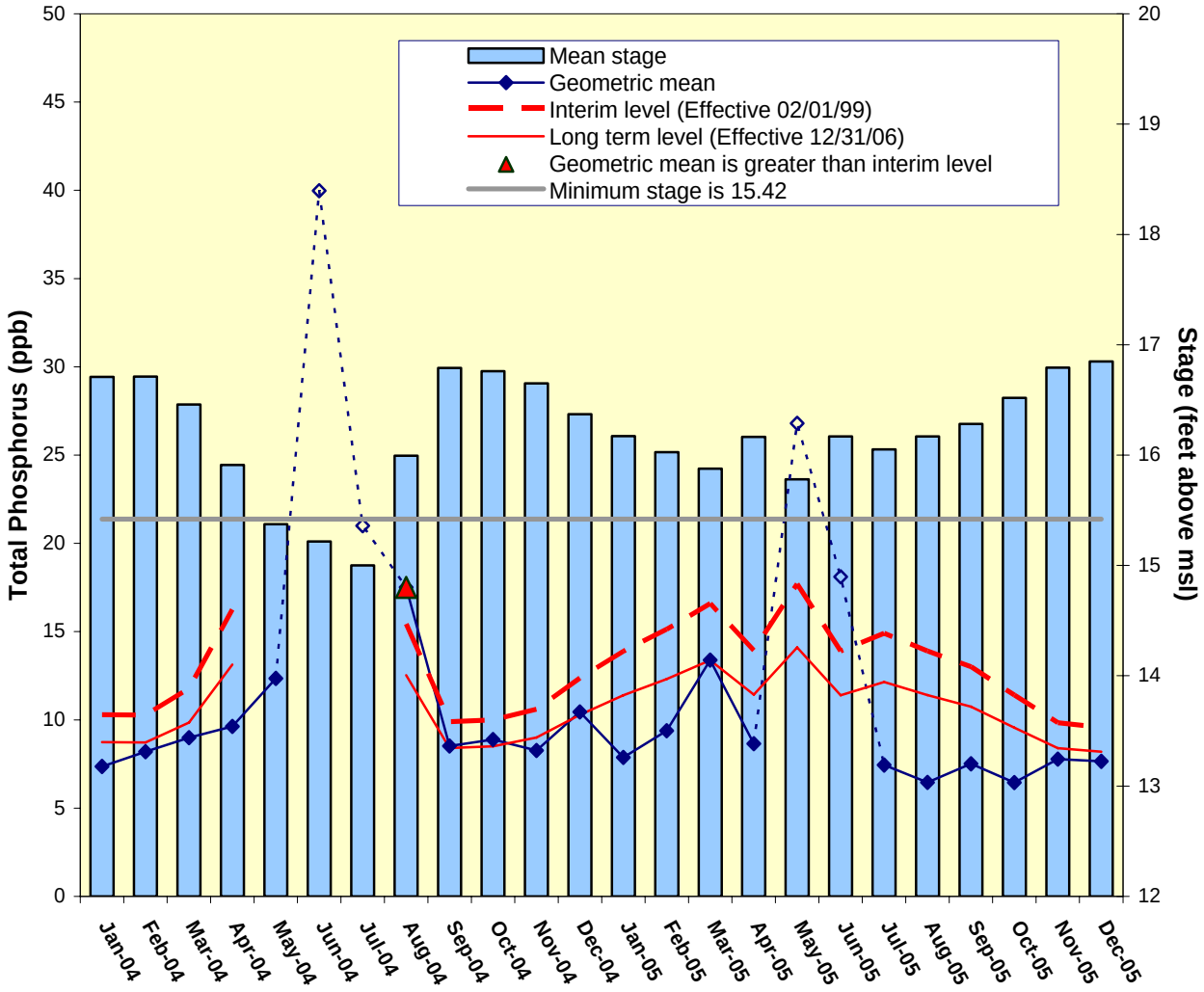

Figure 2. Monthly total phosphorus geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

Interim and Long-term levels are not shown for May 2004 – July 2004 because the levels do not apply when the mean stage is less than 15.42 feet.

The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used. Geometric means for May and June 2005 are shown for reference only and were not considered for compliance purposes.

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

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
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
Apr-2005	8.6	13.9	11.4	16.17	11	3
May-2005*	26.8*	17.7	14.1	15.78	10*	3
June-2005*	18.1*	13.9	11.4	16.17	14*	3
Jul-2005	7.4	14.9	12.1	16.05	14	3
Aug-2005	6.5	13.9	11.4	16.17	12	3
Sep-2005	7.5	13.0	10.8	16.28	11	3
Oct-2005	6.5	11.4	9.6	16.52	13	3
Nov-2005	7.8	9.8	8.4	16.79	14	3
Dec-2005	7.6	9.6	8.2	16.85	14	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.
** The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used.*

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) (**Figure 3**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the total phosphorus concentrations be presented as 12-month flow-weighted means. Only the total phosphorus concentrations for the water year ending September 30 are evaluated for compliance with the Consent Decree limits. 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 (October 1st through September 30th) from 1991 to 2005 (**Figure 4**). The 12-month flow-weighted mean total phosphorus concentration ending September 2005 was 9.4 ppb. Corresponding interim and long-term limits were 9.4 and 7.6 ppb, respectively.

Table 2 presents the 12-month flow-weighted mean concentrations for each month 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 2005, the 12-month flow-weighted mean total phosphorus concentrations were 9.0, 9.1 and 9.1 ppb, respectively. The interim limit was 9.4 ppb for October, November and December 2005. The long-term limits were 7.6 ppb for October, November and December. The October, November and December 2005 12-month flow-weighted mean concentrations were lower than the interim 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 2005, the observed percentage of the sampling event flow-weighted mean total phosphorus concentrations greater than 10 ppb were 40.9, 42.9 and 42.9 percent, respectively. The observed percentage of the sampling event flow-weighted mean total phosphorus concentrations greater than 10 ppb were less than the guideline for the entire period March 2004 to April 2005 and higher than the guidelines from May 2005 to December 2005 (**Table 2**). The individual sampling event flow-weighted mean concentrations and the 12-month flow-weighted mean concentrations are presented in **Figure 5**.

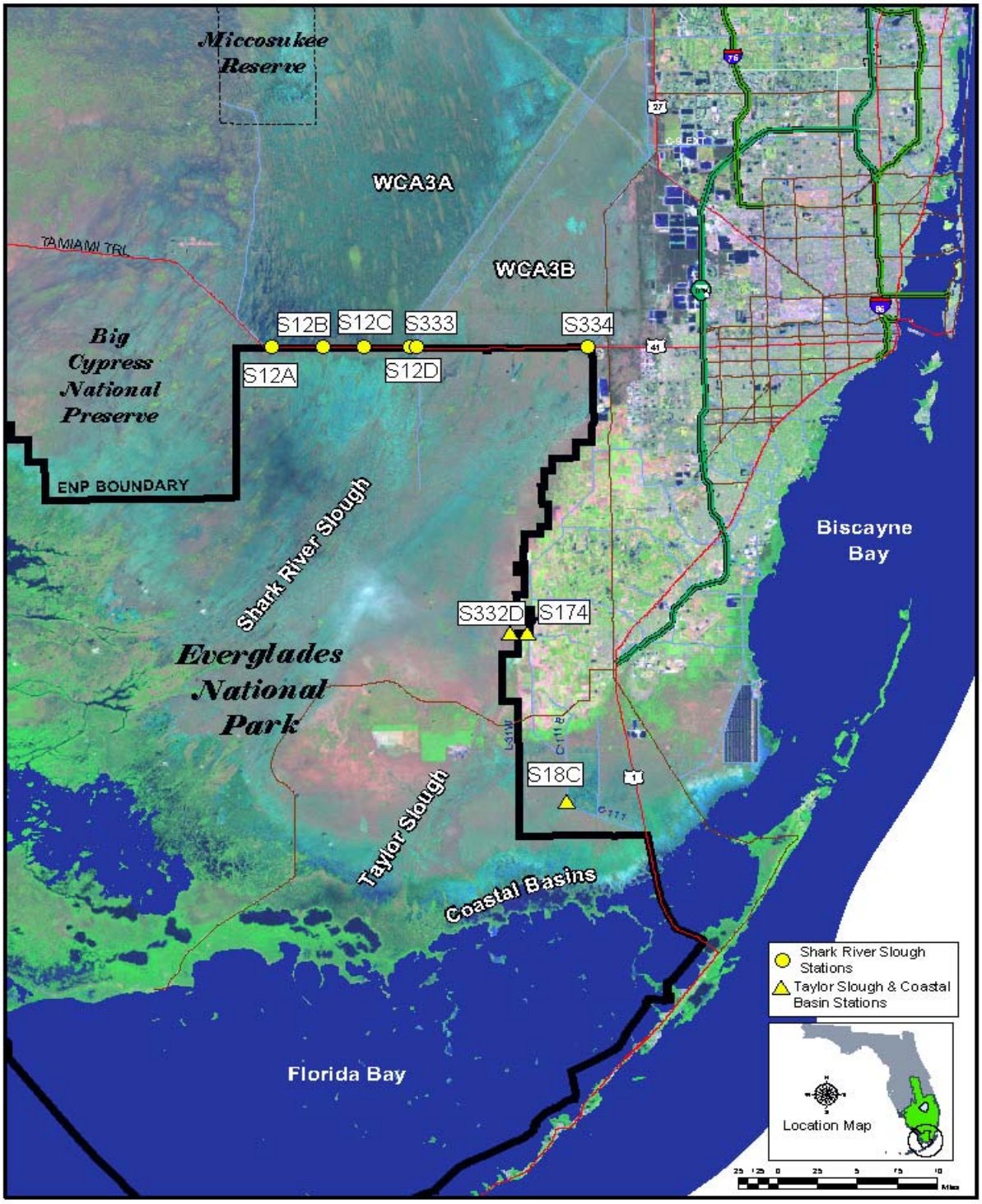

Figure 3. Everglades National Park flow structures

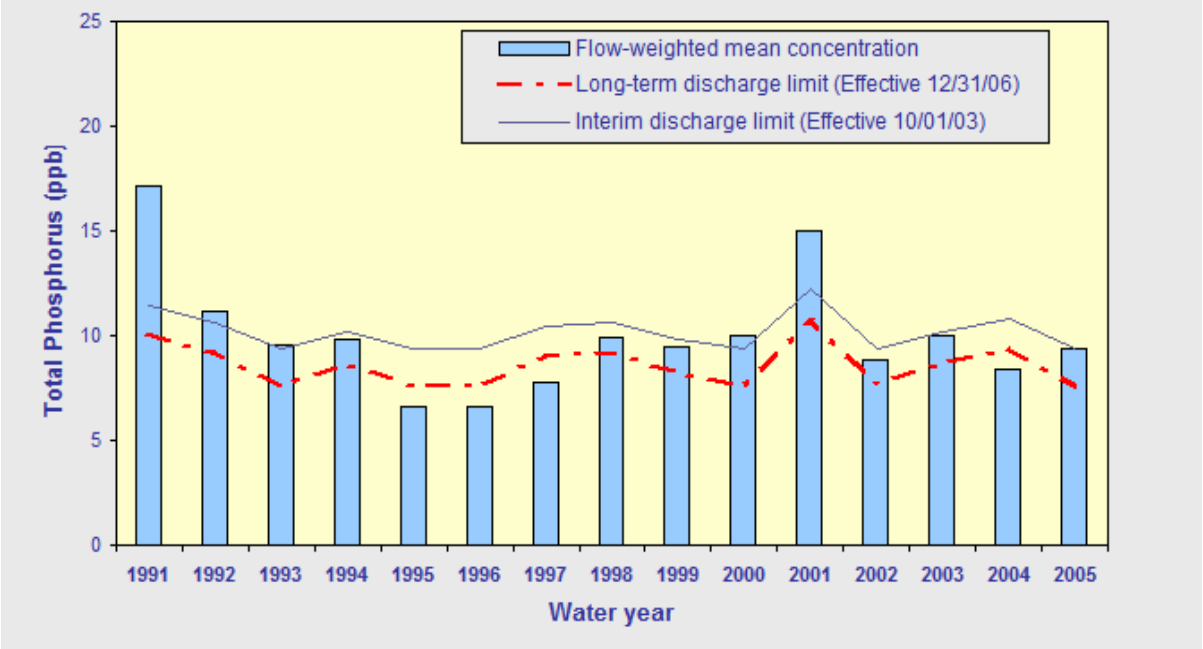

Figure 4. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the total phosphorus interim and long term limits. For the second consecutive compliance year, the 12-month flow-weighed mean concentration was within the interim limits, which became effective on October 1, 2003.

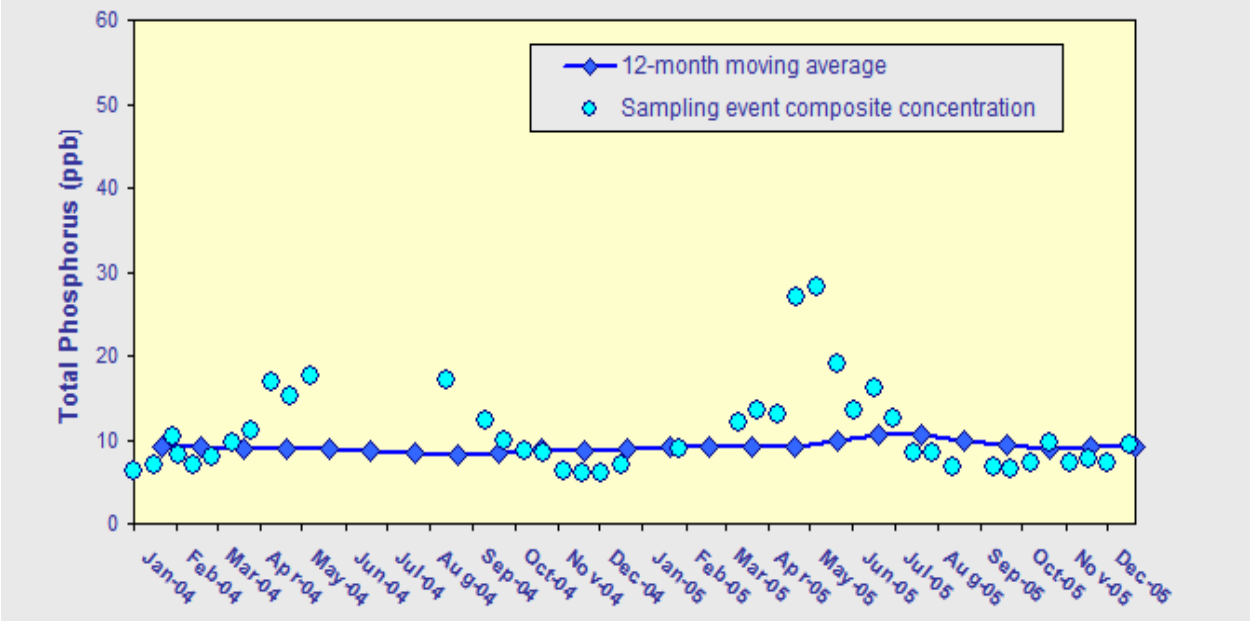

Figure 5. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for June, July 2004 and January 2005 because there was no flow in those periods.

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

12-Month Period Ending On	Total Period Flow (Kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Interim Limit (ppb) Effective 10/1/2003	Long Term Limit (ppb) Effective 12/31/2006	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
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	698.3	9.2	10.8	9.4	49.2	46.7
30-Apr-05	732.6	9.1	10.7	9.3	48.2	46.7
31-May-05	767.1	10.0	10.5	9.1	47.3	***50.0***
30-Jun-05	836.0	10.5	10.2	8.7	45.4	***55.6***
31-Jul-05	1054.7	10.5	9.4	7.7	40.3	***55.0***
31-Aug-05	1269.2	9.8	9.4	7.6	40.1	***47.6***
30-Sep-05	**1345.9**	**9.4**	**9.4**	**7.6**	**40.1**	***42.9***
31-Oct-05	1338.1	9.0	9.4	7.6	40.1	***40.9***
30-Nov-05	1381.7	9.1	9.4	7.6	40.1	***42.9***
31-Dec-05	1447.6	9.1	9.4	7.6	40.1	***42.9***

Notes: 1) Highlighted rows indicate the end of the water year (Oct 1st to Sept 30th), which are the compliance points.

2) Bold italicized values exceeded the guideline percentages.

3) When the total flow for Shark River Slough exceeds 1061 kac-ft/yr, a flow of 1061 kac-ft/yr is used in calculating the discharge limits.

The daily flows through the individual Shark River Slough structures from January 2004 through December 2005 are presented in **Figure 6**. The S12s are operated to meet target discharges per the Shark River Slough Rainfall Plan which has been in effect since July 1985. However, inflows to Shark River Slough were only through S333 and S12D from January 2004 through late June 2005; S12A, S12B and S12C were closed during that period in accordance with Interim Operational Plan (IOP) for protection of the Cape Sable Seaside Sparrow. All S12s were utilized since June 22, 2005, throughout the current reporting quarter except that S12A had been closed since November 16, 2005.

Since October 2004 a large proportion of the flow in the L29 Canal that entered through S333 was released from the system through S334. This condition lasted through the current reporting quarter (**Figure 7**).

For additional information on the S12s and S333 structures, please visit: http://www.sfwmd.gov/org/ema/reports/sharkriver/index.html.

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 8.** Values follow the strong inverse relationship between flow and total phosphorus concentration expected for waters entering the ENP through Shark River Slough.

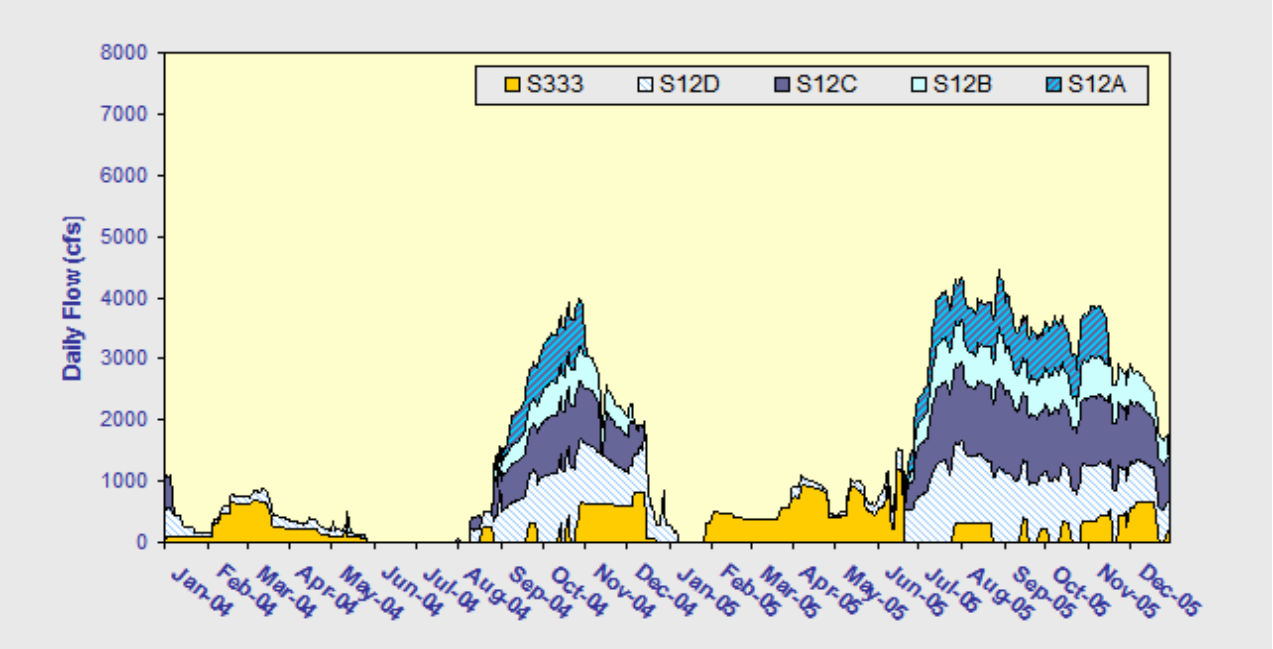

Figure 6. Daily flows into Shark River Slough by structure.

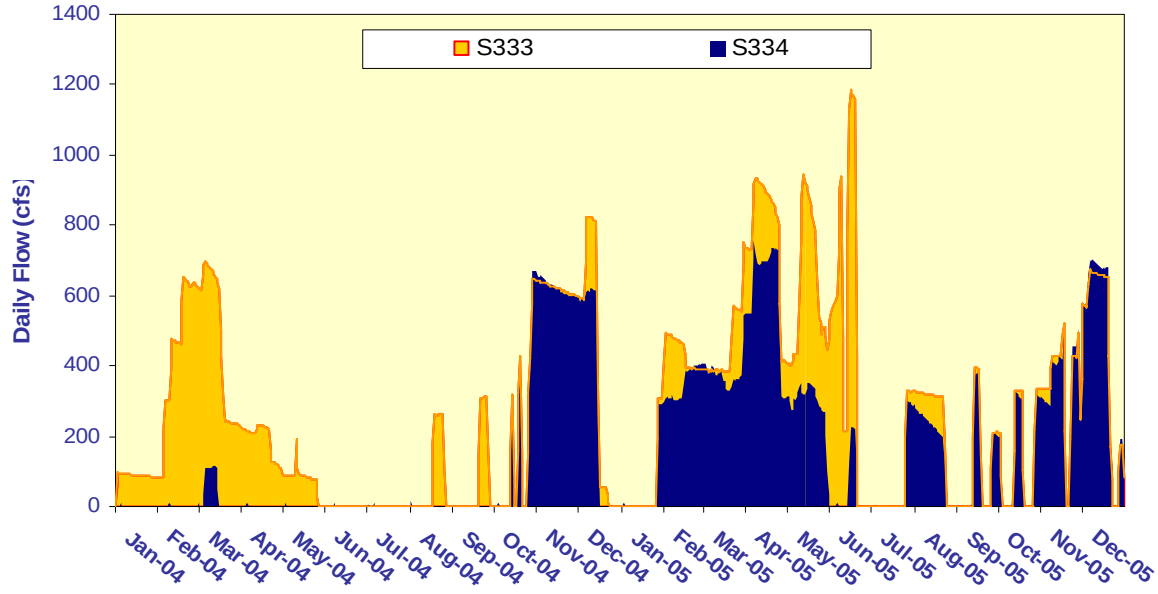

Figure 7. Comparison of daily flows at S333 and S334.

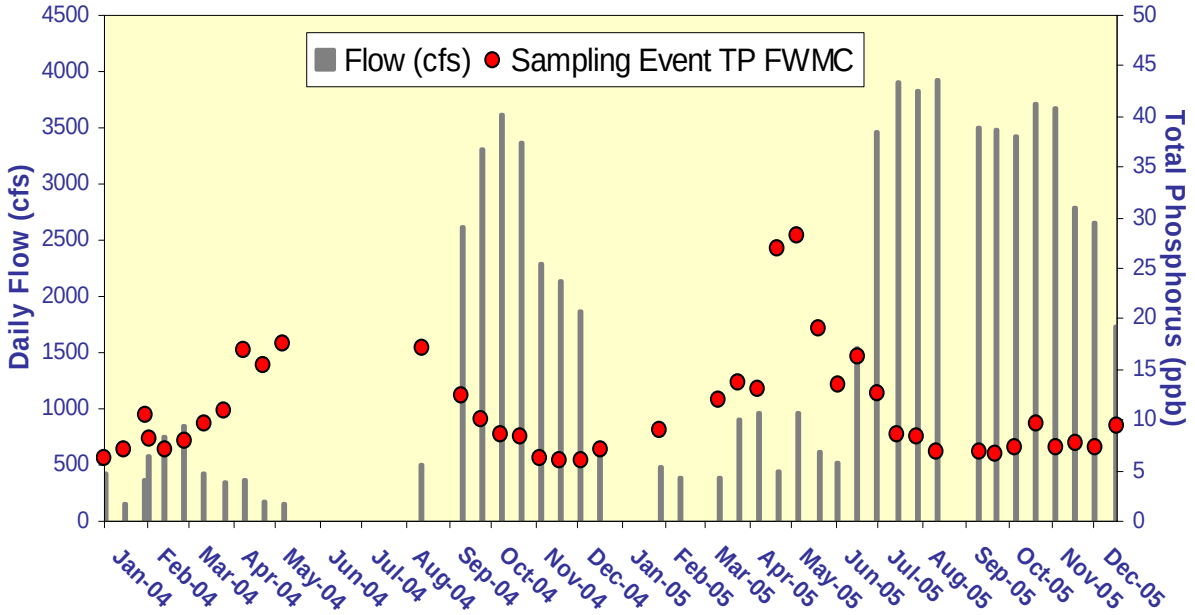

Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events. There was no sampling event flow-weighted mean concentration for the months of June through July 2004 and January 2005 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. For the Water Year ending September 2005, the total phosphorus value was much lower than the long-term limit.

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, Cell 1 through 5, a connector cell between Cell 2 and Cell 3, a flow way cell originating at Berm 3 of Cell 5, and four diversion structures, DS1 through DS4 (**Figure 9**). The flow way cell is the only location to routinely discharge surface water into 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 District started the routine sampling in September 2003.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. The diversion structures DS1 to DS4 were previously refer to as E01 to E04. The diversion structures DS2 and DS4 would discharge into ENP if utilized. Overflows have periodically occurred at DS2 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 June 2005. After this period, overflow events at DS2 occurred for: three days in July 2005 (7/1-7/2 and 7/10), seven days in August 2005 (8/25-8/31), and eight days in September 2005 (9/1-9/6 and 9/20-9/21). For this reporting period (October – December 2005), there was overflow at DS2 on October 24, 2005 during hurricane Wilma. On December 13, 2005 there was overflow for about one hour at DS2. The volume of this overflow event was 0.07 ac-ft. There was no flow at S332B from December 23 to 26, 2005 (Figure **10**). Discharges from the diversion structures DS1 and DS3 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.

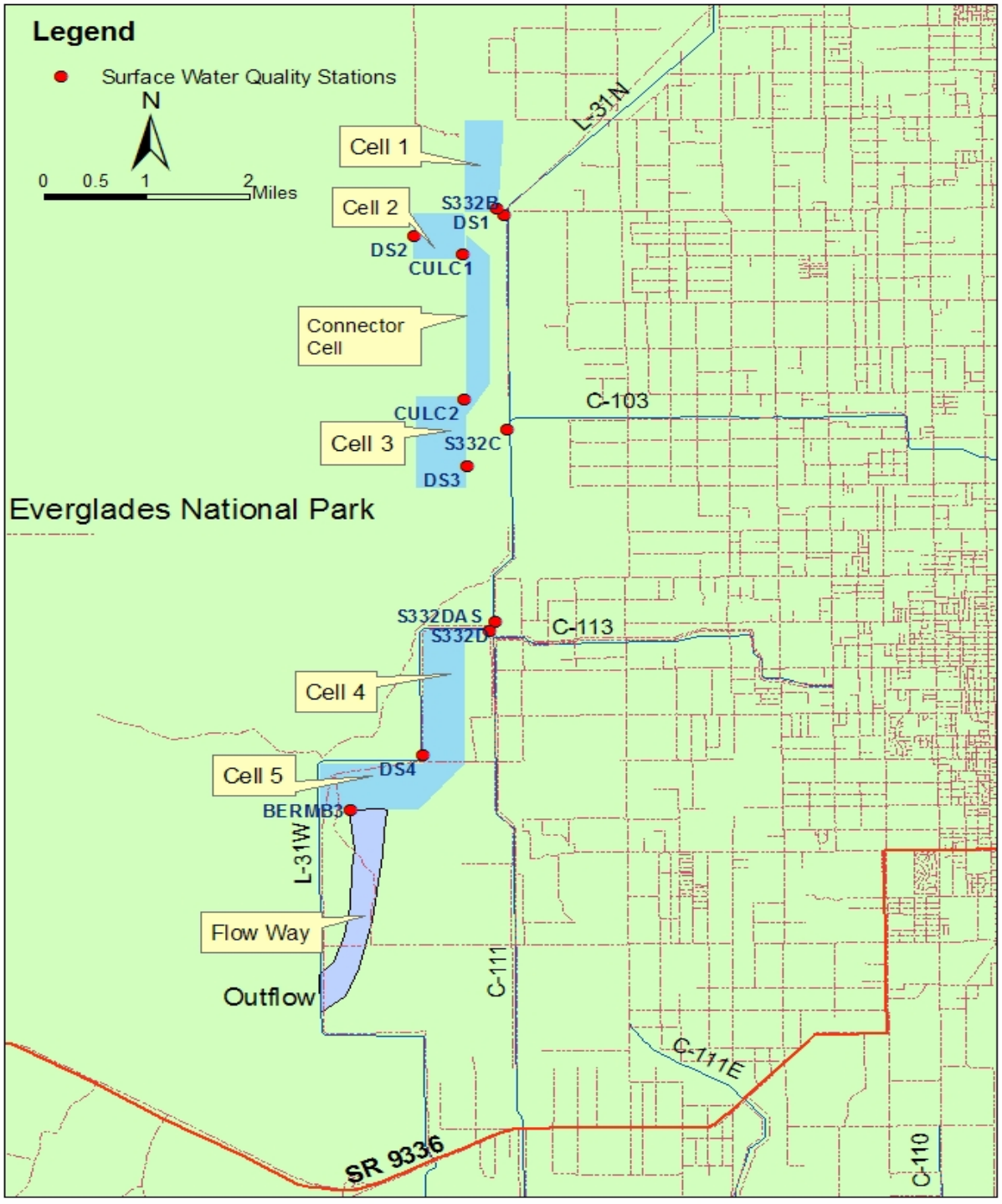

Figure 9. C-111 Project facilities.

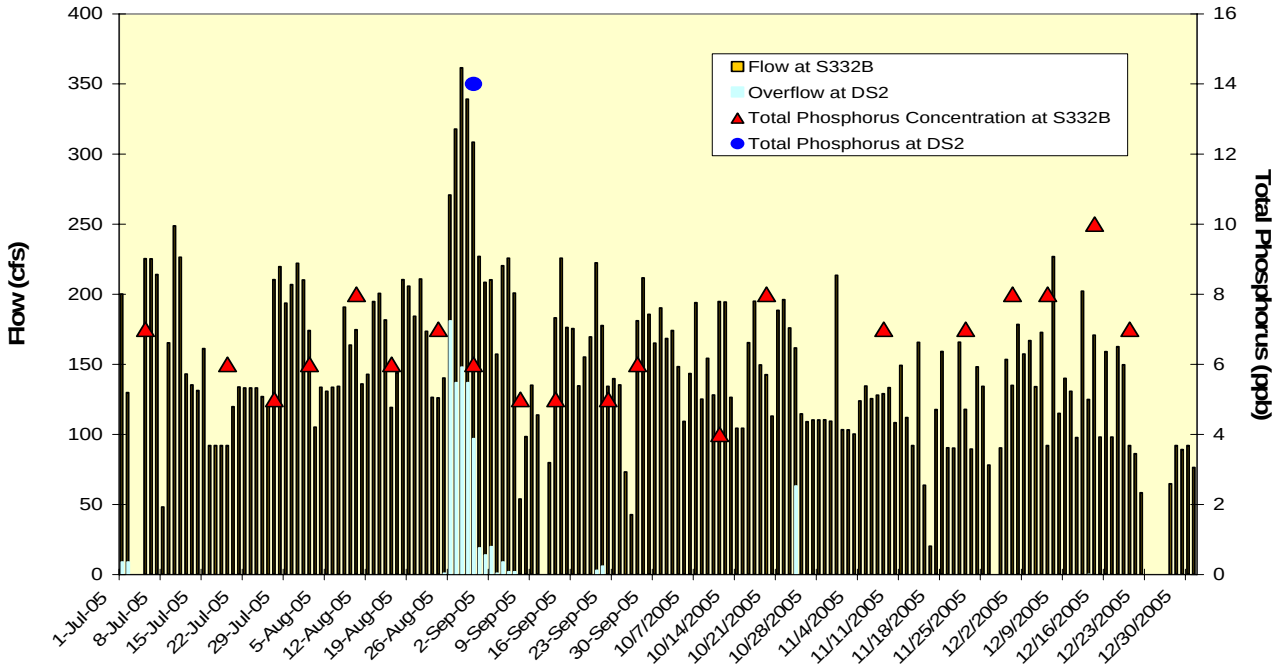

Figure 10. Flows through S332B Pump to West Pond (Cell 2) and grab sample total phosphorus concentrations during overflow events at DS2.

Compliance with Consent Decree

Inflow concentrations of total phosphorus to the ENP 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 11**). The bars in **Figure 11** represent the 12-month 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 2005 represent the new combination of structures.

Figure 12 presents the 12-month 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 11**.

The 12-month flow-weighted mean concentrations for October, November and December 2005 were 6.3, 6.6 and 6.6 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 12.2, 12.0 and 11.8 ppb for the periods ending October, November and December 2005.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 13**. **Figure 14** shows the relationship between the daily inflows and the corresponding flow-weighted mean total phosphorus concentrations for each sampling event.

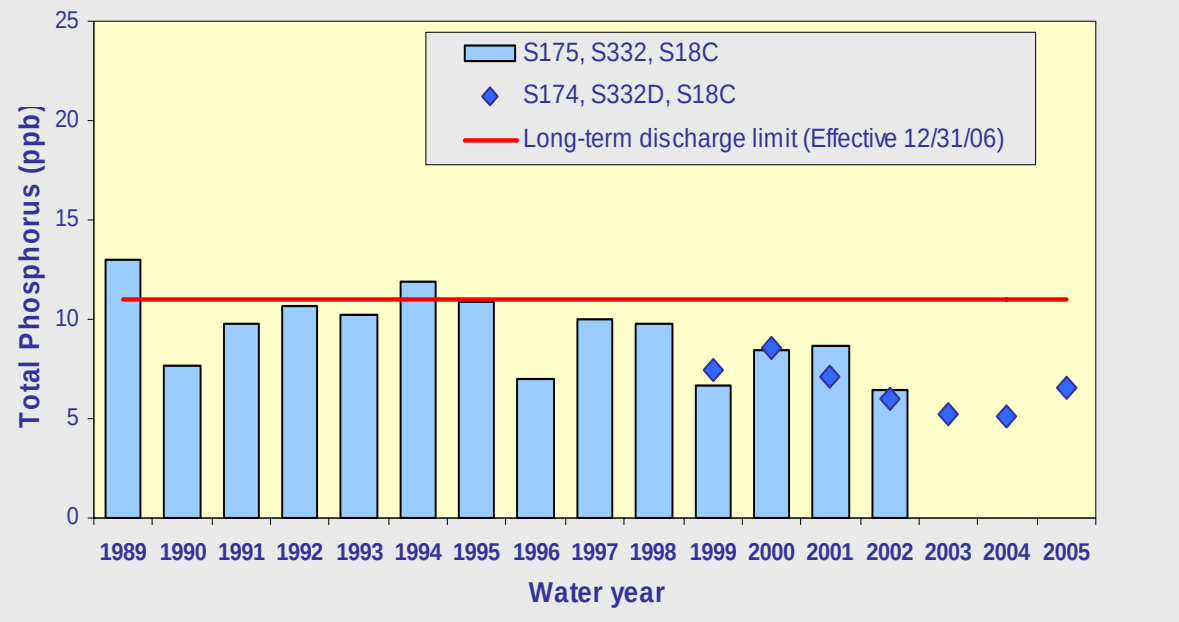

Figure 11. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term total phosphorus limit.

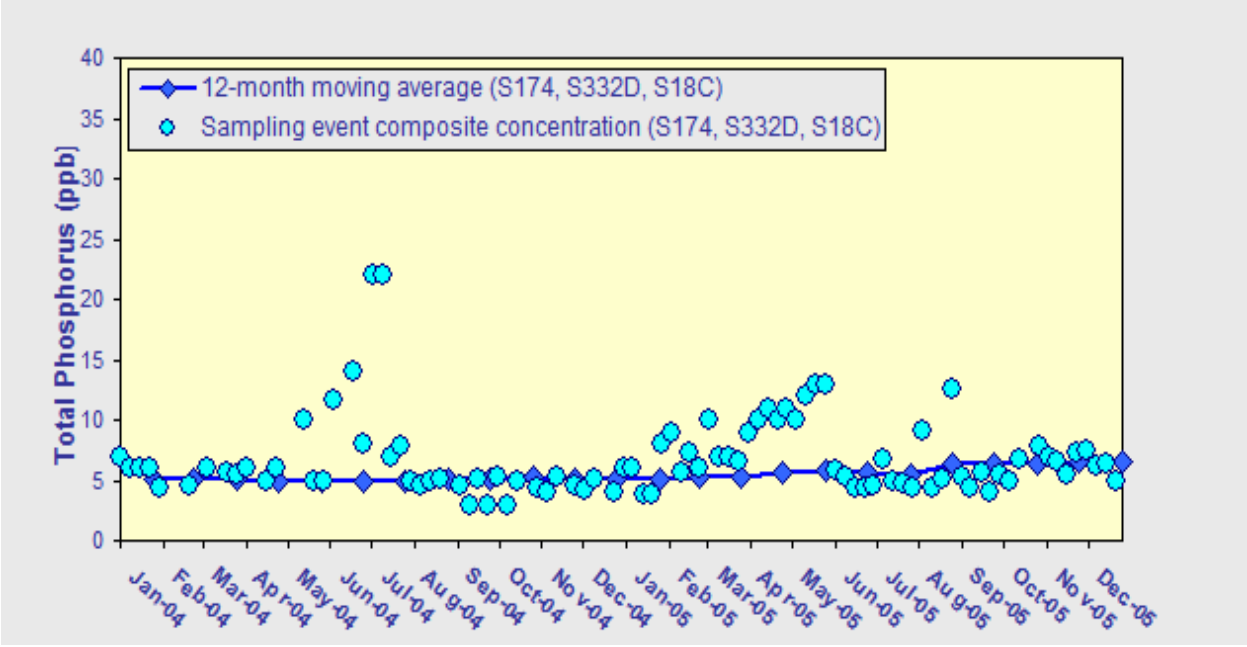

Figure 12. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean concentration for each sampling event.

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

12-Month Period Ending On	Total Period Flow (Kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Long Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
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	6.8
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
30-Apr-05	207.2	5.6	11.0	53.1	13.3
31-May-05	214.1	5.9	11.0	53.1	18.8
30-Jun-05	261.0	5.5	11.0	53.1	14.6
31-Jul-05	304.6	5.4	11.0	53.1	10.4
31-Aug-05	357.1	6.4	11.0	53.1	12.2
30-Sep-05	380.0	6.3	11.0	53.1	12.2
31-Oct-05	373.4	6.3	11.0	53.1	12.2
30-Nov-05	358.6	6.6	11.0	53.1	12.0
31-Dec-05	366.9	6.6	11.0	53.1	11.8

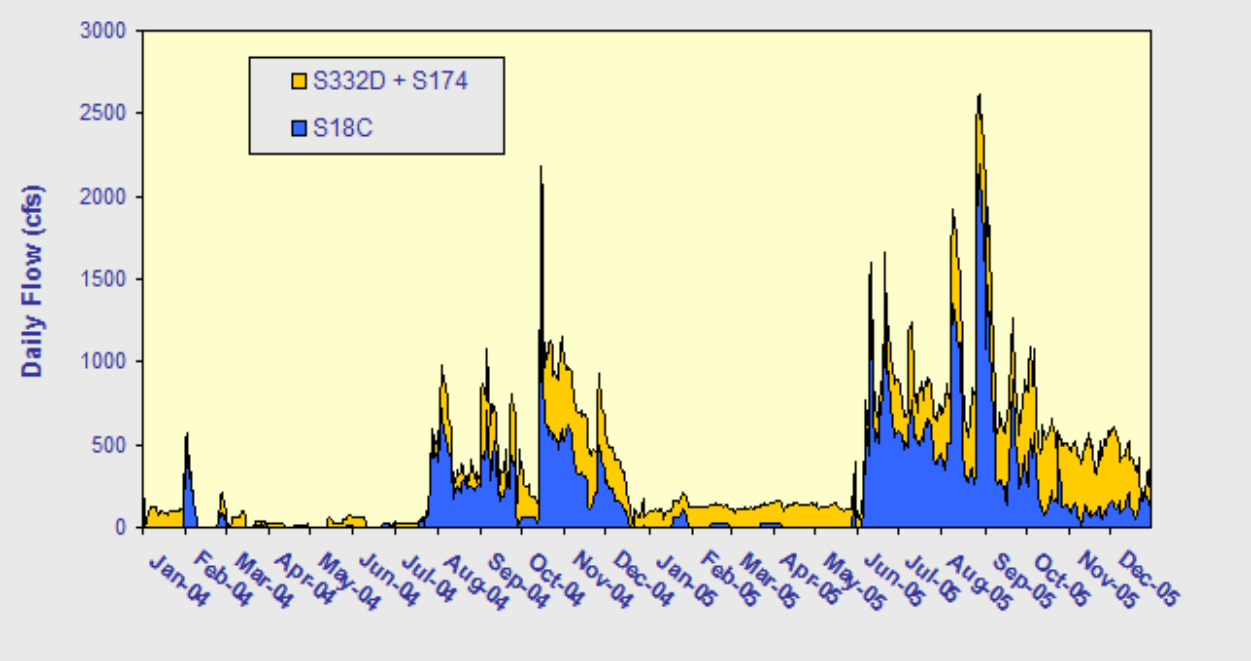

Figure 13. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C.

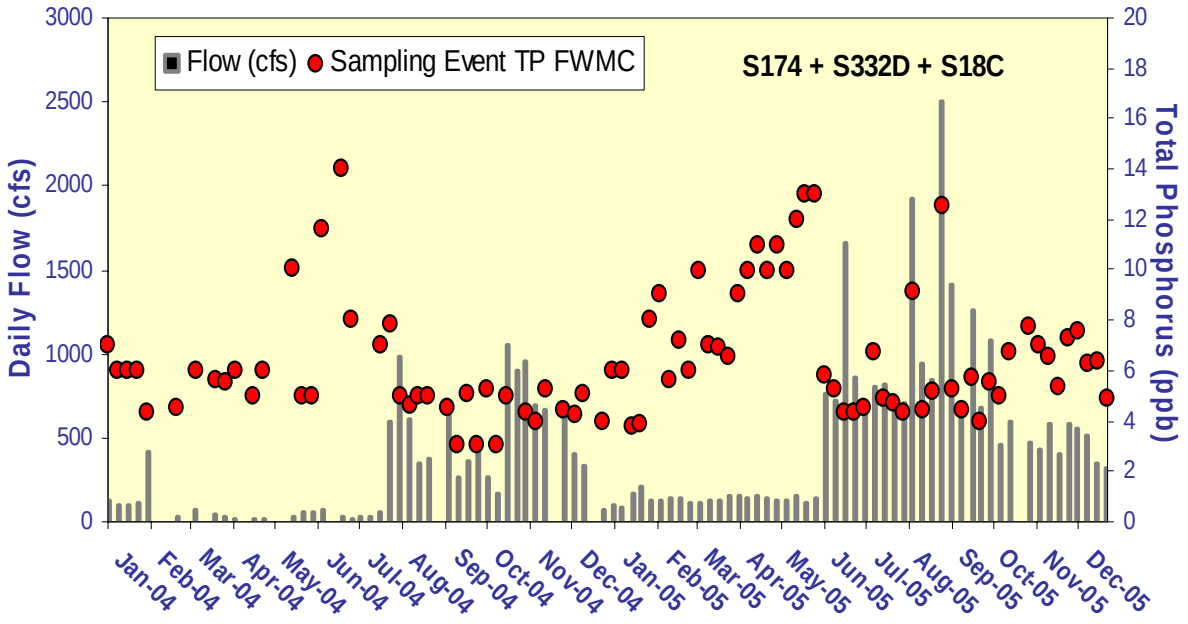

Figure 14. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
January – March 2006 Report

Update, May 18, 2006
Flows at S355A and S355B in February 2006 were added to the Shark River Slough Table 2 (page 8) and text (page 9).

Prepared for the
Technical Oversight Committee
May 12, 2006

Prepared by:
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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. Both the interim and long-term 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.

The interim levels for January, February and March 2006 were 11.6, 11.7 and 13.1 parts per billion (ppb), respectively. The long-term levels were 9.7, 9.8 and 10.8 ppb, respectively. Because the total depth was less than 0.1 meter (m), no water samples were collected at stations LOX3 for January, February and March 2006 and at station LOX5 for March 2006.

Average stages in the Refuge were 16.49, 16.48 and 16.28 feet in January, February and March 2006 respectively (**Figure 2** and **Table 1)**. The geometric means, calculated from total phosphorus concentrations measured in water samples collected in January, February and March 2006 were 6.3, 6.4 and 8.1 ppb, respectively. The geometric means were less than the interim and long-term levels for January, February and March 2006.

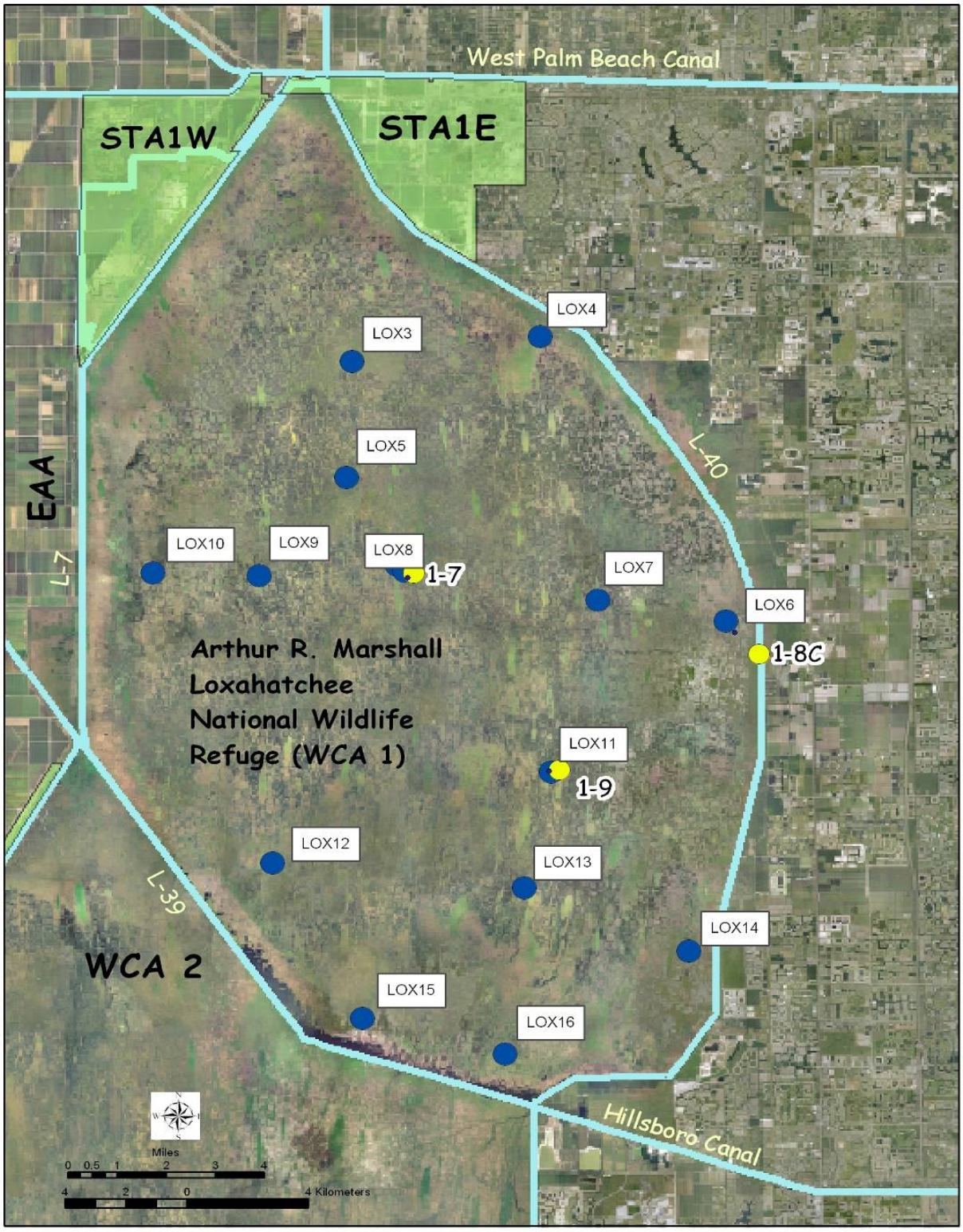

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

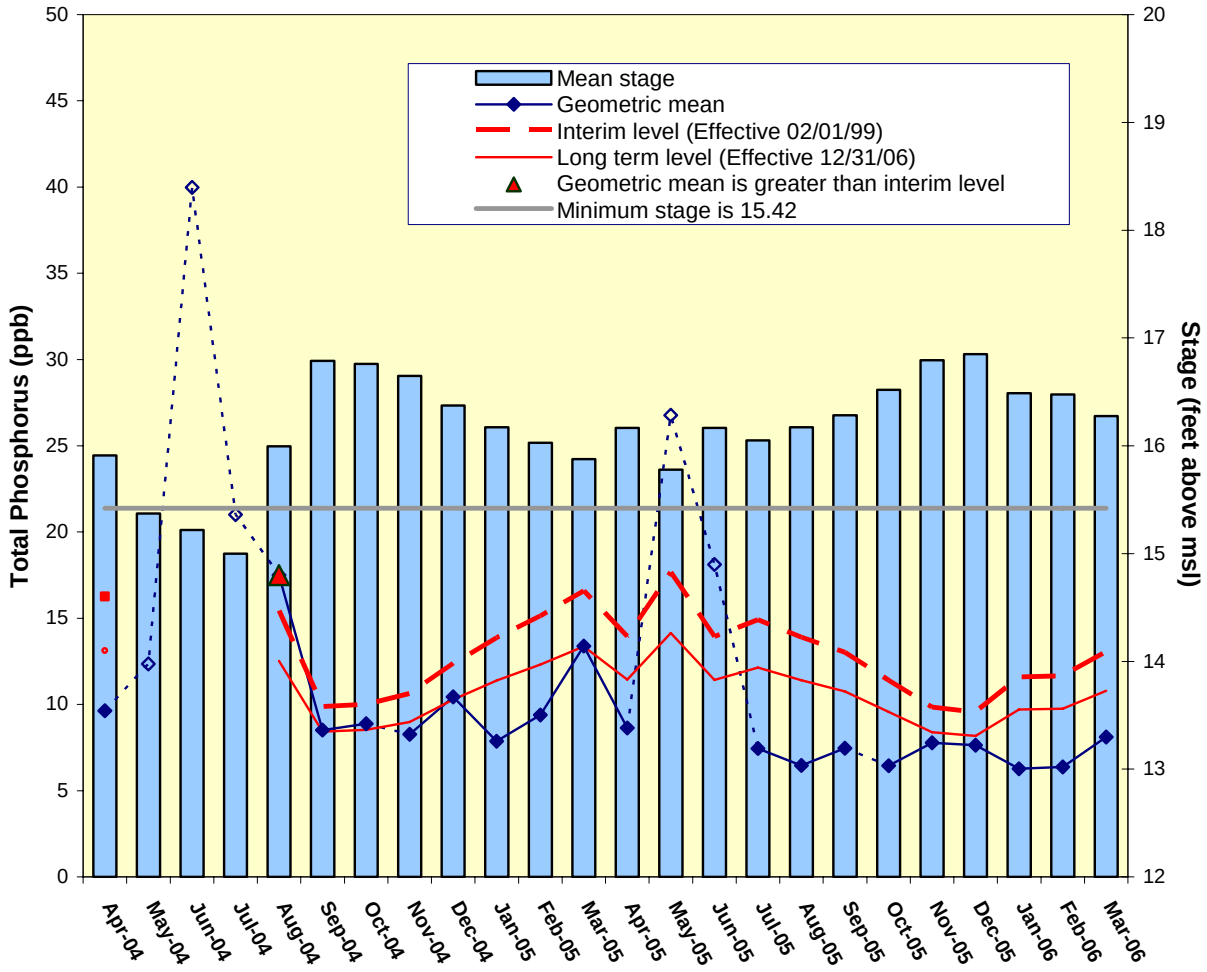

Figure 2. Monthly total phosphorus geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

Interim and Long-term levels are not shown for May 2004 – July 2004 because the levels do not apply when the mean stage is less than 15.42 ft.

The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used. Geometric means for May and June 2005 are shown for reference only and were not considered for compliance purposes.

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

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
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
Apr-2005	8.6	13.9	11.4	16.17	11	3
May-2005*	26.8*	17.7	14.1	15.78	10*	3
Jun-2005*	18.1*	13.9	11.4	16.17	14*	3
Jul-2005	7.4	14.9	12.1	16.05	14	3
Aug-2005	6.5	13.9	11.4	16.17	12	3
Sep-2005	7.5	13.0	10.8	16.28	11	3
Oct-2005	6.5	11.4	9.6	16.52	13	3
Nov-2005	7.8	9.8	8.4	16.79	14	3
Dec-2005	7.6	9.6	8.2	16.85	14	3
Jan-2006	6.3	11.6	9.7	16.49	13	3
Feb-2006	6.4	11.7	9.8	16.48	13	3
Mar-2006	8.1	13.1	10.8	16.28	12	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.
** The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used.*

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) (**Figure 3**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the total phosphorus concentrations be presented as 12-month flow-weighted means. Only the total phosphorus concentrations for the water year ending September 30 are evaluated for compliance with the Consent Decree limits. 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 (October 1st through September 30th) from 1991 to 2005 (**Figure 4**). The 12-month flow-weighted mean total phosphorus concentration ending September 2005 was 9.4 ppb. Corresponding interim and long-term limits were 9.4 and 7.6 ppb, respectively.

Table 2 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding interim and long-term total phosphorus concentration limits, calculated using the 12-month period flow. Only the bi-weekly compliance monitoring concentration data were used for the calculations. For each of the 12-month periods ending in January, February and March 2006, the 12-month flow-weighted mean total phosphorus concentration was 9.0 ppb. The interim limit was 9.4 ppb and the long-term limit was 7.6 ppb during this period. The January, February and March 2006 12-month flow-weighted mean concentrations were lower than the interim 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 January, February and March 2006, the observed percentage of the sampling event flow-weighted mean total phosphorus concentrations greater than 10 ppb were 39.1, 39.1 and 34.8 percent, respectively. The observed percentage of the sampling event flow-weighted mean total phosphorus concentrations greater than 10 ppb had been less than the guideline since March 2004. The values were higher from May 2005 to December 2005 but lower than the guidelines during this reporting period (**Table 2**). The individual sampling events flow-weighted mean concentrations and the 12-month flow-weighted mean concentrations are presented in **Figure 5**.

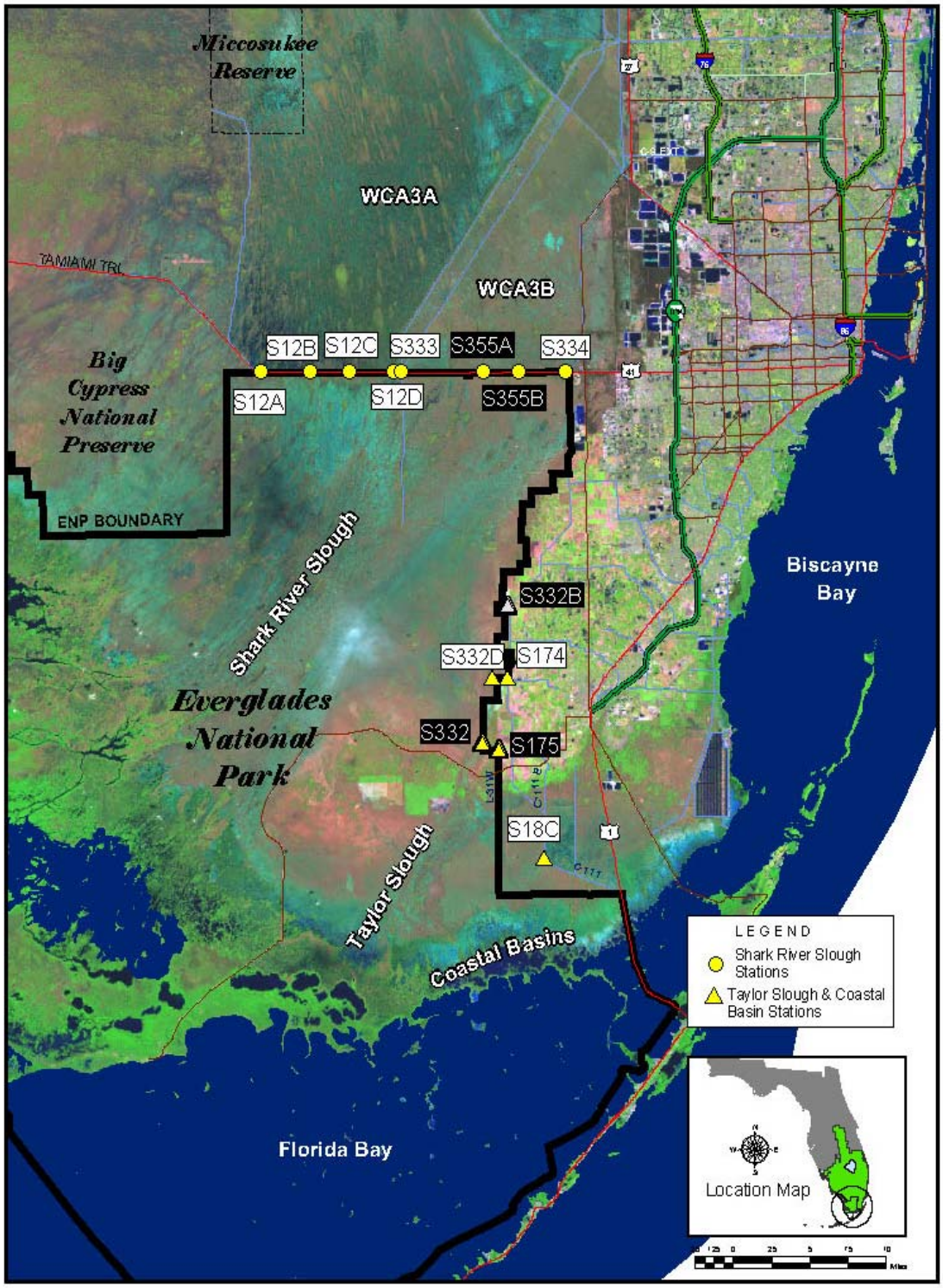

Figure 3. Everglades National Park structures

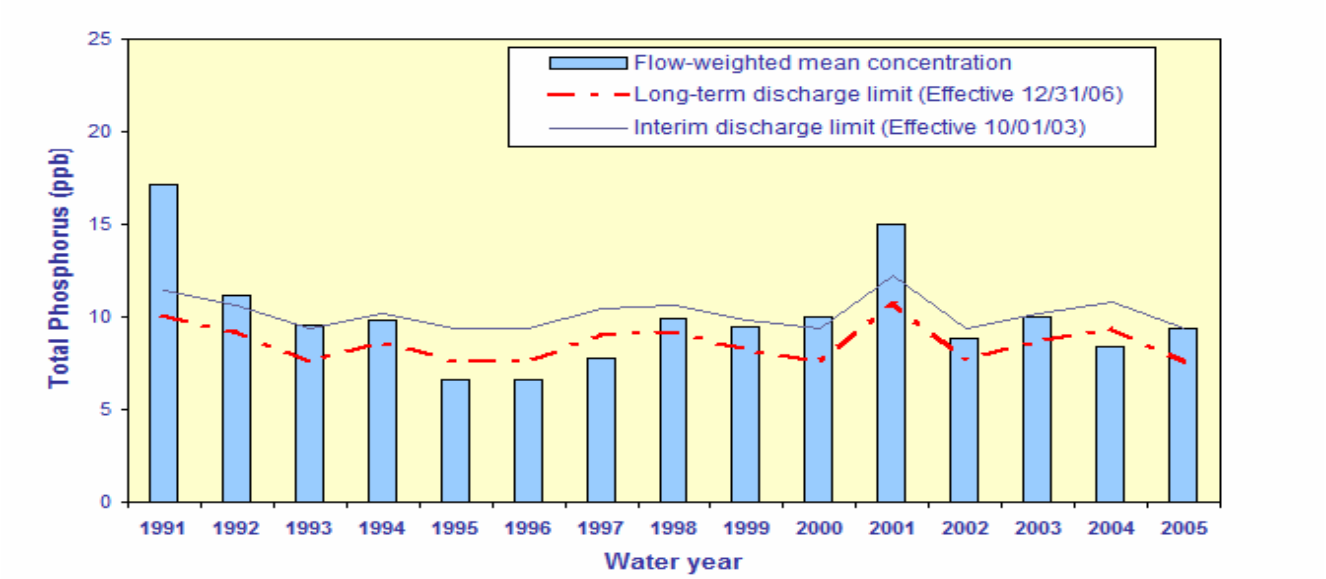

Figure 4. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the total phosphorus interim and long-term limits. For the second consecutive compliance year, the 12-month flow-weighted mean concentration was within the interim limits, which became effective on October 1, 2003.

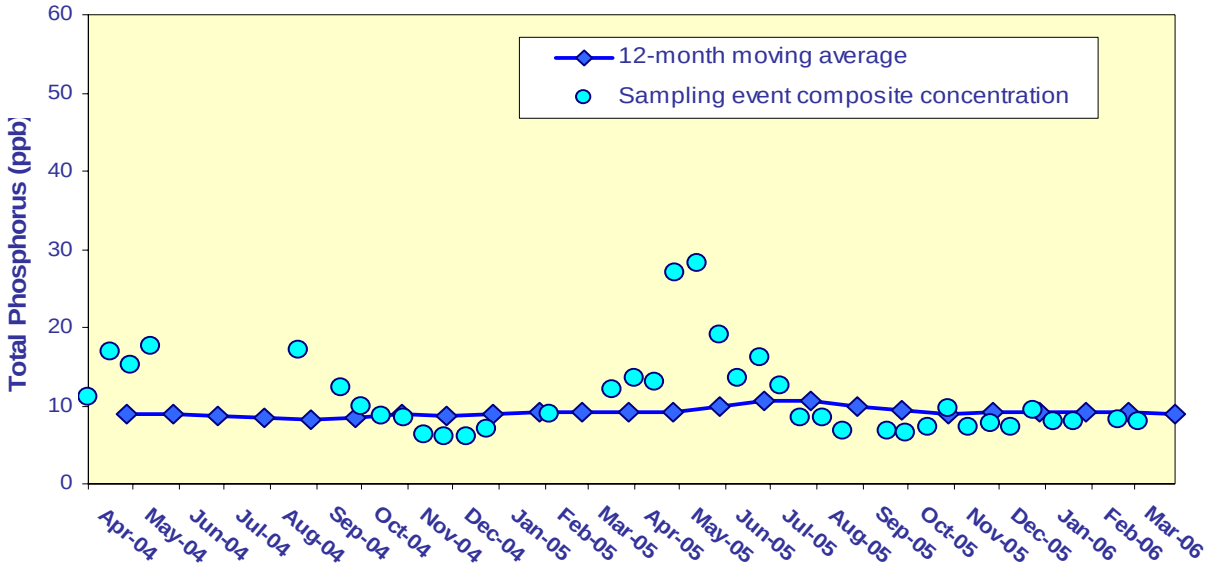

Figure 5. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for June, July 2004 and January 2005 because there was no flow in those periods.

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

12-Month Period Ending On	Total Period Flow (Kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Interim Limit (ppb) Effective 10/1/2003	Long Term Limit (ppb) Effective 12/31/2006	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
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	698.3	9.2	10.8	9.4	49.2	46.7
30-Apr-05	732.6	9.1	10.7	9.3	48.2	46.7
31-May-05	767.1	10.0	10.5	9.1	47.3	***50.0***
30-Jun-05	836.0	10.5	10.2	8.7	45.4	***55.6***
31-Jul-05	1054.7	10.5	9.4	7.7	40.3	***55.0***
31-Aug-05	1269.2	9.8	9.4	7.6	40.1	***47.6***
30-Sep-05	1345.9	9.4	9.4	7.6	40.1	***42.9***
31-Oct-05	1338.1	9.0	9.4	7.6	40.1	***40.9***
30-Nov-05	1381.7	9.1	9.4	7.6	40.1	***42.9***
31-Dec-05	1447.6	9.1	9.4	7.6	40.1	***42.9***
31-Jan-06	1507.7	9.0	9.4	7.6	40.1	39.1
28-Feb-06	1497.6*	9.0	9.4	7.6	40.1	39.1
31-Mar-06	1481.0*	9.0	9.4	7.6	40.1	34.8

Notes: 1) Highlighted rows indicate the end of the water year (Oct 1st to Sept 30th), which are the compliance points.
2) Bold italicized values exceeded the guideline percentages.
3) When the total flow for Shark River Slough exceeds 1061 kac-ft/yr, a flow of 1061 kac-ft/yr is used in calculating the discharge limits.
** Flow of 1.82 kac-ft in February 2006 at S355A and S355B are included for the 12-month total flows.*

The daily flows through the individual Shark River Slough structures from April 2004 through March 2006 are presented in **Figure 6**. The S12s are operated to meet target discharges per the Shark River Slough Rainfall Plan which has been in effect since July 1985. All S12s had been utilized from June 22, 2005, through November 15, 2005. S12A has been closed since November 16, 2005; S12B has been closed since December 30, 2005; S12C has been closed since January 19, 2006; and inflows to Shark River Slough were only through S333 and S12D from then through the reporting period - in accordance with the Interim Operational Plan (IOP) for protection of the Cape Sable Seaside Sparrow.

Since October 2004 a large portion of the flow in the L29 Canal that entered through S333 was released from the system through S334. However, S334 has been closed most of the time since January 18, 2006. Therefore, almost all of the flow through S333 entered Shark River Slough during this reporting period (**Figure 7**).

For additional information on the S12s and S333 structures, please visit:

http://www.sfwmd.gov/org/ema/reports/sharkriver/index.html.

A flow test of S355A (western structure) and S355B (eastern structure), which are located between S333 and S334 (**Figure 3**), was performed from February 2-20, 2006. The estimated daily mean flows were 32 cubic feet per second (cfs) at S355A and 19 cfs at S355B for a total of 1.82 kac-ft for the test period. The flow-weighted mean TP concentration taken on February 16, 2006 was 9 ppb. The flows through S355A and S355B were included in Table 2. Inclusion of these TP loads for the 12-month flow-weighted mean concentration calculations did not change the values.

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 8.** Values had been following the strong inverse relationship between flow and total phosphorus concentration for waters entering the ENP through Shark River Slough. However, the bi-weekly sampling event flow-weighted mean total phosphorus concentrations have been remaining low since late July 2005 through this reporting period.

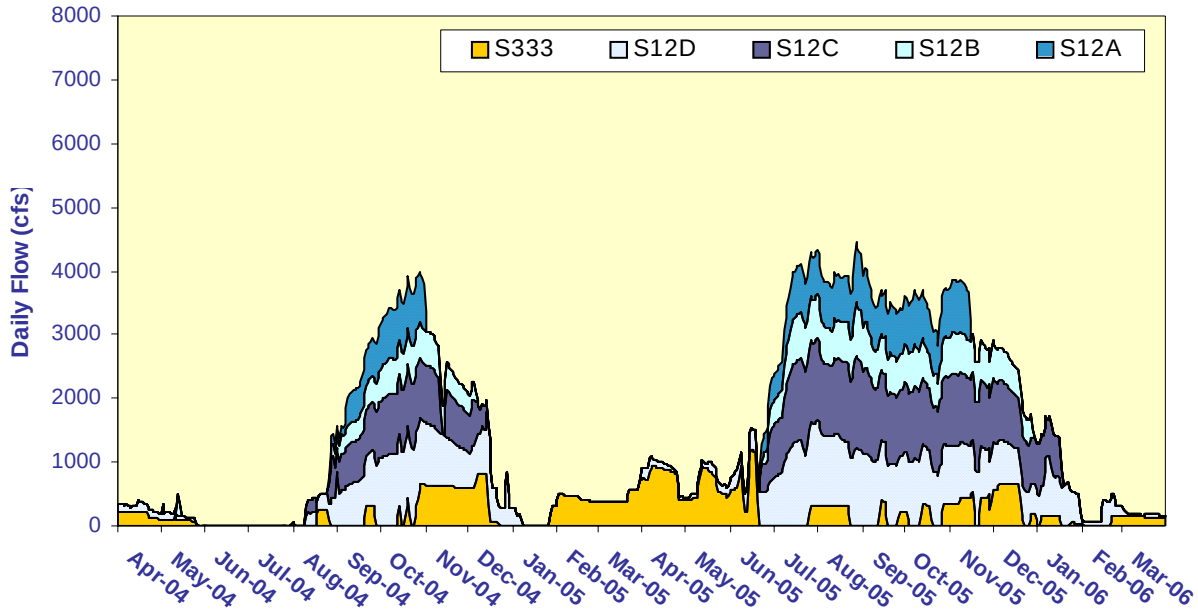

Figure 6. Daily flows into Shark River Slough by structure.

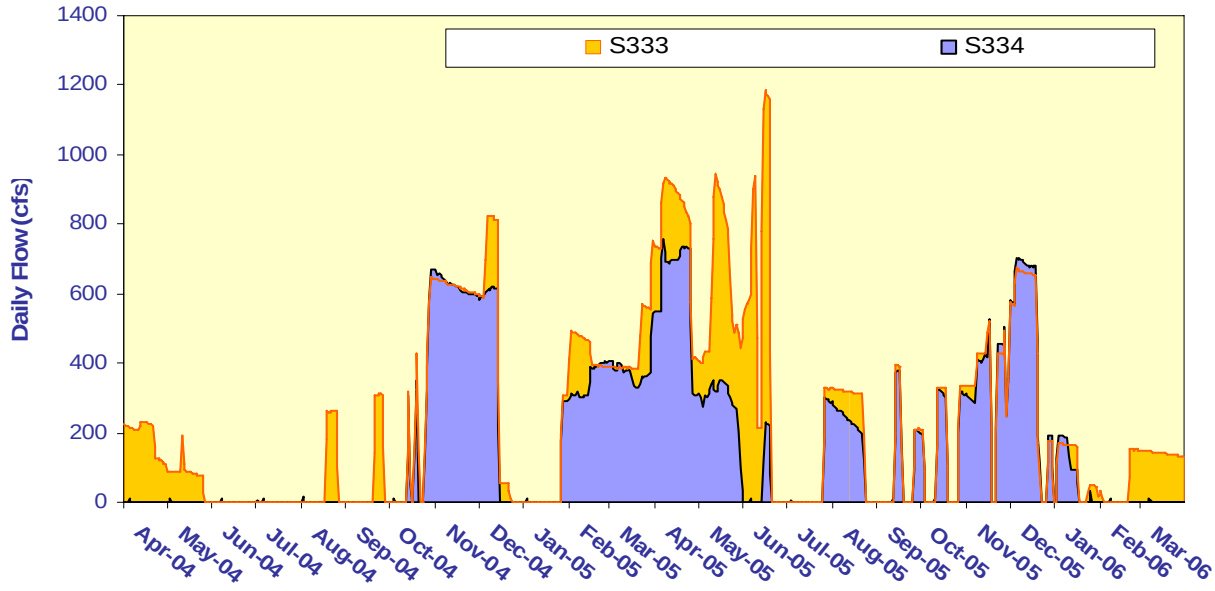

Figure 7. Daily flows comparison between S333 and S334

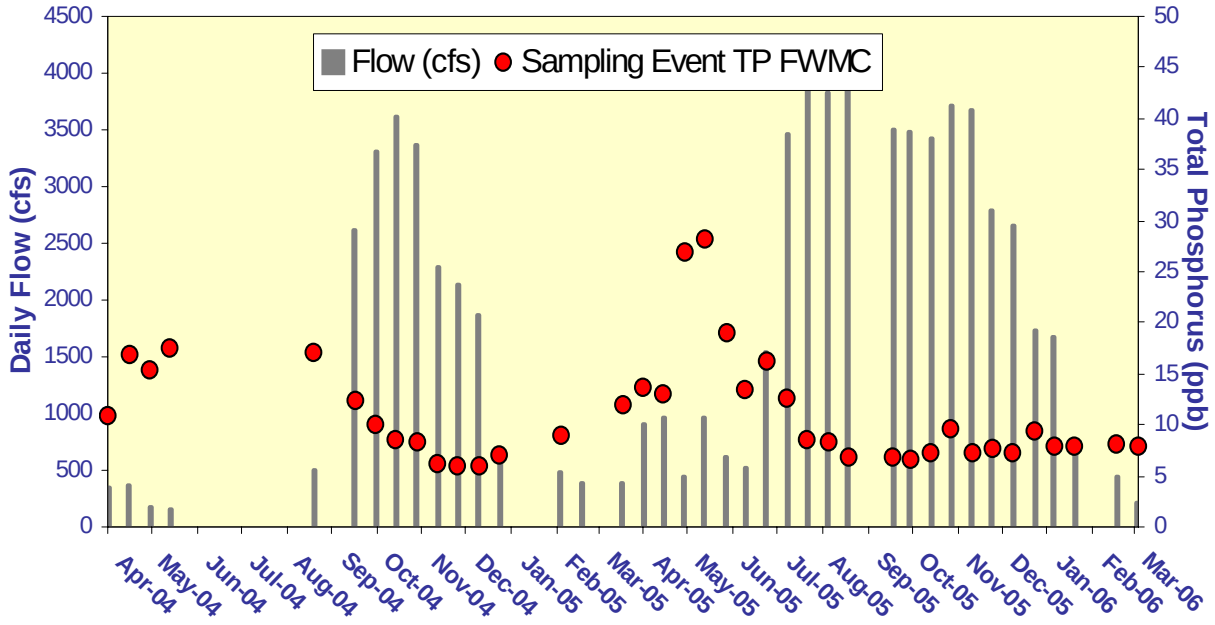

Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

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. For the Water Year ending September 2005, the total phosphorus value was much lower than the long-term limit.

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, Cell 1 through Cell 5, a connector cell between Cell 2 and Cell 3, a flow way cell originating at Berm 3 of Cell 5, and four diversion structures, DS1 through DS4 (**Figure 9**). The flow way cell is the only location to routinely discharge surface water into 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 District started the routine sampling in September 2003.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. The diversion structures DS1 through DS4, previously referred to as EO1 through EO4, would discharge into the ENP if utilized. Overflows have periodically occurred at DS2. Data from these overflows were presented graphically in previous reports. There was no overflow during this reporting period. Discharges from the diversion

structures DS1 and DS3 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.

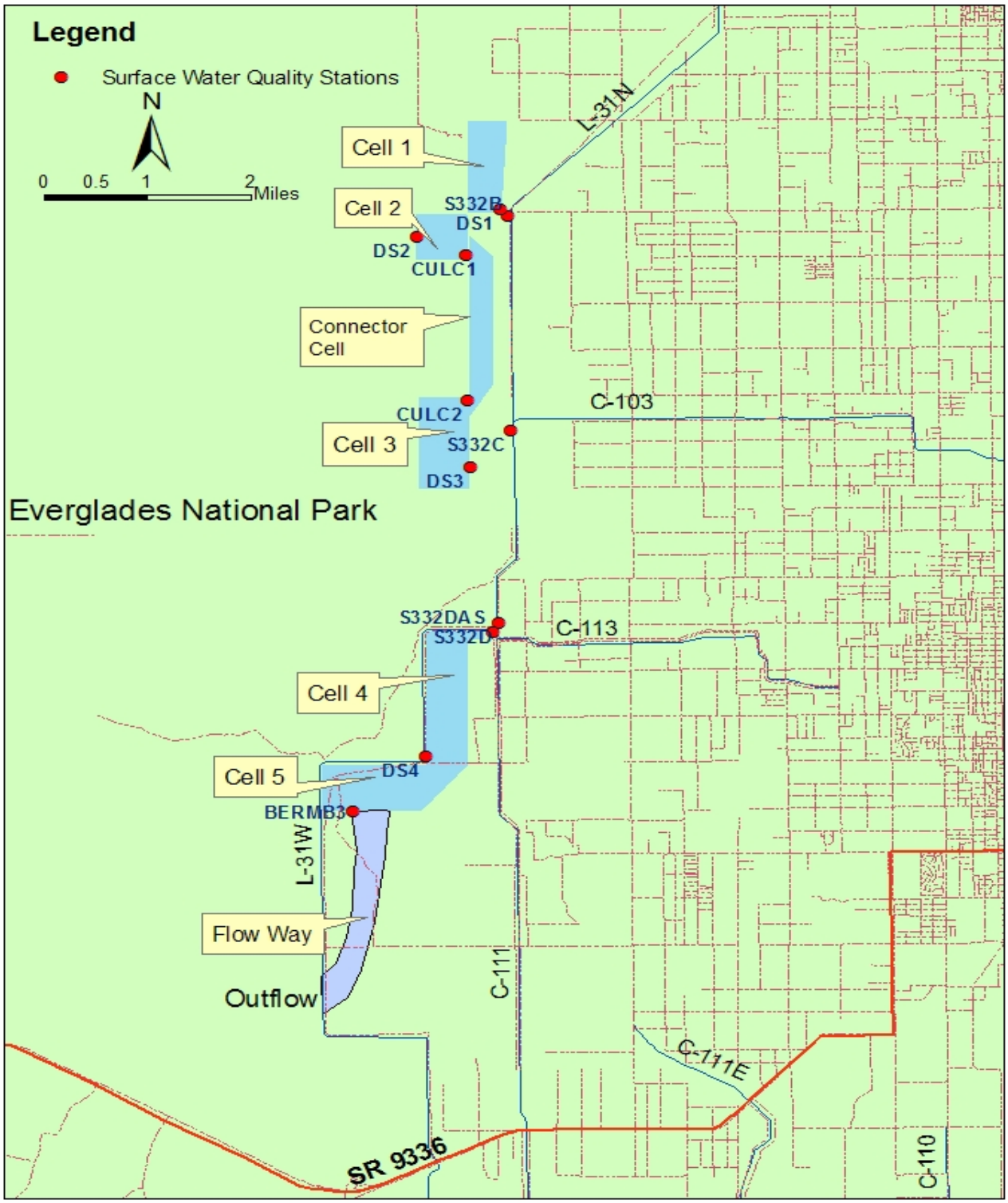

Figure 9. C-111 Project facilities.

Compliance with Consent Decree

Inflow concentrations of total phosphorus to the ENP 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 10**). The bars in **Figure 10** represent the 12-month 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 2005 represent the new combination of 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 10** .

Figure 11 presents the 12-month and individual sampling date flow-weighted mean total phosphorus concentrations at the S174, S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the 3 sites were used for the compliance calculations.

Each of the 12-month flow-weighted mean concentrations for January, February, and March 2006 was 6.6 ppb 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 observed percentage of the sampling event flow-weighted mean total phosphorus concentrations greater than 10 ppb for the combined flow through S174, S332D and S18C was 11.8 percent for the periods ending January, February, and March 2006.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 12**. **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean total phosphorus concentrations for each sampling event. From 1984 to 1990, there was no observable relationship between daily mean flow and flow-weighted mean total phosphorus concentrations at S332 and S18C structures. Some higher concentrations were observed during low flow periods during 2004 and 2005 at S332D, S174 and S18C. However, flow-weighted mean total phosphorus concentrations for all sampling dates have been less than or equal to 9 ppb since September 2005.

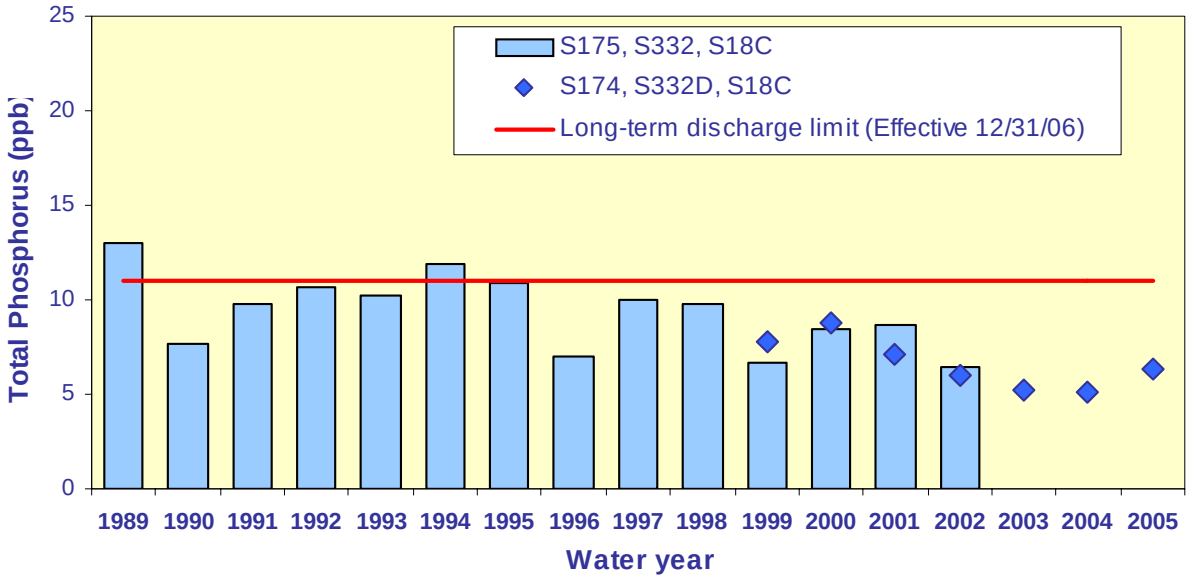

Figure 10. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term total phosphorus limit.

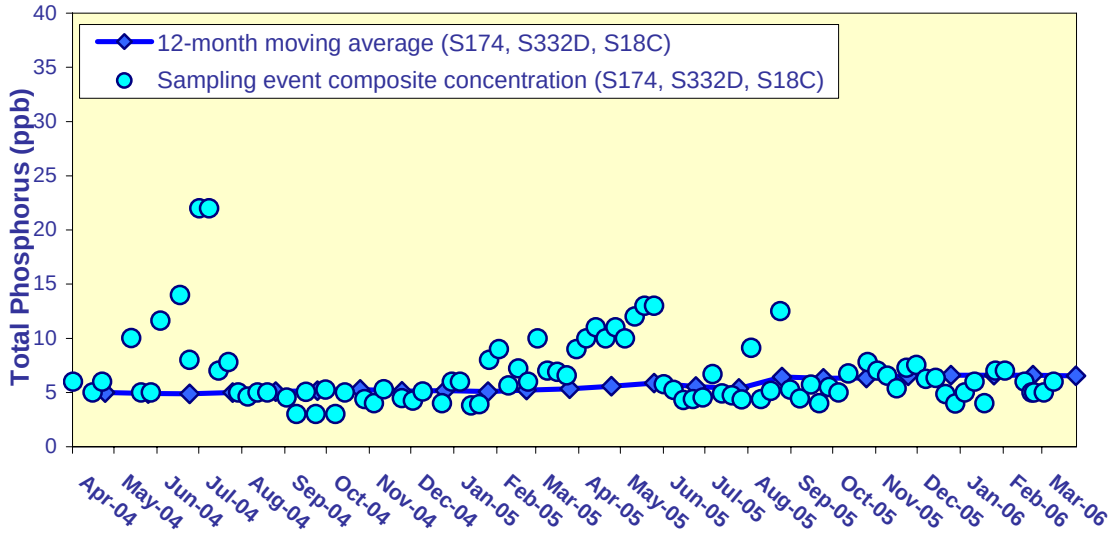

Figure 11. 12-month flow-weighted total phosphorus concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted total phosphorus concentration for each sampling event.

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

12-Month Period Ending On	Total Period Flow (Kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Long Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
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
30-Apr-05	207.2	5.6	11.0	53.1	13.3
31-May-05	214.1	5.9	11.0	53.1	18.8
30-Jun-05	261.0	5.5	11.0	53.1	14.6
31-Jul-05	304.6	5.4	11.0	53.1	10.4
31-Aug-05	357.1	6.4	11.0	53.1	12.2
30-Sep-05	380.0	6.3	11.0	53.1	12.2
31-Oct-05	373.4	6.3	11.0	53.1	12.2
30-Nov-05	358.6	6.6	11.0	53.1	12.0
31-Dec-05	366.9	6.6	11.0	53.1	11.8
31-Jan-06	369.5	6.6	11.0	53.1	11.8
28-Feb-06	364.6	6.6	11.0	53.1	11.8
31-Mar-06	359.7	6.6	11.0	53.1	11.8

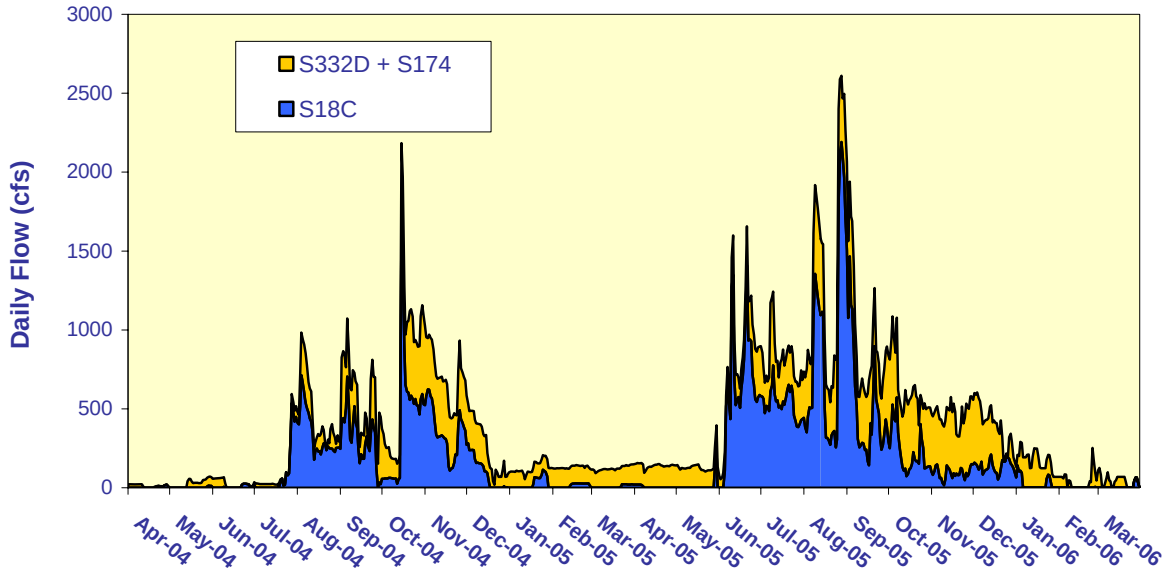

Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C.

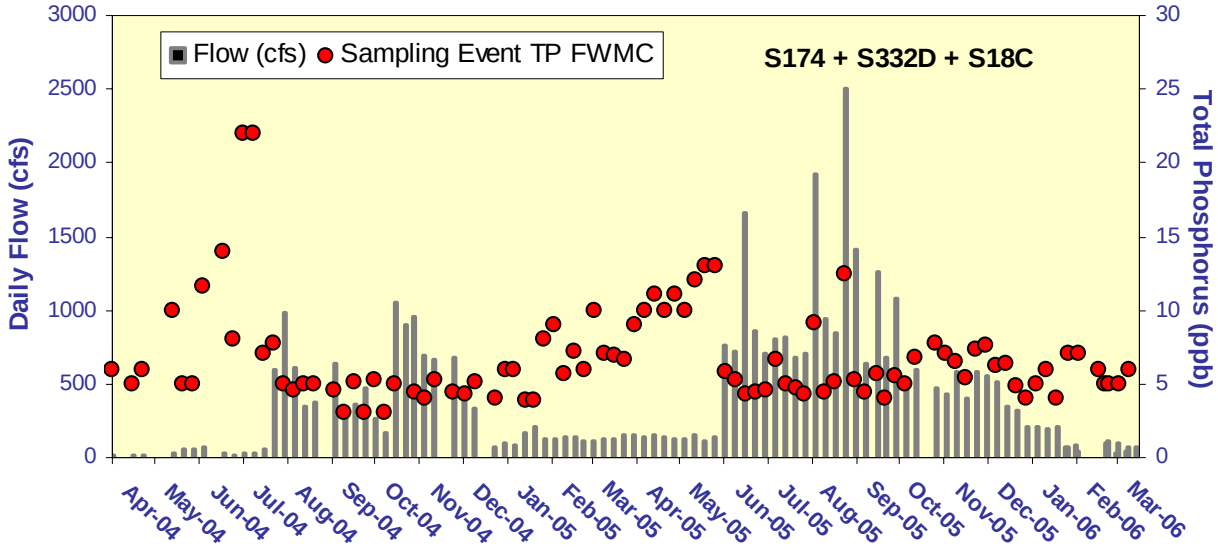

Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Settlement Agreement
April – June 2006 Report

Prepared for the
Technical Oversight Committee

August 14, 2006

Update, August 24, 2006
Text was revised on page 16 to clarify trends in flow-weighted mean TP concentrations into the ENP through S332D.

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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 total phosphorus (TP) concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by February 1, 1999, and December 31, 2006, respectively. Both the interim and long-term 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 in National Geodetic Vertical Datum (NGVD29). The monthly TP concentrations are determined from water samples collected at 14 interior marsh stations, LOX3 through LOX16 (**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.

The interim levels for April, May and June 2006 were 14.9, 20.1 and 21.0 parts per billion (ppb), respectively. The long-term levels were 12.2, 15.9 and 16.5 ppb, respectively. Because the total depth was less than 0.1 meter (m), no water samples were collected at stations LOX3 and LOX5 on April 4, 2006; LOX3, LOX5, LOX9 and LOX 10 on May 1, 2006; LOX3, LOX4, LOX5, LOX7, LOX9, LOX10 on June 12, 2006; and LOX6, LOX11 and LOX13 on June 13, 2006.

Average stages in the Refuge were 16.05, 15.58 and 15.51 feet (NGVD29) in April, May and June 2006, respectively (**Figure 2** and **Table 1)**. The geometric means, calculated from TP concentrations measured in water samples collected in April, May and June 2006 were 8.4, 8.8 and 9.9 ppb, respectively. The geometric means were less than the interim and long-term levels for April, May and June 2006.

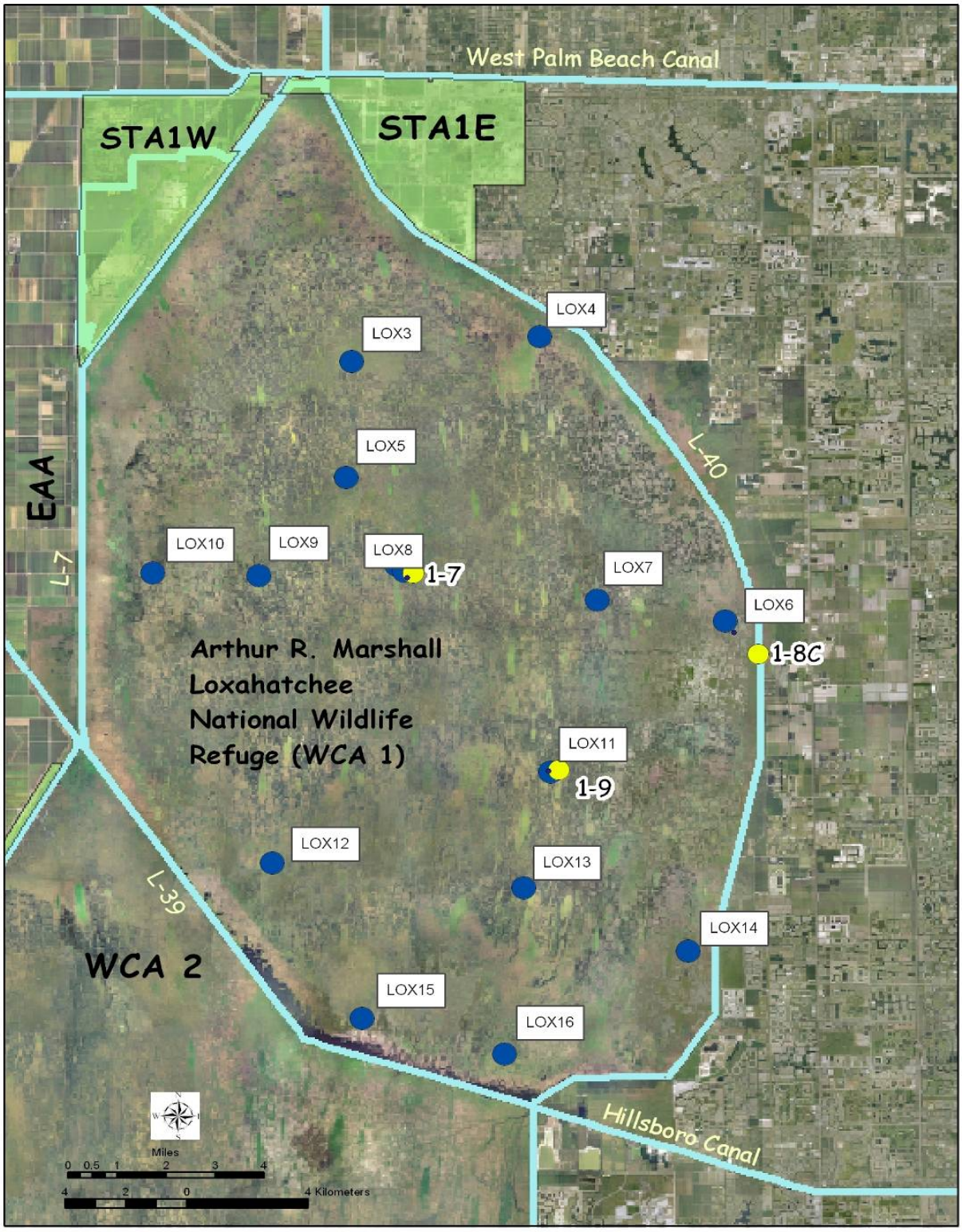

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

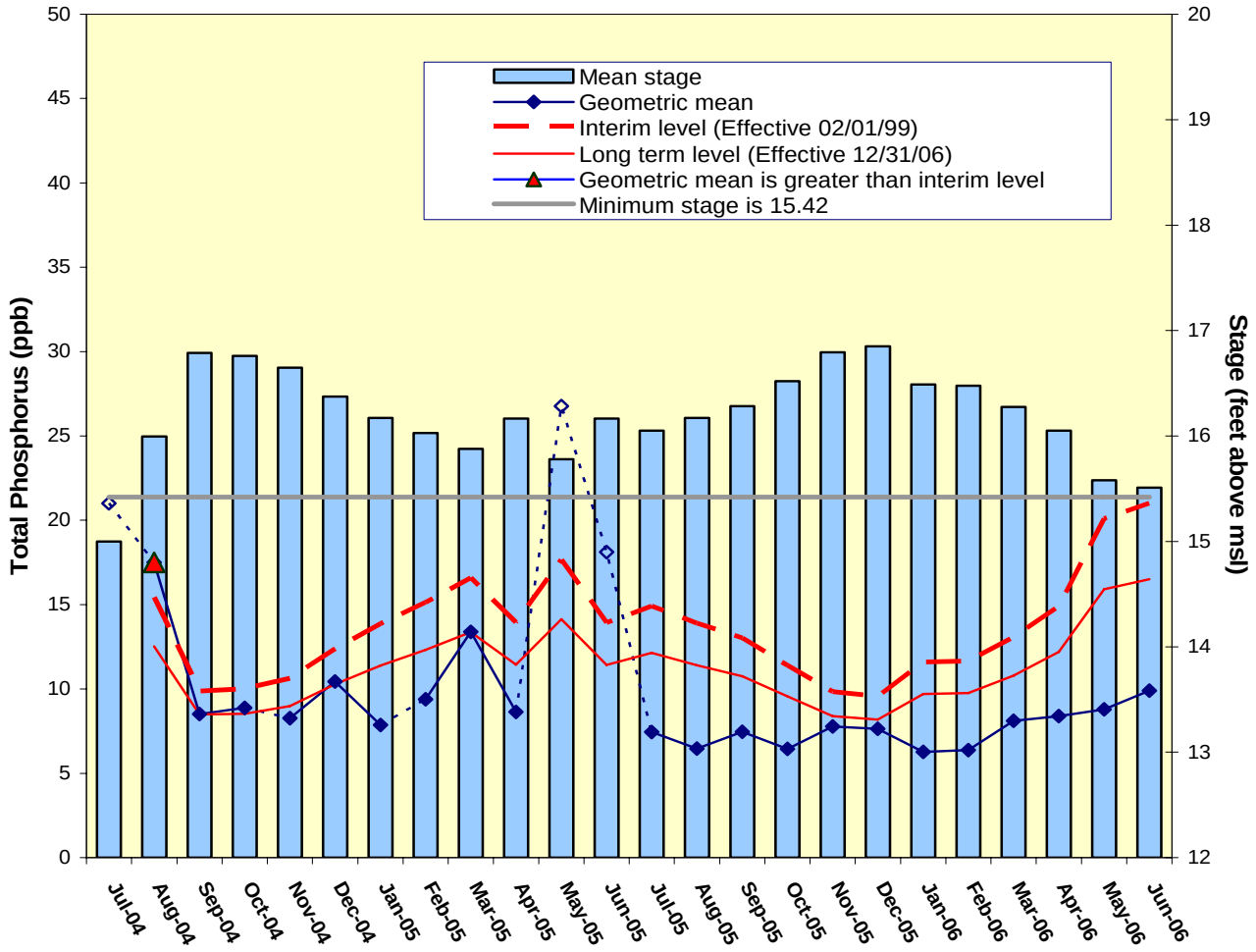

Figure 2. Monthly TP geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

Interim and Long-term levels are not shown for July 2004 because the level does not apply when the mean stage is less than 15.42 ft.

The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used. Geometric means for May and June 2005 are shown for reference only and were not considered for compliance purposes.

Table 1. Loxahatchee National Wildlife Refuge TP Compliance Tracking.

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
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
Apr-2005	8.6	13.9	11.4	16.17	11	3
May-2005*	26.8*	17.7	14.1	15.78	10*	3
Jun-2005*	18.1*	13.9	11.4	16.17	14*	3
Jul-2005	7.4	14.9	12.1	16.05	14	3
Aug-2005	6.5	13.9	11.4	16.17	12	3
Sep-2005	7.5	13.0	10.8	16.28	11	3
Oct-2005	6.5	11.4	9.6	16.52	13	3
Nov-2005	7.8	9.8	8.4	16.79	14	3
Dec-2005	7.6	9.6	8.2	16.85	14	3
Jan-2006	6.3	11.6	9.7	16.49	13	3
Feb-2006	6.4	11.7	9.8	16.48	13	3
Mar-2006	8.1	13.1	10.8	16.28	12	3
Apr-2006	8.4	14.9	12.2	16.05	12	3
May-2006	8.8	20.1	15.9	15.58	10	3
Jun-2006	9.9	21.0	16.5	15.51	5	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.
** The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used.*

EVERGLADES NATIONAL PARK

Shark River Slough

The Consent Decree of 1995 specified that interim and long-term total phosphorus (TP) concentration limits for discharges into the Everglades National Park (ENP) (**Figure 3**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the TP concentrations be presented as 12-month flow-weighted means. Only the TP concentrations for the water year ending September 30 are evaluated for compliance with the Consent Decree limits. The long-term TP 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 TP 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 2005 (**Figure 4**). The 12-month flow-weighted mean TP concentration ending September 2005 was 9.4 ppb. Corresponding interim and long-term limits were 9.4 and 7.6 ppb, respectively.

Table 2 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding interim and long-term TP concentration limits, calculated using the 12-month period flow. Only the bi-weekly compliance monitoring concentration data were used for the calculations. For the 12-month periods ending in April, May and June 2006, the 12-month flow-weighted mean TP concentration was 9.0, 8.5 and 8.2 ppb. The interim limit was 9.4 ppb and the long-term limit was 7.6 ppb during this period. The April, May and June 2006 12-month flow-weighted mean concentrations were lower than the interim limits.

The Consent Decree stipulates that the percent of flow-weighted mean TP 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 April, May and June 2006, the observed percentage of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were 34.8, 31.8 and 25.0 percent, respectively. The observed percentage of the sampling event flow-weighted mean TP concentrations greater than 10 ppb had been higher than the guidelines from May 2005 to December 2005 but lower since January 2006 (**Table 2**). The individual sampling events flow-weighted mean concentrations and the 12-month flow-weighted mean concentrations are presented in **Figure 5**.

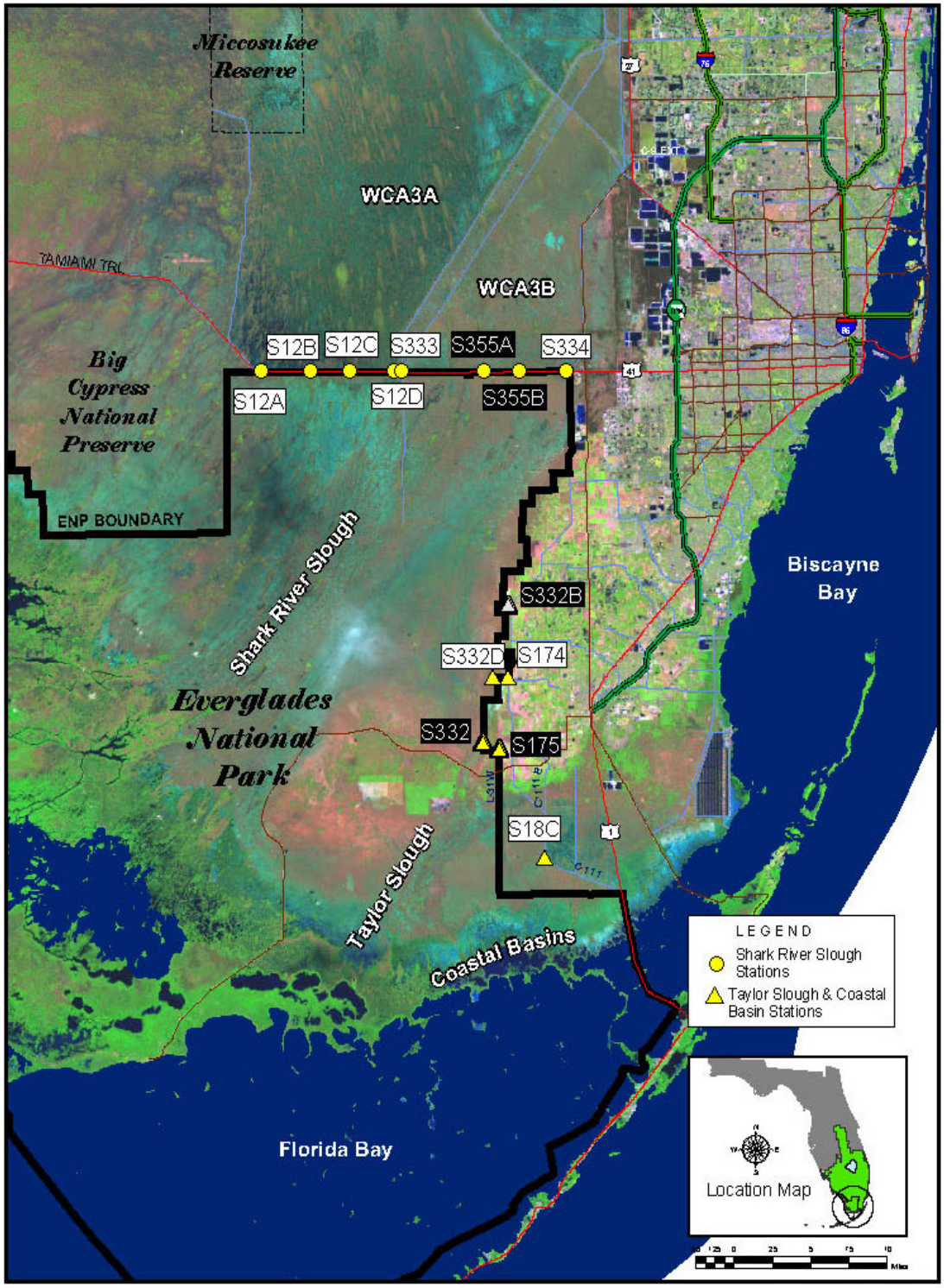

Figure 3. Everglades National Park structures

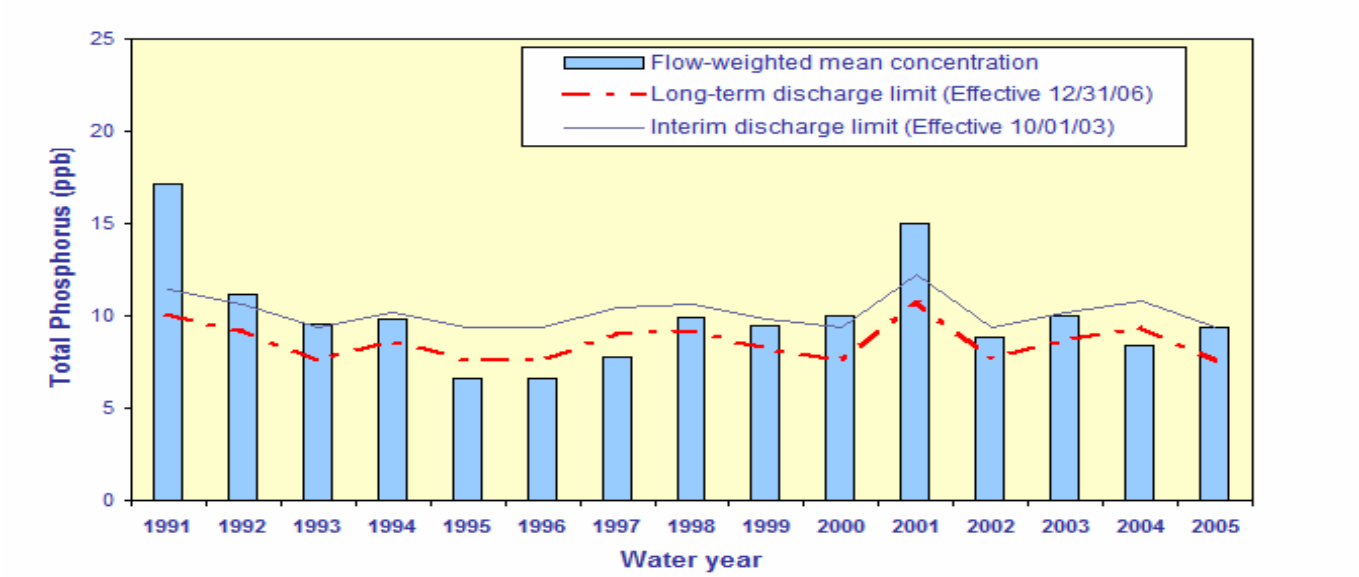

Figure 4. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the TP interim and long-term limits. For the second consecutive compliance year, the 12-month flow-weighted mean concentration was within the interim limits, which became effective on October 1, 2003.

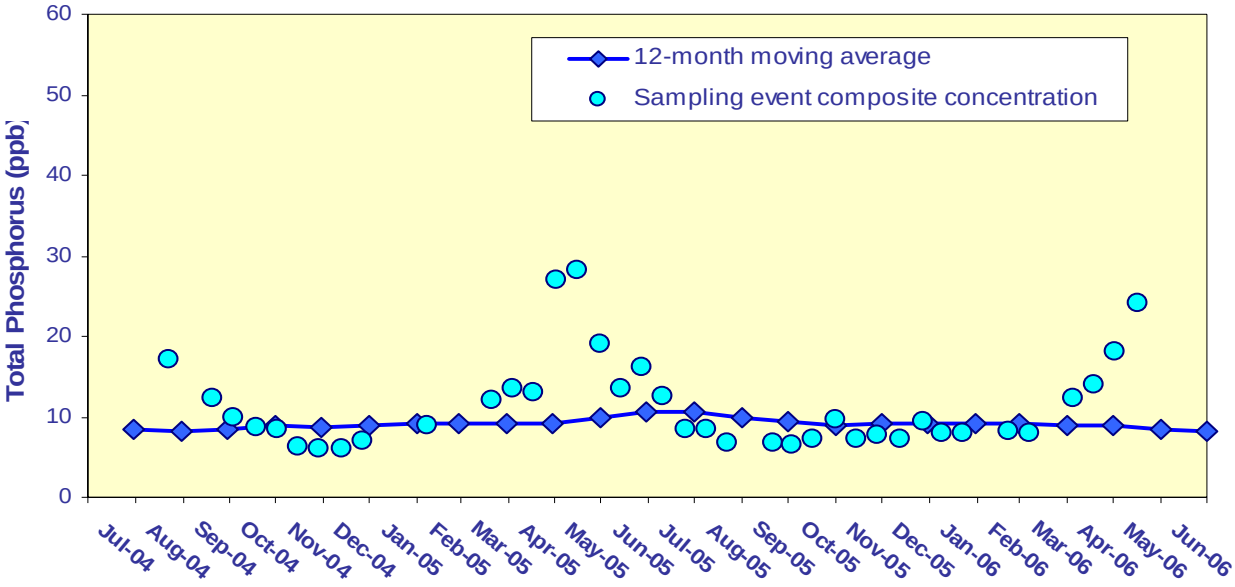

Figure 5. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for July 2004, January 2005, and June 2006 because there was no flow in those periods.

Table 2. Shark River Slough TP Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (Kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Interim Limit (ppb) Effective 10/1/2003	Long Term Limit (ppb) Effective 12/31/2006	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
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	698.3	9.2	10.8	9.4	49.2	46.7
30-Apr-05	732.6	9.1	10.7	9.3	48.2	46.7
31-May-05	767.1	10.0	10.5	9.1	47.3	***50.0***
30-Jun-05	836.0	10.5	10.2	8.7	45.4	***55.6***
31-Jul-05	1054.7	10.5	9.4	7.7	40.3	***55.0***
31-Aug-05	1269.2	9.8	9.4	7.6	40.1	***47.6***
30-Sep-05	**1345.9**	**9.4**	**9.4**	**7.6**	**40.1**	***42.9***
31-Oct-05	1338.1	9.0	9.4	7.6	40.1	***40.9***
30-Nov-05	1381.7	9.1	9.4	7.6	40.1	***42.9***
31-Dec-05	1447.6	9.1	9.4	7.6	40.1	***42.9***
31-Jan-06	1507.7	9.0	9.4	7.6	40.1	39.1
28-Feb-06	1497.6*	9.0	9.4	7.6	40.1	39.1
31-Mar-06	1481.0*	9.0	9.4	7.6	40.1	34.8
30-Apr-06	1436.1*	9.0	9.4	7.6	40.1	34.8
31-May-06	1395.5*	8.5	9.4	7.6	40.1	31.8
30-Jun-06	1326.6*	8.2	9.4	7.6	40.1	25.0

Notes: 1)Highlighted rows indicate the end of the water year (October 1 to September 30), which are the compliance points.

2)Bold italicized values exceeded the guideline percentages.

3)When the total flow for Shark River Slough exceeds 1061 kac-ft/yr, a flow of 1061 kac-ft/yr is used in calculating the discharge limits.

** Flow of 1.82 kac-ft in February 2006 at S355A and S355B was included for the 12-month total flows for February – June 2006.*

There was very little inflow to Shark River Slough during this reporting period (total 11.73 kac-ft). Almost all of the flow was through S333 and much of this was discharged through S334.

The daily flows through the individual Shark River Slough structures from July 2004 through June 2006 are presented in **Figure 6**. The S12s are operated to meet target discharges per the Shark River Slough Rainfall Plan which has been in effect since July 1985. All S12s had been utilized from June 22, 2005, through November 15, 2005. S12A has been closed since November 16, 2005; S12B has been closed since December 30, 2005; S12C has been closed since January 19, 2006; S12D has been closed since April 6, 2006 - in accordance with the Interim Operational Plan (IOP) for protection of the Cape Sable Seaside Sparrow.

S334 had been closed most of the time since January 18, 2006. However, a large portion (61 percent) of the flow in the L29 Canal that entered through S333 was released from the system through S334 and, therefore, only 39 percent of the flow through S333 entered Shark River Slough during this reporting period (**Figure 7**).

For additional information on the S12s and S333 structures, please visit:

http://www.sfwmd.gov/org/ema/reports/sharkriver/index.html.

A flow test of S355A (western structure) and S355B (eastern structure), which are located between S333 and S334 (**Figure 3**), was performed from February 2-20, 2006. The estimated daily mean flows were 32 cubic feet per second (cfs) at S355A and 19 cfs at S355B for a total of 1.82 kac-ft for the test period. The flow-weighted mean TP concentration taken on February 16, 2006 was 9 ppb. The flows through S355A and S355B were included in **Table 2**. The 12-month flow-weighted mean concentration was re-calculated to include these TP loads and flow.

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean TP concentrations for individual sampling events is presented in **Figure 8.** Values had been following the strong inverse relationship between flow and TP concentration for waters entering the ENP through Shark River Slough. The bi-weekly sampling event flow-weighted mean TP concentrations were elevated (12-24 ppb) reflecting the low flow during this reporting period.

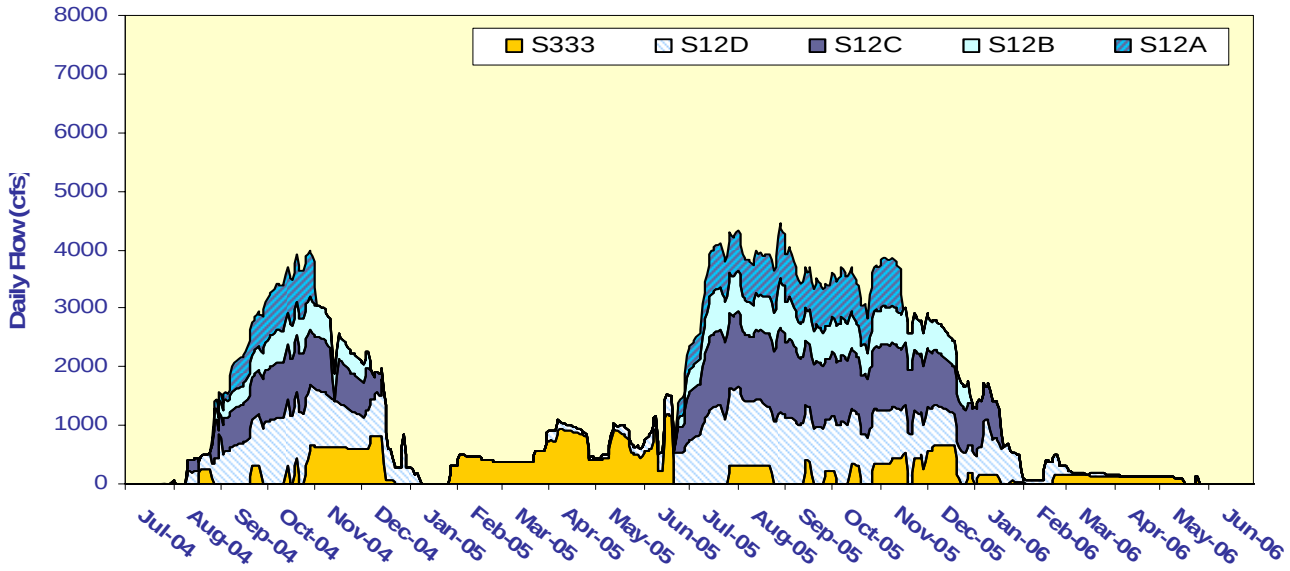

Figure 6. Daily flows into Shark River Slough by structure.

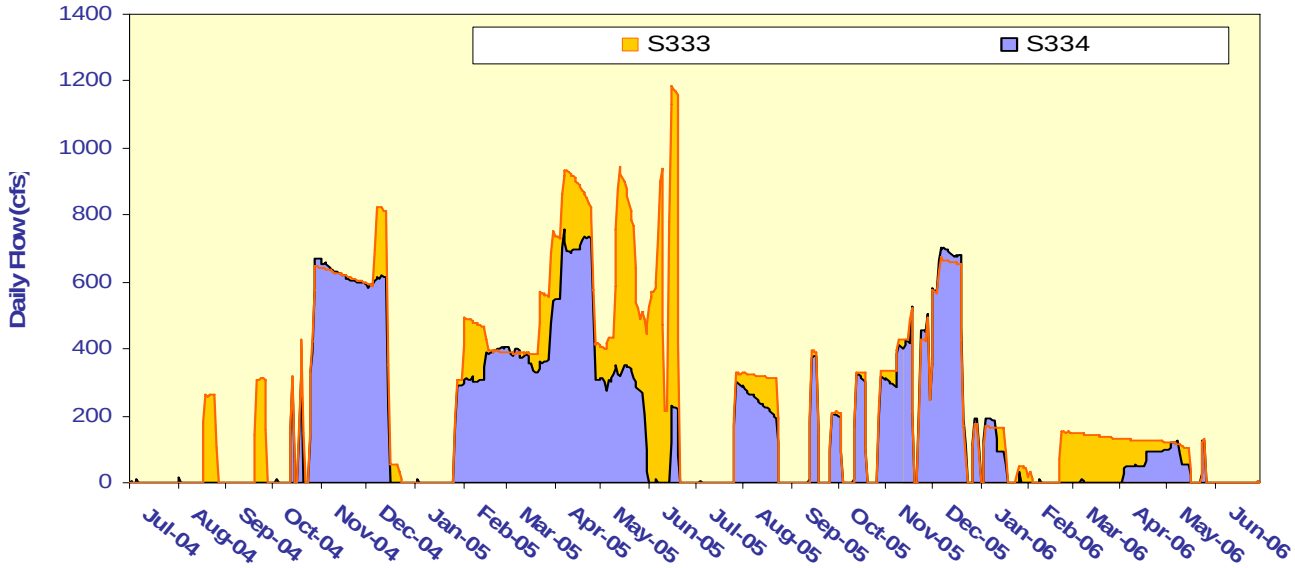

Figure 7. Daily flows comparison between S333 and S334

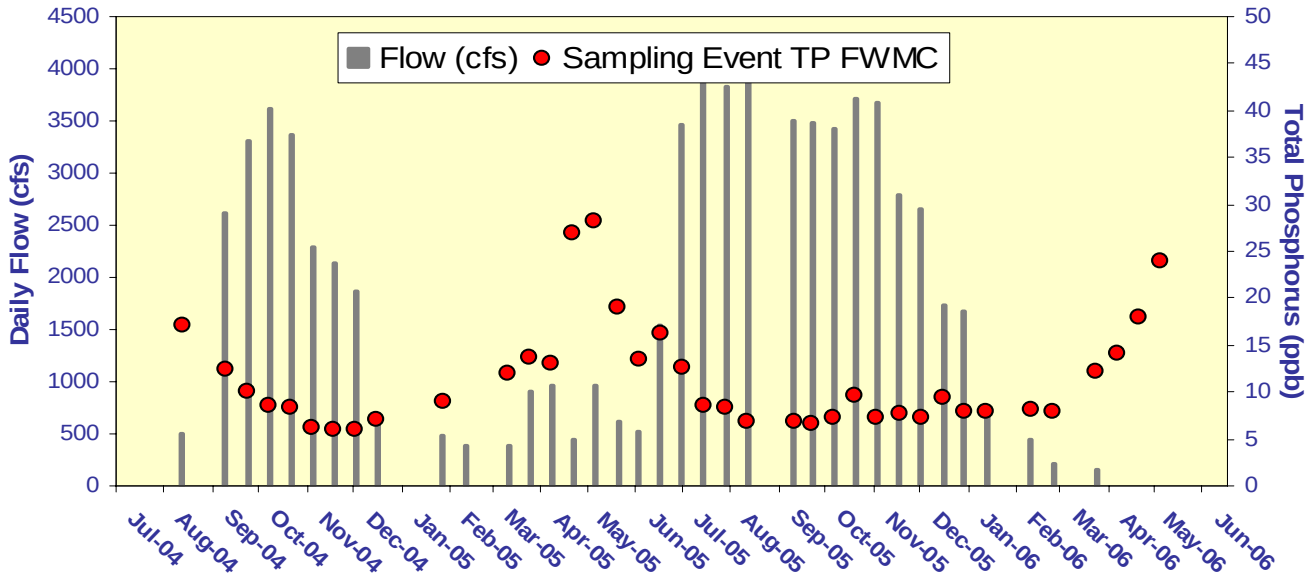

Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Taylor Slough and the Coastal Basins

Under the Consent Decree, a single total phosphorus (TP) 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. For the Water Year ending September 2005, the TP value was much lower than the long-term limit.

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, Cell 1 through Cell 5, a connector cell between Cell 2 and Cell 3, a flow way cell originating at Berm 3 of Cell 5, and four diversion structures, DS1 through DS4 (**Figure 9**). The flow way cell is the only location to routinely discharge surface water into 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 District started the routine sampling in September 2003.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. The diversion structures DS1 through DS4, previously referred to as EO1 through EO4, would discharge into the ENP if utilized. Overflows have periodically occurred at DS2. Data from these overflows were presented graphically in previous reports. There was no overflow during this reporting period. Discharges from the diversion

structures DS1 and DS3 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.

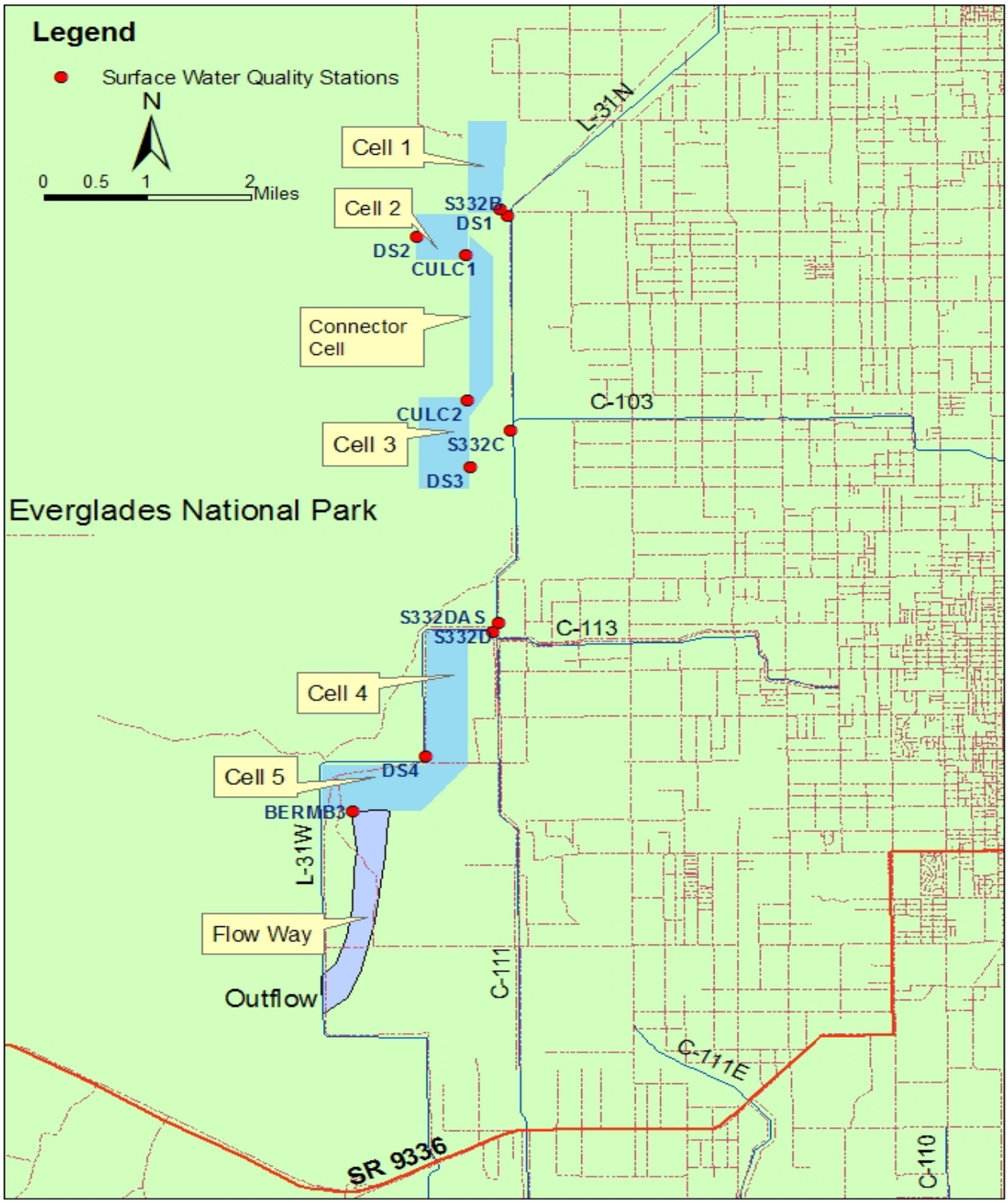

Figure 9. C-111 Project facilities.

Compliance with Consent Decree

Inflow concentrations of TP to the ENP 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 10**). The bars in **Figure 10** represent the 12-month flow-weighted mean TP concentrations from S332, S175 and S18C for water years 1989 through 2002. The diamond point values for water years 1999 through 2005 represent the new combination of structures.

TP 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 TP 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 10** .

Figure 11 presents the 12-month and individual sampling date flow-weighted mean TP concentrations at the S174, S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the 3 sites were used for the compliance calculations.

The 12-month flow-weighted mean concentrations for April, May, and June 2006 were 6.5, 6.4, and 6.7 ppb, respectively, for the combined flow through S174, S332D and S18C (**Table 3**). The Consent Decree stipulates that the percent of flow-weighted mean TP 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 observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb for the combined flow through S174, S332D and S18C were 10,4, 4.6, and 4.9 percent, respectively, for the periods ending April, May, and June 2006.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 12**. **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event. From 1984 to 1990, there was no observable relationship between daily mean flow and flow-weighted mean TP concentrations at S332 and S18C structures. Some higher concentrations were observed during low flow periods during 2004 and 2005 at S332D, S174 and S18C. However, flow-weighted mean TP concentrations for all sampling dates have been less than or equal to 9 ppb since September 2005 except for May 17, 2006, sampling at S332D (13 ppb).

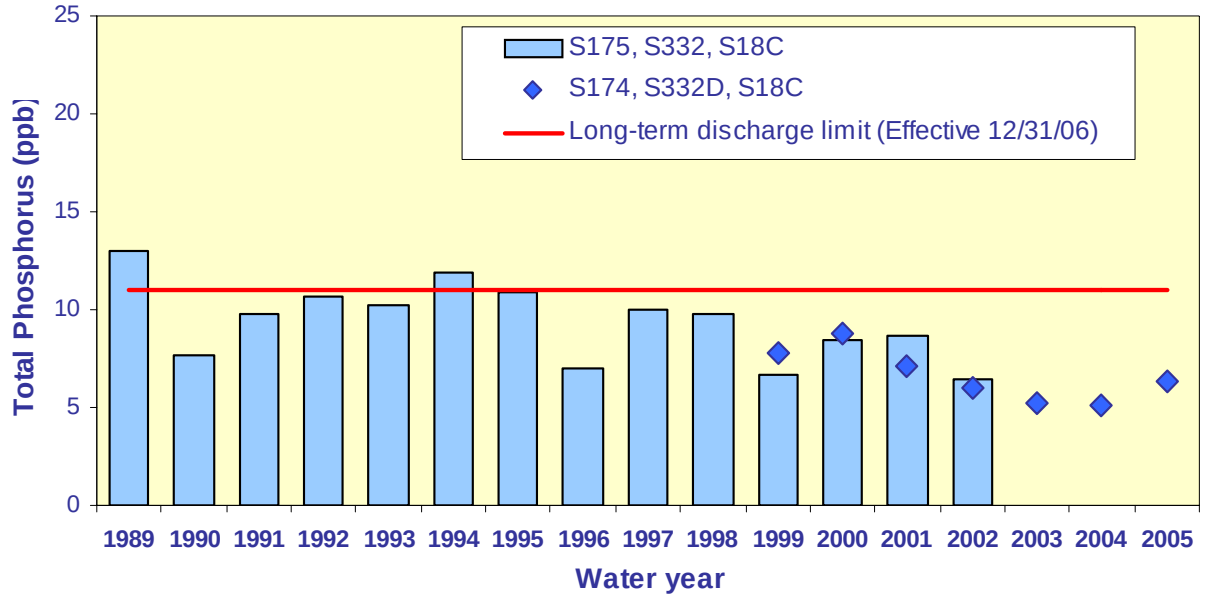

Figure 10. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term TP limit.

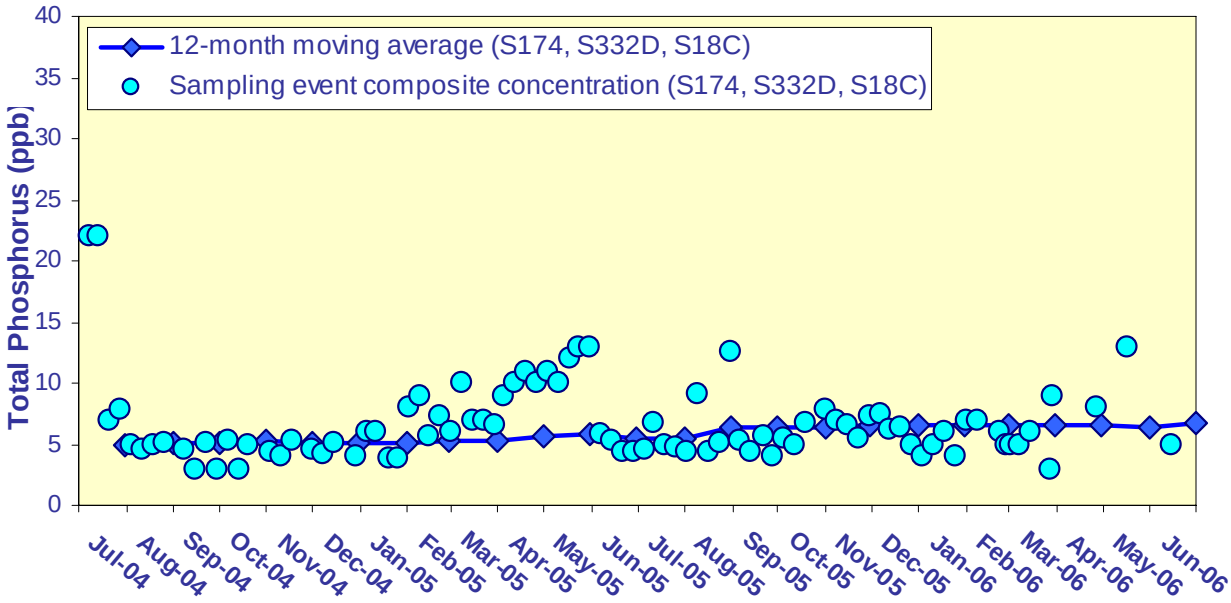

Figure 11. 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean TP concentration for each sampling event.

Table 3. Taylor Slough and the Coastal Basins TP Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (Kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Long Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
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
30-Apr-05	207.2	5.6	11.0	53.1	13.3
31-May-05	214.1	5.9	11.0	53.1	18.8
30-Jun-05	261.0	5.5	11.0	53.1	14.6
31-Jul-05	304.6	5.4	11.0	53.1	10.4
31-Aug-05	357.1	6.4	11.0	53.1	12.2
30-Sep-05	380.0	6.3	11.0	53.1	12.2
31-Oct-05	373.4	6.3	11.0	53.1	12.2
30-Nov-05	358.6	6.6	11.0	53.1	12.0
31-Dec-05	366.9	6.6	11.0	53.1	11.8
31-Jan-06	369.5	6.6	11.0	53.1	11.8
28-Feb-06	364.6	6.6	11.0	53.1	11.8
31-Mar-06	359.7	6.6	11.0	53.1	11.8
30-Apr-06	351.5	6.5	11.0	53.1	10.4
31-May-06	343.7	6.4	11.0	53.1	4.6
30-Jun-06	295.5	6.7	11.0	53.1	4.9

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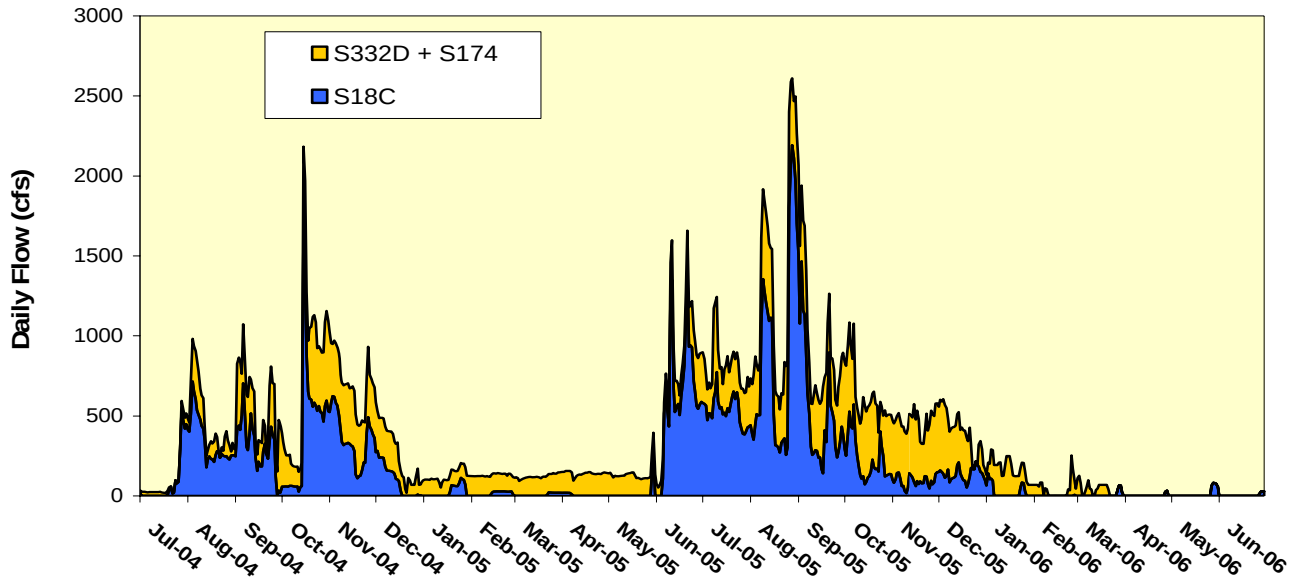

Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C.

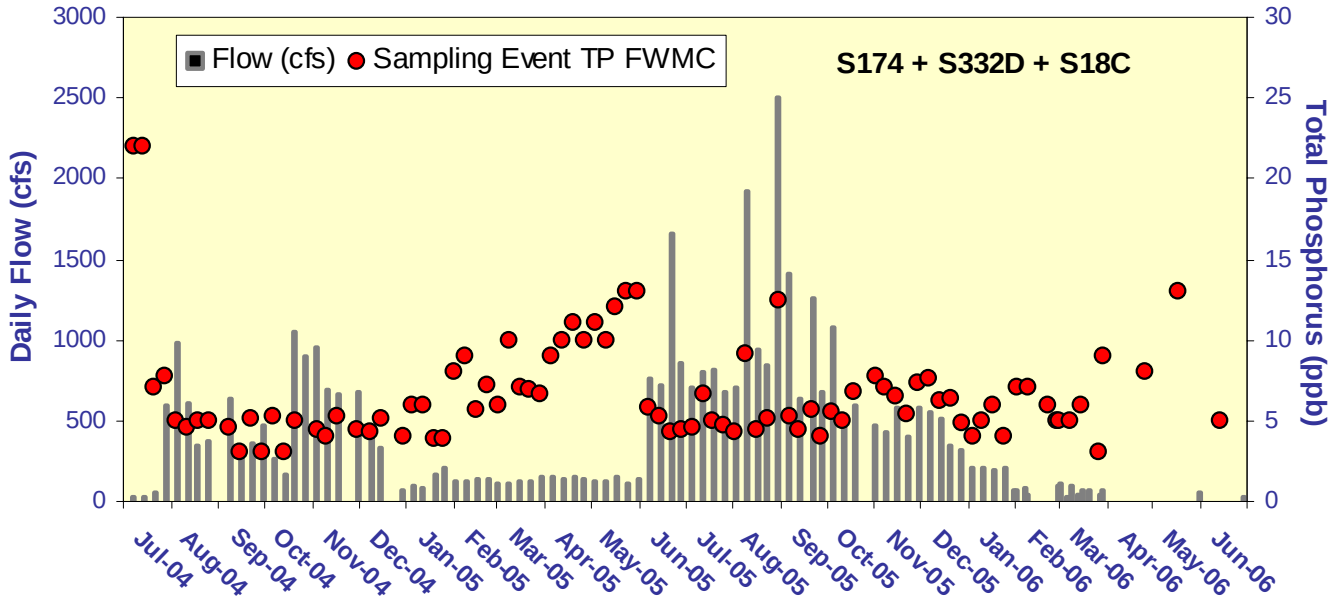

Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Settlement Agreement
July – September 2006 Report

Prepared for the
Technical Oversight Committee
November 9, 2006

Prepared by:
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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 total phosphorus (TP) concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by February 1, 1999, and December 31, 2006, respectively. Both the interim and long – term 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 in National Geodetic Vertical Datum (NGVD29). The monthly TP 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.

The interim levels for July, August and September 2006 were 16.1, 13.5 and 9.1 parts per billion (ppb), respectively. The long-term levels were 13.0, 11.1 and 7.8 ppb, respectively. Because the total depth was less than 0.1 meter (m), no water samples were collected at stations LOX3, LOX4, LOX5, LOX9 and LOX13 on July 10, 2006 and LOX3, LOX5 and LOX11 on August 7, 2006. Average stages in the Refuge were 15.92, 16.22 and 16.96 feet in July, August and September 2006 respectively (**Figure 2** and **Table 1)**. The geometric mean, calculated from TP concentrations measured in water samples collected in July, August and September 2006 were 11.7, 9.0 and 8.2 ppb, respectively. The geometric means were less than the interim and long-term levels for July and August and less than the interim level but higher than long – term level for September 2006.

However, the calculated long-term level reached a 2-year minimum (7.8 ppb) in September 2006 based on the elevated average stage (16.96 ft NGVD).

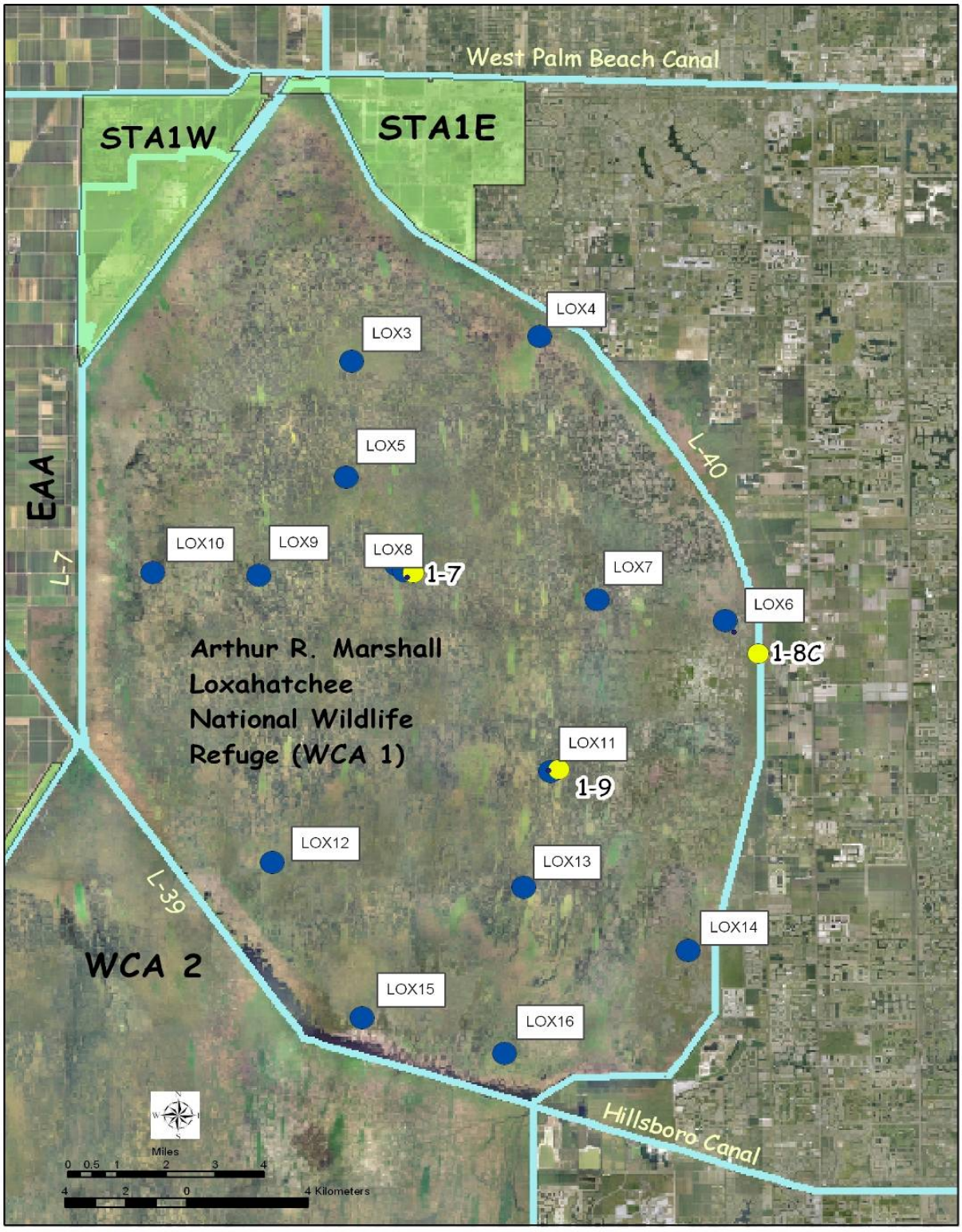

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

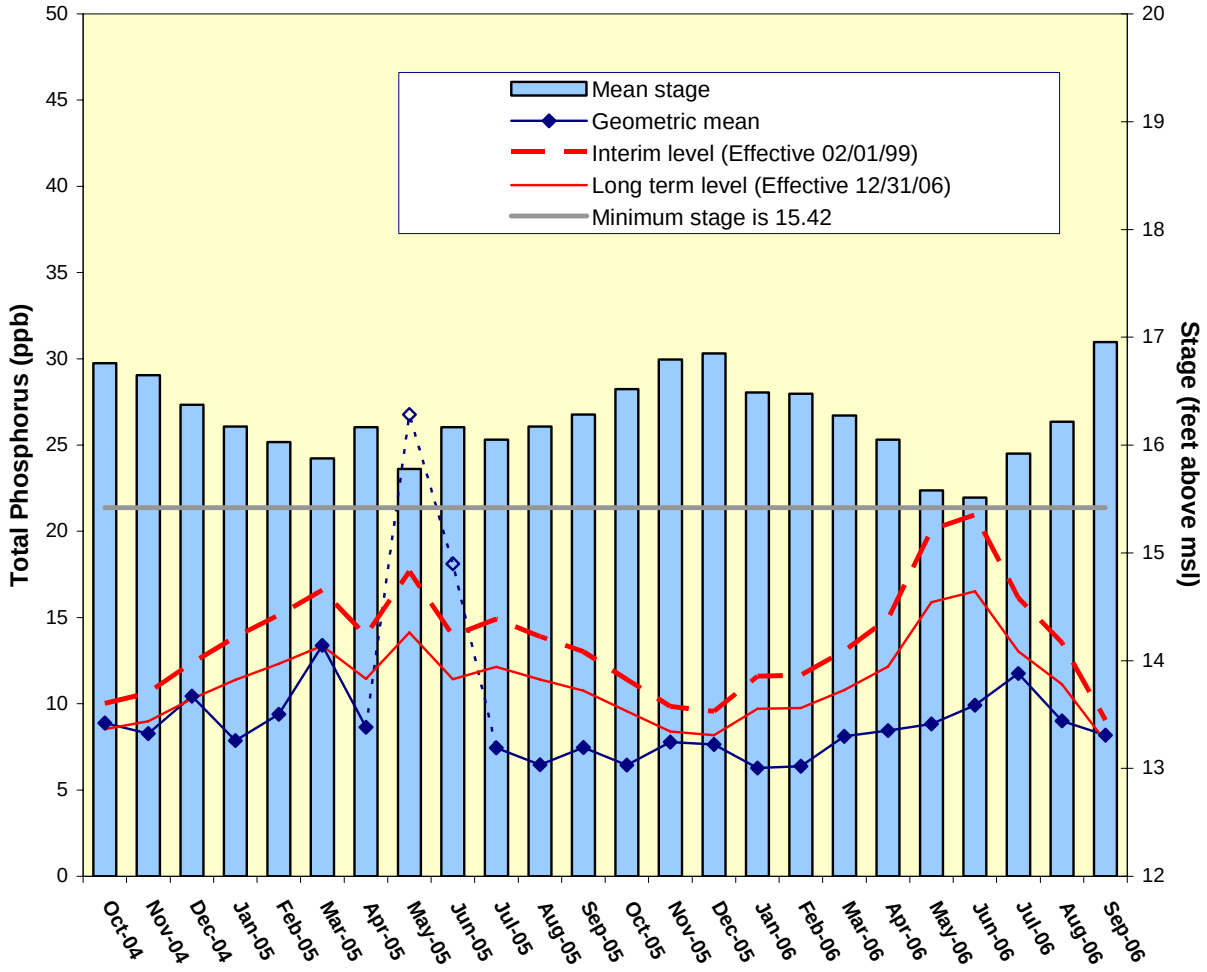

Figure 2. Monthly TP geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used. Geometric means for May and June 2005 are shown for reference only and were not considered for compliance purposes.

Table 1. Loxahatchee National Wildlife Refuge TP Compliance Tracking.

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage[a] (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
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
Apr-2005	8.6	13.9	11.4	16.17	11	3
May-2005[b]	(26.8)	17.7	14.1	15.78	(10)	3
Jun-2005[b]	(18.1)	13.9	11.4	16.17	(14)	3
Jul-2005	7.4	14.9	12.1	16.05	14	3
Aug-2005	6.5	13.9	11.4	16.17	12	3
Sep-2005	7.5	13.0	10.8	16.28	11	3
Oct-2005	6.5	11.4	9.6	16.52	13	3
Nov-2005	7.8	9.8	8.4	16.79	14	3
Dec-2005	7.6	9.6	8.2	16.85	14	3
Jan-2006	6.3	11.6	9.7	16.49	13	3
Feb-2006	6.4	11.7	9.8	16.48	13	3
Mar-2006	8.1	13.1	10.8	16.28	12	3
Apr-2006	8.4	14.9	12.2	16.05	12	3
May-2006	8.8	20.1	15.9	15.58	10	3
Jun-2006	9.9	21.0	16.5	15.51	5	3
Jul-2006	11.7	16.1	13.0	15.92	9	3
Aug-2006	9.0	13.5	11.1	16.22	11	3
Sep-2006	8.2	9.1	7.8	16.96	14	3

Notes: a Average Stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 on the sampling date.
b The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used.

EVERGLADES NATIONAL PARK

Shark River Slough

The Consent Decree of 1995 specified that interim and long-term total phosphorus (TP) concentration limits for discharges into the Everglades National Park (ENP) (**Figure 3**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the TP concentrations be presented as 12-month flow-weighted means. Only the TP concentrations for the water year ending September 30 are evaluated for compliance with the Consent Decree limits. The long-term TP 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 TP 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 2006 (**Figure 4**). The 12-month flow-weighted mean TP concentration ending September 2006 was 8.7 ppb. Corresponding interim and long-term limits were 10.3 and 8.8 ppb, respectively.

Table 2 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding interim and long-term TP concentration limits, calculated using the 12-month period flow. Only the bi-weekly compliance monitoring concentration data were used for the calculations. For the 12-month periods ending in July, August and September 2006, the 12-month flow-weighted mean TP concentrations were 7.7, 8.1 and 8.7 ppb, respectively. The interim limits were 9.4, 9.9 and 10.3 ppb, respectively. The long-term limits were 7.6, 8.3 and 8.8 ppb, respectively. The July, August and September 2006 12-month flow-weighted mean concentrations were lower than the interim limits. The August and September 2006, 12-month flow-weighted mean concentrations were also lower than the long-term limit.

The Consent Decree stipulates that the percentage of flow-weighted mean TP 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 July, August and September 2006, the observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were 26.3, 36.8 and 45.0 percent, respectively. The observed percentage of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were higher than the guidelines from May 2005 to December 2005 and lower than the guidelines since January 2006 (**Table 2**). The flow-weighted mean concentrations and the 12-month flow-weighted mean concentrations for individual sampling events are presented in **Figure 5**.

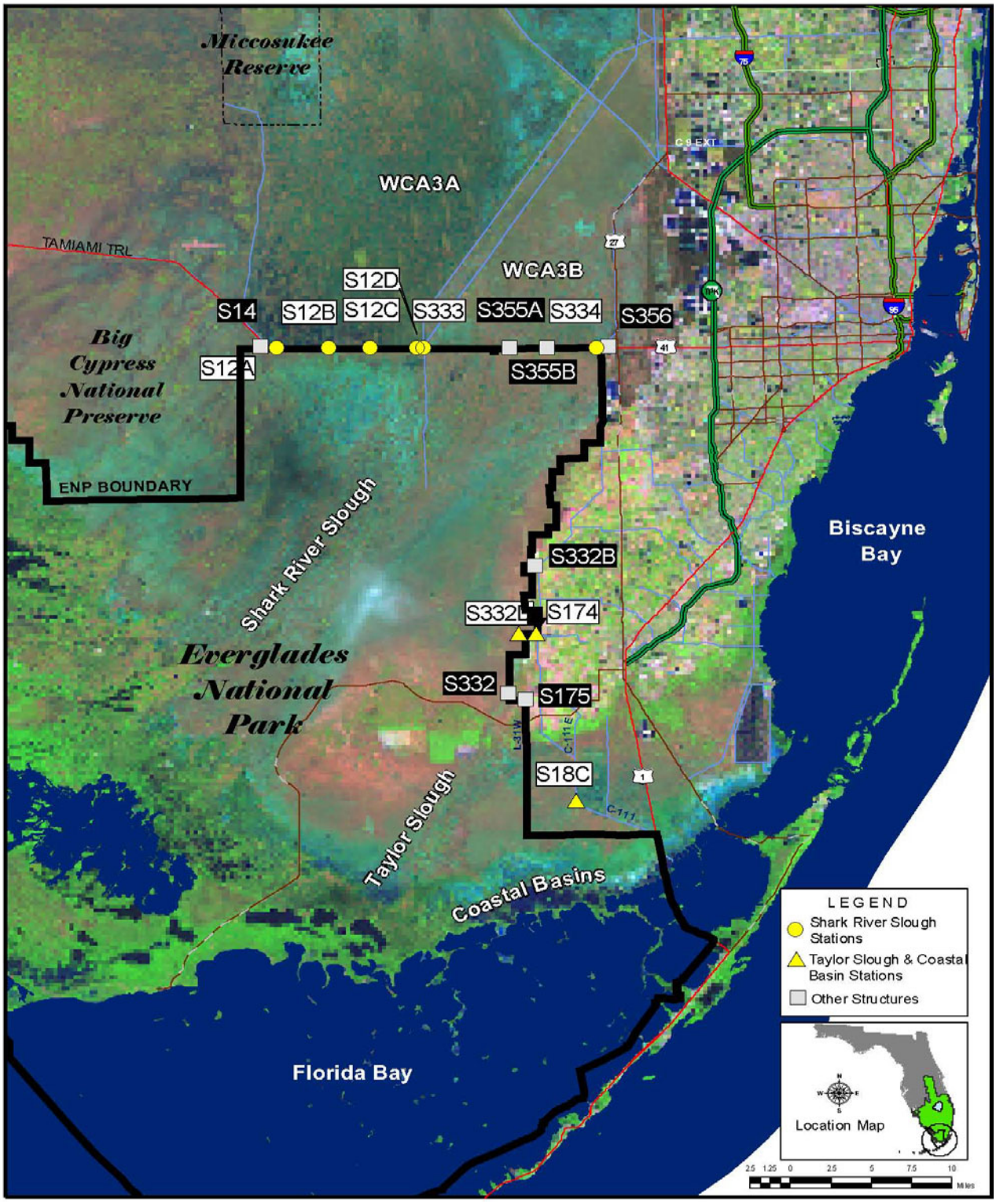

Figure 3. Everglades National Park flow structures

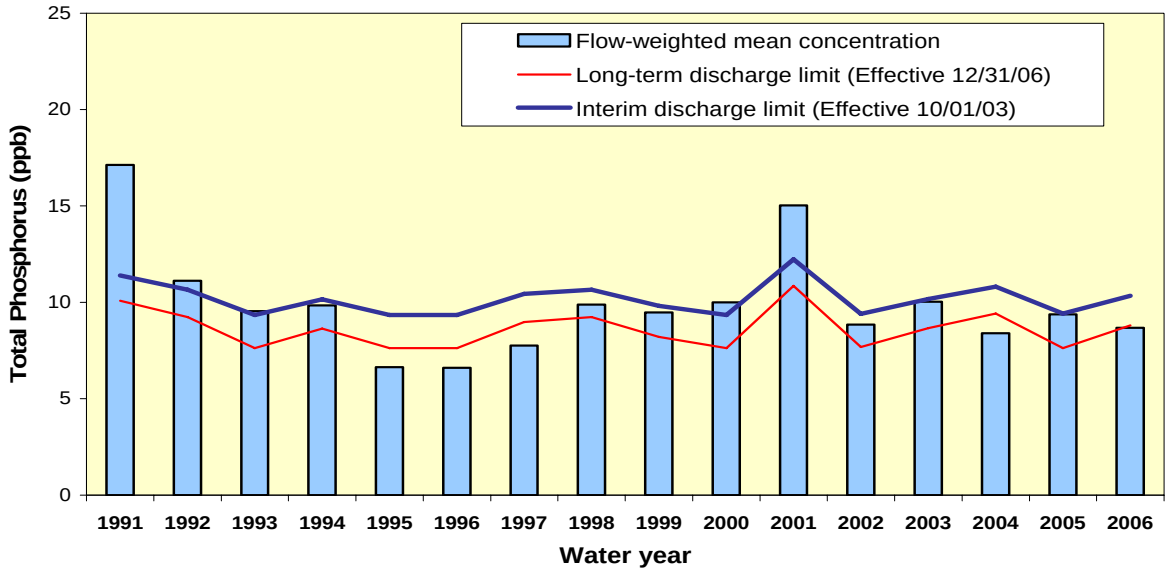

Figure 4. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the TP interim and long-term limits. For the third consecutive compliance year, the 12-month flow-weighted mean concentration was within the interim limits, which became effective on October 1, 2003.

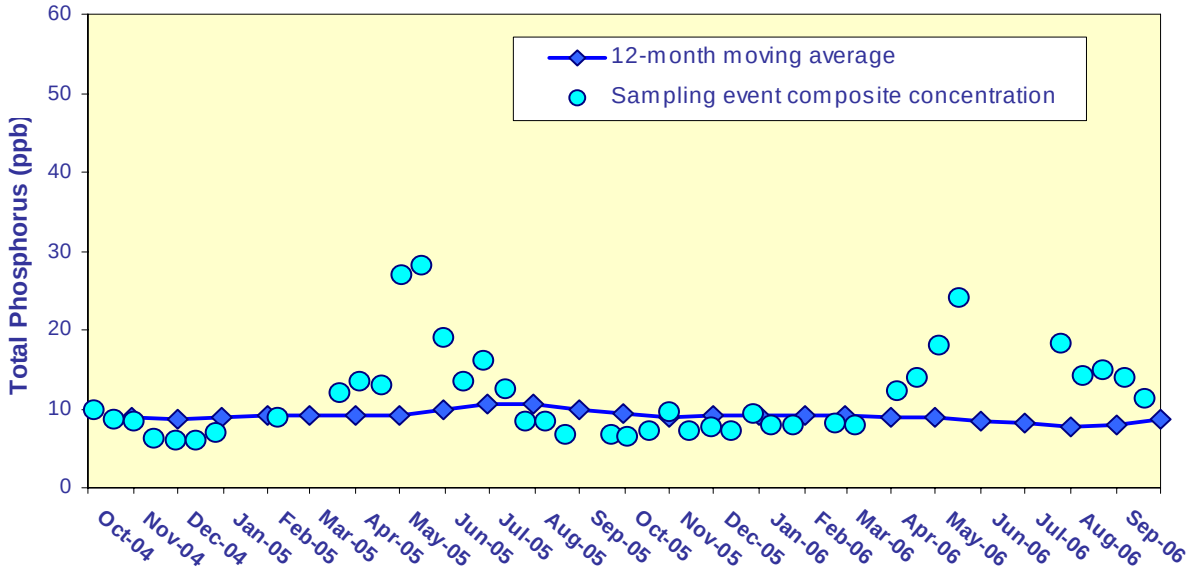

Figure 5. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for January 2005 and June 2006 because there was no flow in those months.

Table 2. Shark River Slough TP Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Interim Limit (ppb) Effective 10/1/2003	Long Term Limit (ppb) Effective 12/31/2006	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
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	698.3	9.2	10.8	9.4	49.2	46.7
30-Apr-05	732.6	9.1	10.7	9.3	48.2	46.7
31-May-05	767.1	10.0	10.5	9.1	47.3	***50.0***
30-Jun-05	836.0	10.5	10.2	8.7	45.4	***55.6***
31-Jul-05	1054.7	10.5	9.4	7.7	40.3	***55.0***
31-Aug-05	1269.2	9.8	9.4	7.6	40.1	***47.6***
30-Sep-05	**1345.9**	**9.4**	**9.4**	**7.6**	**40.1**	***42.9***
31-Oct-05	1338.1	9.0	9.4	7.6	40.1	***40.9***
30-Nov-05	1381.7	9.1	9.4	7.6	40.1	***42.9***
31-Dec-05	1447.6	9.1	9.4	7.6	40.1	***42.9***
31-Jan-06	1507.7	9.0	9.4	7.6	40.1	39.1
28-Feb-06[a]	1497.6	9.0	9.4	7.6	40.1	39.1
31-Mar-06[a]	1481.0	9.0	9.4	7.6	40.1	34.8
30-Apr-06[a]	1436.0	9.0	9.4	7.6	40.1	34.8
31-May-06[a]	1395.5	8.5	9.4	7.6	40.1	31.8
30-Jun-06[a]	1326.6	8.2	9.4	7.6	40.1	25.0
31-Jul-06[a]	1113.3	7.7	9.4	7.6	40.1	26.3
31-Aug-06[b]	914.7	8.1	9.9	8.3	43.5	36.8
30-Sep-06[b]	**814.0**	**8.7**	**10.3**	**8.8**	**46.0**	**45.0**

Notes: *1) Highlighted rows indicate the end of the water year (October 1- September 30), which are the compliance points.*

2) Bold italicized values exceeded the guideline percentages.

3) When the total flow for Shark River Slough exceeds 1061 kac-ft/yr, a flow of 1061 kac-ft/yr is used in calculating the discharge limits.

a Flow of 1.82 kac-ft in February 2006 at S355A and S355B was included for the 12-month total flows .

b Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12 month total flows in addition to the flow of 1.82 kac-ft in February 2006 at S355A and S355B structures.

All S12s have started being utilized in this quarter. S12A had been closed since November 16, 2005; S12B had been closed since December 30, 2005; S12C had been closed since January 19, 2006; S12D had been closed since April 6, 2006 - in accordance with the Interim Operational Plan (IOP) for protection of the Cape Sable Seaside Sparrow.

The daily flows through the individual Shark River Slough structures from October 2004 through September 2006 are presented in **Figure 6**. The S12s are operated to meet target discharges per the Shark River Slough Rainfall Plan which has been in effect since July 1985. There was very little inflow to Shark River Slough until mid July 2006. Since October 2004 a large portion of the flow in the L29 Canal that entered through S333 was released from the system through S334. However, almost all of the flow through S333 during this quarter (July to Sept 2006) was discharged to Shark River Slough and little was diverted to S334 (**Figure 7**).

For additional information on the S12s and S333 structures, please visit: http://www.sfwmd.gov/org/ema/reports/sharkriver/index.html .

A flow test of S355A (western structure) and S355B (eastern structure), which are located between S333 and S334 (**Figure 3**), was performed during February 2-20, 2006. The estimated daily mean flows were 32 cubic feet per second (cfs) at S355A and 19 cfs at S355B for a total of 1.82 kac-ft for the test period. The flow-weighted mean TP concentration taken on February 16, 2006 was 9 ppb.

Another flow test was performed at S356, which is along Tamiami Canal at S334 (**Figure 3**) during August 2-8, 2006. The flow rate was 120 - 250 cfs and a total of 3.33 kac-ft was discharged into L29 from the west side of S334. The average of all TP concentrations taken on July 18, 2206 and on August 14, 2006, was 13 ppb.

The flows through S355A and S355B were included in **Table 2** since February 2006 and flow through S356 since August 2006. The 12-month flow-weighted mean concentrations and limits were re-calculated to include these TP loads and flow. The September 2005 through August 2006 long-term limit was changed from 8.4 ppb to 8.3 ppb. Frequency limit for the period was changed from 43.6 percent to 43.5 percent. The October 2005 through September 2006 long-term limit was changed from 8.9 ppb to 8.8 ppb. The frequency limit for the period was changed from 46.1 percent to 46.0 percent. No other limits and no 12-month flow-weighted mean concentration values in the Table 2 were affected by the inclusion of these flow and TP loads.

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean TP concentrations for individual sampling events is presented in **Figure 8.** Values had been following the strong inverse relationship between flow and TP concentration for waters entering the ENP through Shark River Slough. The elevated (12-24 ppb) bi-weekly sampling event flow-weighted mean TP concentrations, reflecting the low flow during the last reporting period, started to decrease in the current reporting months as the flows into Shark River Slough were increased.

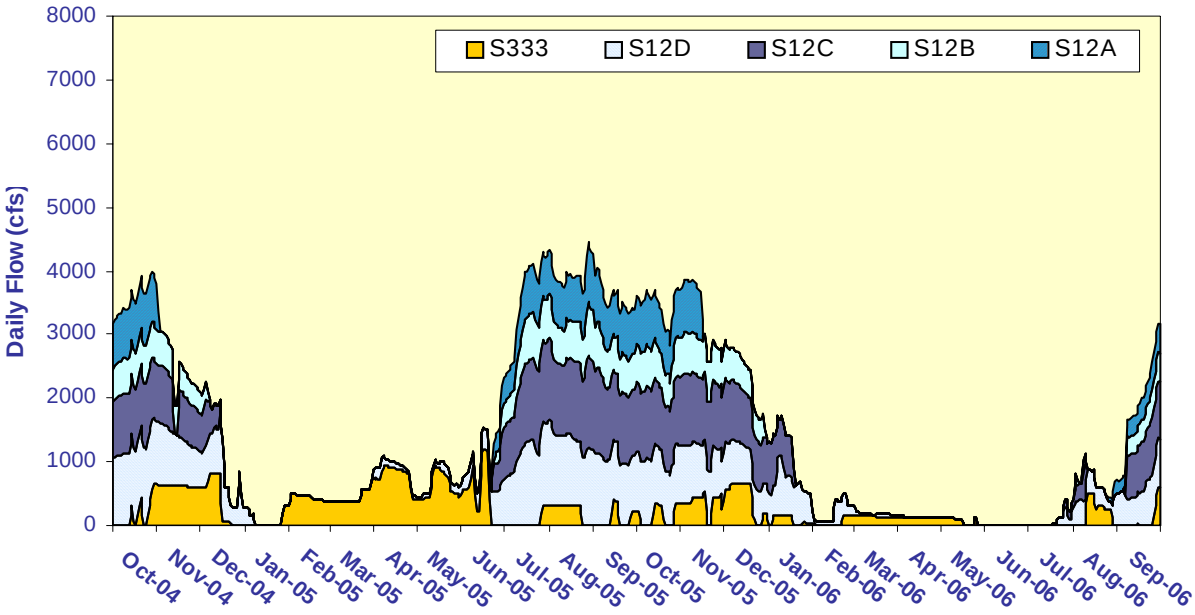

Figure 6. Daily flows into Shark River Slough by structure.

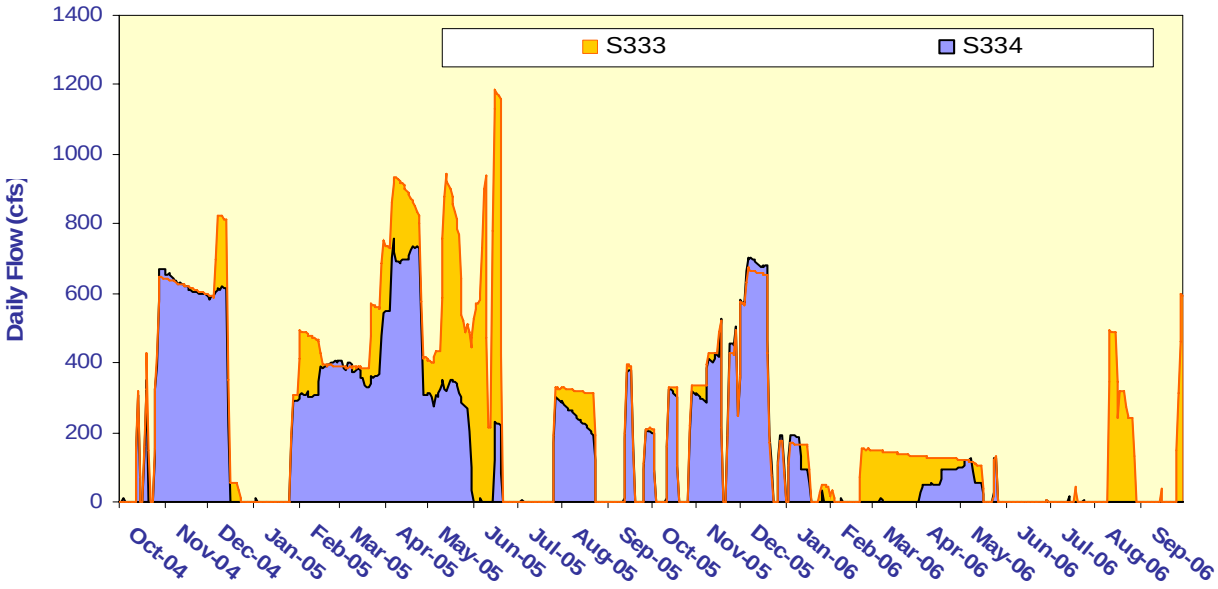

Figure 7. Daily flows comparison between S333 and S334

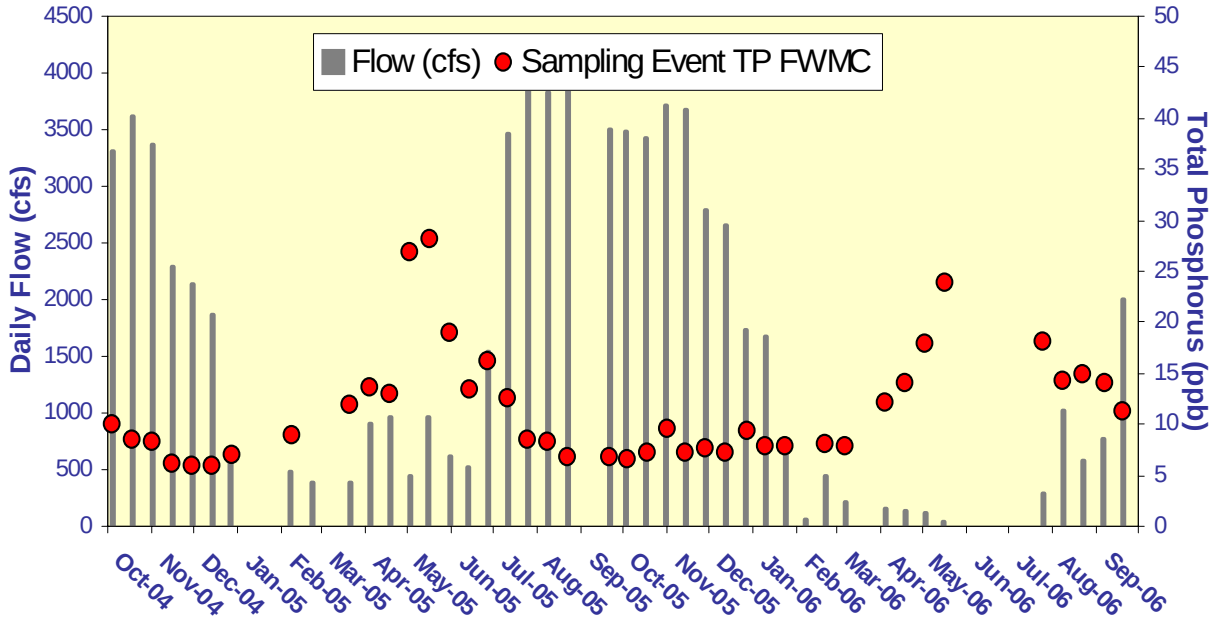

Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean TP concentrations for individual sampling events. There were no sampling event flow-weighted mean concentrations in January 2005 and June 2006 because there was no flow in those months.

Taylor Slough and the Coastal Basins

Under the Consent Decree, a single total phosphorus (TP) 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, 2006; the 12-month flow-weighted mean TP concentration (5.7 ppb) was much lower than the long-term limit.

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, Cell 1 through Cell 5, a connector cell between Cell 2 and Cell 3, a flow way cell originating at Berm 3 of Cell 5, and four diversion structures, DS1 through DS4 (**Figure 9**). The flow way cell is the only location to routinely discharge surface water into 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 District started the routine sampling in September 2003.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. The diversion structures DS1 through DS4, previously referred to as EO1 through EO4, would discharge into the ENP if utilized. Overflows have periodically occurred at DS2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports.

Discharges from the diversion structures DS1 and DS3 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.

The tail water stages at S332B were lower than the weir elevation (8.36 feet, NGVD29) for the reporting period indicating that **no overflow** occurred during the period at the weir.

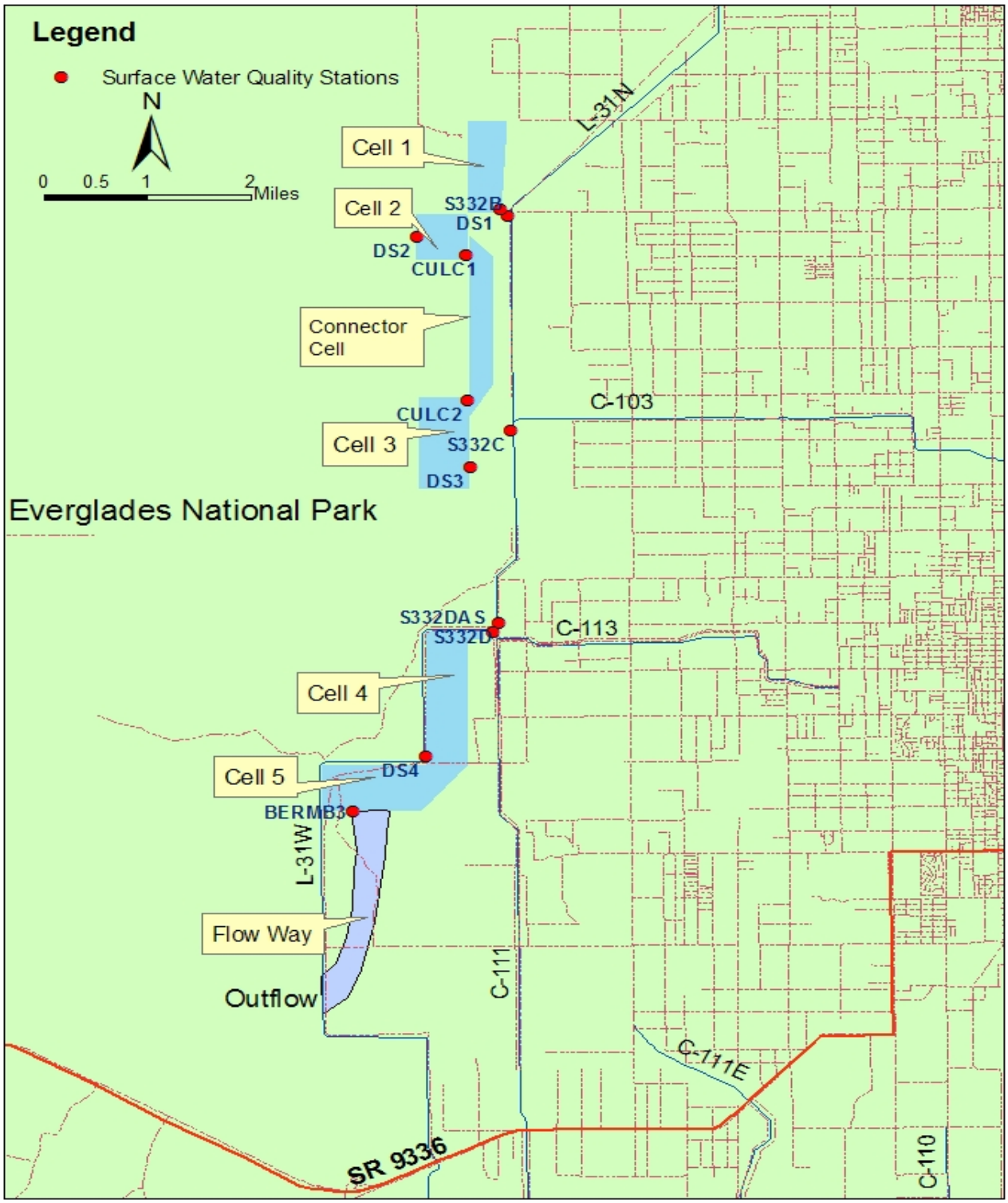

Figure 9. C-111 Project facilities.

Compliance with Consent Decree

Inflow concentrations of TP to the ENP 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 10**). The bars in **Figure 10** represent the 12-month flow-weighted mean TP 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.

TP 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 TP 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 10.**

Figure 11 presents the 12-month and individual sampling event flow-weighted mean TP concentrations at the S174, S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the 3 sites were used for the compliance calculations.

The 12-month flow-weighted mean concentrations for July, August and September 2006 were 6.7, 5.6 and 5.7 ppb, respectively, for the combined flow through S174, S332D and S18C (**Table 3**). The Consent Decree stipulates that the percent of flow-weighted mean TP 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 observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb for the combined flow through S174, S332D and S18C were 4.7, 2.3 and 4.2 percent for the periods ending July, August and September 2006.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 12**. **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event. From 1984 to 1990, there was no observable relationship between daily mean flow and flow-weighted mean TP concentrations at S332 and S18C structures. Some higher concentrations were observed during low flow periods during 2004 and 2005 at S332D, S174 and S18C. However, flow-weighted mean TP concentrations for all sampling dates have been less than or equal to 9 ppb since September 2005 except for May 17, 2006, sampling at S332D (13 ppb) and September 5, 2006, sampling at S18C (11 ppb).

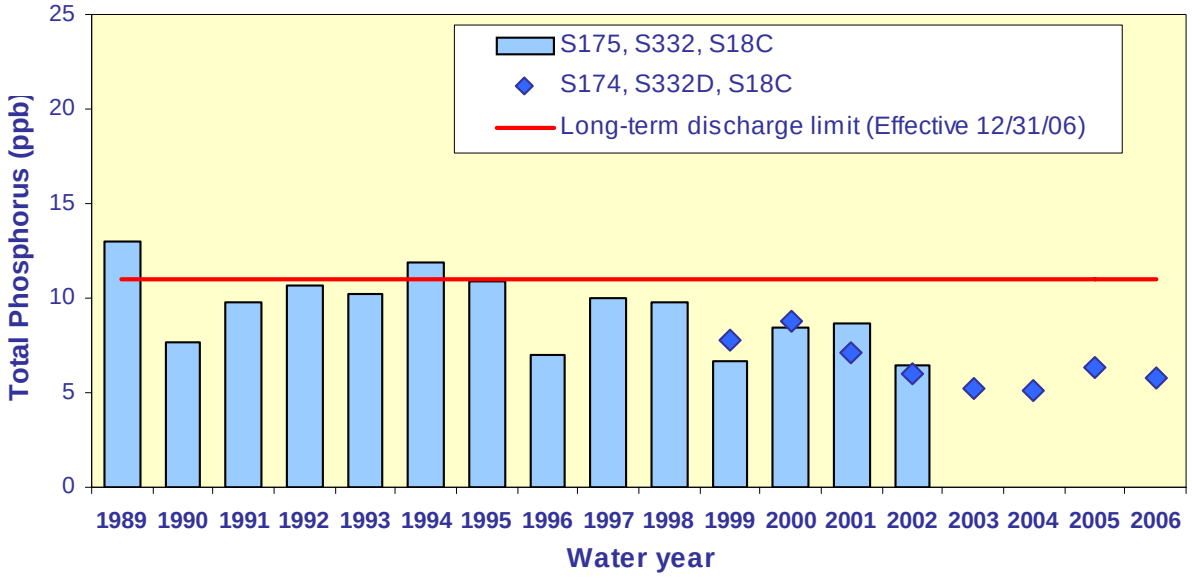

Figure 10. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term TP limit.

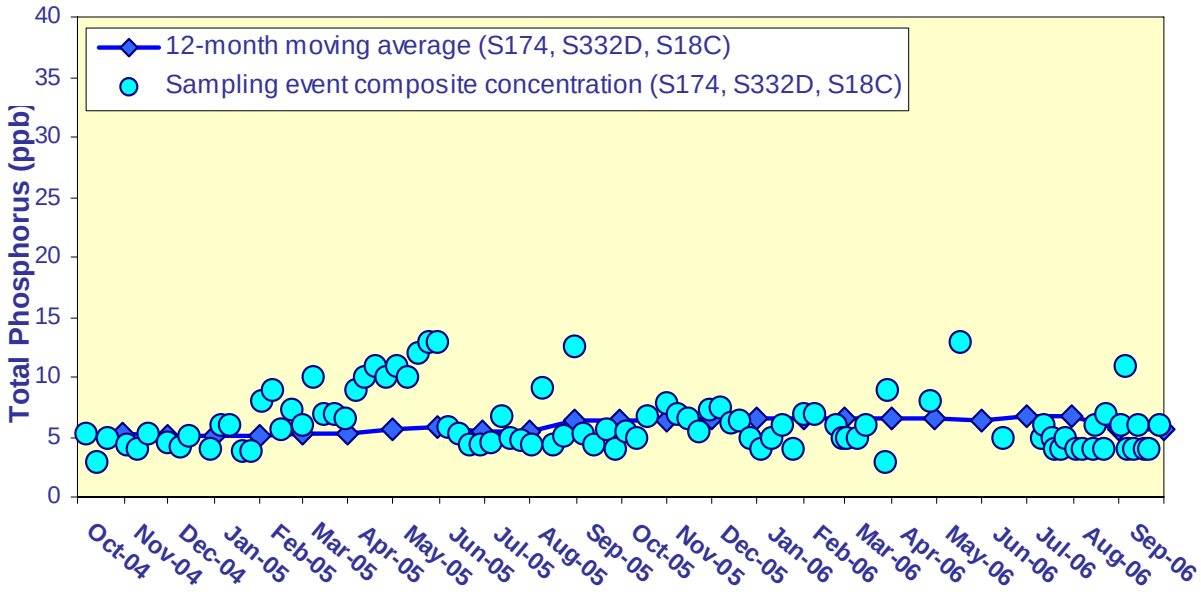

Figure 11. 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean TP concentration for each sampling event.

Table 3. Taylor Slough and the Coastal Basins TP Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Long Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
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
30-Apr-05	207.2	5.6	11.0	53.1	13.3
31-May-05	214.1	5.9	11.0	53.1	18.8
30-Jun-05	261.0	5.5	11.0	53.1	14.6
31-Jul-05	304.6	5.4	11.0	53.1	10.4
31-Aug-05	357.1	6.4	11.0	53.1	12.2
30-Sep-05	380.0	6.3	11.0	53.1	12.2
31-Oct-05	373.4	6.3	11.0	53.1	12.2
30-Nov-05	358.6	6.6	11.0	53.1	12.0
31-Dec-05	366.9	6.6	11.0	53.1	11.8
31-Jan-06	369.5	6.6	11.0	53.1	11.8
28-Feb-06	364.6	6.6	11.0	53.1	11.8
31-Mar-06	359.7	6.6	11.0	53.1	11.8
30-Apr-06	351.5	6.5	11.0	53.1	10.4
31-May-06	343.7	6.4	11.0	53.1	4.5
30-Jun-06	295.5	6.7	11.0	53.1	4.9
31-Jul-06	280.0	6.7	11.0	53.1	4.7
31-Aug-06	227.0	5.6	11.0	53.1	2.3
30-Sep-06	207.4	5.7	11.0	53.1	4.2

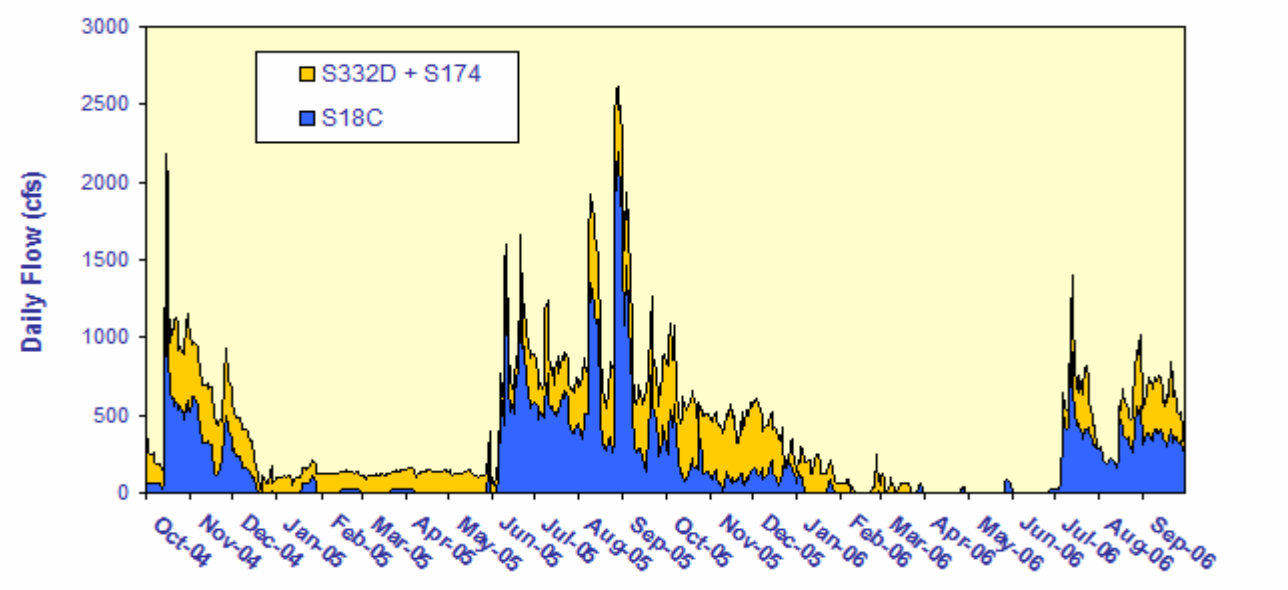

Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C.

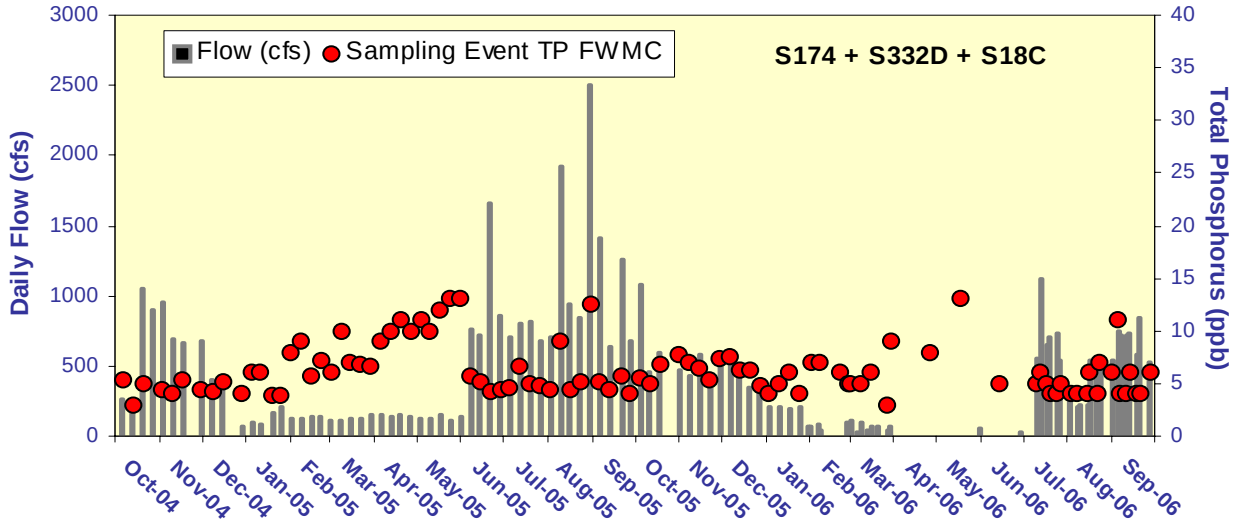

Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Settlement Agreement
October – December 2006 Report

Prepared for the
Technical Oversight Committee
February 14, 2007

Revision on March 2, 2007:
One of the sampling dates at S18C was corrected to December 26, 2007,
in the last sentence on page 15.

Prepared by:
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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 total phosphorus (TP) concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by February 1, 1999, and December 31, 2006, respectively. Both the interim and long – term 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 in National Geodetic Vertical Datum (NGVD29). The monthly TP 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.

The interim levels for October, November and December 2006 were 10.1, 11.1 and 13.4 parts per billion (ppb), respectively. The long-term levels were 8.6, 9.4 and 11.0 ppb, respectively. Because the total depth was less than 0.1 meter (m), no water samples were collected at stations LOX3, LOX4 and LOX5 on December 11, 2006. Average stages in the Refuge were 16.74, 16.56 and 16.23 feet in October, November and December 2006, respectively (**Figure 2** and **Table 1)**. The geometric means, calculated from TP concentrations measured in water samples collected in October, November and December 2006 were 7.5, 7.4 and 5.6 ppb, respectively. The geometric means were less than the interim and long-term levels for October, November and December 2006.

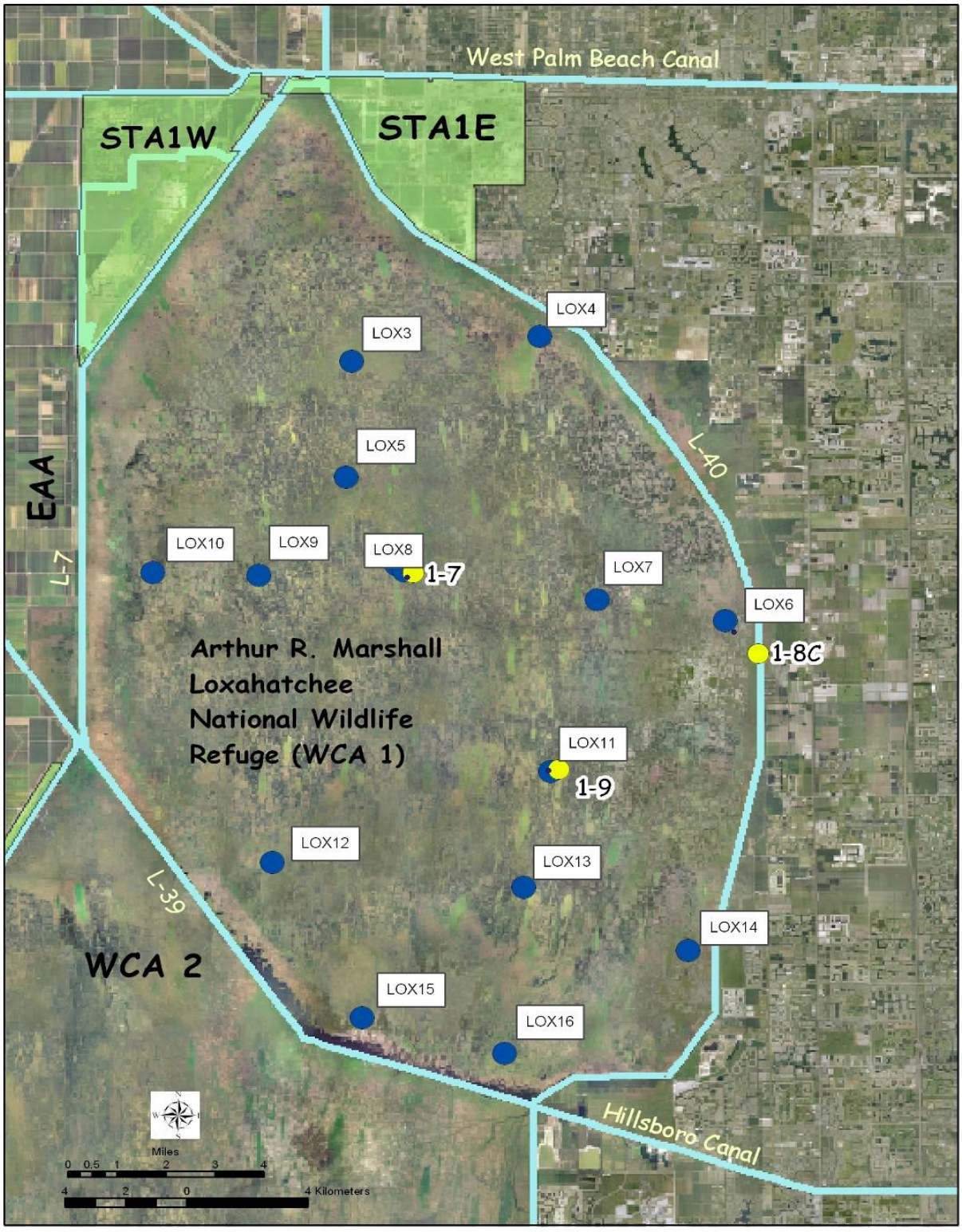

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

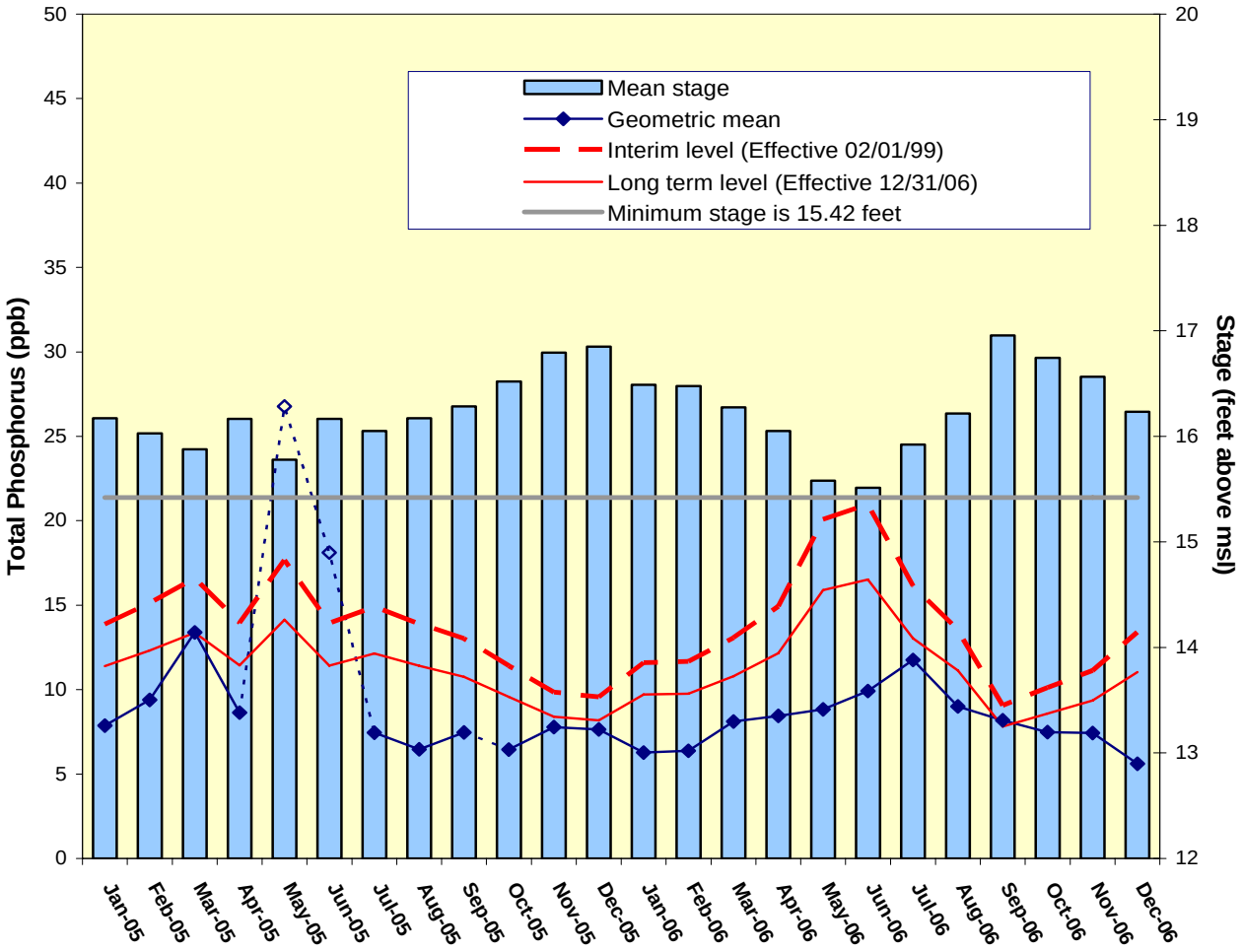

Figure 2. Monthly TP geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used. Geometric means for May and June 2005 are shown for reference only and were not considered for compliance purposes.

Table 1. Loxahatchee National Wildlife Refuge TP Compliance Tracking.

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage[a] (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
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
Apr-2005	8.6	13.9	11.4	16.17	11	3
May-2005[b]	(26.8)	17.7	14.1	15.78	(10)	3
Jun-2005[b]	(18.1)	13.9	11.4	16.17	(14)	3
Jul-2005	7.4	14.9	12.1	16.05	14	3
Aug-2005	6.5	13.9	11.4	16.17	12	3
Sep-2005	7.5	13.0	10.8	16.28	11	3
Oct-2005	6.5	11.4	9.6	16.52	13	3
Nov-2005	7.8	9.8	8.4	16.79	14	3
Dec-2005	7.6	9.6	8.2	16.85	14	3
Jan-2006	6.3	11.6	9.7	16.49	13	3
Feb-2006	6.4	11.7	9.8	16.48	13	3
Mar-2006	8.1	13.1	10.8	16.28	12	3
Apr-2006	8.4	14.9	12.2	16.05	12	3
May-2006	8.8	20.1	15.9	15.58	10	3
Jun-2006	9.9	21.0	16.5	15.51	5	3
Jul-2006	11.7	16.1	13.0	15.92	9	3
Aug-2006	9.0	13.5	11.1	16.22	11	3
Sep-2006	8.2	9.1	7.8	16.96	14	3
Oct-2006	7.5	10.1	8.6	16.74	14	3
Nov-2006	7.4	11.1	9.4	16.56	14	3
Dec-2006	5.6	13.4	11.0	16.23	11	3

Notes: a Average Stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 on the sampling date.
b The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used.

EVERGLADES NATIONAL PARK

Shark River Slough

The Consent Decree of 1995 specified that interim and long-term total phosphorus (TP) concentration limits for discharges into the Everglades National Park (ENP) (**Figure 3**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the TP concentrations be presented as 12-month flow-weighted means. Only the TP concentrations for the water year ending September 30 are evaluated for compliance with the Consent Decree limits. The long-term TP 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 TP 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 2006 (**Figure 4**). The 12-month flow-weighted mean TP concentration ending September 2006 was 8.7 ppb. Corresponding interim and long-term limits were 10.3 and 8.8 ppb, respectively.

Table 2 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding interim and long-term TP concentration limits, calculated using the 12-month period flow. Only the bi-weekly compliance monitoring concentration data were used for the calculations. For the 12-month periods ending in October, November and December 2006, the 12-month flow-weighted mean TP concentrations were 9.5, 10.0 and 10.3 ppb, respectively. The interim limits were 10.5, 11.1 and 11.8 ppb, respectively. The long-term limits were 9.0, 9.7 and 10.5 ppb, respectively. The October, November and December 2006 12-month flow-weighted mean concentrations were lower than the interim limits. The December 2006, 12-month flow-weighted mean concentration was lower than the long-term limit.

The Consent Decree stipulates that the percentage of flow-weighted mean TP 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 2006, the observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were 50.0 percent. The observed percentage of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were higher than the guidelines from May 2005 to December 2005 and September to December 2006 lower than the guidelines from January to August 2006 (**Table 2**). The flow-weighted mean concentrations and the 12-month flow-weighted mean concentrations for individual sampling events are presented in **Figure 5**.

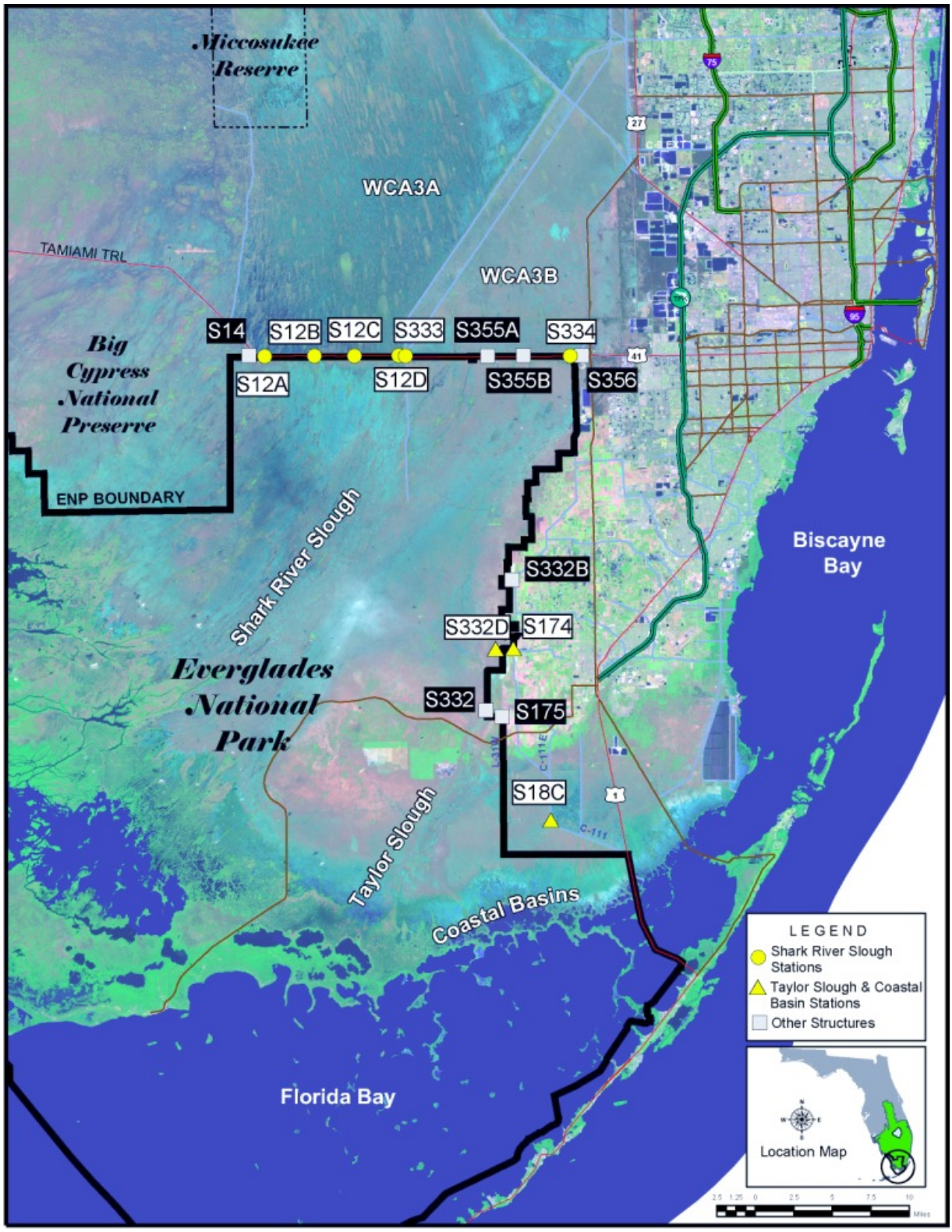

Figure 3. Everglades National Park flow structures

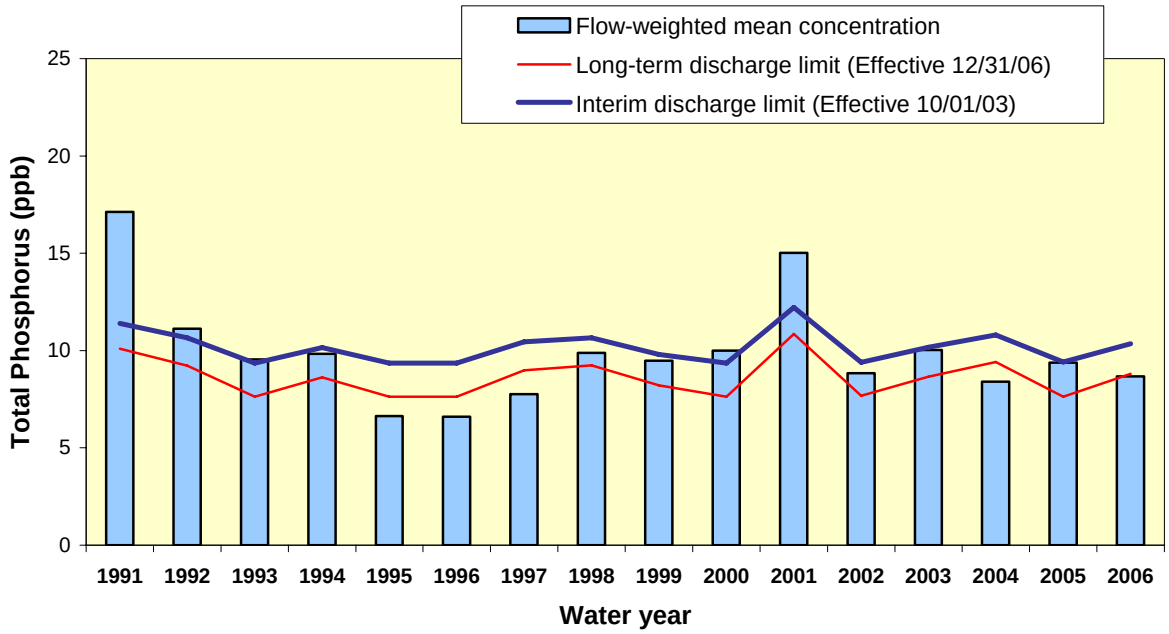

Figure 4. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the TP interim and long-term limits. For the third consecutive compliance year, the 12-month flow-weighted mean concentration was within the interim limits, which became effective on October 1, 2003.

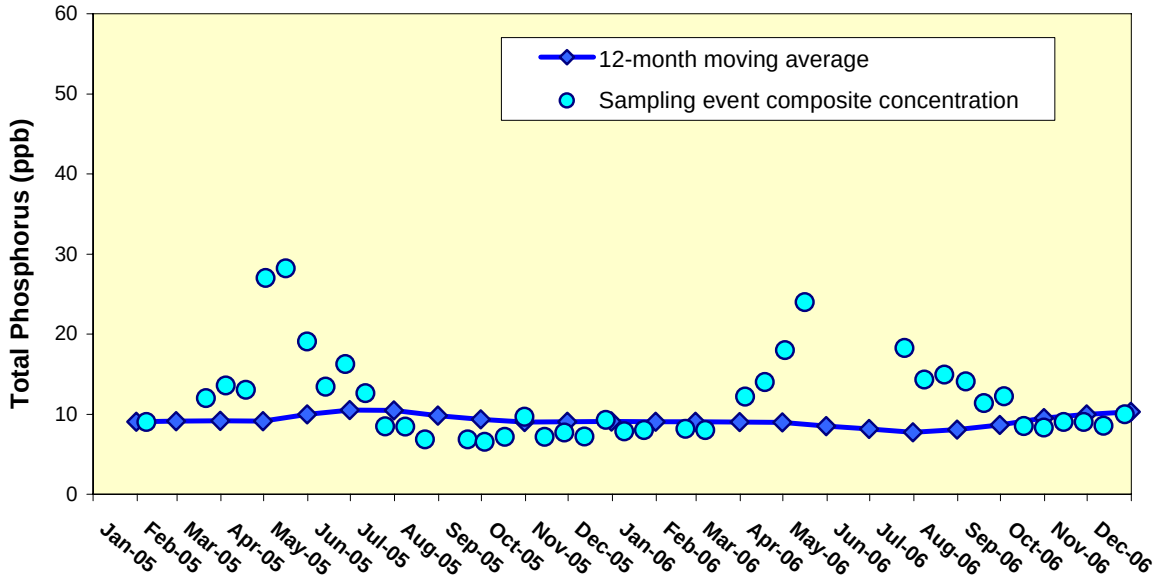

Figure 5. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for January 2005 and June 2006 because there was no flow in those months.

Table 2. Shark River Slough TP Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Interim Limit (ppb) Effective 10/1/2003	Long Term Limit (ppb) Effective 12/31/2006	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
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	698.3	9.2	10.8	9.4	49.2	46.7
30-Apr-05	732.6	9.1	10.7	9.3	48.2	46.7
31-May-05	767.1	10.0	10.5	9.1	47.3	***50.0***
30-Jun-05	836.0	10.5	10.2	8.7	45.4	***55.6***
31-Jul-05	1054.7	10.5	9.4	7.7	40.3	***55.0***
31-Aug-05	1269.2	9.8	9.4	7.6	40.1	***47.6***
30-Sep-05	**1345.9**	**9.4**	**9.4**	**7.6**	**40.1**	***42.9***
31-Oct-05	1338.1	9.0	9.4	7.6	40.1	***40.9***
30-Nov-05	1381.7	9.1	9.4	7.6	40.1	***42.9***
31-Dec-05	1447.6	9.1	9.4	7.6	40.1	***42.9***
31-Jan-06	1507.7	9.0	9.4	7.6	40.1	39.1
28-Feb-06[a]	1497.6	9.0	9.4	7.6	40.1	39.1
31-Mar-06[a]	1481.0	9.0	9.4	7.6	40.1	34.8
30-Apr-06[a]	1436.0	9.0	9.4	7.6	40.1	34.8
31-May-06[a]	1395.5	8.5	9.4	7.6	40.1	31.8
30-Jun-06[a]	1326.6	8.2	9.4	7.6	40.1	25.0
31-Jul-06[a]	1113.3	7.7	9.4	7.6	40.1	26.3
31-Aug-06[b]	914.7	8.1	9.9	8.3	43.5	36.8
30-Sep-06[b]	**814.0**	**8.7**	**10.3**	**8.8**	**46.0**	**45.0**
31-Oct-06[b]	779.6	9.5	10.5	9.0	46.9	**50.0**
30-Nov-06[b]	642.7	10.0	11.1	9.7	50.8	50.0
31-Dec-06[b]	507.9	10.3	11.8	10.5	55.0	50.0

Notes: *1) Highlighted rows indicate the end of the water year (October 1- September 30), which are the compliance points.*

2) Bold italicized values exceeded the guideline percentages.

3) When the total flow for Shark River Slough exceeds 1061 kac-ft/yr, a flow of 1061 kac-ft/yr is used in calculating the discharge limits.

a Flow of 1.82 kac-ft in February 2006 at S355A and S355B was included for the 12-month total flows.

b Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows in addition to the flow of 1.82 kac-ft in February 2006 at S355A and S355B structures.

Stage levels at Water Conservation Area (WCA) 3A continued to decrease during the reporting quarter and dropped below the regulation schedule by November 2006. All S12s and S333 were utilized until the end of November 2006 to meet target discharges described in the Shark River Slough "Rain Driven Water Deliveries to Everglades National Park" which has been in effect since July 1985 and the regulation schedule of WCA 3A.

The daily flows through the individual Shark River Slough structures from October 2004 through September 2006 are presented in **Figure 6**. S12A has been closed since November 1, 2006 in accordance with the Interim Operational Plan (IOP) for protection of the Cape Sable Seaside Sparrow. S12B was closed on November 4, 2006; S12C was closed on November 17, 2006; S12D was closed on December 14, 2006.

Since October 2004, a large portion of the flow in the L29 Canal that entered through S333 was released from the system through S334. However, almost all of the flow through S333 during the last quarter of 2006 was discharged to Shark River Slough and little was diverted to S334 (**Figure 7**).

For additional information on the S12s and S333 structures, please visit: http://www.sfwmd.gov/org/ema/reports/sharkriver/index.html .

A flow test of S355A (western structure) and S355B (eastern structure), which are located between S333 and S334 (**Figure 3**), was performed during February 2-20, 2006. The estimated daily mean flows were 32 cubic feet per second (cfs) at S355A and 19 cfs at S355B for a total of 1.82 kac-ft for the test period. The flow-weighted mean TP concentration taken on February 16, 2006, was 9 ppb.

Another flow test was performed at S356, which is along Tamiami Canal at S334 (**Figure 3**) during August 2-8, 2006. The flow rate was 120 - 250 cfs and a total of 3.33 kac-ft was discharged into L29 from the west side of S334. The average of all TP concentrations taken on July 18, 2006 and on August 14, 2006, was 13 ppb.

The flow of 1.82 kac-ft through S355A and S355B during the February 2006 flow test is included in the 12-month total flows in **Table 2** since February 2006. The flow of 3.33 kac-ft through S356 during the August 2006 flow test is included in the 12-month total flows in **Table 2** since August 2006. Including these TP loads and flow and re-calculating 12-month flow-weighted mean concentrations and limits did not change the values in the table for the reporting months. The frequency limits for the period were changed from 47.1, 50.9, and 55.2 percent to 46.9, 50.8, and 55.0 percent for October, November, and December 2006, respectively.

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean TP concentrations for individual sampling events is presented in **Figure 8.** Values had been following the strong inverse relationship between flow and TP concentration for waters entering the ENP through Shark River Slough. However, the bi-weekly sampling event flow-weighted mean TP concentrations remained low at 10 ppb with low flows during this reporting period.

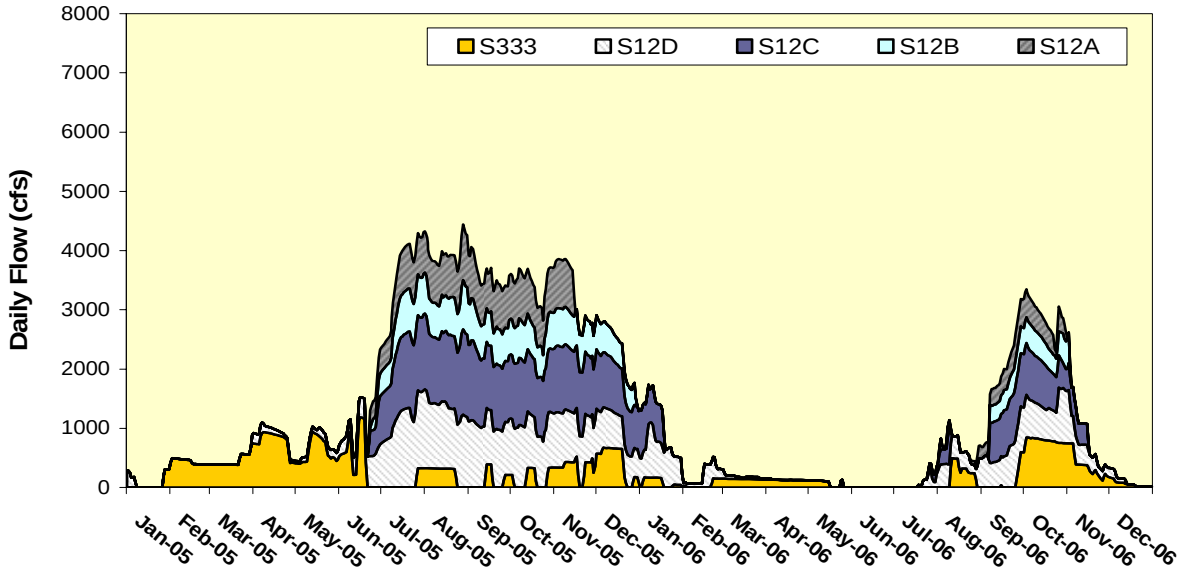

Figure 6. Daily flows into Shark River Slough by structure.

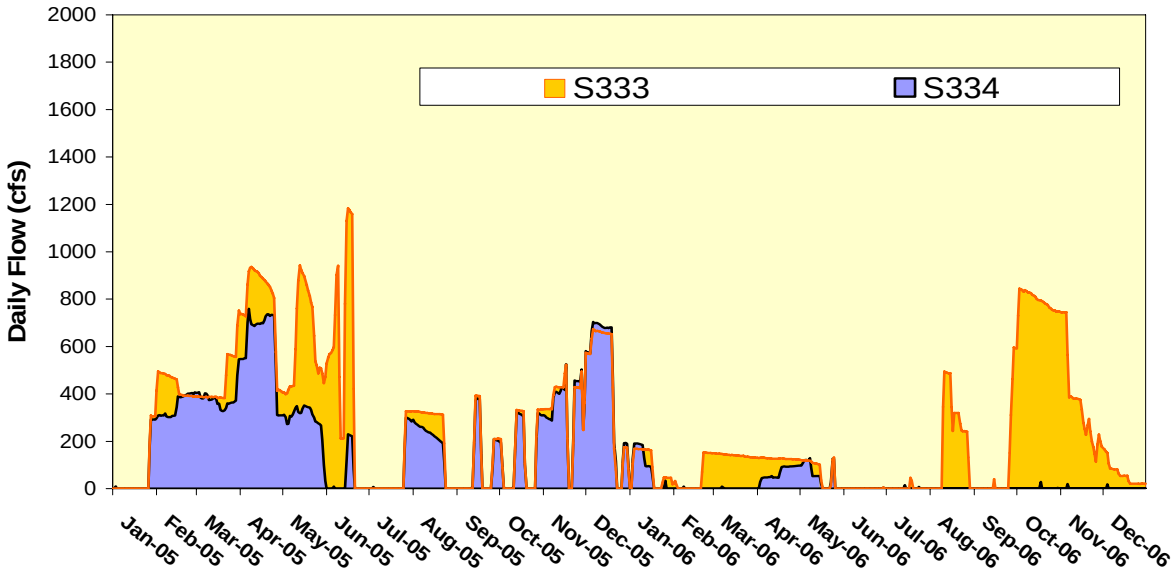

Figure 7. Daily flows comparison between S333 and S334

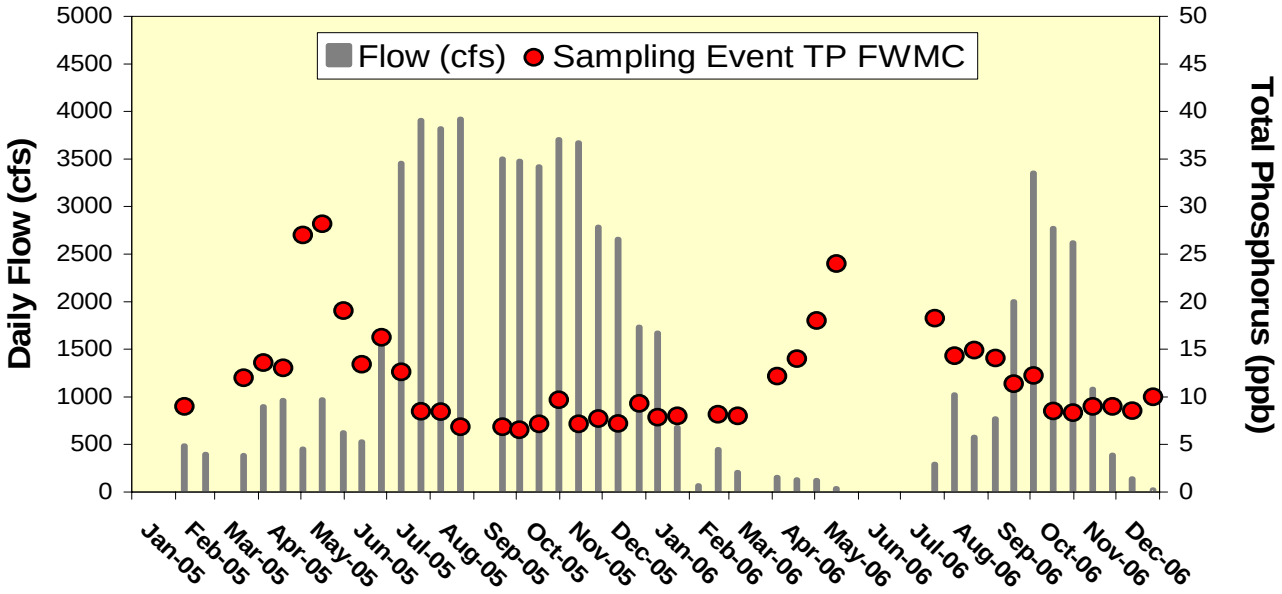

Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean TP concentrations for individual sampling events. There were no sampling event flow-weighted mean concentrations in January 2005 and June 2006 because there was no flow in those months.

Taylor Slough and the Coastal Basins

Under the Consent Decree, a single total phosphorus (TP) 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 12-month flow-weighted mean concentrations have been lower than the long-term limit of 11 ppb.

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, Cell 1 through Cell 5, a connector cell between Cell 2 and Cell 3, a flow way cell originating at Berm 3 of Cell 5, and four diversion structures, DS1 through DS4 (**Figure 9**). The flow way cell is the only location to routinely discharge surface water into 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 District started the routine sampling in September 2003.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. The diversion structures DS1 through DS4, previously referred to as EO1 through EO4, would discharge into the ENP if utilized. Overflows have periodically occurred at DS2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports.

Discharges from the diversion structures DS1 and DS3 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.

A total of 12 acre-feet of water was pumped at S332B to the west pond (Cell 2) during the reporting quarter. The tail water stages at S332B were lower than the weir elevation (8.36 feet, NGVD29) for the period indicating that **no overflow** occurred during the period at the weir.

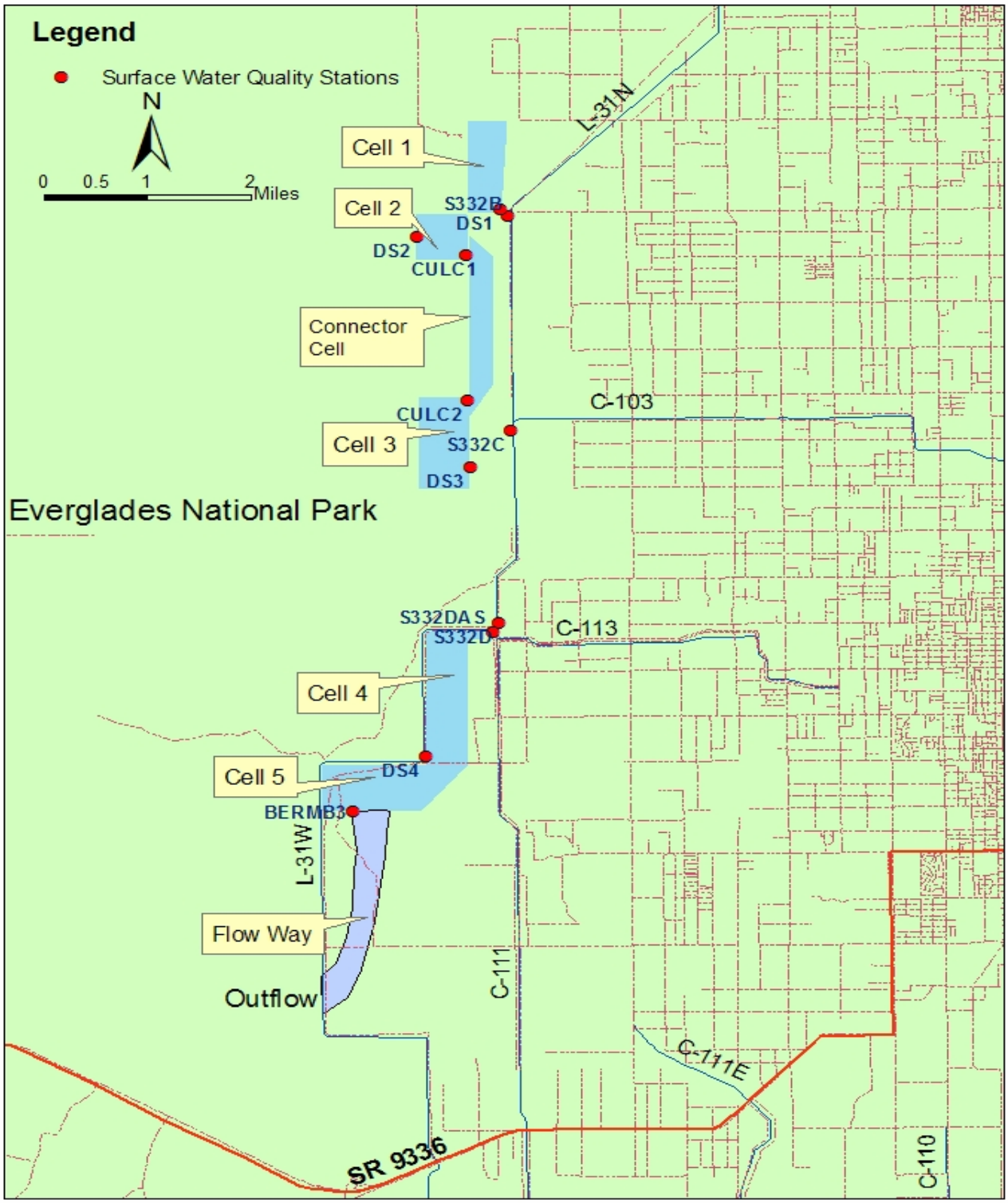

Figure 9. C-111 Project facilities.

Compliance with Consent Decree

Inflow TP concentrations to the ENP 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 10**). The bars in **Figure 10** represent the 12-month flow-weighted mean TP concentrations from S332, S175 and S18C for water years 1989 through 2002. The diamond point values for water years 1999 through 2006 represent the new combination of structures.

TP and flow data from both sets of structures presented in prior editions of this report through December 2001 (April 2002 report) showed that, beginning in 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 TP 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 10.**

Figure 11 presents the 12-month and individual sampling event flow-weighted mean TP concentrations at the S174, S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the 3 sites were used for the compliance calculations.

The 12-month flow-weighted mean concentrations for October, November and December 2006 were 5.7, 5.4 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 TP 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 observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb for the combined flow through S174, S332D and S18C were 4.0, 4.0 and 6.1 percent for the periods ending October, November and December 2006.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 12**. **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event. From 1984 to 1990, there was no observable relationship between daily mean flow and flow-weighted mean TP concentrations at S332 and S18C structures. Some higher concentrations were observed during low flow periods during 2004 and 2005 at S332D, S174 and S18C. However, flow-weighted mean TP concentrations have been consistently less than or equal to 9 ppb since September 2005 except for sampling at S332D on May 17, 2006 (13 ppb), sampling at S18C on September 5, 2006 (11 ppb), and sampling at S18C on December 26, 2006 (15 ppb).

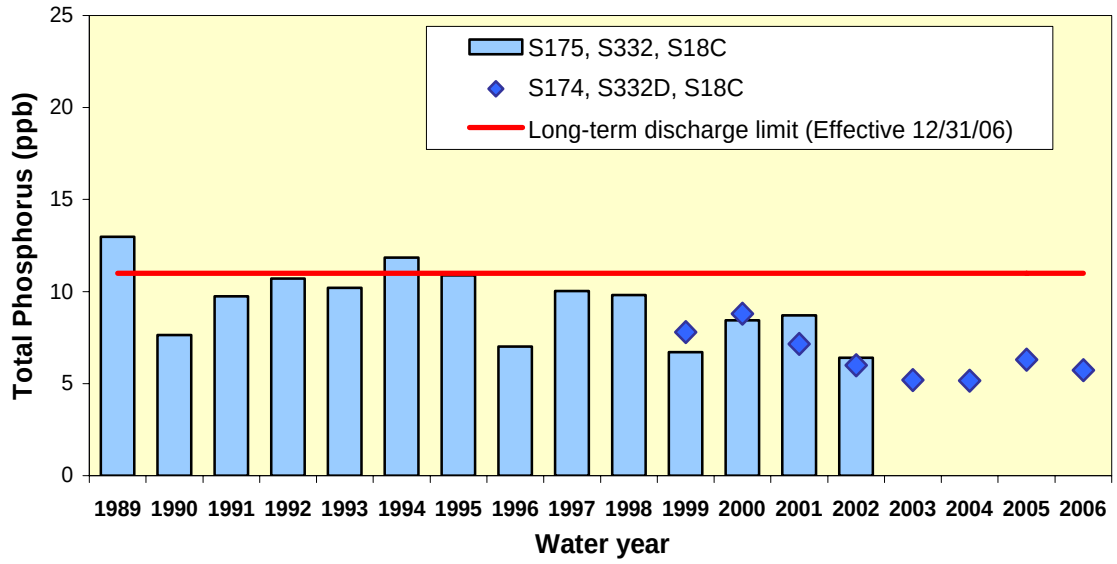

Figure 10. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term TP limit.

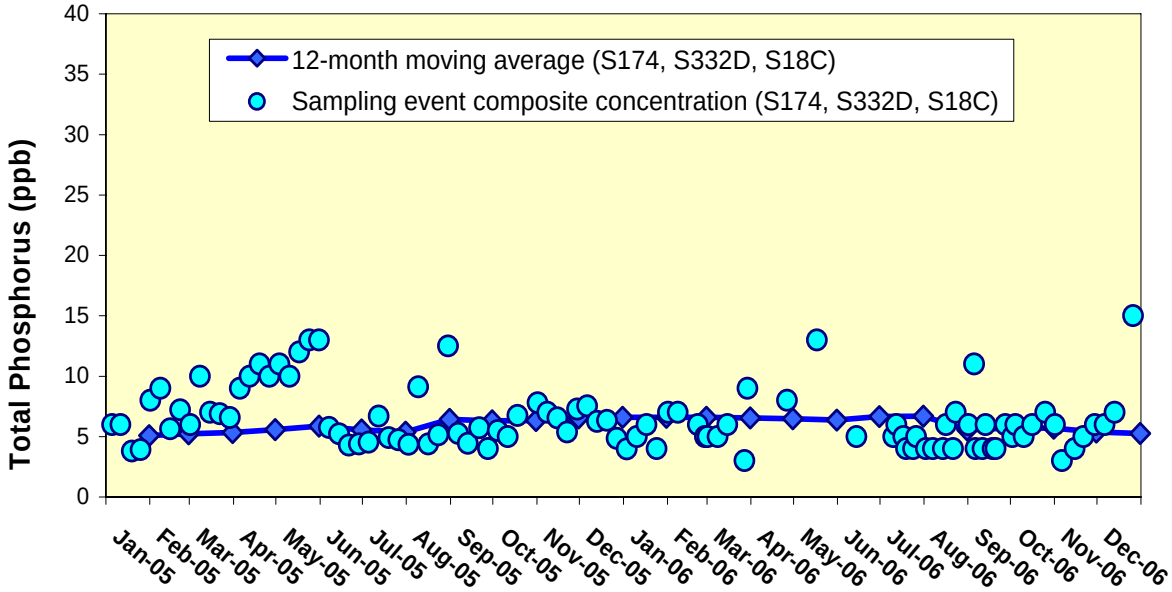

Figure 11. 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean TP concentration for each sampling event.

Table 3. Taylor Slough and the Coastal Basins TP Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Long Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
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
30-Apr-05	207.2	5.6	11.0	53.1	13.3
31-May-05	214.1	5.9	11.0	53.1	18.8
30-Jun-05	261.0	5.5	11.0	53.1	14.6
31-Jul-05	304.6	5.4	11.0	53.1	10.4
31-Aug-05	357.1	6.4	11.0	53.1	12.2
30-Sep-05	380.0	6.3	11.0	53.1	12.2
31-Oct-05	373.4	6.3	11.0	53.1	12.2
30-Nov-05	358.6	6.6	11.0	53.1	12.0
31-Dec-05	366.9	6.6	11.0	53.1	11.8
31-Jan-06	369.5	6.6	11.0	53.1	11.8
28-Feb-06	364.6	6.6	11.0	53.1	11.8
31-Mar-06	359.7	6.6	11.0	53.1	11.8
30-Apr-06	351.5	6.5	11.0	53.1	10.4
31-May-06	343.7	6.4	11.0	53.1	4.5
30-Jun-06	295.5	6.7	11.0	53.1	4.9
31-Jul-06	280.0	6.7	11.0	53.1	4.7
31-Aug-06	227.0	5.6	11.0	53.1	2.3
30-Sep-06	207.4	5.7	11.0	53.1	4.2
31-Oct-06	179.5	5.7	11.0	53.1	4.0
30-Nov-06	158.8	5.4	11.0	53.1	4.0
31-Dec-06	137.4	5.3	11.0	53.1	6.1

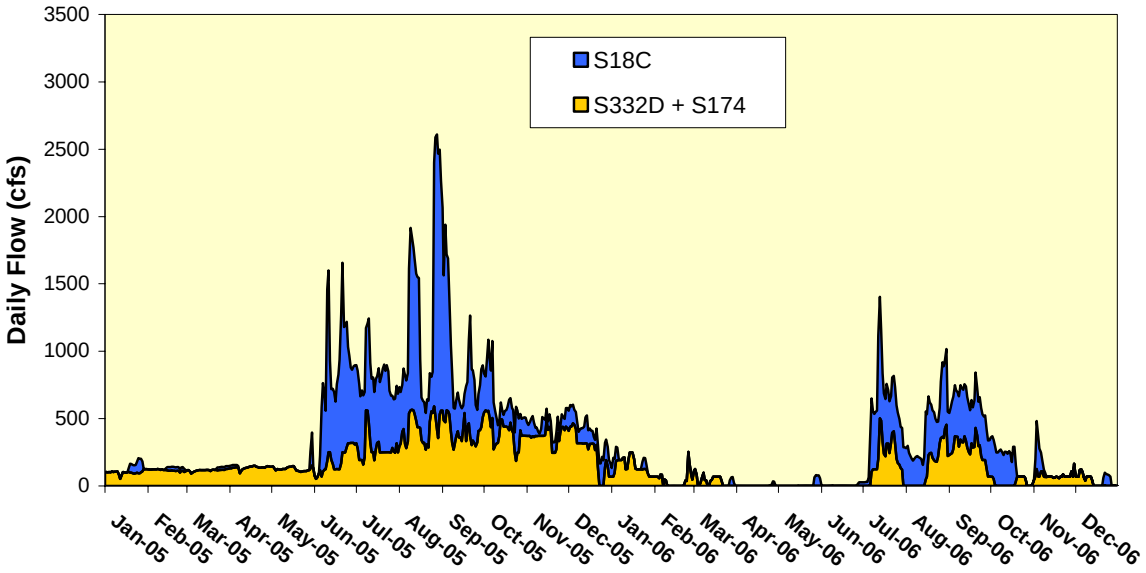

Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C.

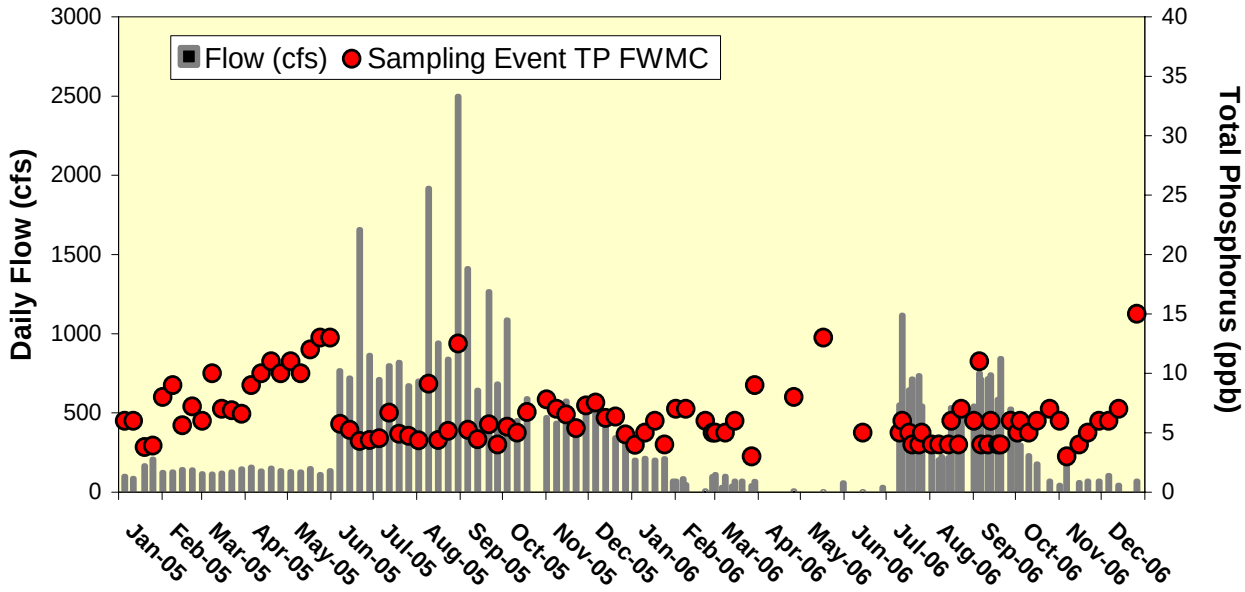

Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Settlement Agreement
January - March 2007 Report

Prepared for the
Technical Oversight Committee
May 16, 2007

Prepared by:
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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 total phosphorus (TP) concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by February 1, 1999, and December 31, 2006, respectively. Both the interim and long – term 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 in National Geodetic Vertical Datum of 1929 (NGVD29). The monthly TP 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 16.57, 16.34 and 16.10 feet in January, February and March 2007, respectively (**Figure 2** and **Table 1)**. Because the total depth was less than 0.1 meter (m), no water samples were collected at station LOX3 on February 5, 2007 and at stations LOX3, LOX5, LOX9, LOX10, on March 5, 2007. The geometric means, calculated from TP concentrations measured in water samples collected in January, February and March 2007 were 6.9, 6.2 and 7.3 ppb, respectively. The geometric means were less than the long-term levels for January, February and March 2007. The long – term levels (effective on December 31, 2006) were 9.3, 10.4 and 11.8 ppb, respectively.

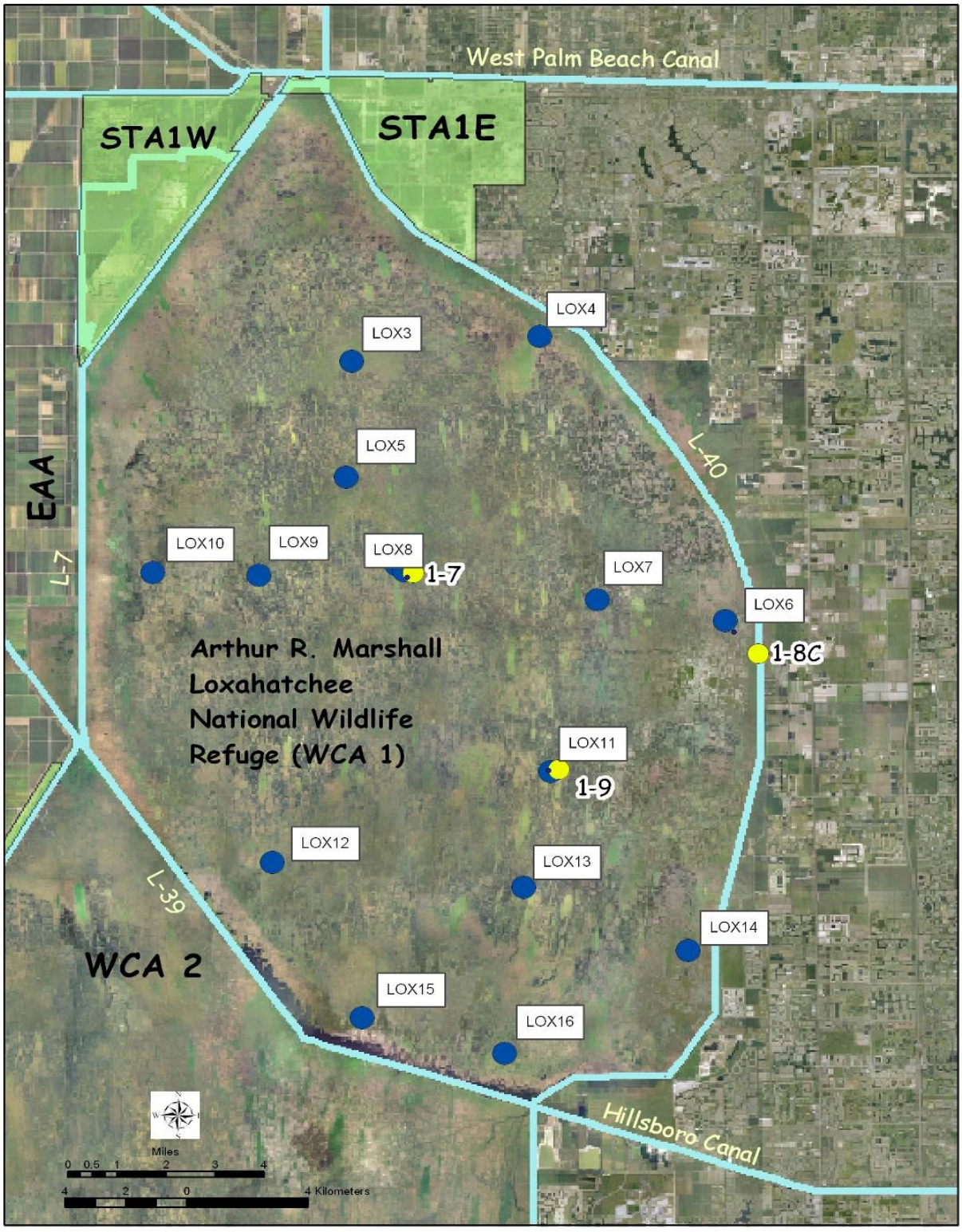

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

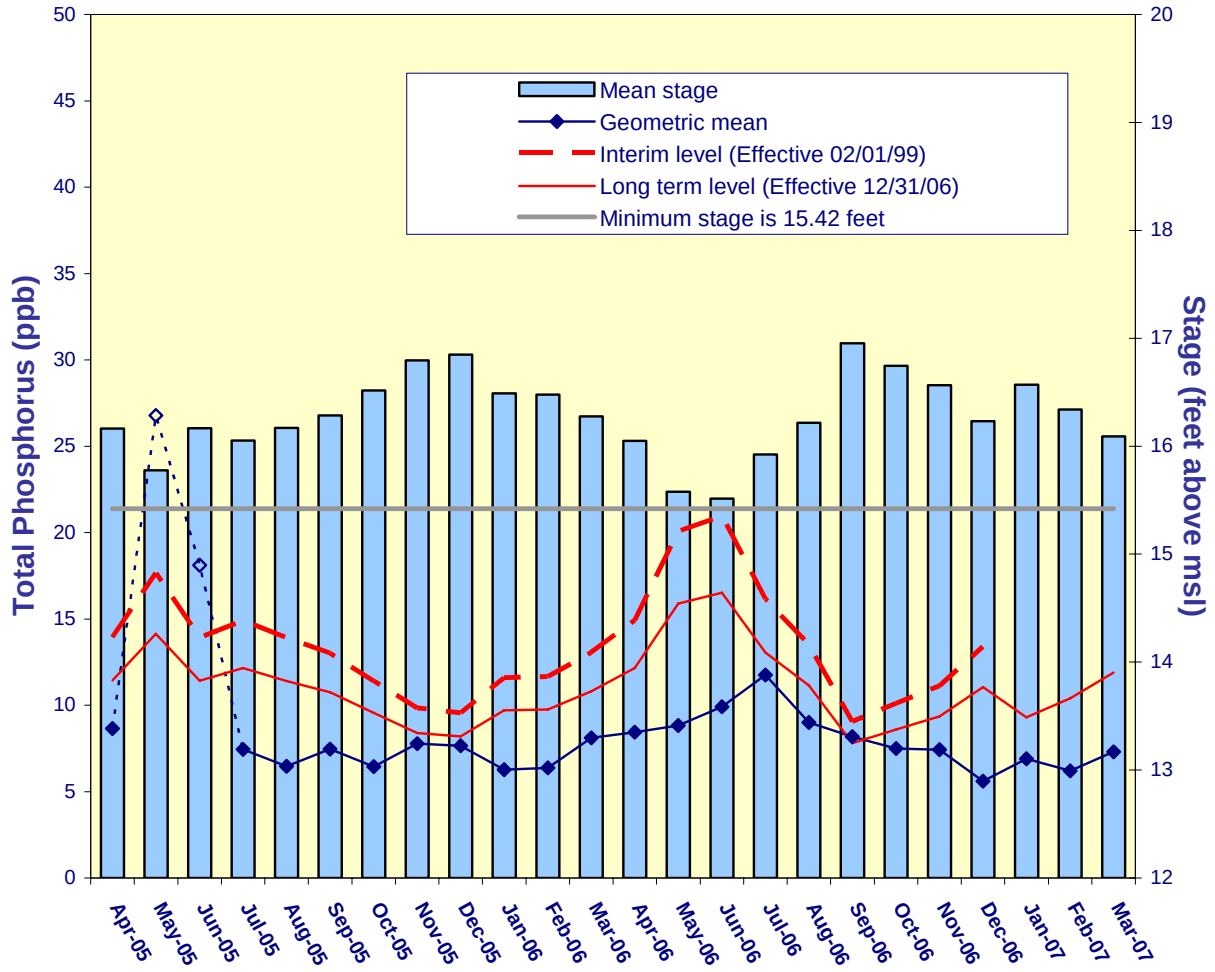

Figure 2. Monthly TP geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated level concentrations are adjusted for fluctuations in stage.

The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used. Geometric means for May and June 2005 are shown for reference only and were not considered for compliance purposes.

Table 1. Loxahatchee National Wildlife Refuge TP Compliance Tracking.

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage[a] (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
Apr-2005	8.6	13.9	11.4	16.17	11	3
May-2005[b]	(26.8)	17.7	14.1	15.78	(10)	3
Jun-2005[b]	(18.1)	13.9	11.4	16.17	(14)	3
Jul-2005	7.4	14.9	12.1	16.05	14	3
Aug-2005	6.5	13.9	11.4	16.17	12	3
Sep-2005	7.5	13.0	10.8	16.28	11	3
Oct-2005	6.5	11.4	9.6	16.52	13	3
Nov-2005	7.8	9.8	8.4	16.79	14	3
Dec-2005	7.6	9.6	8.2	16.85	14	3
Jan-2006	6.3	11.6	9.7	16.49	13	3
Feb-2006	6.4	11.7	9.8	16.48	13	3
Mar-2006	8.1	13.1	10.8	16.28	12	3
Apr-2006	8.4	14.9	12.2	16.05	12	3
May-2006	8.8	20.1	15.9	15.58	10	3
Jun-2006	9.9	21.0	16.5	15.51	5	3
Jul-2006	11.7	16.1	13.0	15.92	9	3
Aug-2006	9.0	13.5	11.1	16.22	11	3
Sep-2006	8.2	9.1	7.8	16.96	14	3
Oct-2006	7.5	10.1	8.6	16.74	14	3
Nov-2006	7.4	11.1	9.4	16.56	14	3
Dec-2006	5.6	13.4	11.0	16.23	11	3
Jan-2007	6.9	11.1	9.3	16.57	14	3
Feb-2007	6.2	12.6	10.4	16.34	13	3
Mar-2007	7.3	14.5	11.8	16.10	10	3

[a]Average stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 on the sampling date.
[b]The TP data from May and June 2005 have been qualified as questionable in accordance with Chapter 62-160 F.A.C. and should not be used.

EVERGLADES NATIONAL PARK

Shark River Slough

The Consent Decree of 1995 specified that interim and long-term total phosphorus (TP) concentration limits for discharges into the Everglades National Park (ENP) (**Figure 3**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the TP concentrations be presented as 12-month flow-weighted means. Only the TP concentrations for the water year ending September 30 are evaluated for compliance with the Consent Decree limits. The long-term TP 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 TP 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 2006 (**Figure 4**). The 12-month flow-weighted mean TP concentration ending September 2006 was 8.7 ppb. Corresponding interim and long-term limits were 10.3 and 8.8 ppb, respectively.

Table 2 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding interim and long-term TP concentration limits, calculated using the 12-month period flow. Only the bi-weekly compliance monitoring grab concentration data were used for the calculations. For the 12-month periods ending in January, February and March 2007, the 12-month flow-weighted mean TP concentrations were 10.7, 10.7 and 10.8 ppb, respectively. The long-term limits were 10.9, 10.9 and 10.8 ppb, respectively. The 12-month flow-weighted mean concentration was lower than the long-term limit for the month of January and February 2007 and equal to the long-term limit for the month of March 2007.

The Consent Decree stipulates that the percentage of flow-weighted mean TP 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 2007, the observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were 55.0, 52.4 and 57.1 percent, respectively. The observed percentage of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were lower than the guidelines for January and February 2007, and higher for March 2007 (**Table 2**). The 12-month flow-weighted mean concentrations and the flow-weighted mean concentrations for individual sampling events are presented in **Figure 5**.

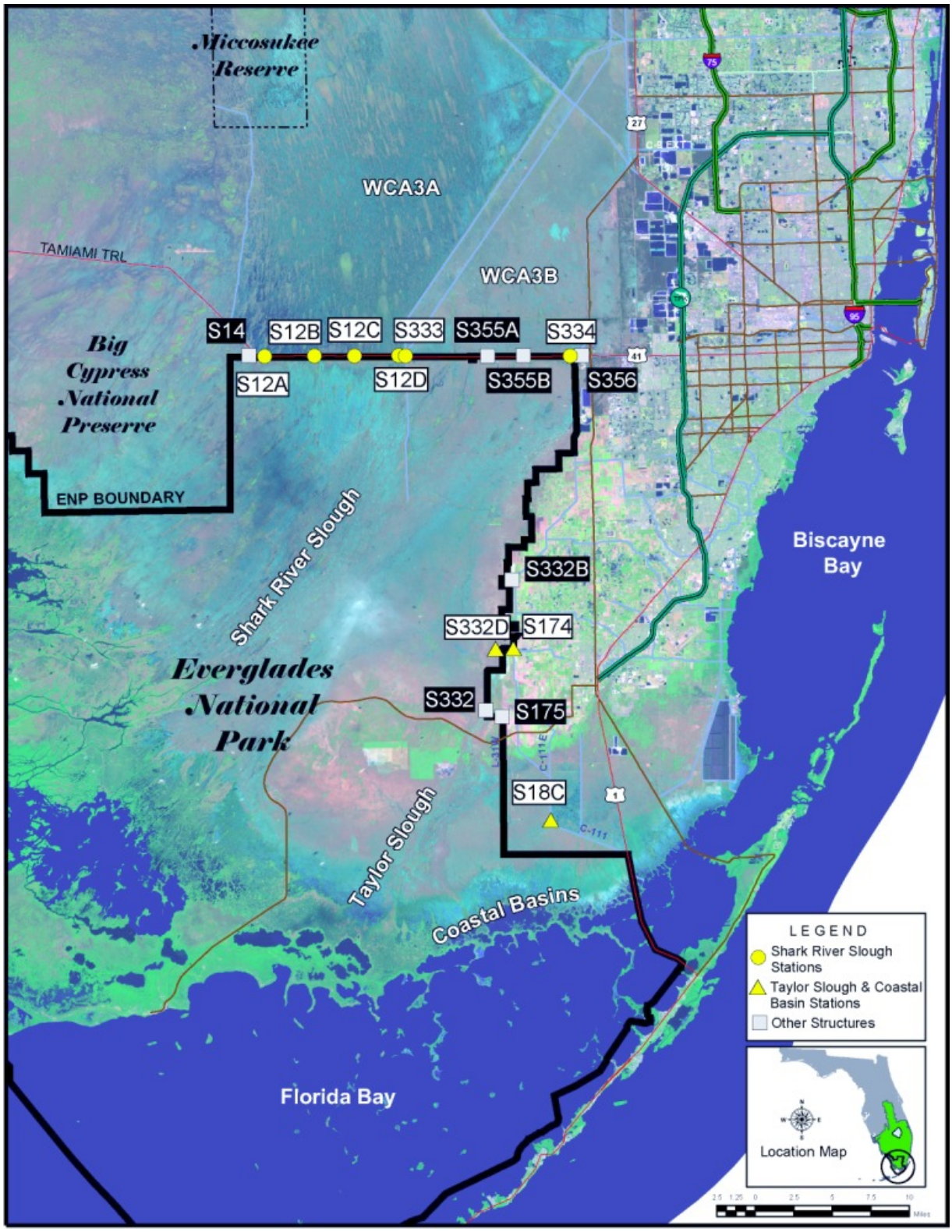

Figure 3. Everglades National Park flow structures

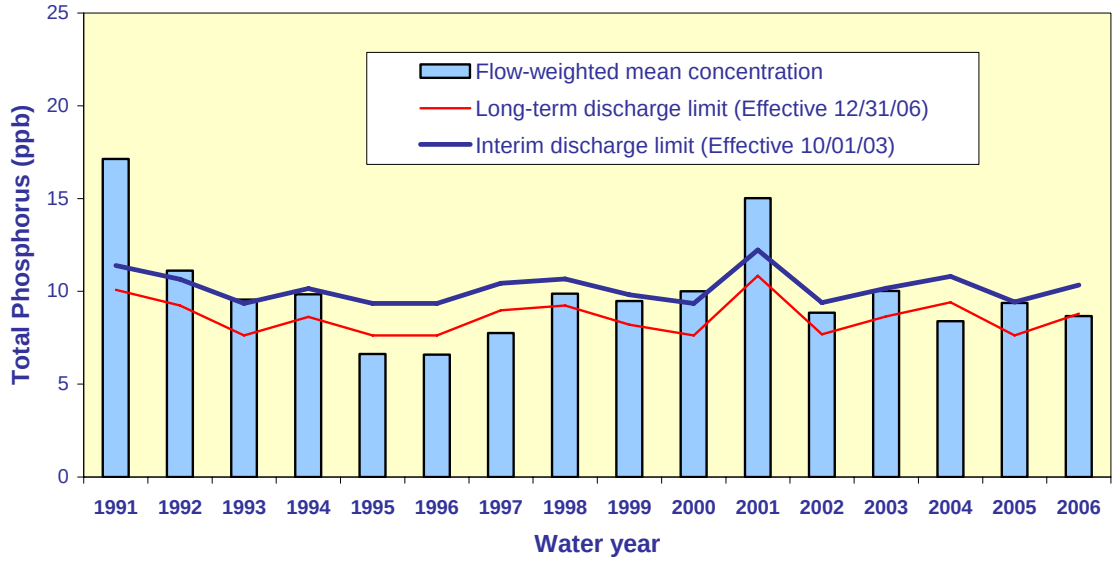

Figure 4. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the TP interim and long-term limits. For the third consecutive compliance year, the 12-month flow-weighted mean concentration was within the interim limits, which became effective on October 1, 2003.

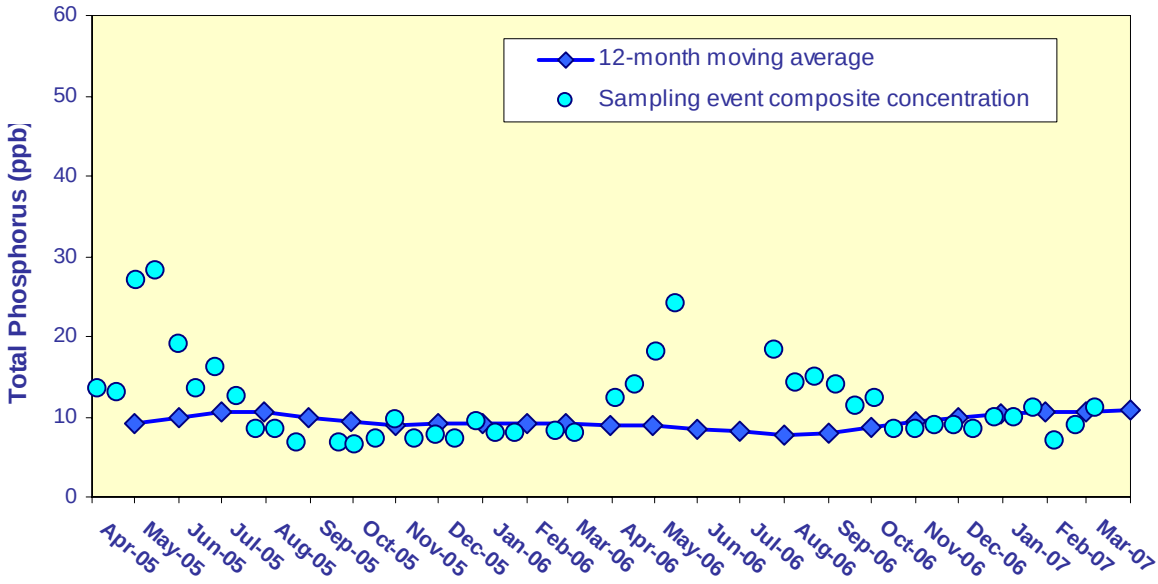

Figure 5. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for January 2005 and June 2006 because there was no flow in those months.

Table 2. Shark River Slough TP Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Interim Limit (ppb) Effective 10/1/2003	Long Term Limit (ppb) Effective 12/31/2006	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
30-Apr-05	732.6	9.1	10.7	9.3	48.2	46.7
31-May-05	767.1	10.0	10.5	9.1	47.3	***50.0***
30-Jun-05	836.0	10.5	10.2	8.7	45.4	***55.6***
31-Jul-05	1054.7	10.5	9.4	7.7	40.3	***55.0***
31-Aug-05	1269.2	9.8	9.4	7.6	40.1	***47.6***
30-Sep-05	**1345.9**	**9.4**	**9.4**	**7.6**	**40.1**	***42.9***
31-Oct-05	1338.1	9.0	9.4	7.6	40.1	***40.9***
30-Nov-05	1381.7	9.1	9.4	7.6	40.1	***42.9***
31-Dec-05	1447.6	9.1	9.4	7.6	40.1	***42.9***
31-Jan-06	1507.7	9.0	9.4	7.6	40.1	39.1
28-Feb-06[a]	1497.6	9.0	9.4	7.6	40.1	39.1
31-Mar-06[a]	1481.0	9.0	9.4	7.6	40.1	34.8
30-Apr-06[a]	1436.0	9.0	9.4	7.6	40.1	34.8
31-May-06[a]	1395.5	8.5	9.4	7.6	40.1	31.8
30-Jun-06[a]	1326.6	8.2	9.4	7.6	40.1	25.0
31-Jul-06[a]	1113.3	7.7	9.4	7.6	40.1	26.3
31-Aug-06[b]	914.7	8.1	9.9	8.3	43.5	36.8
30-Sep-06[b]	**814.0**	**8.7**	**10.3**	**8.8**	**46.0**	**45.0**
31-Oct-06[b]	779.6	9.5	10.5	9.0	46.9	***50.0***
30-Nov-06[b]	642.7	10.0	11.1	9.7	50.8	50.0
31-Dec-06[b]	507.9	10.3	11.8	10.5	55.0	50.0
31-Jan-07[b]	446.1	10.7	12.1	10.9	57.0	55.0
28-Feb-07[b]	444.2	10.7	12.1	10.9	57.1	52.4
31-Mar-07[b]	457.8	10.8	12.0	10.8	56.6	***57.1***

[a] *Flow of 1.82 kac-ft in February 2006 at S355A and S355B was included for the 12-month total flows.*
[b] *Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows in addition to the flow of 1.82 kac-ft in February 2006 at S355A and S355B structures.*

Notes: 1) Highlighted rows indicate the end of the water year (October 1- September 30), which are the compliance points.
2) Bold italicized values exceeded the guideline percentages.

Stage levels at Water Conservation Area (WCA) 3A have been below the regulation schedule since November 2006 and continued to decrease during the reporting quarter.

The daily flows through the individual Shark River Slough structures from October 2004 through September 2006 are presented in Figure 6. S12A, S12B and S12C were closed for the quarter in accordance with the Interim Operational Plan (IOP) for protection of the Cape Sable Seaside Sparrow. S12D was closed for the structure maintenance dredging during the reporting quarter. Only S333 was utilized to meet target discharges described in the Shark River Slough "Rain Driven Water Deliveries to Everglades National Park" which has been in effect since July 1985.

However, almost all of the flow in the L29 Canal that entered through through S333 was diverted to S334 in the first quarter (**Figure 7**) for water supply to Miami-Dade county urban areas during the drought.

For additional information on the S12s and S333 structures, please visit: http://www.sfwmd.gov/org/ema/reports/sharkriver/index.html .

A flow test of S355A (western structure) and S355B (eastern structure), which are located between S333 and S334 (**Figure 3**), was performed during February 2-20, 2006. The estimated daily mean flows were 32 cubic feet per second (cfs) at S355A and 19 cfs at S355B for a total of 1.82 kac-ft for the test period. The flow-weighted mean TP concentration taken on February 16, 2006, was 9 ppb.

Another flow test was performed at S356, which is along Tamiami Canal at S334 (**Figure 3**) during August 2-8, 2006. The flow rate was 120 - 250 cfs and a total of 3.33 kac-ft was discharged into L29 from the west side of S334. The average of all TP concentrations taken on July 18, 2006 and on August 14, 2006, was 13 ppb.

The flow of 1.82 kac-ft through S355A and S355B during the February 2006 flow test is included in the 12-month total flows in Table 2 since February 2006. The flow of 3.33 kac-ft through S356 during the August 2006 flow test is included in the 12-month total flows in Table 2 since August 2006. Including these TP loads and flow and re-calculating 12-month flow-weighted mean concentrations and limits did not change the values in the table for the reporting months.

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean TP concentrations for individual sampling events is presented in **Figure 8**. Values had been following the strong inverse relationship between flow and TP concentration for waters entering the ENP through Shark River Slough. However, the bi-weekly sampling event flow-weighted mean TP concentrations remained low at 11 ppb with low flows during this reporting period.

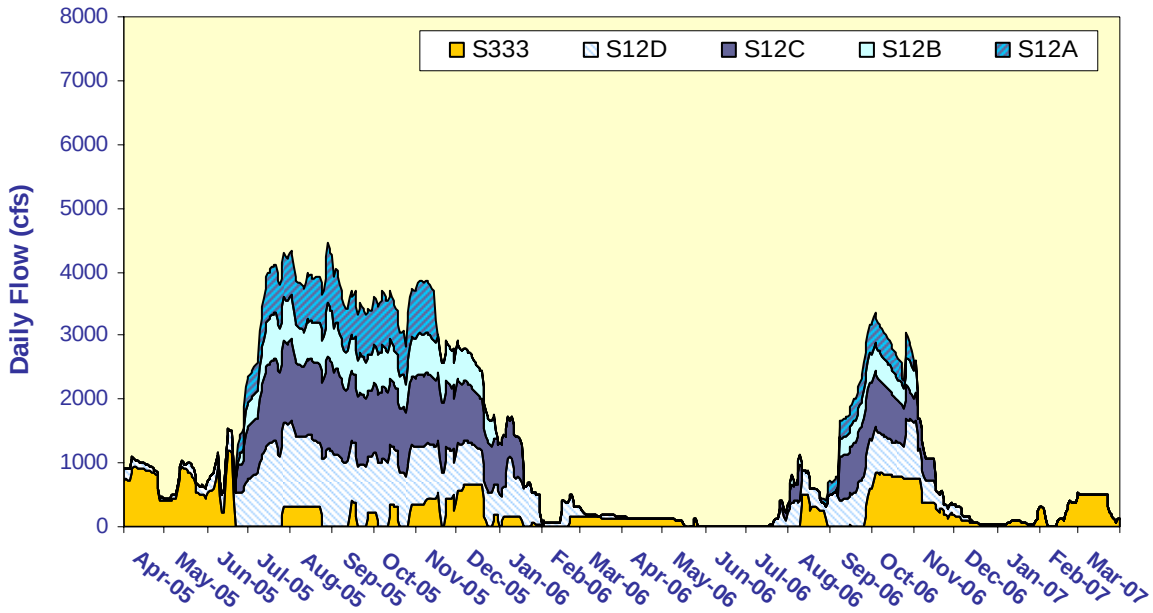

Figure 6. Daily flows into Shark River Slough by structure.

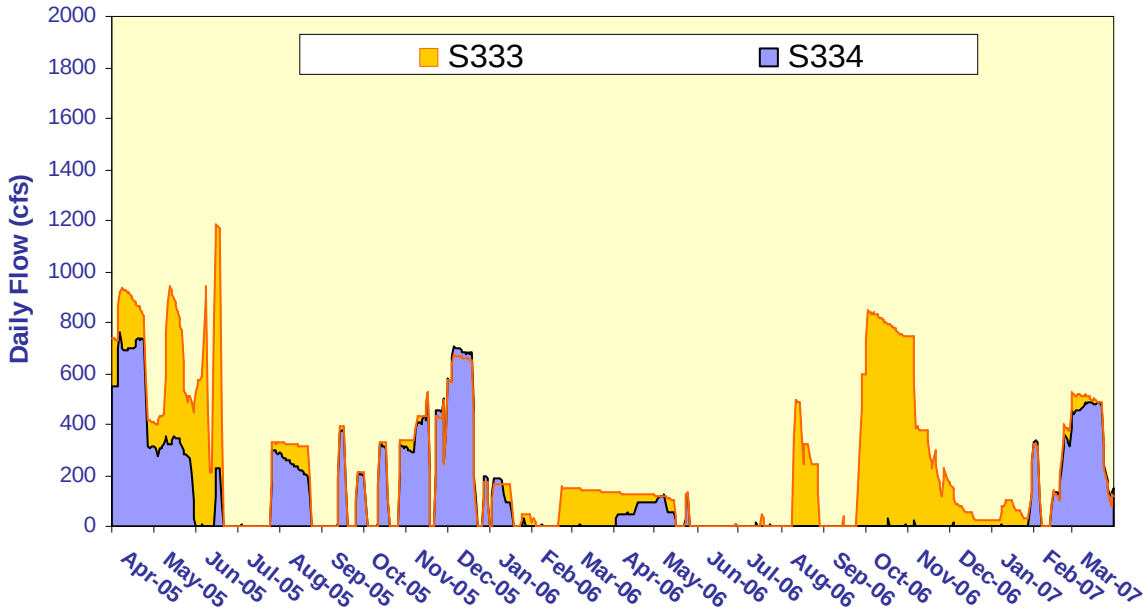

Figure 7. Daily flows comparison between S333 and S334

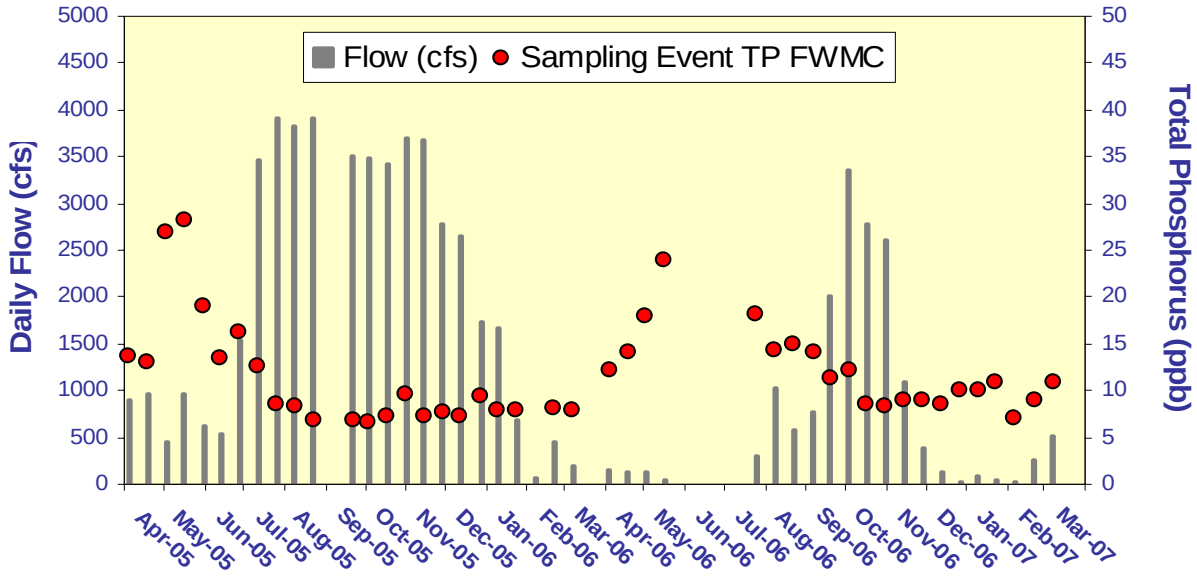

Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Taylor Slough and the Coastal Basins

Under the Consent Decree, a single total phosphorus (TP) 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 12-month flow-weighted mean concentrations have been lower than the long-term limit of 11 ppb.

C-111 Project Structures and Detention Areas

Beginning in August 1999, structure S332D, a 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, Cell 1 through Cell 5, a connector cell between Cell 2 and Cell 3, a flow way cell originating at Berm 3 of Cell 5, and four diversion structures, DS1 through DS4 (**Figure 9**). The flow way cell is the only location to routinely discharge surface water into 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 District started the routine sampling in September 2003.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. The diversion structures DS1 through DS4, previously referred to as EO1 through EO4, would discharge into the ENP if utilized. Overflows have periodically occurred at DS2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports.

Discharges from the diversion structures DS1 and DS3 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.

There were no overflows during the period from January 2007 through March 2007.

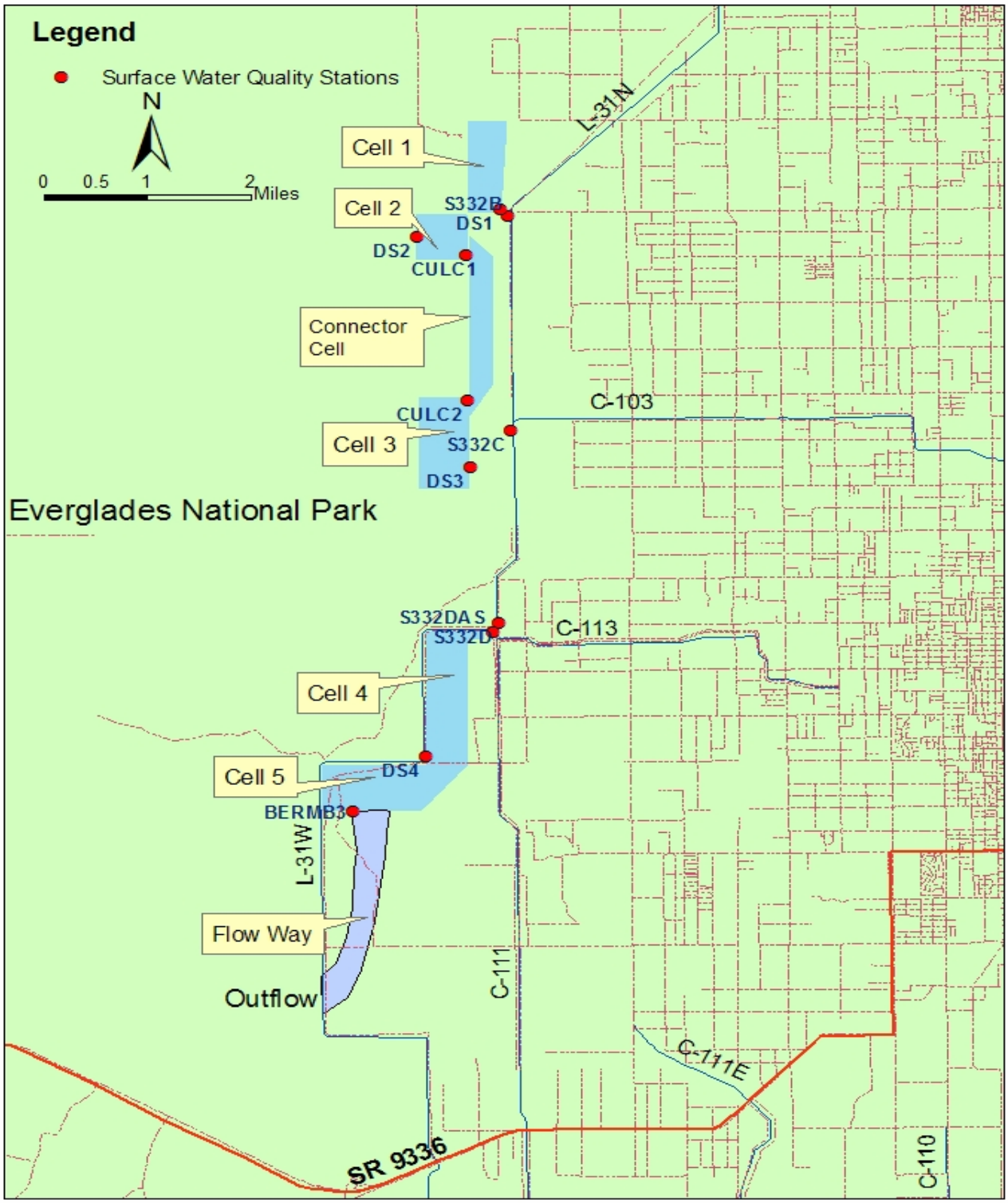

Figure 9. C-111 Project facilities.

Compliance with Consent Decree

Inflow TP concentrations to the ENP 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 10**). The bars in **Figure 10** represent the 12-month flow-weighted mean TP concentrations from S332, S175 and S18C for water years 1989 through 2002. The diamond point values for water years 1999 through 2006 represent the new combination of structures.

TP and flow data from both sets of structures presented in prior editions of this report through December 2001 (April 2002 report) showed that, beginning in 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 TP 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 10.**

Figure 11 presents the 12-month and individual sampling event flow-weighted mean TP concentrations at the S174, S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the 3 sites were used for the compliance calculations.

The 12-month flow-weighted mean concentration was 5.2 ppb, for the combined flow through S174, S332D and S18C for January, February and March 2007 (**Table 3**). The Consent Decree stipulates that the percent of flow-weighted mean TP 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 observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb for the combined flow through S174, S332D and S18C were 6.7, 7.0 and 10.0 percent for the periods ending January, February and March 2007.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 12**. There was very little flow (1.8 kac-ft) through the structures during the reporting period. **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event. From 1984 to 1990, there was no observable relationship between daily mean flow and flow-weighted mean TP concentrations at S332 and S18C structures. A few high concentration values for the area, such as 15 ppb on December 26, 2006, and 11 ppb on March 6, 2007, were observed during low flow periods in recent years.

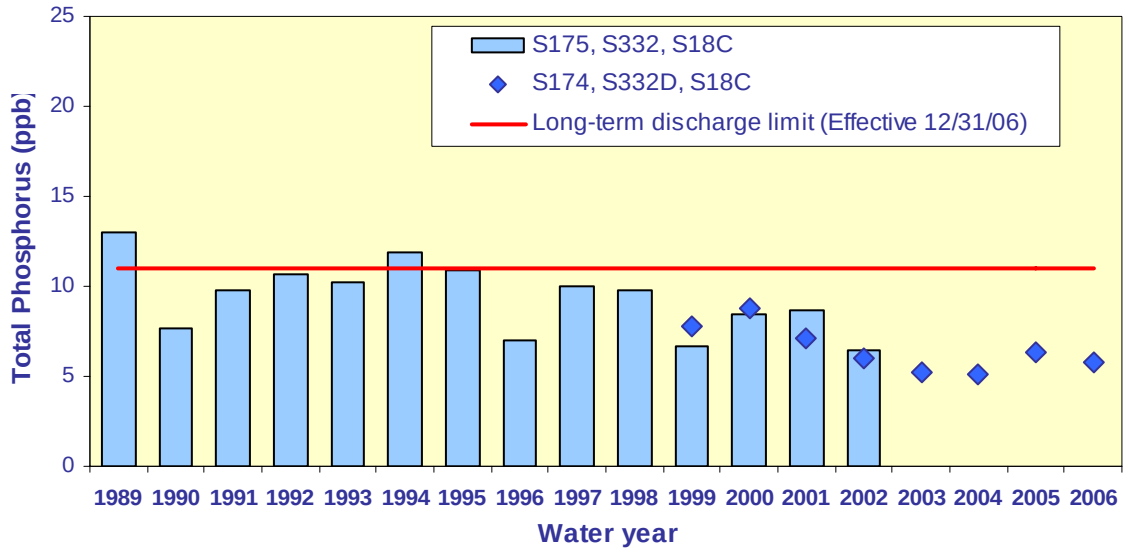

Figure 10. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term TP limit.

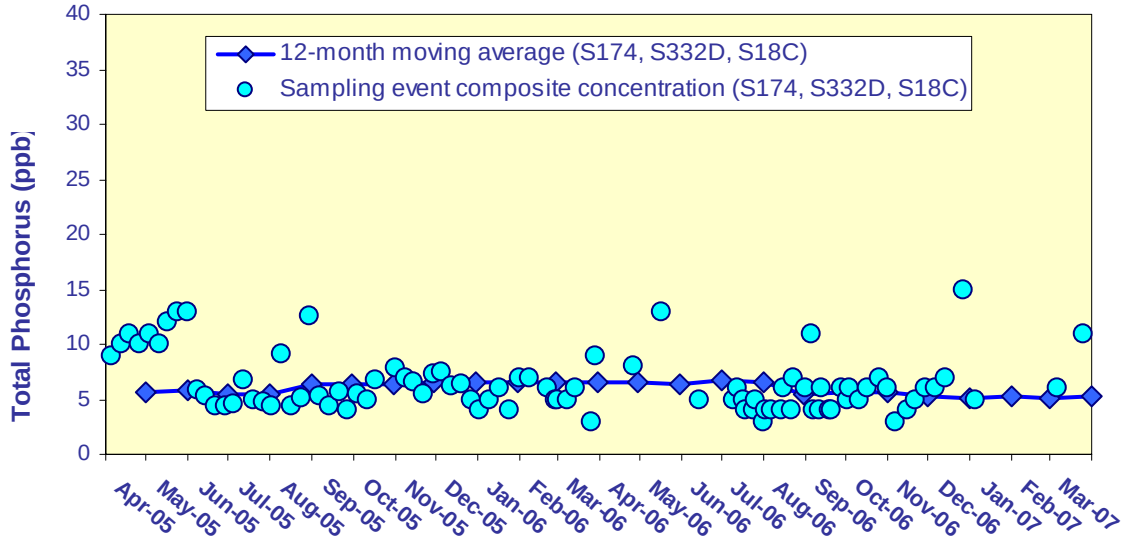

Figure 11. 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean TP concentration for each sampling event.

Table 3. Taylor Slough and the Coastal Basins TP Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Long Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
30-Apr-05	207.2	5.6	11.0	53.1	13.3
31-May-05	214.1	5.9	11.0	53.1	18.8
30-Jun-05	261.0	5.5	11.0	53.1	14.6
31-Jul-05	304.6	5.4	11.0	53.1	10.4
31-Aug-05	357.1	6.4	11.0	53.1	12.2
30-Sep-05	380.0	6.3	11.0	53.1	12.2
31-Oct-05	373.4	6.3	11.0	53.1	12.2
30-Nov-05	358.6	6.6	11.0	53.1	12.0
31-Dec-05	366.9	6.6	11.0	53.1	11.8
31-Jan-06	369.5	6.6	11.0	53.1	11.8
28-Feb-06	364.6	6.6	11.0	53.1	11.8
31-Mar-06	359.7	6.6	11.0	53.1	11.8
30-Apr-06	351.5	6.5	11.0	53.1	10.4
31-May-06	343.7	6.4	11.0	53.1	4.5
30-Jun-06	295.5	6.7	11.0	53.1	4.9
31-Jul-06	280.0	6.6[a]	11.0	53.1	4.5[a]
31-Aug-06	227.0	5.5[a]	11.0	53.1	2.2[a]
30-Sep-06	207.4	5.7	11.0	53.1	4.1[a]
31-Oct-06	179.5	5.6[a]	11.0	53.1	3.9[a]
30-Nov-06	158.8	5.3[a]	11.0	53.1	3.9[a]
31-Dec-06	137.4	5.2[a]	11.0	53.1	6.0[a]
31-Jan-07	127.6	5.2	11.0	53.1	6.4
28-Feb-07	125.4	5.2	11.0	53.1	7.0
31-Mar-07	123.8	5.2	11.0	53.1	10.0

[a]*The grab sample concentration (0.003 mg/L) for S18C on July 31, 2006, was erroneously flagged and has since been corrected. Removal of the erroneous flag slightly reduced the previously reported 12-month flow-weighted mean TP concentration and 12-month percentage of sampling events greater than 10 ppb.*

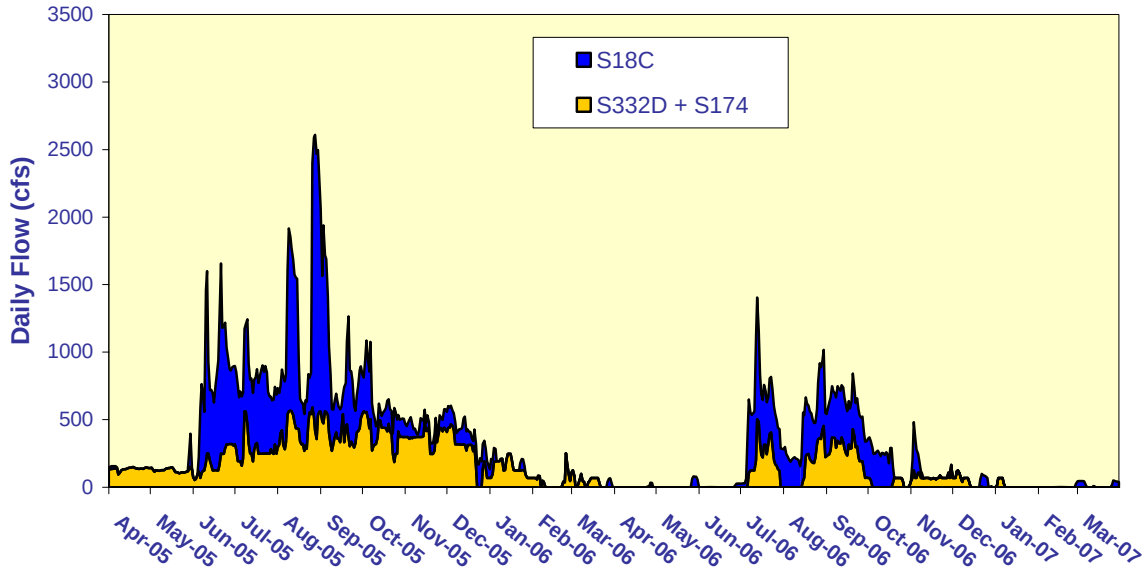

Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C.

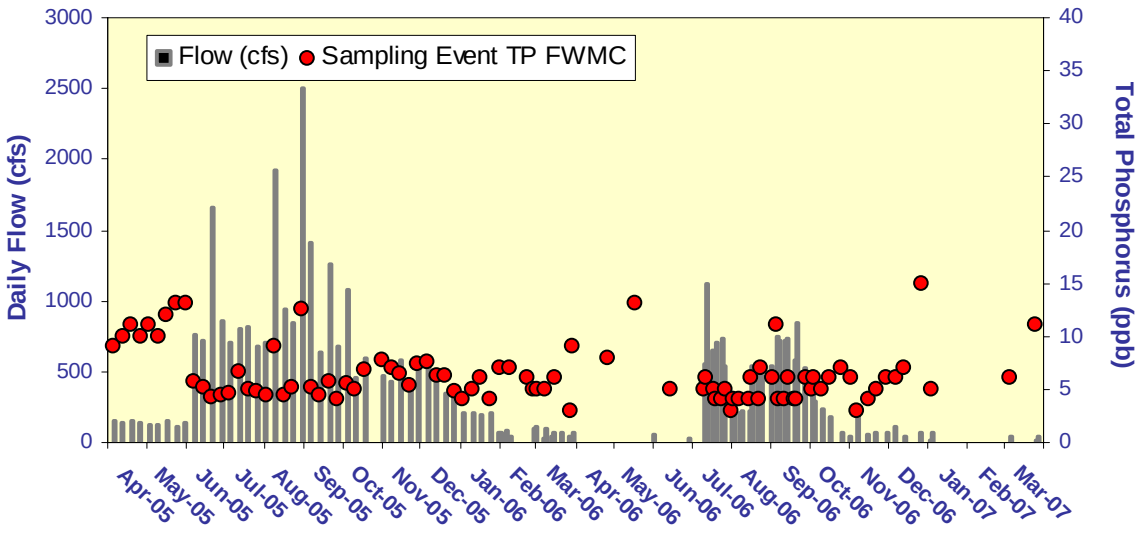

Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Settlement Agreement
April - June 2007 Report

Prepared for the
Technical Oversight Committee
August 21, 2007

Prepared by:
Cheol Mo, Violeta Ciuca and Pamela Lehr
Water Quality Assessment Division
South Florida Water Management District
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West Palm Beach, FL 33406

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 total phosphorus (TP) concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by February 1, 1999, and December 31, 2006, respectively. Both the interim and long – term 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 in National Geodetic Vertical Datum of 1929 (NGVD29). The monthly TP 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 15.30, 14.68 and 15.37 feet in April, May and June 2007, respectively (**Figure 2** and **Table 1**). Water samples were collected only at stations LOX11, LOX12, and LOX13 in April 2007 because total depth at all other stations was less than 0.1 meter. Only one sample (LOX12) was collected for the month of May 2007 but that sample was deemed not representative because the sampling site was an isolated pool. Water samples were collected only at stations LOX8, LOX11, LOX13, and LOX14 in June 2007 because total depth at all other stations was less than 0.1 meter. The geometric means, calculated from TP concentrations measured in water samples collected in April and June 2007 were 8.0 and 13.6 ppb, respectively. The levels were not applicable for April through June 2007 because the average stages were less than 15.42 feet.

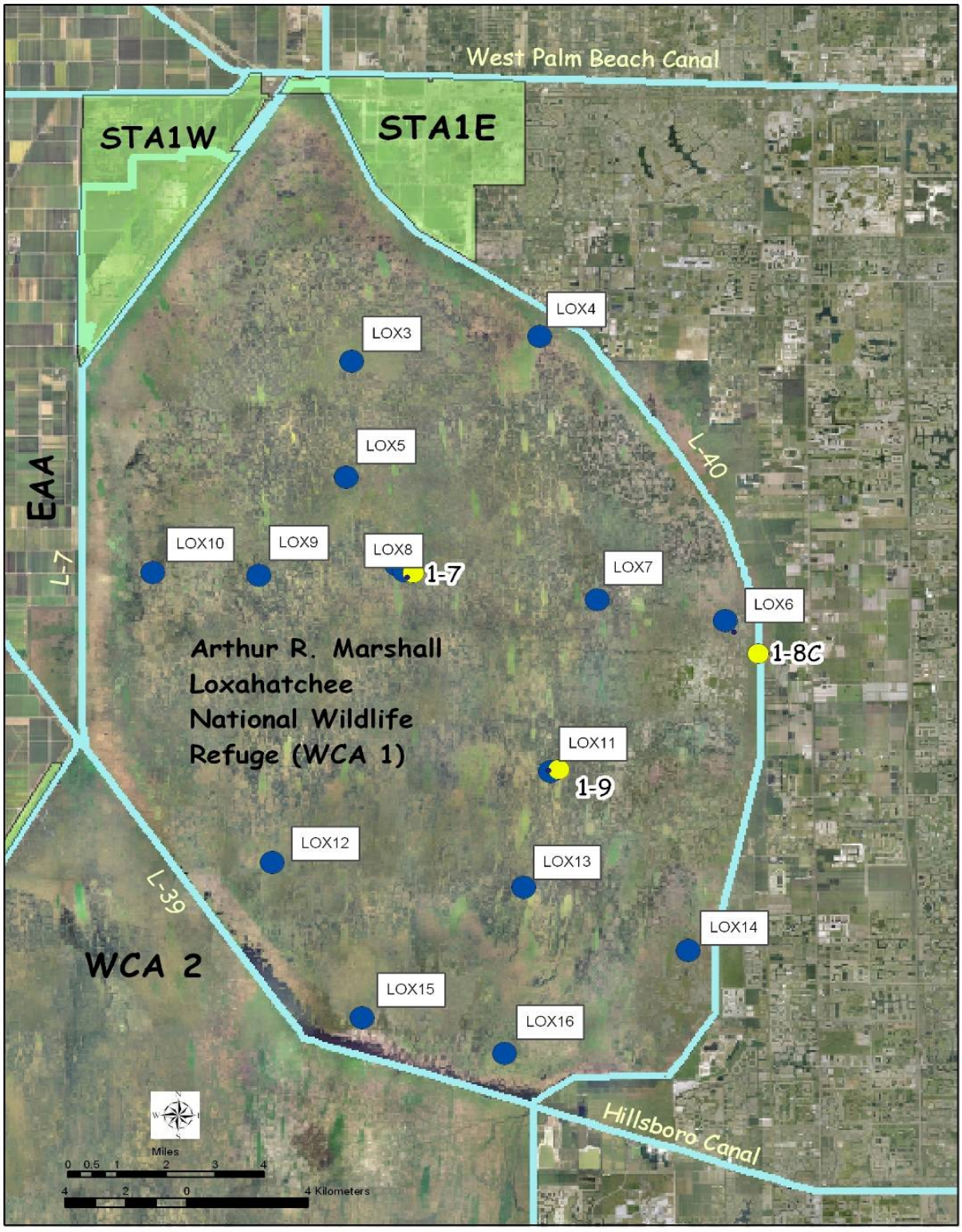

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

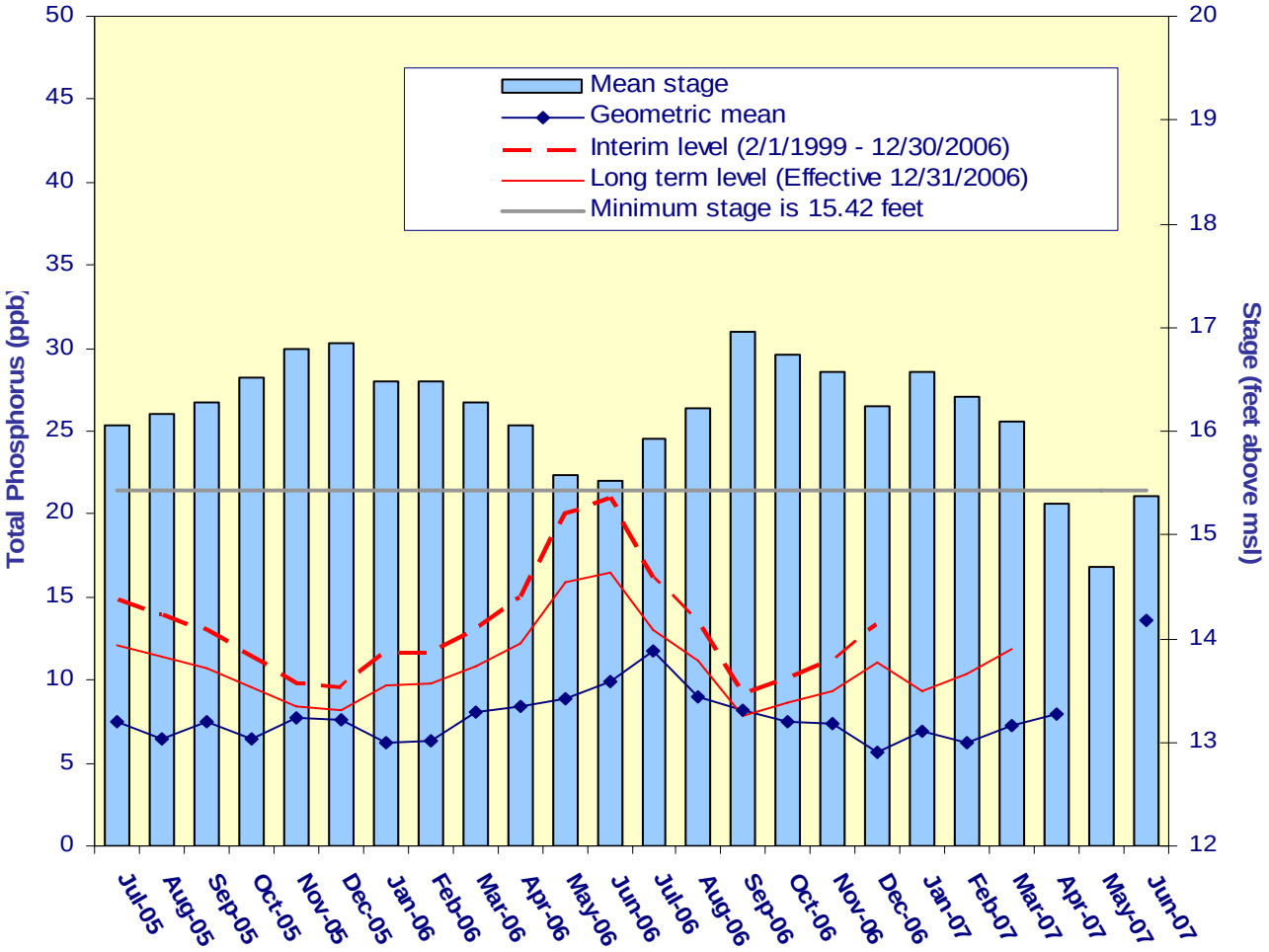

Figure 2. Monthly TP geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated concentration levels are adjusted for fluctuations in stage. The long term levels were not applicable for April through June 2007 because the average stages were less than 15.42 feet.

Table 1. Loxahatchee National Wildlife Refuge TP Compliance Tracking.

Month - Year	Geometric Mean Concentration (ppb)	Interim Level (ppb) Effective 2/1/99	Long Term Level (ppb) Effective 12/31/06	Average Stage[a] (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
Jul-2005	7.4	14.9	12.1	16.05	14	3
Aug-2005	6.5	13.9	11.4	16.17	12	3
Sep-2005	7.5	13.0	10.8	16.28	11	3
Oct-2005	6.5	11.4	9.6	16.52	13	3
Nov-2005	7.8	9.8	8.4	16.79	14	3
Dec-2005	7.6	9.6	8.2	16.85	14	3
Jan-2006	6.3	11.6	9.7	16.49	13	3
Feb-2006	6.4	11.7	9.8	16.48	13	3
Mar-2006	8.1	13.1	10.8	16.28	12	3
Apr-2006	8.4	14.9	12.2	16.05	12	3
May-2006	8.8	20.1	15.9	15.58	10	3
Jun-2006	9.9	21.0	16.5	15.51	5	3
Jul-2006	11.7	16.1	13.0	15.92	9	3
Aug-2006	9.0	13.5	11.1	16.22	11	3
Sep-2006	8.2	9.1	7.8	16.96	14	3
Oct-2006	7.5	10.1	8.6	16.74	14	3
Nov-2006	7.4	11.1	9.4	16.56	14	3
Dec-2006	5.6	13.4	11.0	16.23	11	3
Jan-2007	6.9	11.1	9.3	16.57	14	3
Feb-2007	6.2	12.6	10.4	16.34	13	3
Mar-2007	7.3	14.5	11.8	16.10	10	3
Apr-2007	8.0	N/A[b]	N/A[b]	15.30	3	3
May-2007	n/a	N/A[b]	N/A[b]	14.68	0	3
Jun-2007	13.6	N/A[b]	N/A[b]	15.37	4	3

[a] *Average stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 on the sampling date.*
[b] *N/A denotes that the level was 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 (TP) concentration limits for discharges into the Everglades National Park (ENP) (**Figure 3**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the TP concentrations be presented as 12-month flow-weighted means. Only the TP concentrations for the water year ending September 30 are evaluated for compliance with the Consent Decree limits. The long-term TP 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 TP 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 2006 (**Figure 4**). The 12-month flow-weighted mean TP concentration ending September 2006 was 8.7 ppb. Corresponding interim and long-term limits were 10.3 and 8.8 ppb, respectively.

Table 2 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding interim and long-term TP concentration limits, calculated using the 12-month period flow. Only the bi-weekly compliance monitoring grab concentration data were used for the calculations. For the 12-month periods ending in April, May and June 2007, the 12-month flow-weighted mean TP concentrations were 10.8, 10.7 and 10.8 ppb, respectively. The long-term limits were 10.8, 10.9 and 10.8 ppb, respectively. The 12-month flow-weighted mean concentration was lower than the long-term limit for the month of May 2007 and equal to the long-term limit for April and June 2007.

The Consent Decree stipulates that the percentage of flow-weighted mean TP 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 April, May and June TP concentrations greater than 10 ppb were 52.6, 47.1 and 50.0 percent, respectively. The observed percentage of the sampling event flow-weighted mean TP concentrations greater than 10 ppb was lower than the guidelines for April, May and June 2007 (**Table 2**). The 12-month flow-weighted mean concentrations and the flow-weighted mean concentrations for individual sampling events are presented in **Figure 5**.

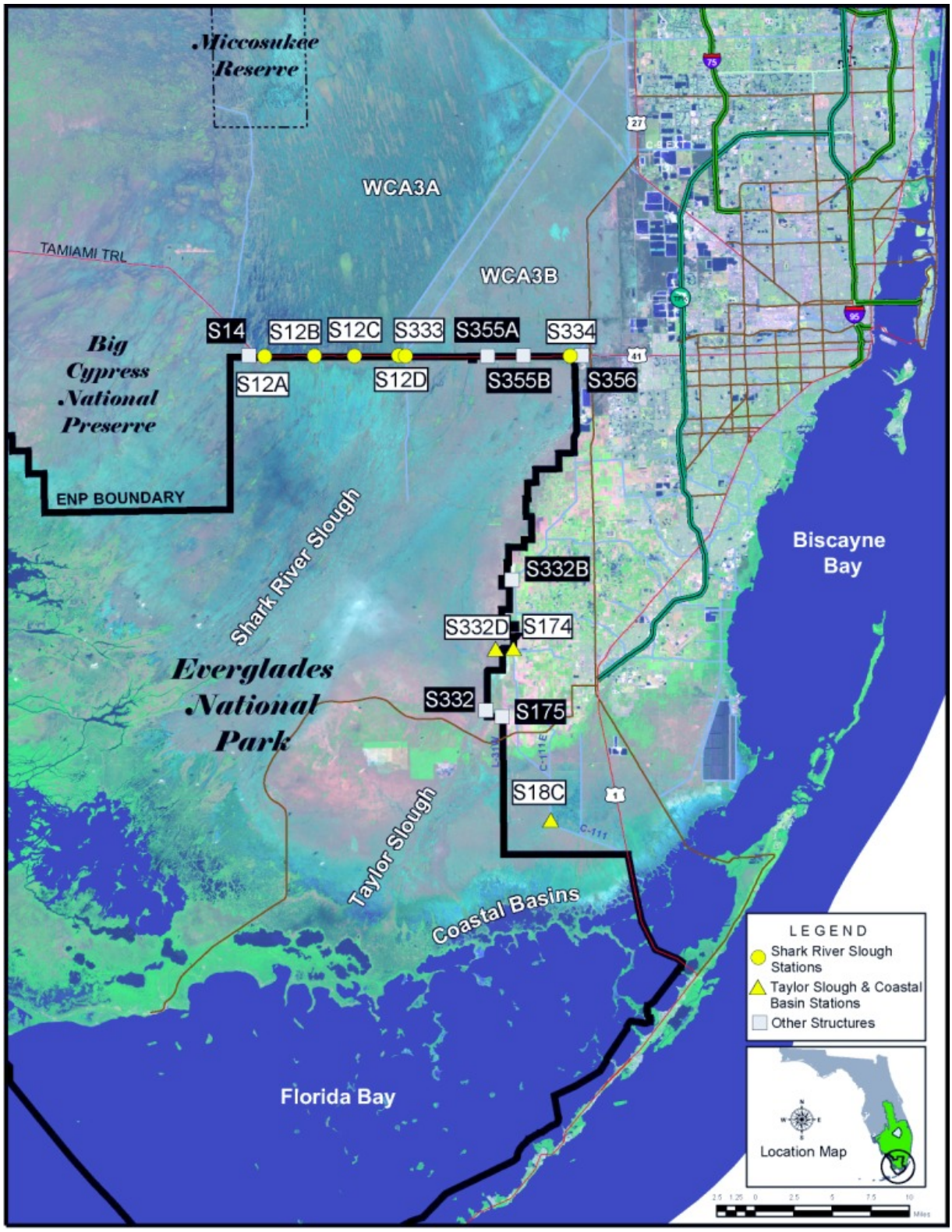

Figure 3. Everglades National Park flow structures

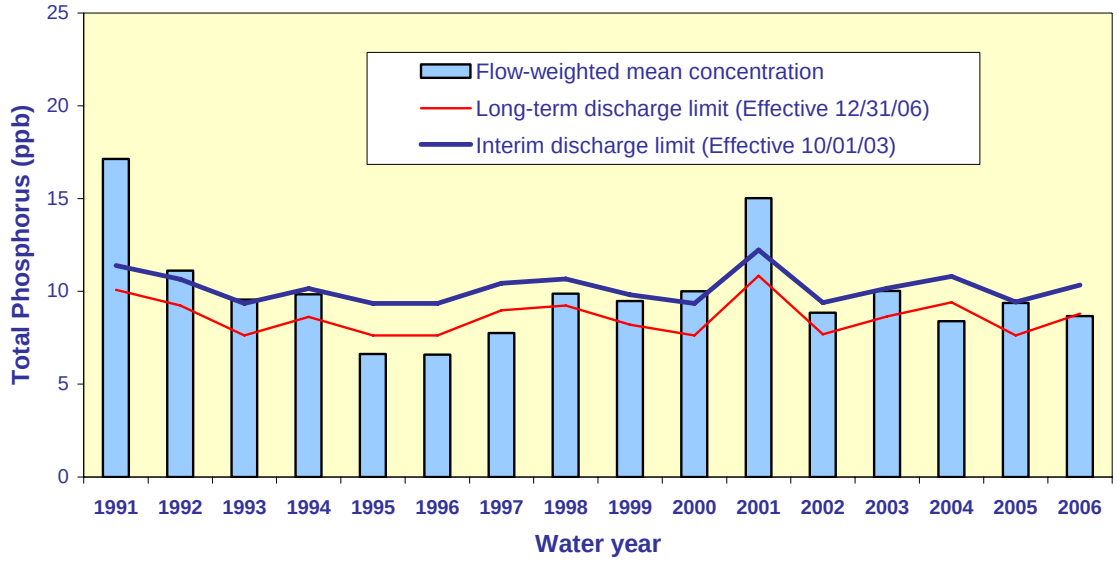

Figure 4. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the TP interim and long-term limits. For the third consecutive compliance year, the 12-month flow-weighted mean concentration was within the interim limits, which became effective on October 1, 2003.

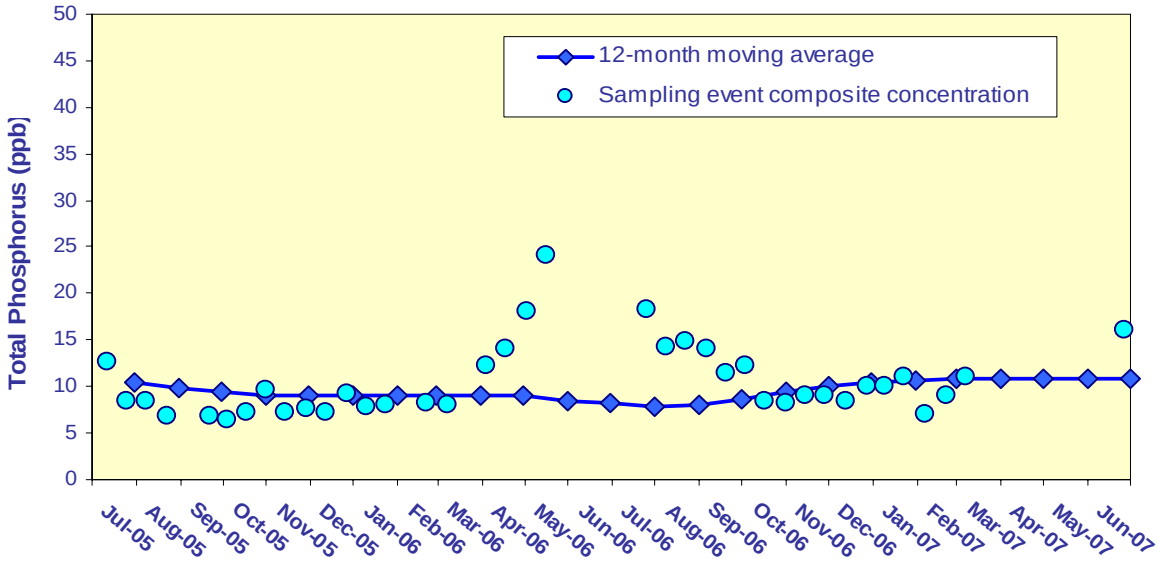

Figure 5. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for June 2006 and for April through mid June 2007 because there was little or no flow in those periods.

Table 2. Shark River Slough TP Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Interim Limit (ppb) Effective 10/1/2003	Long Term Limit (ppb) Effective 12/31/2006	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
31-Jul-05	1054.7	10.5	9.4	7.7	40.3	***55.0***
31-Aug-05	1269.2	9.8	9.4	7.6	40.1	***47.6***
30-Sep-05	**1345.9**	**9.4**	**9.4**	**7.6**	**40.1**	***42.9***
31-Oct-05	1338.1	9.0	9.4	7.6	40.1	***40.9***
30-Nov-05	1381.7	9.1	9.4	7.6	40.1	***42.9***
31-Dec-05	1447.6	9.1	9.4	7.6	40.1	***42.9***
31-Jan-06	1507.7	9.1	9.4	7.6	40.1	39.1
28-Feb-06[a]	1497.6	9.0	9.4	7.6	40.1	39.1
31-Mar-06[a]	1481.0	9.0	9.4	7.6	40.1	34.8
30-Apr-06[a]	1436.1	9.0	9.4	7.6	40.1	34.8
31-May-06[a]	1395.5	8.5	9.4	7.6	40.1	31.8
30-Jun-06[a]	1326.6	8.2	9.4	7.6	40.1	25.0
31-Jul-06[a]	1113.3	7.7	9.4	7.6	40.1	26.3
31-Aug-06[b]	914.7	8.1	9.9	8.3	43.5	36.8
30-Sep-06[b]	**814.1**	**8.7**	**10.3**	**8.8**	**46.0**	**45.0**
31-Oct-06[b]	779.6	9.5	10.5	9.0	46.9	***50.0***
30-Nov-06[b]	642.8	10.0	11.1	9.7	50.8	50.0
31-Dec-06[b]	507.9	10.3	11.8	10.5	55.0	50.0
31-Jan-07[b]	446.1	10.7	12.1	10.9	57.0	55.0
28-Feb-07[c]	442.4	10.8	12.1	10.9	57.2	52.4
31-Mar-07[c]	456.0	10.8	12.0	10.8	56.7	***57.1***
30-Apr-07[c]	449.5	10.8	12.1	10.8	56.9	52.6
31-May-07[c]	445.5	10.7	12.1	10.9	57.1	47.1
30-Jun-07[c]	447.6	10.8	12.1	10.8	57.0	50.0

[a] *Flow of 1.82 kac-ft in February 2006 at S355A and S355B was included for the 12-month total flows.*
[b] *Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows in addition to the flow of 1.82 kac-ft in February 2006 at S355A and S355B structures.*
[c] *Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows.*

Notes: 1) Highlighted rows indicate the end of the water year (October 1- September 30), which are the compliance points.
2) Bold italicized values exceeded the guideline percentages.

Stage levels at Water Conservation Area (WCA) 3A have been below the regulation schedule since November 2006 and remained below the regulation through the reporting quarter.

The daily flows through the individual Shark River Slough structures from July 2005 through June 2007 are presented in **Figure 6**. S12A, S12B and S12C were closed for the quarter in accordance with the Interim Operational Plan (IOP) for protection of the Cape Sable Seaside Sparrow. S12D had been closed for the structure maintenance dredging but that work was substantially finished on June 5, 2007. S12D started to be utilized on June 20, 2007.

S12D and S333 were utilized to meet target discharges described in the Shark River Slough "Rain Driven Water Deliveries to Everglades National Park" which has been in effect since July 1985. However, there was little flow in the system during the period except for 1.27 kac-ft in early April and 2.59 kac-ft in late June 2007. None of this flow in the L29 Canal that entered through S333 was diverted to S334 in the second quarter of 2007 (**Figure 7**).

For additional information on the S12s and S333 structures, please visit: http://www.sfwmd.gov/org/ema/reports/sharkriver/index.html .

The flow and loads through S355A and S355B during the February 2006 flow test is included in the 12-month total flows since February 2006 through January 2007 calculations in **Table 2**. The flow of 3.33 kac-ft through S356 during the August 2006 flow test is included in the 12-month total flows in **Table 2** since August 2006. Including these TP loads and flow for the 12-month flow-weighted mean concentration calculations did not change the values. However, including this flow for the limit calculations lowered the long term limits for the 12-month period ending April 2007 and June 2007 from 10.9 ppb to 10.8 ppb.

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean TP concentrations for individual sampling events is presented in **Figure 8**. Values had been following the strong inverse relationship between flow and TP concentration for waters entering the ENP through Shark River Slough. However, only one sampling event flow-weighted mean concentration taken on June 26, 2007 (16 ppb) was available the reporting period due to the low or no flow at the sites.

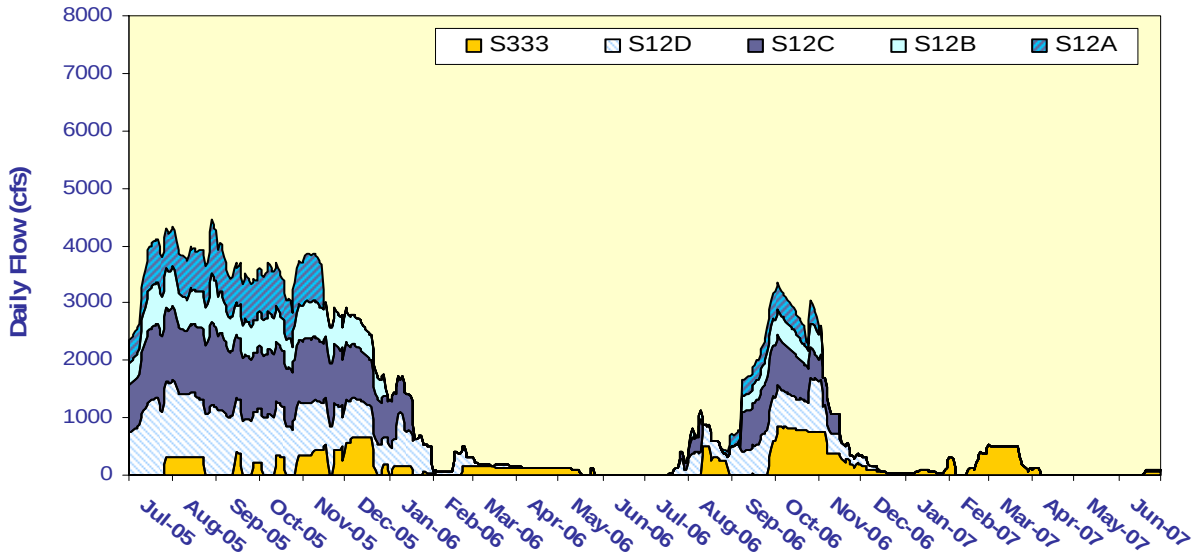

Figure 6. Daily flows into Shark River Slough by structure.

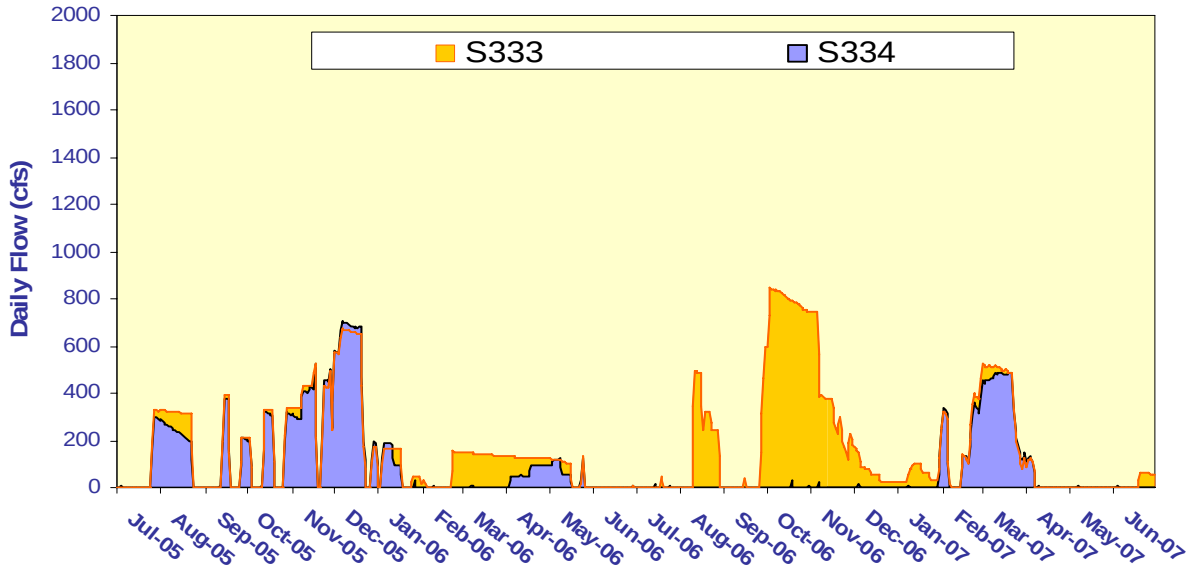

Figure 7. Daily flows comparison between S333 and S334

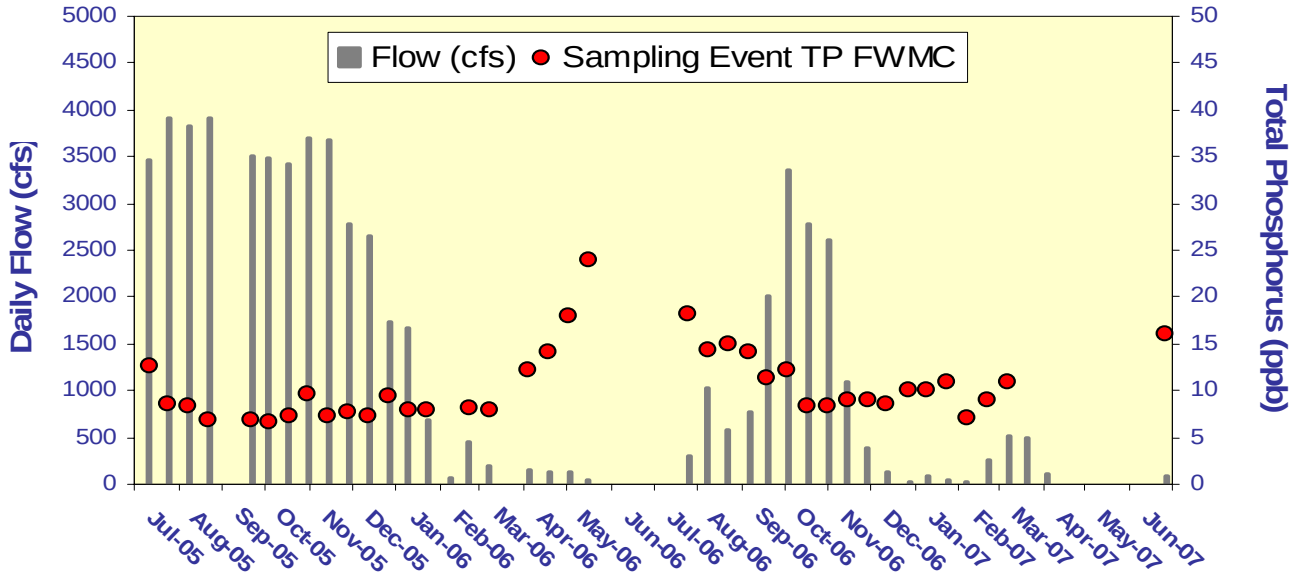

Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Taylor Slough and the Coastal Basins

Under the Consent Decree, a single total phosphorus (TP) 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 12-month flow-weighted mean concentrations have been lower than the long-term limit of 11 ppb.

C-111 Project Structures and Detention Areas

Beginning in August 1999, structure S332D, a 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, Cell 1 through Cell 5, a connector cell between Cell 2 and Cell 3, a flow way cell originating at Berm 3 of Cell 5, and four diversion structures, DS1 through DS4 (**Figure 9**). The flow way cell is the only location to routinely discharge surface water into 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 District started the routine sampling in September 2003.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. The diversion structures DS1 through DS4, previously referred to as EO1 through EO4, would discharge into the ENP if utilized. Overflows have periodically occurred at DS2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports.

Discharges from the diversion structures DS1 and DS3 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.

S332B pumped 2.17 kac-ft to Cell 1 (North Pond) and 2.27 kac-ft to Cell 2 (West Pond) in June 2007 but there were no overflows during the reporting period.

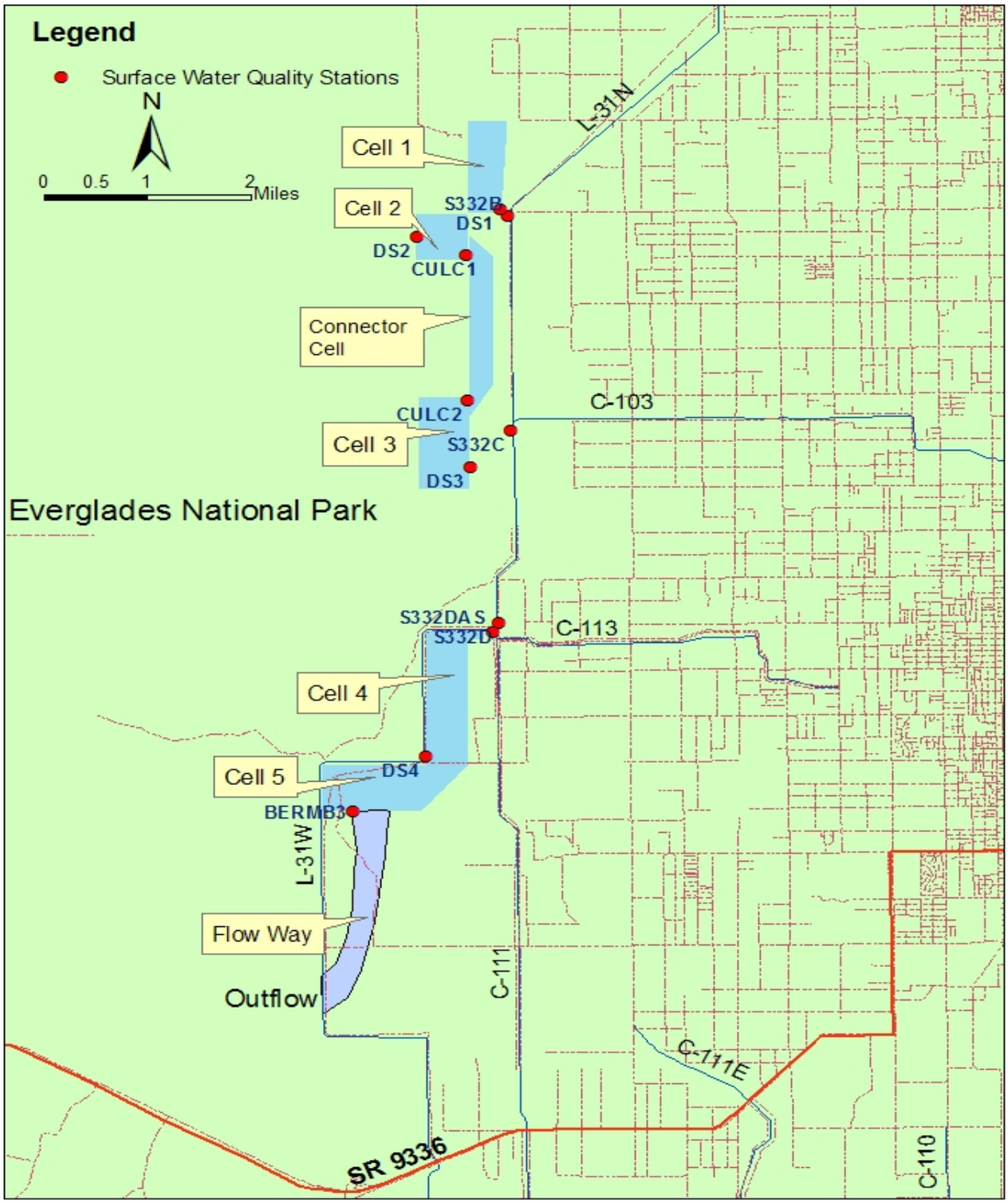

Figure 9. C-111 Project facilities.

Compliance with Consent Decree

Inflow TP concentrations to the ENP 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 10**). The bars in **Figure 10** represent the 12-month flow-weighted mean TP concentrations from S332, S175 and S18C for water years 1989 through 2002. The diamond point values for water years 1999 through 2006 represent the new combination of structures.

TP and flow data from both sets of structures presented in prior editions of this report through December 2001 (April 2002 report) showed that, beginning in 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 TP 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 10.**

Figure 11 presents the 12-month and individual sampling event flow-weighted mean TP concentrations at the S174, S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the 3 sites were used for the compliance calculations.

The 12-month flow-weighted mean concentration was 5.2 ppb for April and May 2007 and 5.1 ppb for June 2007 respectively, for the combined flow through S174, S332D and S18C for April, May and June 2007 (**Table 3**). The Consent Decree stipulates that the percent of flow-weighted mean TP 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 observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb for the combined flow through S174, S332D and S18C were 10.0, 7.5 and 6.5 percent for the periods ending April, May and June 2007, repectively.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 12**. **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event. From 1984 to 1990, there was no observable relationship between daily mean flow and flow-weighted mean TP concentrations at S332 and S18C structures. A few high concentration values for the area, such as 15 ppb on December 26, 2006, and 11 ppb on March 6, 2007, were observed during low flow periods in recent years. However, the flow-weighted mean concentrations remained very low, 4 to 7 ppb, during the reporting period.

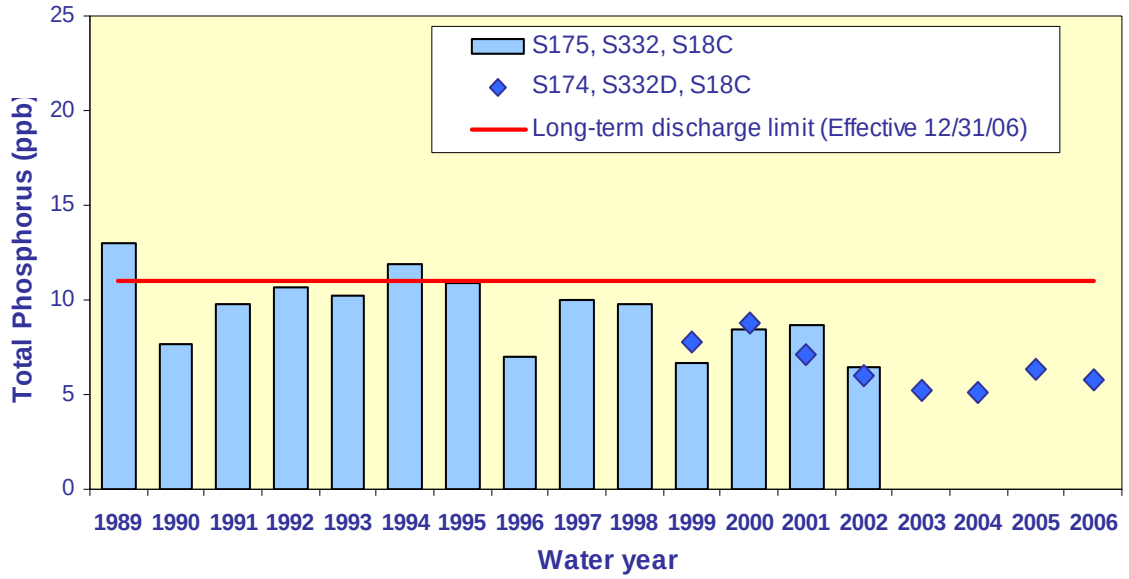

Figure 10. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term TP limit.

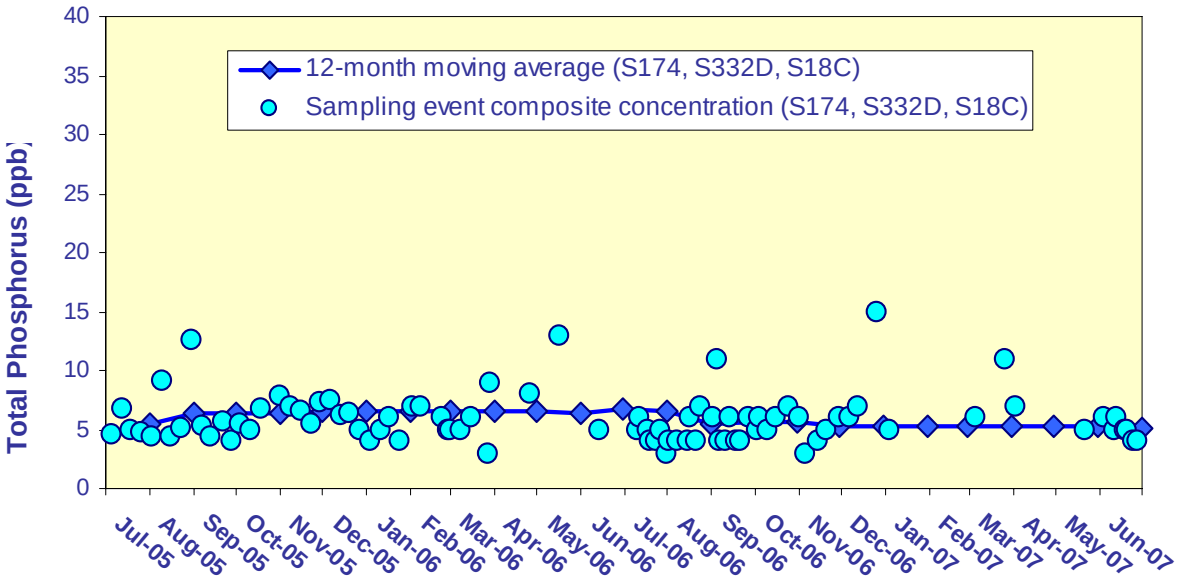

Figure 11. 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean TP concentration for each sampling event.

Table 3. Taylor Slough and the Coastal Basins TP Concentration Compliance Tracking.

12-Month Period Ending On	Total Period Flow (kac-ft)	Flow Weighted Mean Total Phosphorus (ppb)	Long Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
31-Jul-05	304.6	5.4	11.0	53.1	10.4
31-Aug-05	357.1	6.4	11.0	53.1	12.2
30-Sep-05	380.0	6.3	11.0	53.1	12.2
31-Oct-05	373.4	6.3	11.0	53.1	12.2
30-Nov-05	358.6	6.6	11.0	53.1	12.0
31-Dec-05	366.9	6.6	11.0	53.1	11.8
31-Jan-06	369.5	6.6	11.0	53.1	11.8
28-Feb-06	364.6	6.6	11.0	53.1	11.8
31-Mar-06	359.7	6.6	11.0	53.1	11.8
30-Apr-06	351.5	6.5	11.0	53.1	10.4
31-May-06	343.7	6.4	11.0	53.1	4.5
30-Jun-06	295.5	6.7	11.0	53.1	4.9
31-Jul-06	280.0	6.6	11.0	53.1	4.5
31-Aug-06	227.0	5.5	11.0	53.1	2.2
30-Sep-06	207.4	5.7	11.0	53.1	4.1
31-Oct-06	179.5	5.6	11.0	53.1	3.9
30-Nov-06	158.8	5.3	11.0	53.1	3.9
31-Dec-06	137.4	5.2	11.0	53.1	6.0
31-Jan-07	127.6	5.2	11.0	53.1	6.4
28-Feb-07	125.4	5.2	11.0	53.1	7.0
31-Mar-07	123.8	5.2	11.0	53.1	10.0
30-Apr-07	125.4	5.2	11.0	53.1	10.0
31-May-07	126.1	5.2	11.0	53.1	7.5
30-Jun-07	153.0	5.1	11.0	53.1	6.5

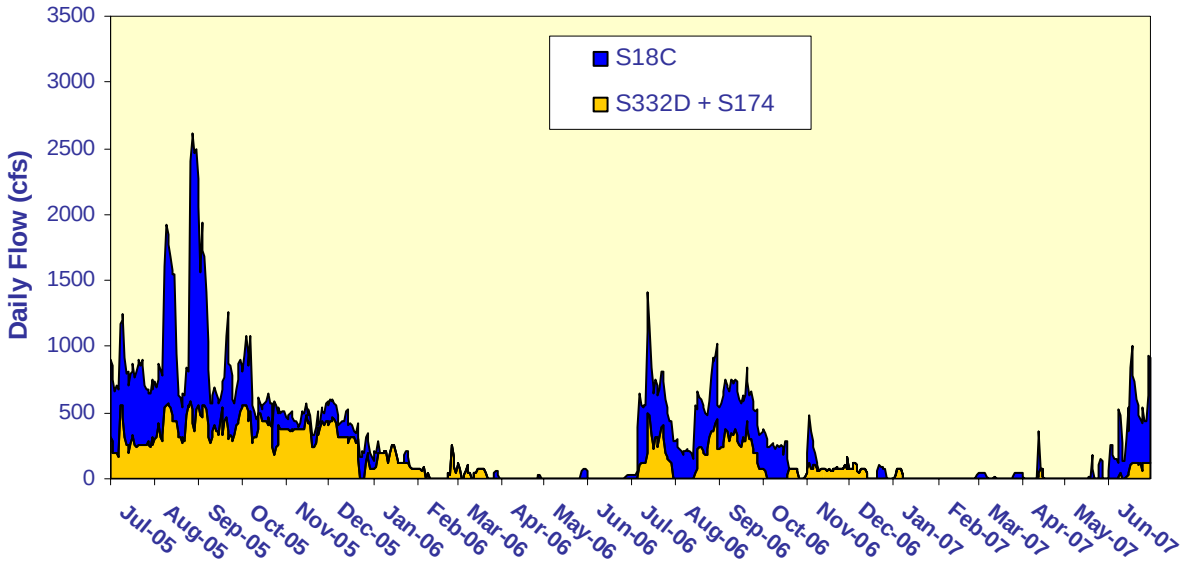

Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C.

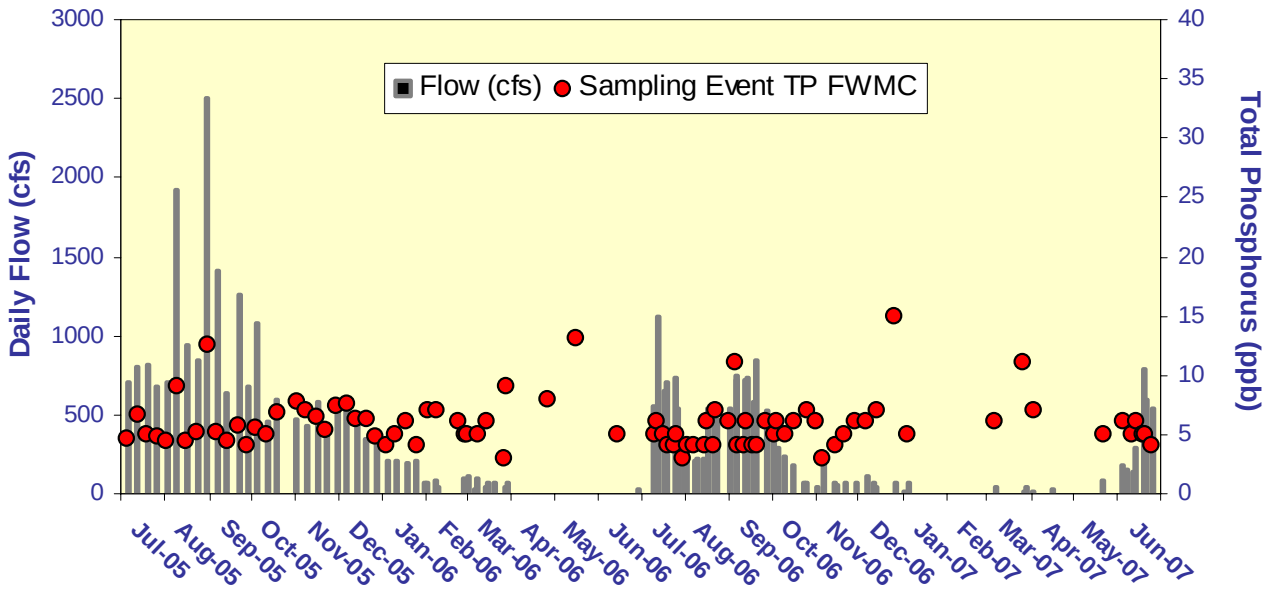

Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Settlement Agreement
July - September 2007 Report

Prepared for the
Technical Oversight Committee
December 5, 2007

Prepared by:
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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 total phosphorus (TP) concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by February 1, 1999, and December 31, 2006, respectively. Both the interim and long–term 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 in National Geodetic Vertical Datum of 1929 (NGVD29). The monthly TP 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 15.86, 16.33 and 16.59 feet in July, August and September 2007, respectively (**Figure 2** and **Table 1**). Water samples were not collected at station LOX10 in July and at station LOX13 in August because total depth was less than 0.1 meter. The geometric means, calculated from TP concentrations measured in water samples collected in July, August and September 2007 were 10.4, 10.1 and 8.5 ppb, respectively. The geometric means were less than the long-term levels, which became effective on December 31, 2006.

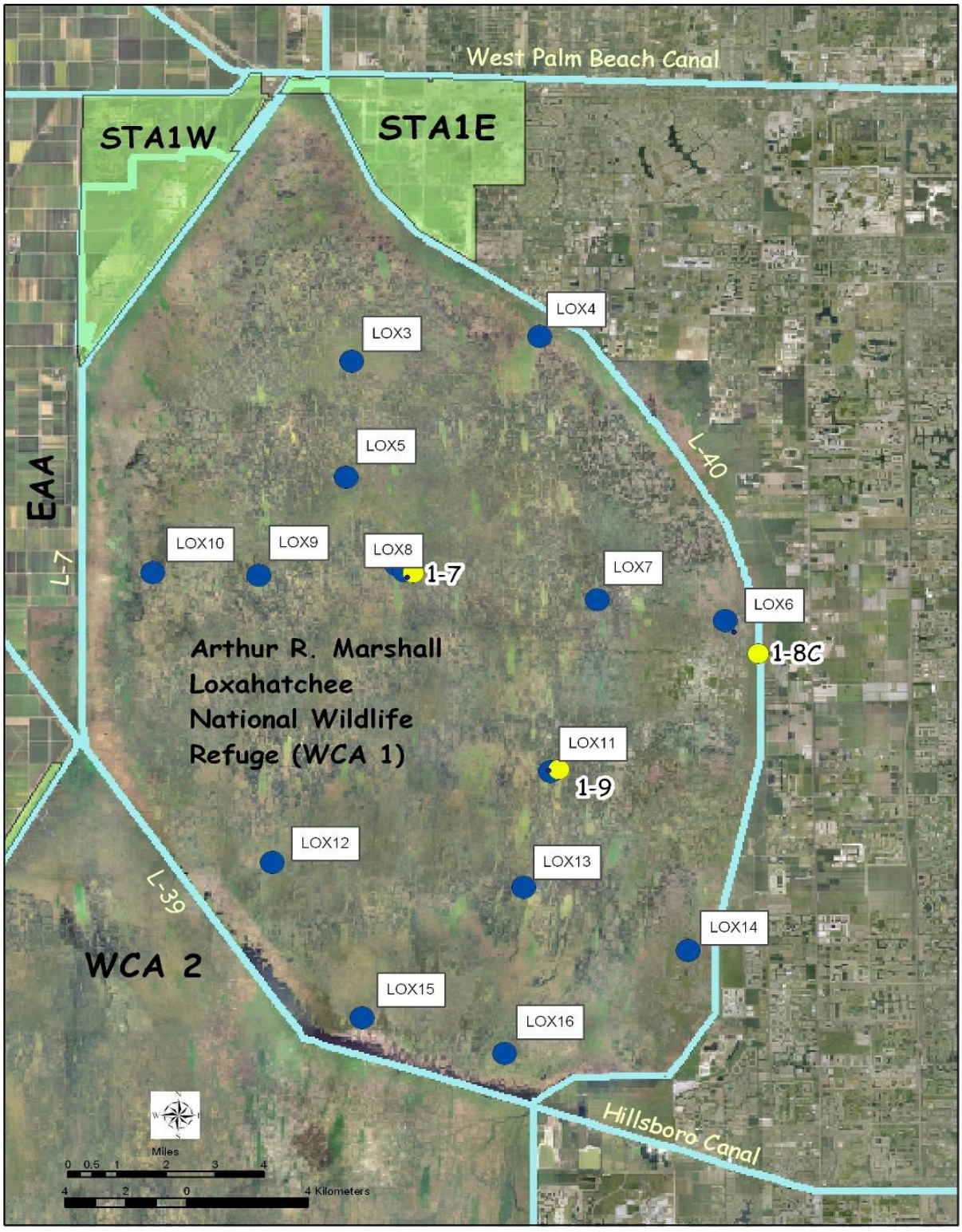

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

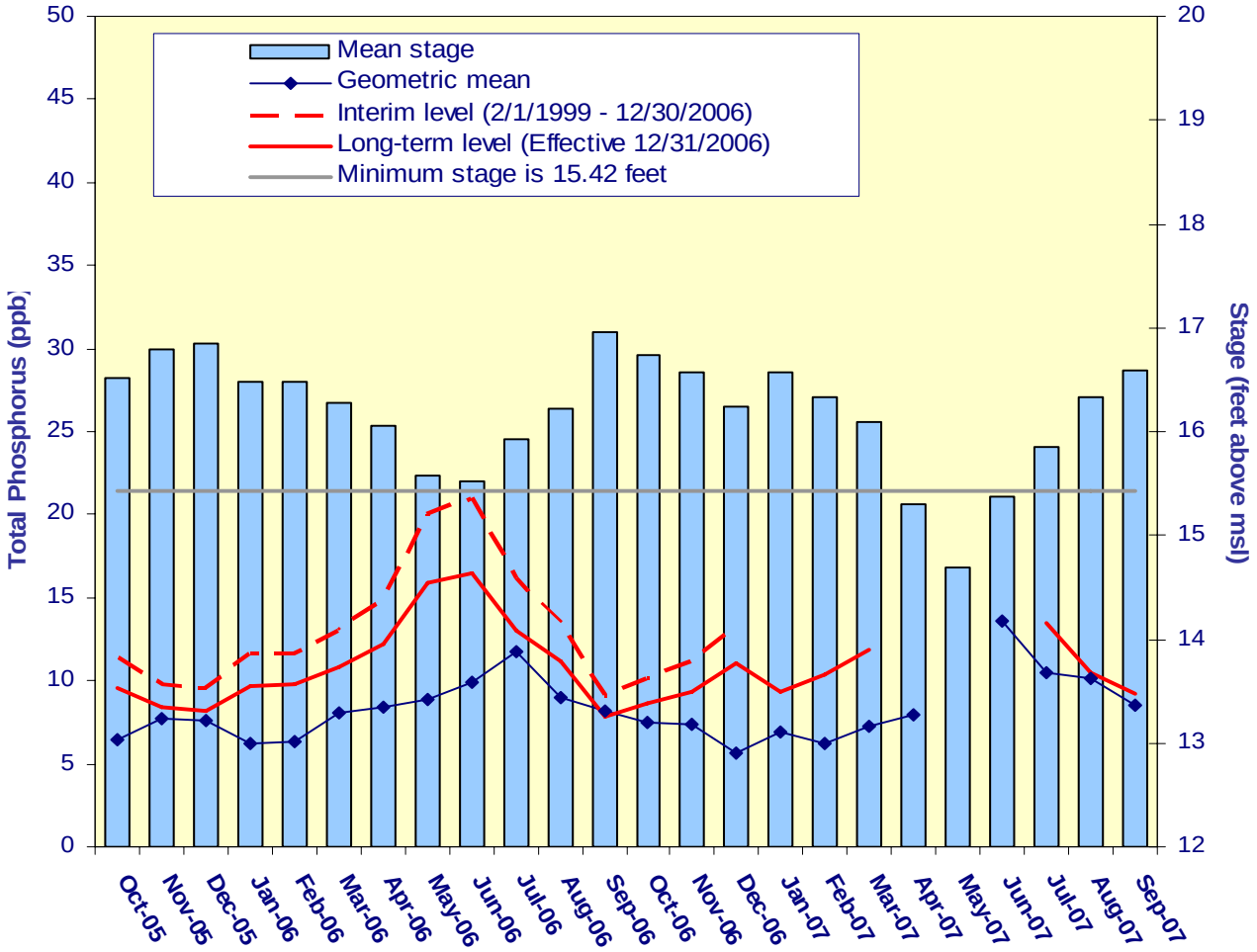

Figure 2. Monthly TP geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated concentration levels are adjusted for fluctuations in stage. The long-term levels were not applicable for April 2007 through June 2007 because the average stages were less than 15.42 feet.

Table 1. Loxahatchee National Wildlife Refuge TP Compliance Tracking.

Month - Year	Geometric Mean Concentration (ppb)	Interim Level[a] (ppb) Effective 2/1/99-12/30/06	Long-Term Level[a] (ppb) Effective 12/31/06	Average Stage[b] (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
Oct-2005	6.5	11.4	9.6	16.52	13	3
Nov-2005	7.8	9.8	8.4	16.79	14	3
Dec-2005	7.6	9.6	8.2	16.85	14	3
Jan-2006	6.3	11.6	9.7	16.49	13	3
Feb-2006	6.4	11.7	9.8	16.48	13	3
Mar-2006	8.1	13.1	10.8	16.28	12	3
Apr-2006	8.4	14.9	12.2	16.05	12	3
May-2006	8.8	20.1	15.9	15.58	10	3
Jun-2006	9.9	21.0	16.5	15.51	5	3
Jul-2006	11.7	16.1	13.0	15.92	9	3
Aug-2006	9.0	13.5	11.1	16.22	11	3
Sep-2006	8.2	9.1	7.8	16.96	14	3
Oct-2006	7.5	10.1	8.6	16.74	14	3
Nov-2006	7.4	11.1	9.4	16.56	14	3
Dec-2006	5.6	13.4	11.0	16.23	11	3
Jan-2007	6.9	11.1	9.3	16.57	14	3
Feb-2007	6.2	12.6	10.4	16.34	13	3
Mar-2007	7.3	14.5	11.8	16.10	10	3
Apr-2007	8.0	N/A	N/A	15.30	3	3
May-2007	n/a	N/A	N/A	14.68	0	3
Jun-2007	13.6	N/A	N/A	15.37	4	3
Jul-2007	10.4	16.8	13.5	15.86	13	3
Aug-2007	10.1	12.7	10.5	16.33	13	3
Sep-2007	8.5	10.9	9.2	16.59	14	3

[a] *N/A denotes that the level was not applicable because the average stage was less than 15.42 feet.*
[b] *Average stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 on the sampling dates.*

EVERGLADES NATIONAL PARK

Shark River Slough

The Consent Decree of 1995 specified that interim and long-term total phosphorus (TP) concentration limits for discharges into the Everglades National Park (ENP) (**Figure 3**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the TP concentrations be presented as 12-month flow-weighted means. Only the TP concentrations for the water year ending September 30th are evaluated for compliance with the Consent Decree limits. The long-term TP 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 TP 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 2006 (**Figure 4**). The 12-month flow-weighted mean TP concentration for October 2006 through September 2007 was 9.8 ppb. The corresponding long-term limit, which became effective on December 31, 2006, was 11.8 ppb (**Table 2**).

Table 2 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding interim and long-term TP concentration limits, calculated using the 12-month period flow. Only the bi-weekly compliance monitoring grab concentration data were used for the calculations. For the 12-month periods ending in July, August and September 2007, the 12-month flow-weighted mean TP concentrations were 10.6, 10.3, and 9.8 ppb, respectively. The long-term limits were 10.9, 11.1 and 11.8 ppb, respectively. The 12-month flow-weighted mean concentrations were lower than the long-term limits for the months of July, August and September 2007.

The Consent Decree stipulates that the percentage of flow-weighted mean TP 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 July, August and September TP concentrations greater than 10 ppb were 47.4, 44.4 and 37.5 percent, respectively. The observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were lower than the guidelines for July, August and September 2007 (**Table 2**). The 12-month flow-weighted mean concentrations and the flow-weighted mean concentrations for individual sampling events are presented in **Figure 5**.

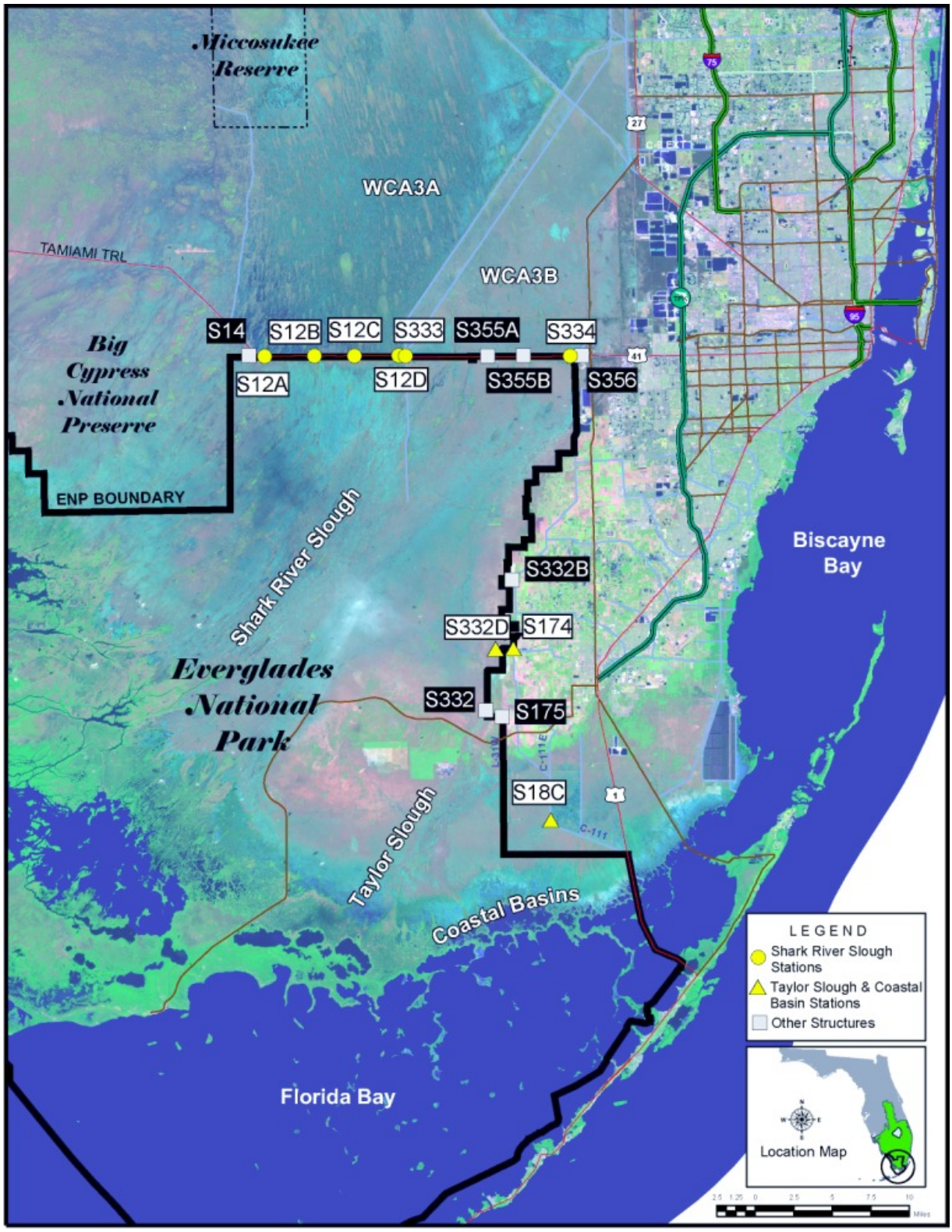

Figure 3. Everglades National Park flow structures

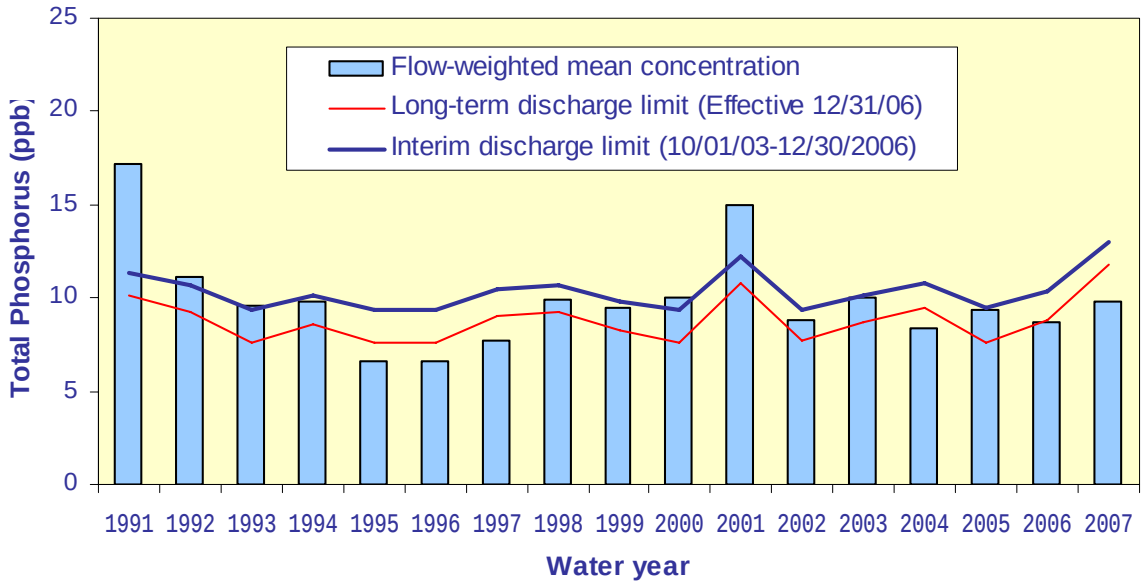

Figure 4. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the TP interim and long-term limits. The 12-month flow-weighted mean concentrations have met the interim limits since they became effective on October 1, 2003. In addition, the 12-month flow-weighted mean TP concentration for the compliance year through September 2007 was below the long-term limit, effective December 31, 2006.

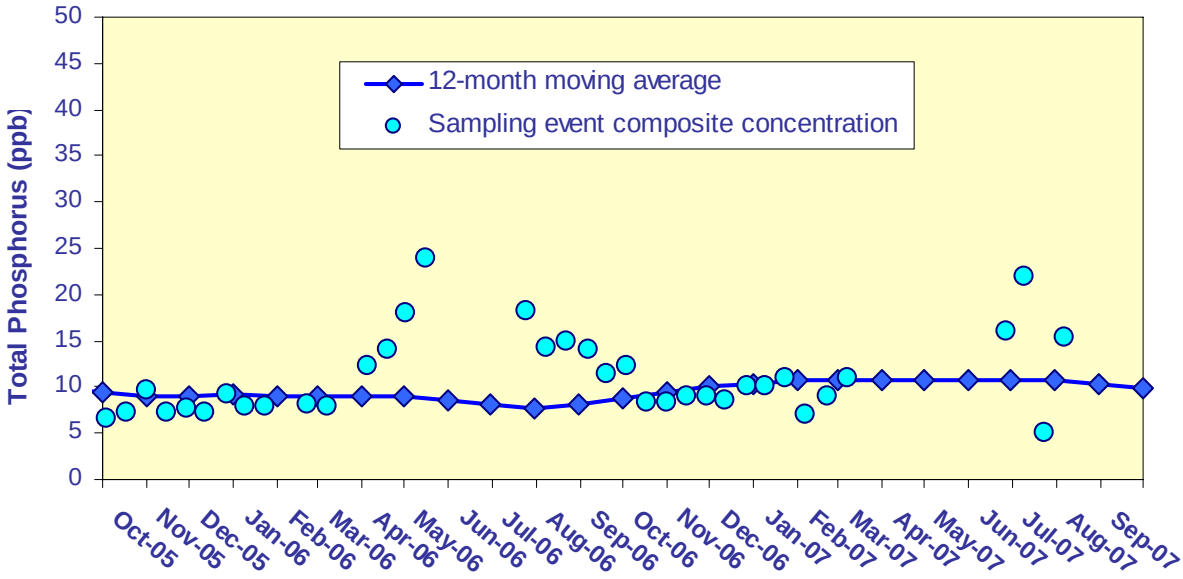

Figure 5. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for some months because there was little or no flow in those periods.

Table 2. Shark River Slough TP Concentration Compliance Tracking.

12-Month Period	Total Flow (kac-ft)	TP Flow Weighted Mean (ppb)	Interim Limit (ppb) Effective 10/1/03-12/30/06	Long-Term Limit (ppb) Effective 12/31/06	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
11/1/04 - 10/31/2005	1338.1	9.0	9.4	7.6	40.1	***40.9***
12/1/04 - 11/30/2005	1381.7	9.1	9.4	7.6	40.1	***42.9***
1/1/05 - 12/31/2005	1447.6	9.1	9.4	7.6	40.1	***42.9***
2/1/05 - 1/31/2006	1507.7	9.1	9.4	7.6	40.1	39.1
3/1/05 - 2/28/2006	1497.6[a]	9.0	9.4	7.6	40.1	39.1
4/1/05 - 3/31/2006	1481.0[a]	9.0	9.4	7.6	40.1	34.8
5/1/05 - 4/30/2006	1436.1[a]	9.0	9.4	7.6	40.1	34.8
6/1/05 - 5/31/2006	1395.5[a]	8.5	9.4	7.6	40.1	31.8
7/1/05 - 6/30/2006	1326.6[a]	8.2	9.4	7.6	40.1	25.0
8/1/05 - 7/31/2006	1113.3[a]	7.7	9.4	7.6	40.1	26.3
9/1/05 - 8/31/2006	914.7[b]	8.1	9.9	8.3	43.5	36.8
10/1/05 - 9/30/2006	**814.1[b]**	**8.7**	**10.3**	**8.8**	**46.0**	**45.0**
11/1/05 - 10/31/2006	779.6[b]	9.5	10.5	9.0	46.9	***50.0***
12/1/05 - 11/30/2006	642.8[b]	10.0	11.1	9.7	50.8	50.0
1/1/06 - 12/31/2006	507.9[b]	10.3	11.8	10.5	55.0	50.0
2/1/06 - 1/31/2007	446.1[b]	10.7	12.1	10.9	57.0	55.0
3/1/06 - 2/28/2007	442.4[c]	10.8	12.1	10.9	57.2	52.4
4/1/06 - 3/31/2007	456.0[c]	10.8	12.0	10.8	56.7	***57.1***
5/1/06 - 4/30/2007	449.5[c]	10.8	12.1	10.8	56.9	52.6
6/1/06 - 5/31/2007	445.5[c]	10.7	12.1	10.9	57.1	47.1
7/1/06 - 6/30/2007	447.6[c]	10.8	12.1	10.8	57.0	50.0
8/1/06 - 7/31/2007	444.6[c]	10.6	12.1	10.9	57.1	47.4
9/1/06 - 8/31/2007	401.0	10.3	12.3	11.1	58.6	44.4
10/1/06 - 9/30/2007	**289.7**	**9.8**	13.0	**11.8**	**62.6**	**37.5**

[a] *Flow of 1.82 kac-ft in February 2006 at S355A and S355B was included for the 12-month total flows.*
[b] *Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows in addition to the flow of 1.82 kac-ft in February 2006 at S355A and S355B structures.*
[c] *Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows.*

Notes: 1) Highlighted rows indicate the end of the water year (October 1- September 30), which are the compliance points.
2) Bold italicized values exceeded the guideline percentages.

The daily flows through the individual Shark River Slough structures from October 2005 through September 2007 are presented in **Figure 6**. S12A, S12B and S12C were closed until mid-July in accordance with the Interim Operational Plan (IOP) for protection of the Cape Sable Seaside Sparrow. S12D had been closed for the structure maintenance dredging, which was substantially completed on June 5, 2007; S12D was reopened on June 20, 2007.

There was little flow in the system during the reporting period because the stage levels at Water Conservation Area (WCA) 3A remained below the regulation schedule through the quarter. S12s and S333 were utilized only to meet the target discharges described in the Shark River Slough "Rain Driven Water Deliveries to Everglades National Park". Very little flow entered the L29 Canal through S333 and almost no water in the L29 Canal was diverted to S334 during the third quarter of 2007 (**Figure 7**).

The flow through S355A and S355B during the February 2006 flow test and the flow through S356 during the August 2006 pump test are included in the 12-month total flows in **Table 2.** Including the flows and associated TP loads from the tests in the 12-month flow-weighted mean concentration calculations did not change the values. However, including this flow for the limit calculations lowered the long-term limits for the 12-month period ending April 2007 and June 2007 from 10.9 ppb to 10.8 ppb.

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean TP concentrations for individual sampling events is presented in **Figure 8**. Values had been following the strong inverse relationship between flow and TP concentration for waters entering the ENP through Shark River Slough. However, these high sampling event flow-weighted mean concentrations taken during the reporting quarter did not impact the 12-month flow-weighted mean concentrations because of the low flow on the sampling days.

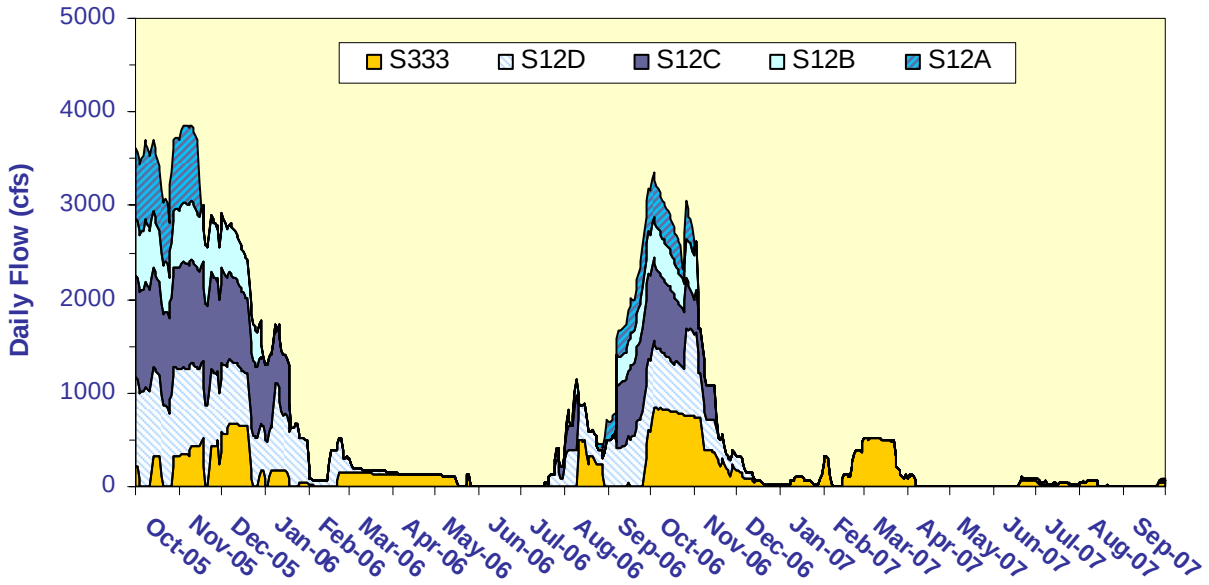

Figure 6. Daily flows into Shark River Slough by structure.

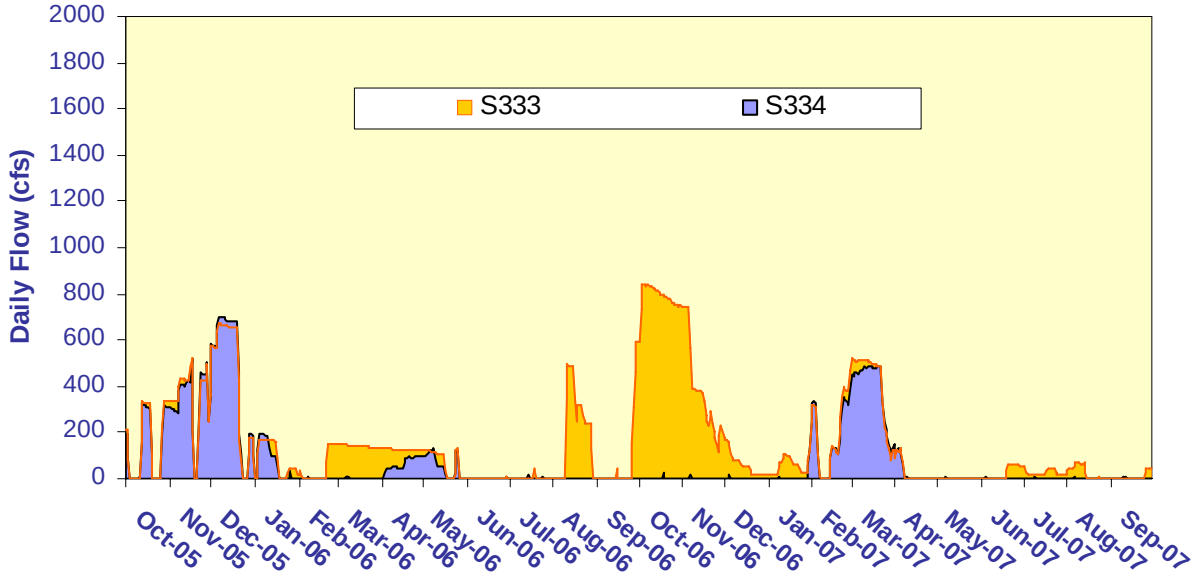

Figure 7. Daily flows comparison between S333 and S334

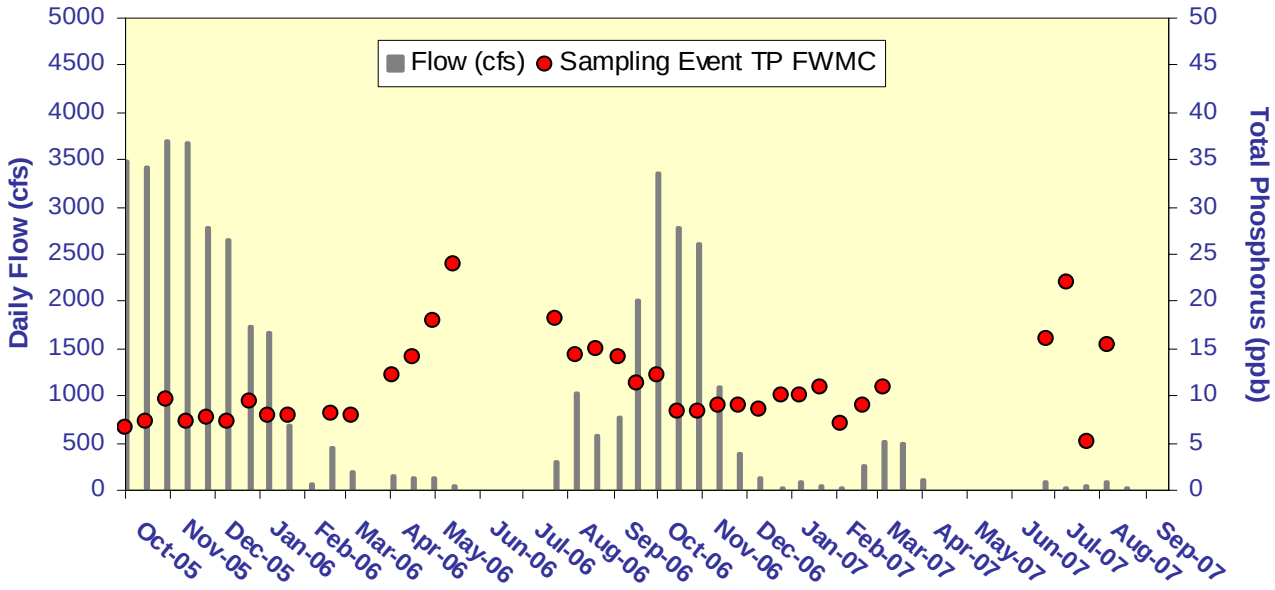

Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Taylor Slough and the Coastal Basins

Under the Consent Decree, a single total phosphorus (TP) 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 12-month flow-weighted mean concentrations have consistently been lower than the long-term limit of 11 ppb.

C-111 Project Structures and Detention Areas

Beginning in August 1999, structure S332D, a 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, Cell 1 through Cell 5, a connector cell between Cell 2 and Cell 3, a flow way cell originating at Berm 3 of Cell 5, and four diversion structures, DS1 through DS4 (**Figure 9**). The flow way cell is the only location to routinely discharge surface water into 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 District started the routine sampling in September 2003.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. The diversion structures DS1 and DS4 would discharge into the ENP if utilized. Overflows periodically occurred at DS2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports.

Discharges from the diversion structures DS1 and DS3 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.

S332B pumped 7.0 kac-ft to Cell 1 (North Pond) and 5.2 kac-ft to Cell 2 (West Pond) during the reporting quarter but there were no overflows.

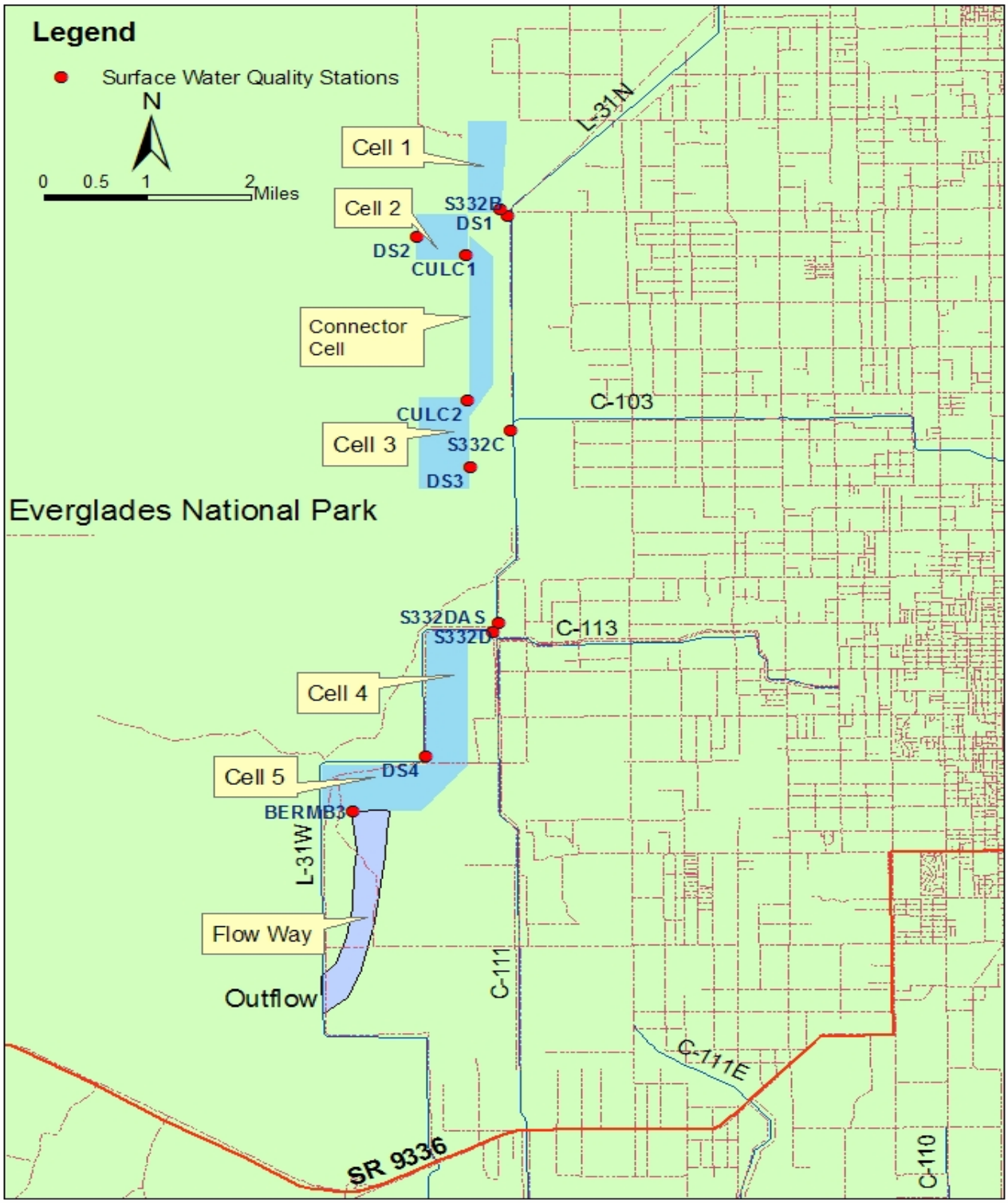

Figure 9. C-111 Project facilities.

Compliance with Consent Decree

Inflow TP concentrations to the ENP 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 10**). The bars in **Figure 10** represent the 12-month flow-weighted mean TP concentrations from S332, S175 and S18C for water years 1989 through 2002. The diamond point values for water years 1999 through 2007 represent the new combination of structures.

TP and flow data from both sets of structures presented in prior editions of this report through December 2001 (April 2002 report) showed that, beginning in 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 TP 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 10.**

Figure 11 presents the 12-month and individual sampling event flow-weighted mean TP concentrations at the S174, S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the 3 sites were used for the compliance calculations.

For the 12-month periods ending in July, August, and September 2007, the 12-month flow-weighted mean TP concentrations were 5.1, 5.0, and 4.8 ppb, respectively, for the combined flow through S174, S332D and S18C (**Table 3**). The Consent Decree stipulates that the percent of flow-weighted mean TP 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 observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb for the combined flow through S174, S332D and S18C were 6.4, 6.4, and 4.6 percent for the periods ending July, August, and September 2007, respectively.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 12**. **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event. From 1984 to 1990, there was no observable relationship between daily mean flow and flow-weighted mean TP concentrations at S332 and S18C structures. A few high concentration values for the area, such as 15 ppb on December 26, 2006, and 11 ppb on March 6, 2007, were observed during low flow periods in recent years. However, the flow-weighted mean concentrations remained very low, 3 to 7 ppb, since April 2007.

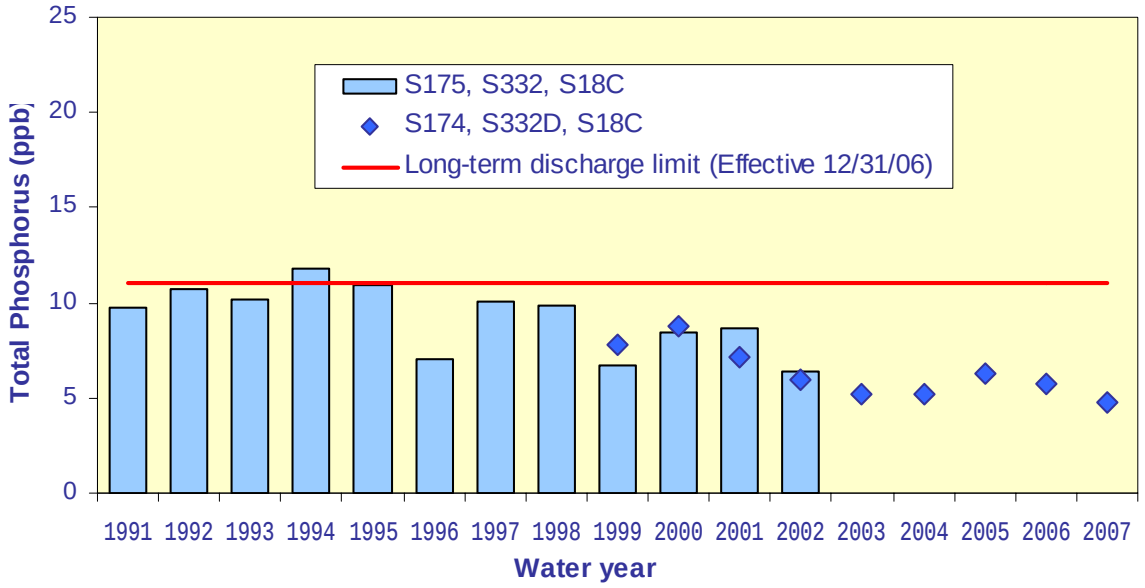

Figure 10. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term TP limit.

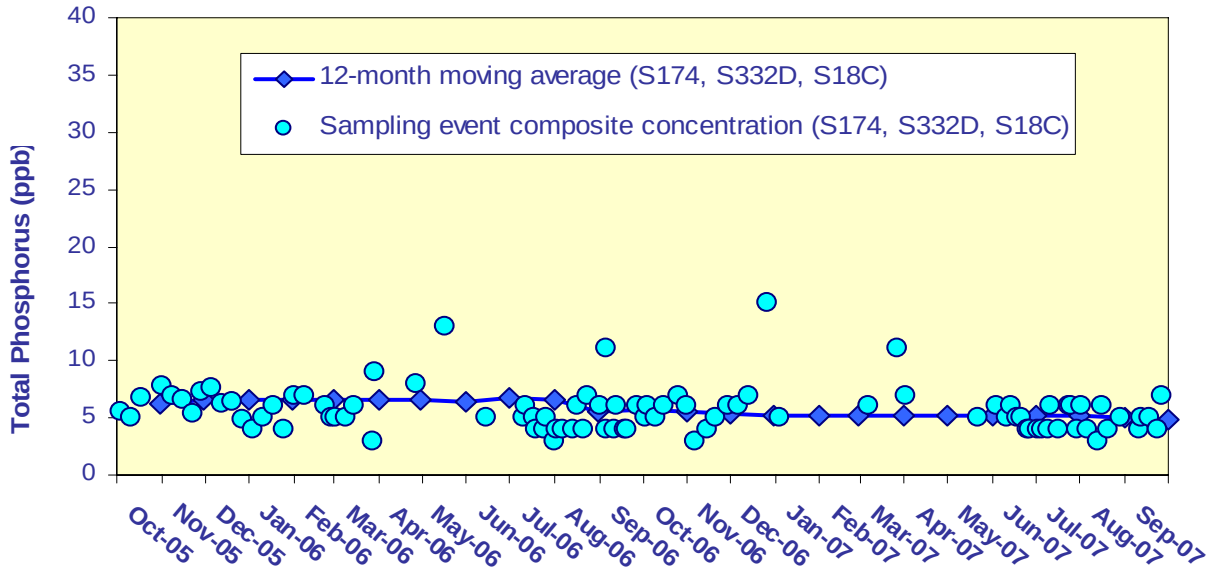

Figure 11. 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean TP concentration for each sampling event.

Table 3. Taylor Slough and the Coastal Basins TP Concentration Compliance Tracking.

12-Month Period	Total Flow (kac-ft)	TP Flow Weighted Mean (ppb)	Long-Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
11/1/2004 - 10/31/2005	373.4	6.3	11.0	53.1	12.2
12/1/2004 - 11/30/2005	358.6	6.6	11.0	53.1	12.0
1/1/2005 - 12/31/2005	366.9	6.6	11.0	53.1	11.8
2/1/2005 - 1/31/2006	369.5	6.6	11.0	53.1	11.8
3/1/2005 - 2/28/2006	364.6	6.6	11.0	53.1	11.8
4/1/2005 - 3/31/2006	359.7	6.6	11.0	53.1	11.8
5/1/2005 - 4/30/2006	351.5	6.5	11.0	53.1	10.4
6/1/2005 - 5/31/2006	343.7	6.4	11.0	53.1	4.5
7/1/2005 - 6/30/2006	295.5	6.7	11.0	53.1	4.9
8/1/2005 - 7/31/2006	280.0	6.6	11.0	53.1	4.5
9/1/2005 - 8/31/2006	227.0	5.5	11.0	53.1	2.2
10/1/2005 - 9/30/2006	**207.4**	**5.7**	**11.0**	**53.1**	**4.1**
11/1/2005 - 10/31/2006	179.5	5.6	11.0	53.1	3.9
12/1/2005 - 11/30/2006	158.8	5.3	11.0	53.1	3.9
1/1/2006 - 12/31/2006	137.4	5.2	11.0	53.1	6.0
2/1/2006 - 1/31/2007	127.6	5.2	11.0	53.1	6.4
3/1/2006 - 2/28/2007	125.4	5.2	11.0	53.1	7.0
4/1/2006 - 3/31/2007	123.8	5.2	11.0	53.1	10.0
5/1/2006 - 4/30/2007	125.4	5.2	11.0	53.1	10.0
6/1/2006 - 5/31/2007	126.1	5.2	11.0	53.1	7.5
7/1/2006 - 6/30/2007	153.0	5.1	11.0	53.1	6.5
8/1/2006 - 7/31/2007	153.4	5.1	11.0	53.1	6.4
9/1/2006 - 8/31/2007	143.6	5.0	11.0	53.1	6.4
10/1/2006 - 9/30/2007	**120.8**	**4.8**	**11.0**	**53.1**	**4.6**

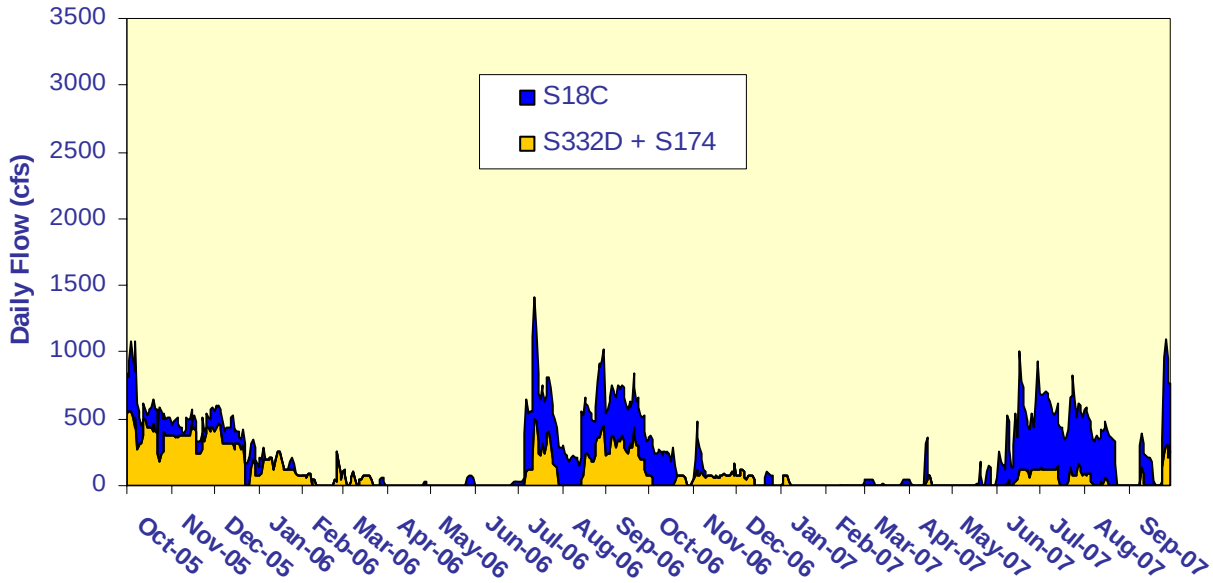

Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C.

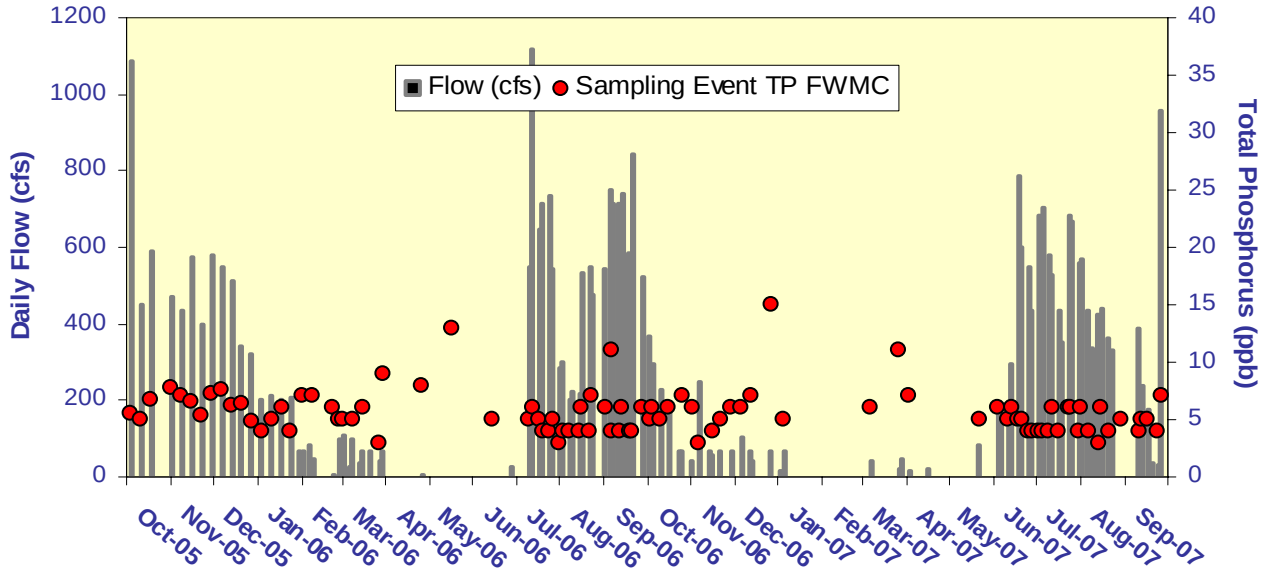

Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Settlement Agreement
October - December 2007 Report

Prepared for the
Technical Oversight Committee
February 15, 2008

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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 total phosphorus (TP) concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by February 1, 1999, and December 31, 2006, respectively. Both the interim and long–term 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 in National Geodetic Vertical Datum of 1929 (NGVD29). The monthly TP 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 17.26, 17.19 and 16.84 feet in October, November, and December 2007, respectively (Figure 2 and Table 1). The geometric means, calculated from TP concentrations measured in water samples collected in October, November, and December 2007 were 8.4, 7.0 and 7.9 ppb, respectively. The geometric means were higher than the long-term levels, which became effective on December 31, 2006, in October 2007 but lower than the long-term levels in November and December 2007.

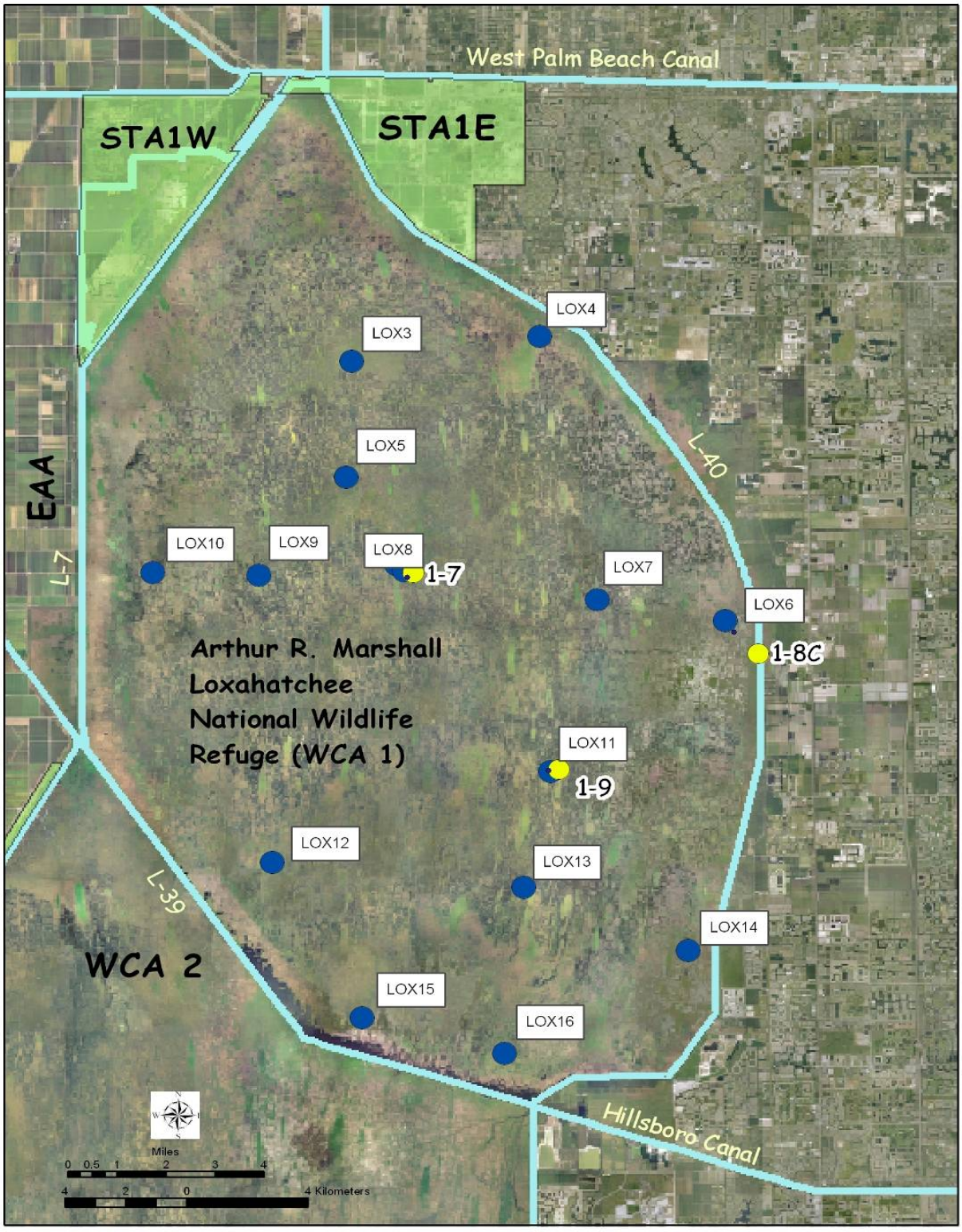

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

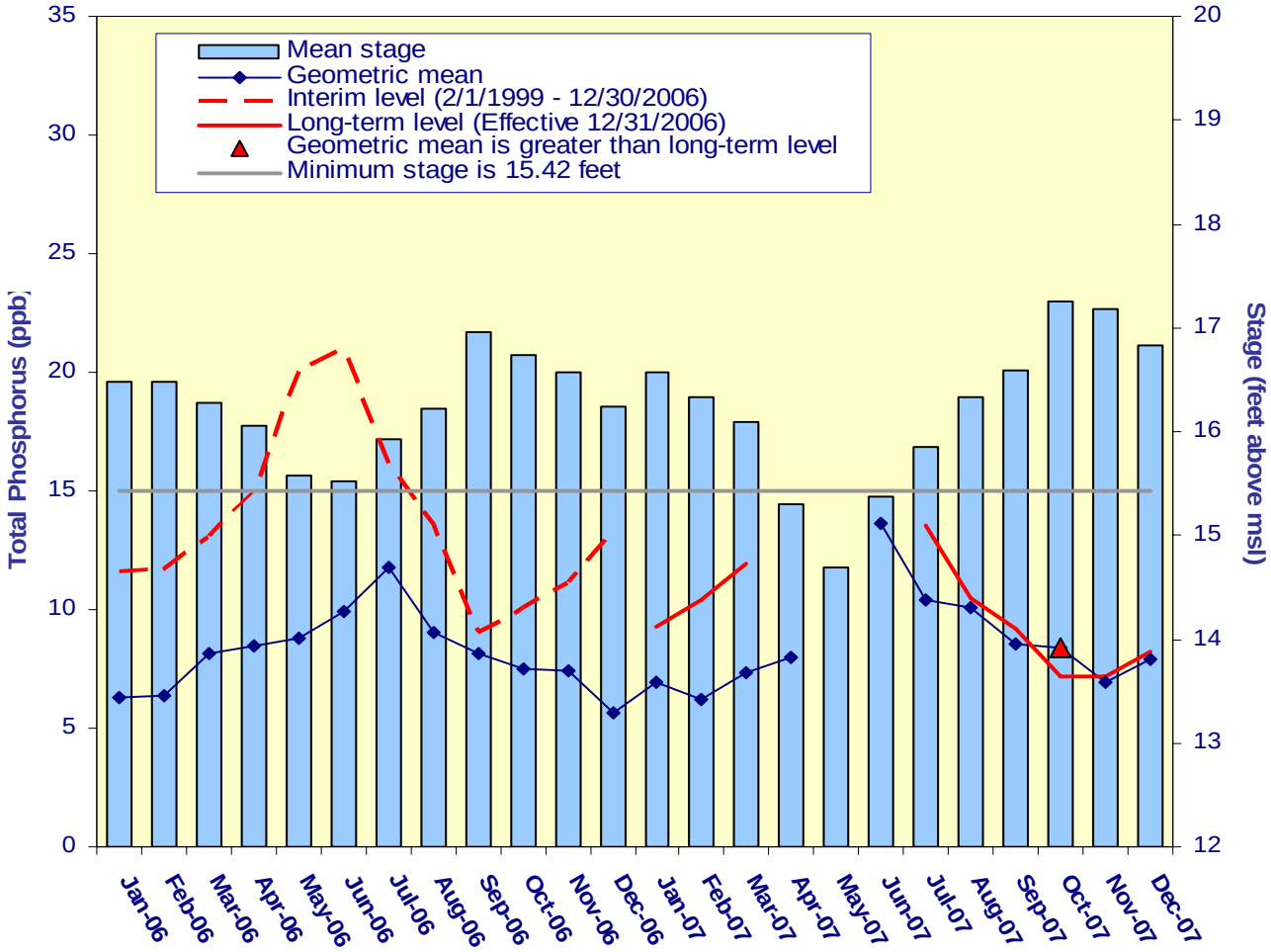

Figure 2. Monthly TP geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated concentration levels are adjusted for fluctuations in stage. The long-term levels were not applicable for April 2007 through June 2007 because the average stage was less than 15.42 feet.

Table 1. Loxahatchee National Wildlife Refuge TP Compliance Tracking.

Month - Year	Geometric Mean Concentration (ppb)	Interim Level[a] (ppb) Effective 2/1/99-12/30/06	Long-Term Level[a] (ppb) Effective 12/31/06	Average Stage[b] (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
Jan-2006	6.3	11.6	9.7	16.49	13	3
Feb-2006	6.4	11.7	9.8	16.48	13	3
Mar-2006	8.1	13.1	10.8	16.28	12	3
Apr-2006	8.4	14.9	12.2	16.05	12	3
May-2006	8.8	20.1	15.9	15.58	10	3
Jun-2006	9.9	21.0	16.5	15.51	5	3
Jul-2006	11.7	16.1	13.0	15.92	9	3
Aug-2006	9.0	13.5	11.1	16.22	11	3
Sep-2006	8.2	9.1	7.8	16.96	14	3
Oct-2006	7.5	10.1	8.6	16.74	14	3
Nov-2006	7.4	11.1	9.4	16.56	14	3
Dec-2006	5.6	13.4	11.0	16.23	11	3
Jan-2007	6.9	11.1	9.3	16.57	14	3
Feb-2007	6.2	12.6	10.4	16.34	13	3
Mar-2007	7.3	14.5	11.8	16.10	10	3
Apr-2007	8.0	N/A	N/A	15.30	3	3
May-2007	n/a	N/A	N/A	14.68	0	3
Jun-2007	13.6	N/A	N/A	15.37	4	3
Jul-2007	10.4	16.8	13.5	15.86	13	3
Aug-2007	10.1	12.7	10.5	16.33	13	3
Sep-2007	8.5	10.9	9.2	16.59	14	3
Oct-2007	**8.4**	**8.3**	**7.2**	**17.26**	**14**	**3**
Nov-2007	7.0	8.3	7.2	17.19	14	3
Dec-2007	7.9	9.6	8.2	16.84	14	3

[a] *N/A denotes that the level was not applicable because the average stage was less than 15.42 feet.*
[b] *Average stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 on the sampling dates.*

Notes: Highlighted row indicates the month when excursion over the Long-Term Level occurred.

EVERGLADES NATIONAL PARK

Shark River Slough

The Consent Decree of 1995 specified that interim and long-term total phosphorus (TP) concentration limits for discharges into the Everglades National Park (ENP) (**Figure 3**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the TP concentrations be presented as 12-month flow-weighted means. Only the TP concentrations for the water year ending September 30th are evaluated for compliance with the Consent Decree limits. The long-term TP 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 TP 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 2007 (**Figure 4**). The 12-month flow-weighted mean TP concentration for October 2006 through September 2007 was 9.8 ppb. The corresponding long-term limit, which became effective on December 31, 2006, was 11.8 ppb (**Table 2**).

Table 2 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding interim and long-term TP concentration limits, calculated using the 12-month period flow. Supplemental water quality samples were collected at some of the Shark River Slough monitoring sites from January 2006 through September 2007, but only the bi-weekly compliance monitoring grab concentration data were used for flow-weighted mean TP concentration calculations. Routine monitoring was changed to weekly[1] for all Shark River Slough sites beginning in October 2007. In accordance with Appendix A of the Consent Decree, only the every-other-week grab concentration data were used for the flow-weighted mean calculations for October through December 2007[2]. For the 12-month periods ending in October, November, and December 2007, the 12-month flow-weighted mean TP concentrations were 11.7, 12.6, and 12.8 ppb, respectively. The long-term limits were 12.7, 12.8 and 12.8 ppb, respectively. The 12-month flow-weighted mean concentrations were lower than the long-term limits for the months of October, November, and December 2007.

[1] *S12A and S333 are sampled weekly if flowing, otherwise monthly. S12B, S12C, and S12D are sampled weekly if flowing.*

[2] *Flow-weighted mean concentrations using all available weekly grab data instead of every-other-week grab data were 12.2, 12.3 12.4 ppb for October, November, and December 2007, respectively.*

The Consent Decree stipulates that the percentage of flow-weighted mean TP 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 2007 TP concentrations greater than 10 ppb were 57.9, 66.7 and 75.0 percent, respectively. The observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were less than the guidelines for October and November 2007 but more than the guideline for December 2007 (**Table 2**). The 12-month flow-weighted mean concentrations and the flow-weighted mean concentrations for individual sampling events are presented in **Figure 5**.

The daily flows through the individual Shark River Slough structures from October 2005 through September 2007 are presented in **Figure 6**. S12A, was closed from November 1, 2007, in accordance with the Interim Operational Plan (IOP) for protection of the Cape Sable Seaside Sparrow.

The stage levels at Water Conservation Area (WCA) 3A remained below the regulation schedule through the quarter and the S12s and S333 were utilized only to meet the target discharges described in the Shark River Slough "Rain Driven Water Deliveries to Everglades National Park".

The total flow through the Shark River Slough structures during the fourth quarter of 2007 was the lowest recorded flow for the fourth quarter since 1989. Almost no flow through S333 was diverted to S334 during the quarter (**Figure 7**).

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean TP concentrations for individual sampling events is presented in **Figure 8**. Flow and TP concentrations for waters entering the ENP through Shark River Slough followed an inverse relationship during the quarter, as they had been in previous periods.

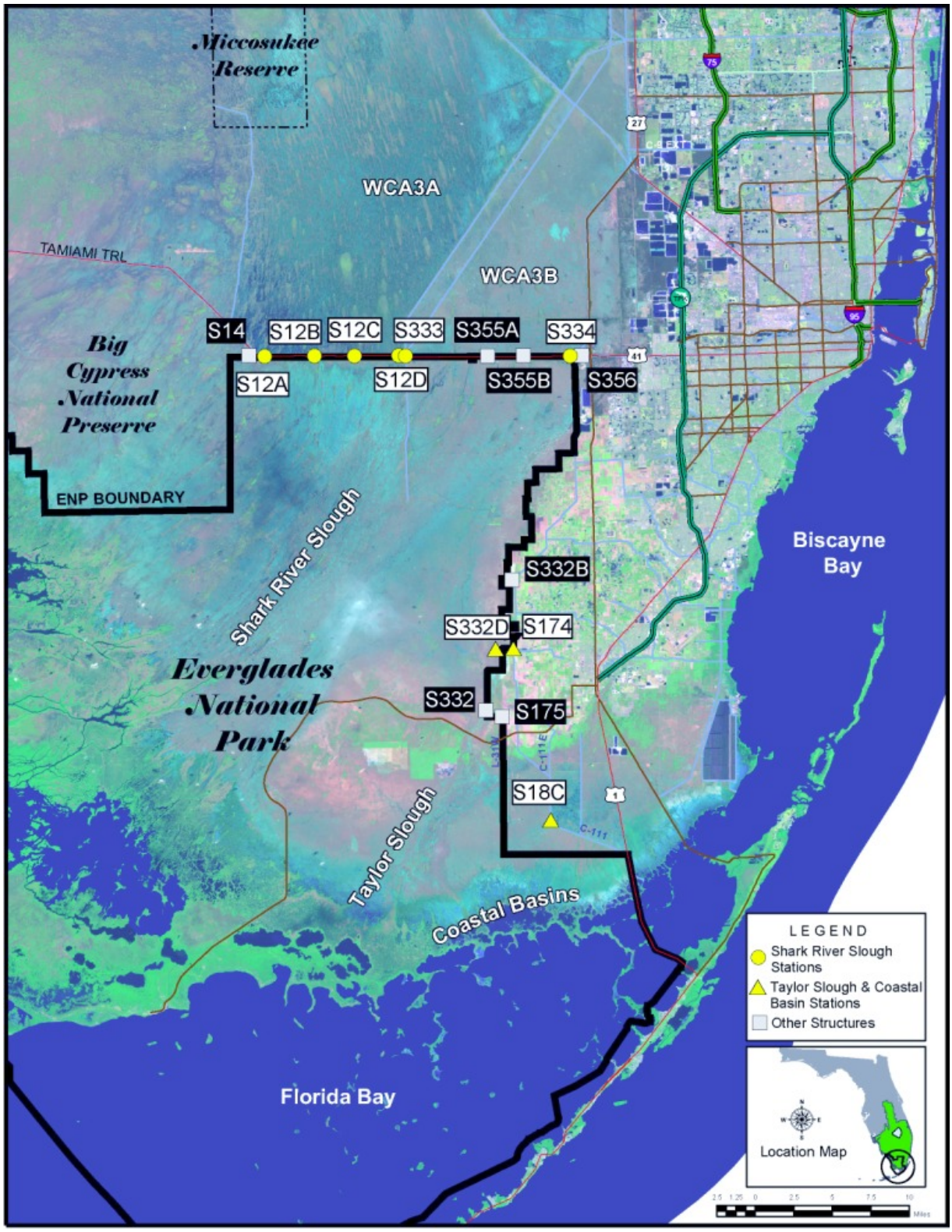

Figure 3. Everglades National Park flow structures

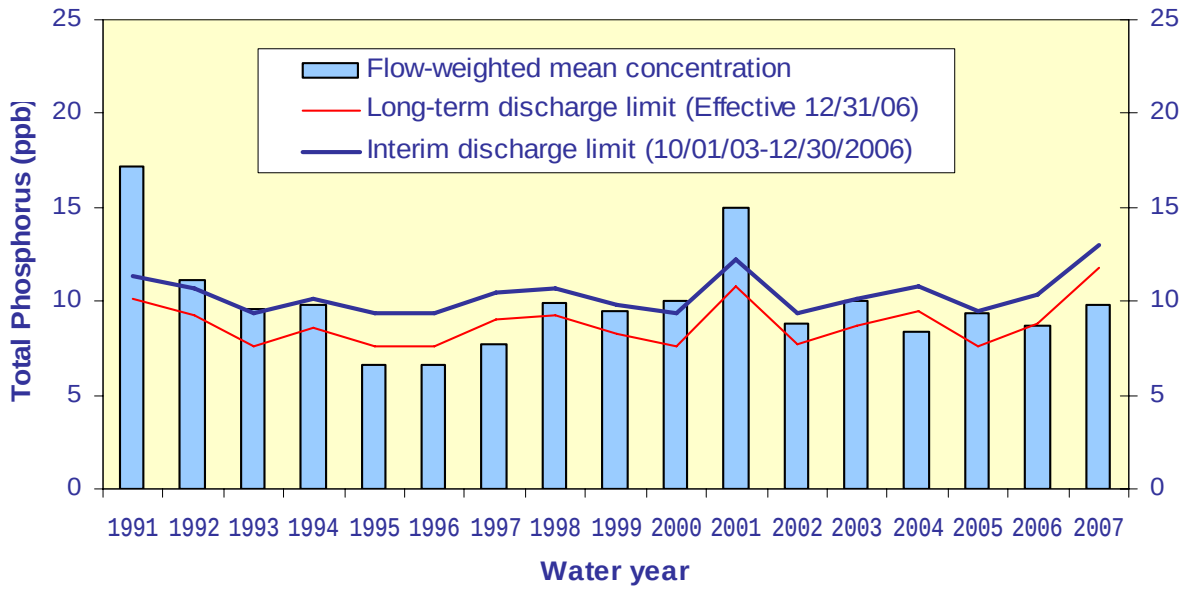

Figure 4. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the TP interim and long-term limits. The 12-month flow-weighted mean concentrations have met the interim limits since they became effective on October 1, 2003. In addition, the 12-month flow-weighted mean TP concentration for the compliance year through September 2007 was below the long-term limit, effective December 31, 2006.

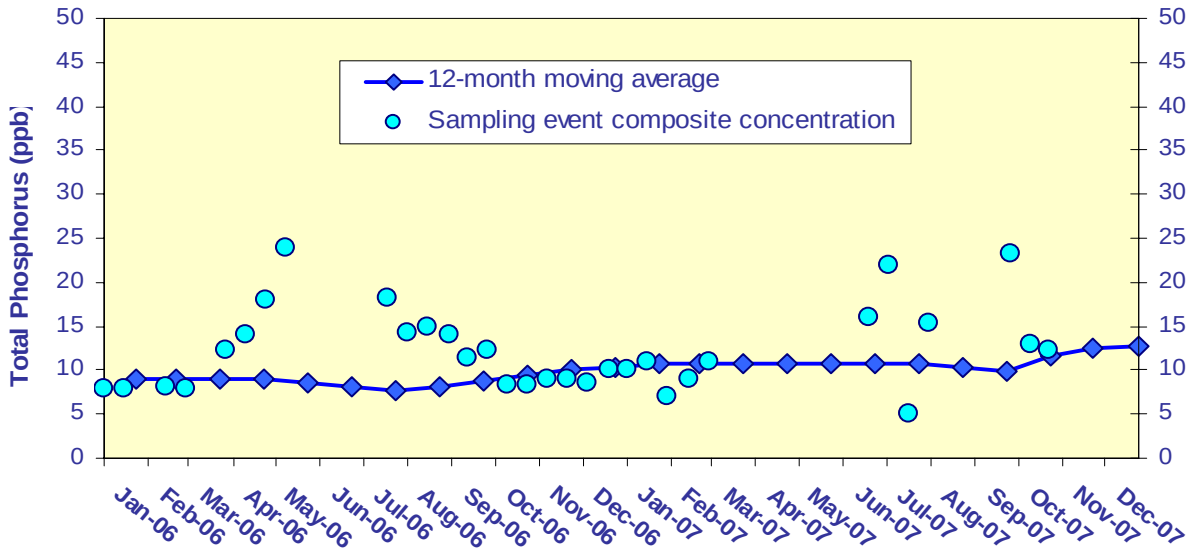

Figure 5. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for some months because there was little or no flow in those periods.

Table 2. Shark River Slough TP Concentration Compliance Tracking.

12-Month Period	Total Flow (kac-ft)	TP Flow Weighted Mean (ppb)	Interim Limit (ppb) Effective 10/1/03-12/30/06	Long-Term Limit (ppb) Effective 12/31/06	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
2/1/2005 - 1/31/2006	1507.7	9.1	9.4	7.6	40.1	39.1
3/1/2005 - 2/28/2006	1497.6[a]	9.0	9.4	7.6	40.1	39.1
4/1/2005 - 3/31/2006	1481.0[a]	9.0	9.4	7.6	40.1	34.8
5/1/2005 - 4/30/2006	1436.1[a]	9.0	9.4	7.6	40.1	34.8
6/1/2005 - 5/31/2006	1395.5[a]	8.5	9.4	7.6	40.1	31.8
7/1/2005 - 6/30/2006	1326.6[a]	8.2	9.4	7.6	40.1	25.0
8/1/2005 - 7/31/2006	1113.3[a]	7.7	9.4	7.6	40.1	26.3
9/1/2005 - 8/31/2006	914.7[b]	8.1	9.9	8.3	43.5	36.8
10/1/2005 - 9/30/2006	**814.1[b]**	**8.7**	**10.3**	**8.8**	**46.0**	**45.0**
11/1/2005 - 10/31/2006	779.6[b]	9.5	10.5	9.0	46.9	***50.0***
12/1/2005 - 11/30/2006	642.8[b]	10.0	11.1	9.7	50.8	50.0
1/1/2006 - 12/31/2006	507.9[b]	10.3	11.8	10.5	55.0	50.0
2/1/2006 - 1/31/2007	446.1[b]	10.7	12.1	10.9	57.0	55.0
3/1/2006 - 2/28/2007	442.4[c]	10.8	12.1	10.9	57.2	52.4
4/1/2006 - 3/31/2007	456.0[c]	10.8	12.0	10.8	56.7	***57.1***
5/1/2006 - 4/30/2007	449.5[c]	10.8	12.1	10.8	56.9	52.6
6/1/2006 - 5/31/2007	445.5[c]	10.7	12.1	10.9	57.1	47.1
7/1/2006 - 6/30/2007	447.6[c]	10.8	12.1	10.8	57.0	50.0
8/1/2006 - 7/31/2007	444.6[c]	10.6	12.1	10.9	57.1	47.4
9/1/2006 - 8/31/2007	401.0	10.3	12.3	11.1	58.6	44.4
10/1/2006 - 9/30/2007	**289.7**	**9.8**	**13.0**	**11.8**	**62.6**	**37.5**
11/1/2006 - 10/31/2007	147.9	11.7[d]	13.8	12.7	67.9	50.0
12/1/2006 - 11/30/2007	121.2	12.6[d]	13.9	12.8	68.9	62.5
1/1/2007 - 12/31/2007	118.2	12.8[d]	14.0	12.8	69.1	***71.4***

[a] *Flow of 1.82 kac-ft in February 2006 at S355A and S355B was included for the 12-month total flows.*
[b] *Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows in addition to the flow of 1.82 kac-ft in February 2006 at S355A and S355B structures.*
[c] *Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows.*
[d] *Flow-weighted mean concentrations using all available weekly grab data instead of every-other-week grab data were 12.2, 12.3 12.4 ppb for October, November, and December 2007, respectively.*

Notes: 1) Highlighted rows indicate the end of the water year, which are the compliance points.
2) Bold italicized values exceeded the guideline percentages.

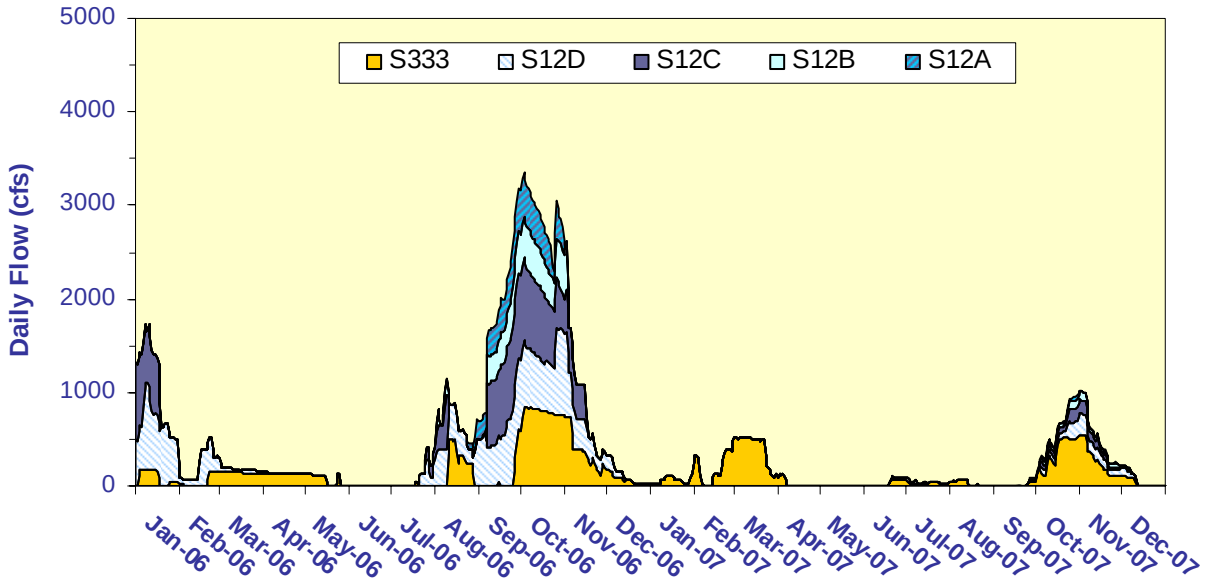

Figure 6. Daily flows into Shark River Slough by structure.

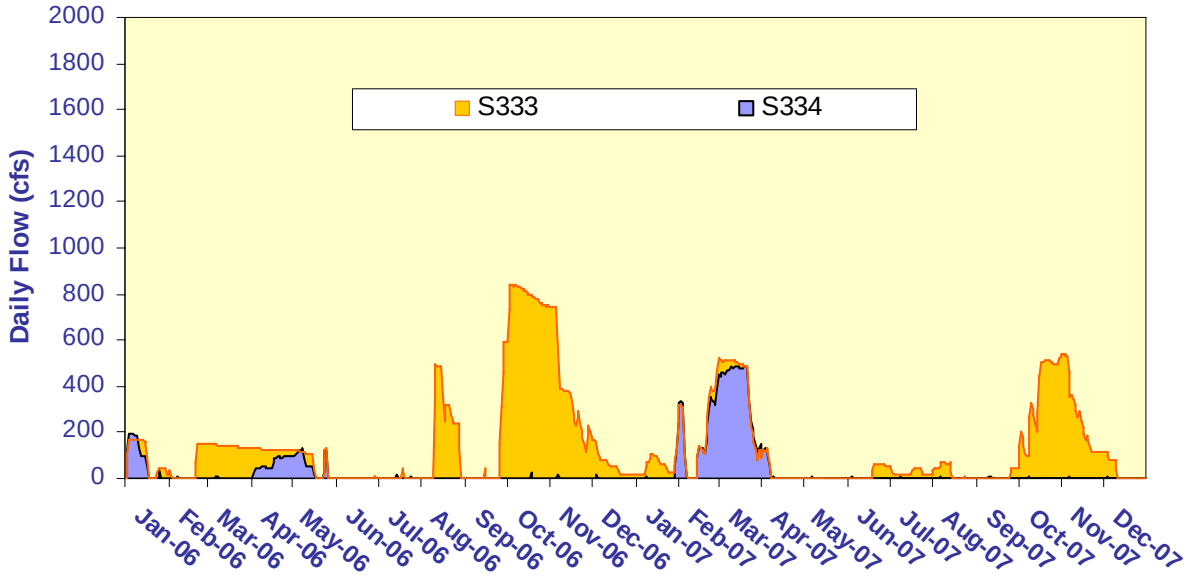

Figure 7. Daily flows comparison between S333 and S334

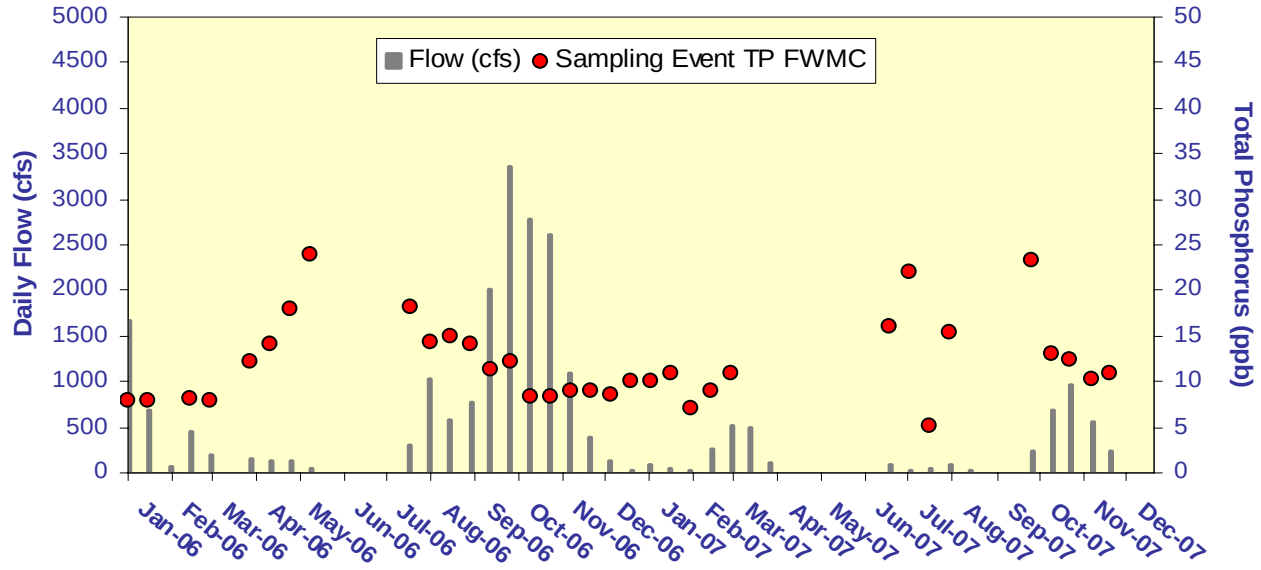

Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Taylor Slough and the Coastal Basins

Under the Consent Decree, a single total phosphorus (TP) 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 12-month flow-weighted mean concentrations have consistently been lower than the long-term limit of 11 ppb.

C-111 Project Structures and Detention Areas

Beginning in August 1999, structure S332D, a 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, Cell 1 through Cell 5, a connector cell between Cell 2 and Cell 3, a flow way cell originating at Berm 3 of Cell 5, and four diversion structures, DS1 through DS4 (**Figure 9**). The flow way cell is the only location to routinely discharge surface water into 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, has implemented 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 District started the routine sampling in September 2003.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. The diversion structures DS2 and DS4 would discharge into the ENP if utilized. Overflows periodically occurred at DS2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports.

Discharges from the diversion structures DS1 and DS3 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 groundwater seepage in an easterly direction from ENP.

S332B pumped 6,058 ac-ft to Cell 1 (North Pond) and 3,336 ac-ft to Cell 2 (West Pond) during the reporting quarter. Most of the flow, 5,496 ac-ft at Cell 1 and 3,321 ac-ft at Cell 2, occurred in October 2007. The highest instantaneous reading of the tail water stage at S332B pump station was 8.05 feet on October 2, 2007. This is lower than the threshold height of 8.36 feet at the diversion structure DS2, indicating that there were no overflows at the structure during the quarter.

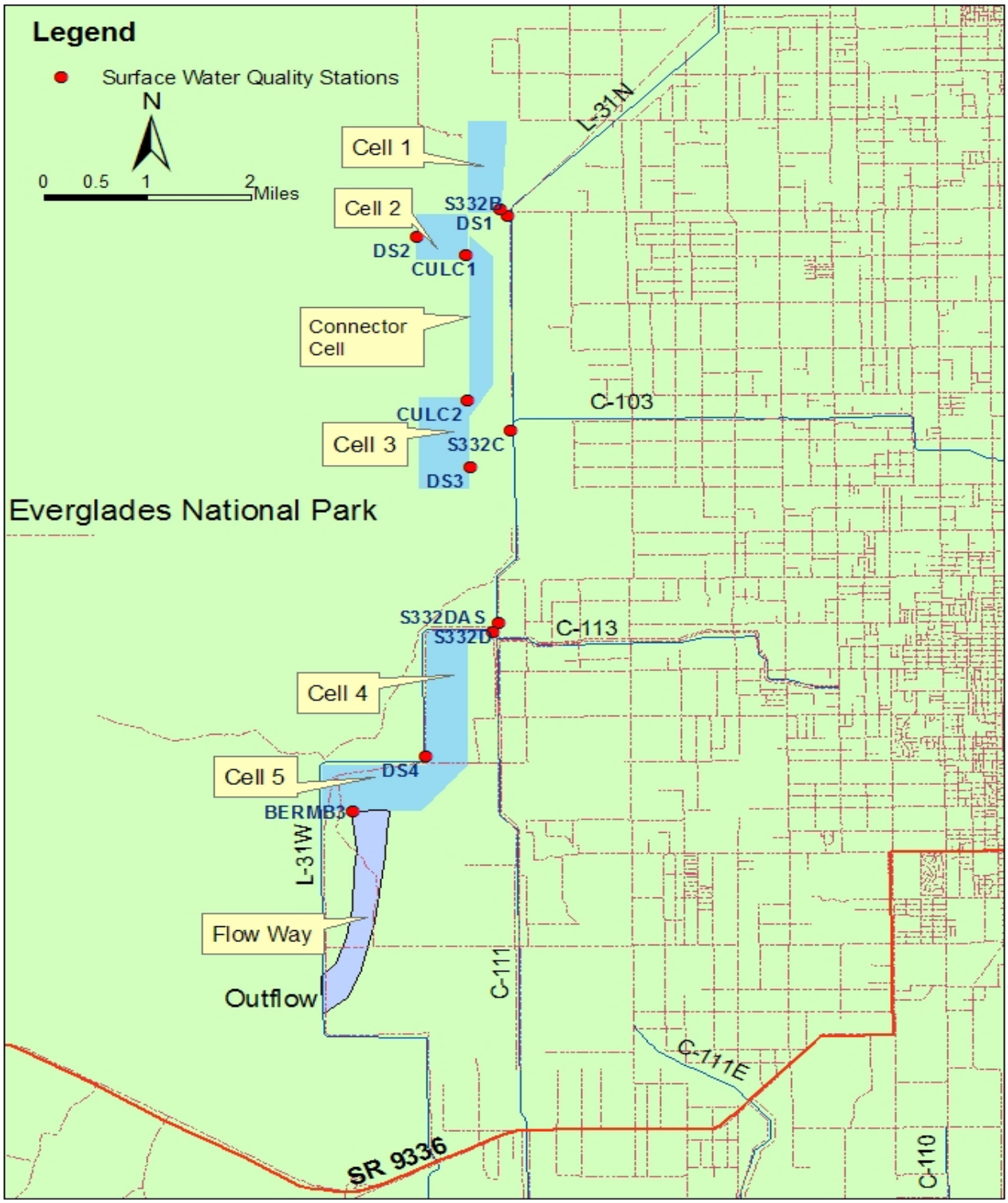

Figure 9. C-111 Project facilities.

Compliance with Consent Decree

Inflow TP concentrations to the ENP 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 10**). The bars in **Figure 10** represent the 12-month flow-weighted mean TP concentrations from S332, S175 and S18C for water years 1989 through 2002. The diamond point values for water years 1999 through 2007 represent the new combination of structures.

TP and flow data from both sets of structures presented in prior editions of this report through December 2001 (April 2002 report) showed that, beginning in 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 TP 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 10.** However, there had been almost no flow since March 2006 at S174. The site was plugged in September 2007, preventing any flow through S174.

Figure 11 presents the 12-month and individual sampling event flow-weighted mean TP concentrations at the S174, S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the 3 sites were used for the compliance calculations.

For the 12-month periods ending in October, November, and December 2007, the 12-month flow-weighted mean TP concentrations were 4.8, 4.8, and 4.7 ppb, respectively, for the combined flow through S174, S332D and S18C (**Table 3**). The Consent Decree stipulates that the percent of flow-weighted mean TP 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 observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb for the combined flow through S174, S332D and S18C were 4.2, 4.3, and 2.3 percent for the periods ending October, November, and December 2007, respectively.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 12**. **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event. The sampling event flow-weighted mean concentrations remained very low, 3 to 7 ppb, since April 2007.

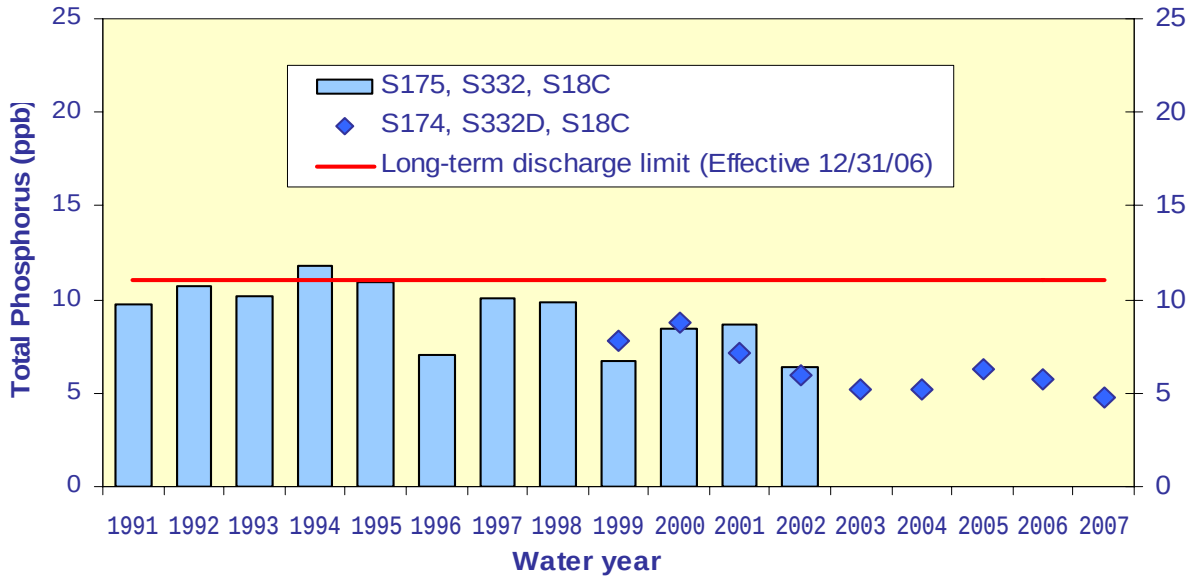

Figure 10. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term TP limit.

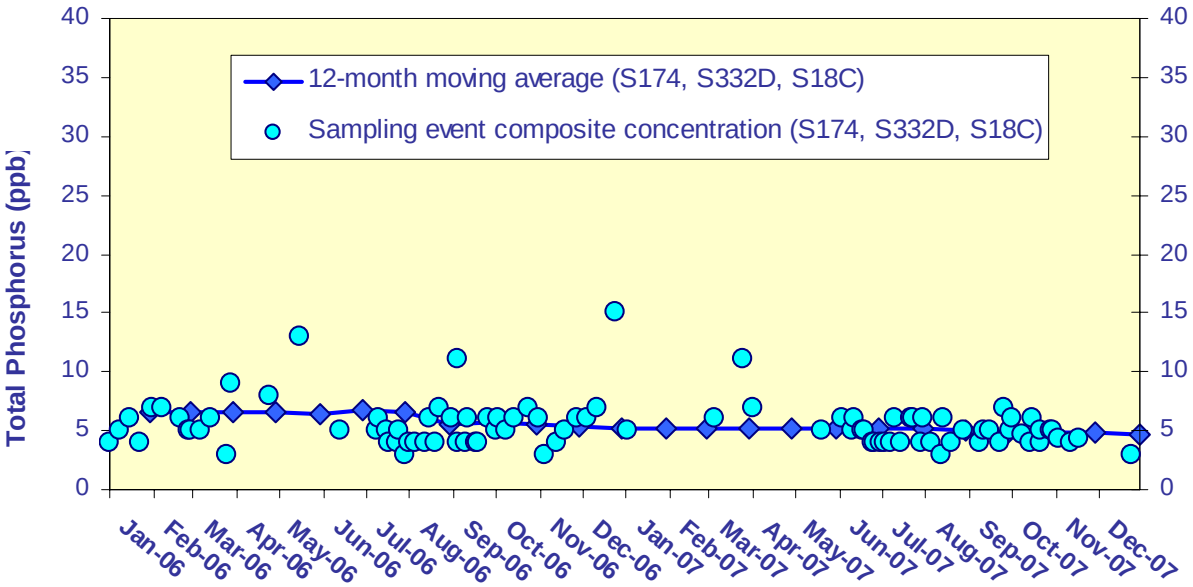

Figure 11. 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean TP concentration for each sampling event.

Table 3. Taylor Slough and the Coastal Basins TP Concentration Compliance Tracking.

12-Month Period	Total Flow (kac-ft)	TP Flow Weighted Mean (ppb)	Long-Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
2/1/2005 - 1/31/2006	369.5	6.6	11.0	53.1	11.8
3/1/2005 - 2/28/2006	364.6	6.6	11.0	53.1	11.8
4/1/2005 - 3/31/2006	359.7	6.6	11.0	53.1	11.8
5/1/2005 - 4/30/2006	351.5	6.5	11.0	53.1	10.4
6/1/2005 - 5/31/2006	343.7	6.4	11.0	53.1	4.5
7/1/2005 - 6/30/2006	295.5	6.7	11.0	53.1	4.9
8/1/2005 - 7/31/2006	280.0	6.6	11.0	53.1	4.5
9/1/2005 - 8/31/2006	227.0	5.5	11.0	53.1	2.2
10/1/2005 - 9/30/2006	**207.4**	**5.7**	**11.0**	**53.1**	**4.1**
11/1/2005 - 10/31/2006	179.5	5.6	11.0	53.1	3.9
12/1/2005 - 11/30/2006	158.8	5.3	11.0	53.1	3.9
1/1/2006 - 12/31/2006	137.4	5.2	11.0	53.1	6.0
2/1/2006 - 1/31/2007	127.6	5.2	11.0	53.1	6.4
3/1/2006 - 2/28/2007	125.4	5.2	11.0	53.1	7.0
4/1/2006 - 3/31/2007	123.8	5.2	11.0	53.1	10.0
5/1/2006 - 4/30/2007	125.4	5.2	11.0	53.1	10.0
6/1/2006 - 5/31/2007	126.1	5.2	11.0	53.1	7.5
7/1/2006 - 6/30/2007	153.0	5.1	11.0	53.1	6.5
8/1/2006 - 7/31/2007	153.4	5.1	11.0	53.1	6.4
9/1/2006 - 8/31/2007	143.6	5.0	11.0	53.1	6.4
10/1/2006 - 9/30/2007	**120.8**	**4.8**	**11.0**	**53.1**	**4.6**
11/1/2006 - 10/30/2007	150.5	4.8	11.0	53.1	4.2
12/1/2006 - 11/30/2007	155.8	4.8	11.0	53.1	4.3
1/1/2007 - 12/31/2007	154.8	4.7	11.0	53.1	2.3

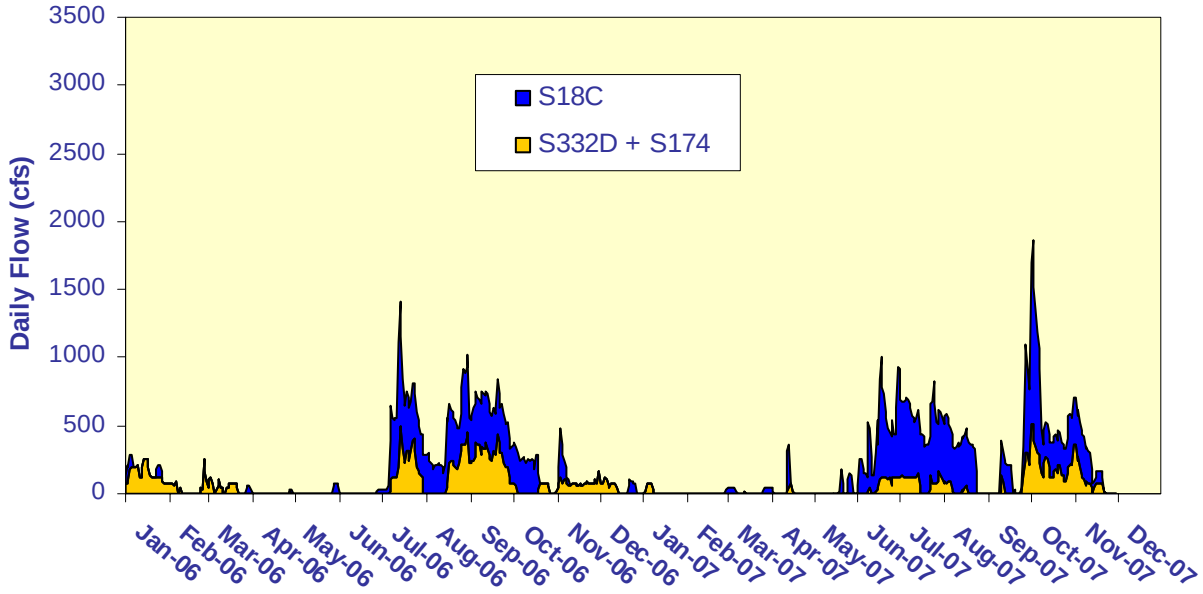

Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C.

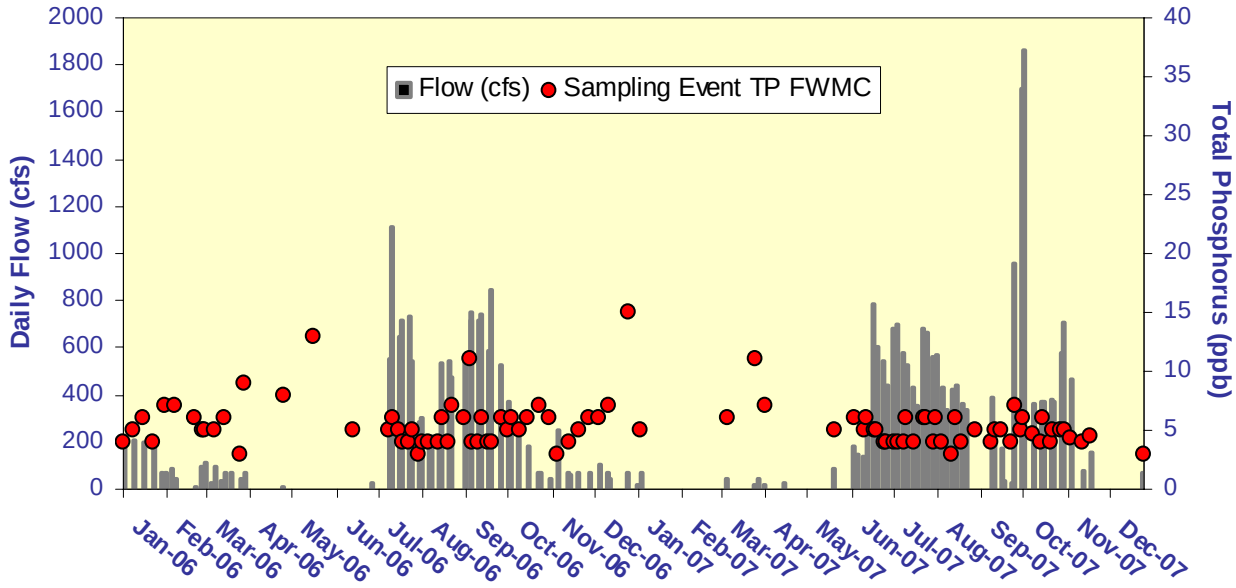

Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Settlement Agreement
January - March 2008 Report

Prepared for the
Technical Oversight Committee
May 14, 2008

Prepared by:
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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 total phosphorus (TP) concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by February 1, 1999, and December 31, 2006, respectively. Both the interim and long–term 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 in National Geodetic Vertical Datum of 1929 (NGVD29). The monthly TP 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 16.68, 16.55 and 16.54 feet in January, February, and March 2008, respectively (**Figure 2** and **Table 1**). The geometric means, calculated from TP concentrations measured in water samples collected in January, February, and March 2008 were 6.3, 7.6 and 6.7 ppb, respectively. The geometric means were lower than the long-term levels, which became effective on December 31, 2006, for the months of January, February, and March 2008.

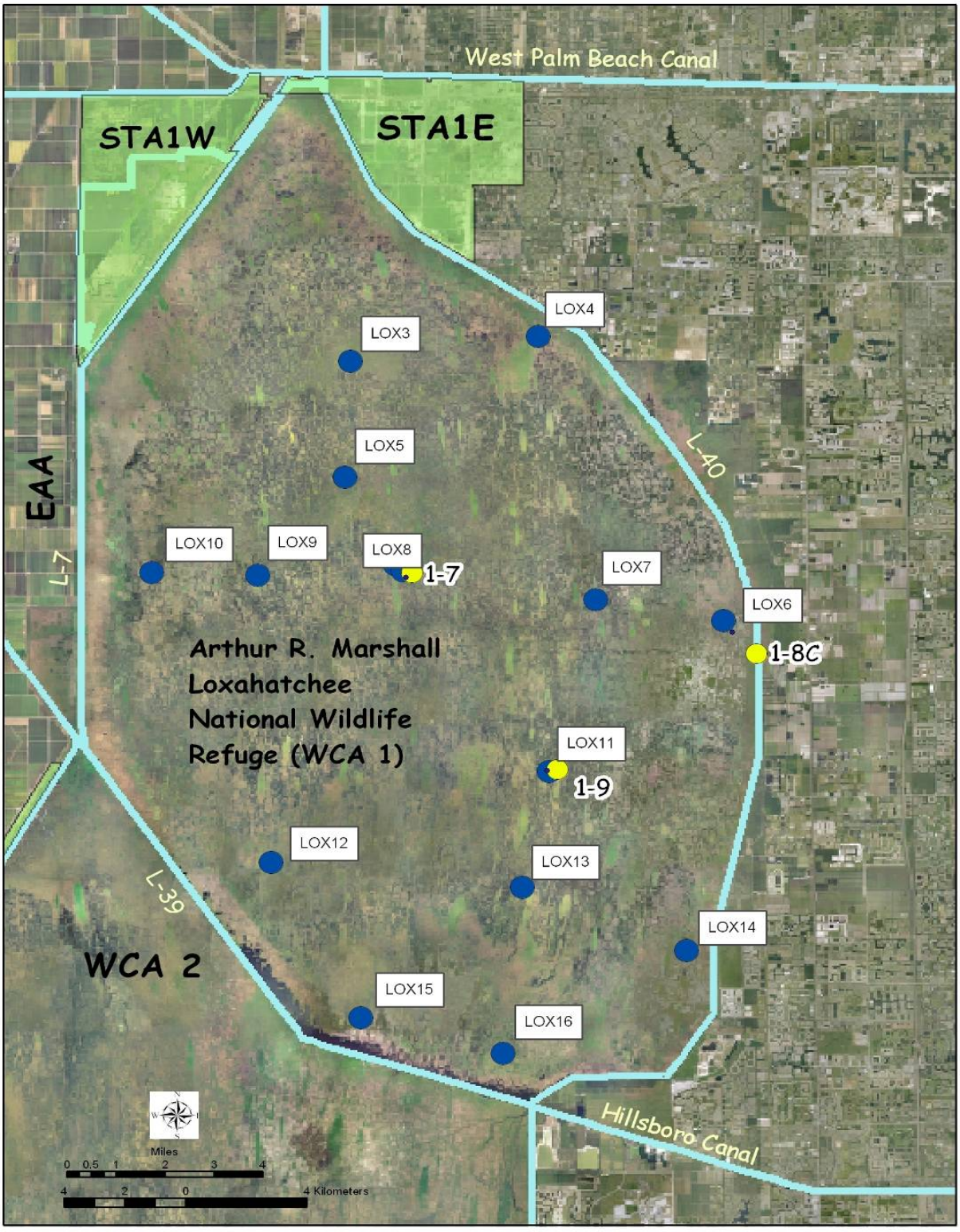

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

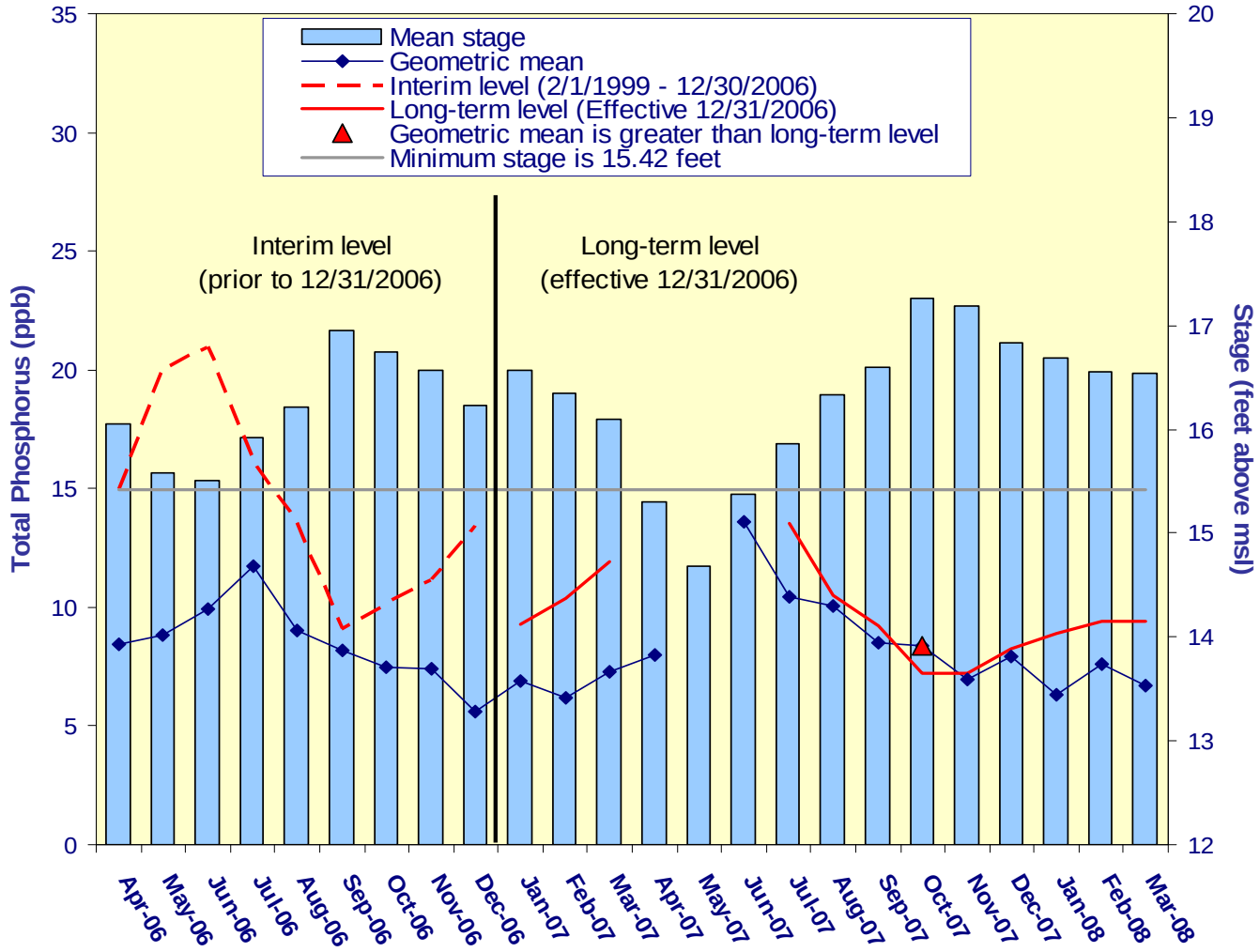

Figure 2. Monthly TP geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated concentration levels are adjusted for fluctuations in stage. The long-term levels were not applicable for April 2007 through June 2007 because the average stage was less than 15.42 feet.

Table 1. Loxahatchee National Wildlife Refuge TP Compliance Tracking.

Month - Year	Geometric Mean Concentration (ppb)	Interim Level[a] (ppb) Effective 2/1/99-12/30/06	Long-Term Level[a] (ppb) Effective 12/31/06	Average Stage[b] (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
Apr-2006	8.4	14.9	12.2	16.05	12	3
May-2006	8.8	20.1	15.9	15.58	10	3
Jun-2006	9.9	21.0	16.5	15.51	5	3
Jul-2006	11.7	16.1	13.0	15.92	9	3
Aug-2006	9.0	13.5	11.1	16.22	11	3
Sep-2006	8.2	9.1	7.8	16.96	14	3
Oct-2006	7.5	10.1	8.6	16.74	14	3
Nov-2006	7.4	11.1	9.4	16.56	14	3
Dec-2006	5.6	13.4	11.0	16.23	11	3
Jan-2007	6.9	11.1	9.3	16.57	14	3
Feb-2007	6.2	12.6	10.4	16.34	13	3
Mar-2007	7.3	14.5	11.8	16.10	10	3
Apr-2007	8.0	N/A	N/A	15.30	3	3
May-2007	n/a	N/A	N/A	14.68	0	3
Jun-2007	13.6	N/A	N/A	15.37	4	3
Jul-2007	10.4	16.8	13.5	15.86	13	3
Aug-2007	10.1	12.7	10.5	16.33	13	3
Sep-2007	8.5	10.9	9.2	16.59	14	3
Oct-2007	**8.4**	**8.3**	**7.2**	**17.26**	**14**	**3**
Nov-2007	7.0	8.3	7.2	17.19	14	3
Dec-2007	7.9	9.6	8.2	16.84	14	3
Jan-2008	6.3	10.5	8.9	16.68	14	3
Feb-2008	7.6	11.2	9.4	16.55	14	3
Mar-2008	6.7	11.2	9.4	16.54	14	3

[a] *N/A denotes that the level was not applicable because the average stage was less than 15.42 feet.*
[b] *Average stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 on the sampling dates.*

Notes: Highlighted row indicates the month (October 2007) when an excursion over the long-term level occurred.

EVERGLADES NATIONAL PARK

Shark River Slough

The Consent Decree of 1995 specified that interim and long-term total phosphorus (TP) concentration limits for discharges into the Everglades National Park (ENP) (**Figure 3**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the TP concentrations be presented as 12-month flow-weighted means. Only the TP concentrations for the water year ending September 30th are evaluated for compliance with the Consent Decree limits. The long-term TP 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 TP 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 2007 (**Figure 4**). The 12-month flow-weighted mean TP concentration for October 2006 through September 2007 was 9.8 ppb. The corresponding long-term limit, which became effective on December 31, 2006, was 11.8 ppb (**Table 2**).

Table 2 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding interim and long-term TP concentration limits, calculated using the 12-month period flow. Supplemental water quality samples were collected at some of the Shark River Slough monitoring sites from January 2006 through September 2007, but only the bi-weekly compliance monitoring grab concentration data were used for flow-weighted mean TP concentration calculations. Routine monitoring was changed to weekly[1] for all Shark River Slough sites beginning in October 2007. In accordance with Appendix A of the Consent Decree, only the every-other-week grab concentration data were used for the flow-weighted mean calculations for January through March 2008[2]. For the 12-month periods ending in January, February, and March 2008, the 12-month flow-weighted mean TP concentrations were 12.9, 12.9, and 12.8 ppb, respectively. The long-term limits were 12.9, 12.9 and 13.0 ppb, respectively. The 12-month flow-weighted mean TP concentrations were equal to or lower than the long-term limits for the months of January, February, and March 2008.

[1] *S12A and S333 are sampled weekly if flowing, otherwise monthly. S12B, S12C, and S12D are sampled weekly if flowing.*

[2] *Flow-weighted mean TP concentrations using all available weekly grab data instead of every-other-week grab data were 12.5, 12.6 12.4 ppb for January, February, and March 2008, respectively.*

The Consent Decree stipulates that the percentage of flow-weighted mean TP 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 2008, TP concentrations greater than 10 ppb were 69.2, 81.8 and 75.0 percent, respectively. The observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were the same as the guideline for January 2008 but more than the guidelines for February and March 2008 (**Table 2**). The 12-month flow-weighted mean TP concentrations and the flow-weighted mean TP concentrations for individual sampling events are presented in **Figure 5**.

The daily flows through the individual Shark River Slough structures from April 2006 through March 2008 are presented in **Figure 6**. There was very little flow through the system due to the drought condition during the first quarter of 2008. There was no flow at S12A, S12B, and S12C during the quarter. S12D was opened on February 26, 2008 and 3,273 acre-feet of water was discharged through the structure by the end of the quarter.

The stage levels at Water Conservation Area (WCA) 3A remained below the regulation schedule through the quarter and the S12s and S333 were utilized only to meet the target discharges described in the Shark River Slough "Rain Driven Water Deliveries to Everglades National Park" and S333 for water supply discharges to East Coast and ENP-South Dade Conveyance System. S333 started to discharge on January 23, 2008. A total of 6,846 acre-feet of water was discharged through the structure; 2,869 acre-feet was diverted to S334 during the quarter (**Figure 7**).

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean TP concentrations for individual sampling events is presented in **Figure 8**. Flow and TP concentrations for waters entering the ENP through Shark River Slough had been following an inverse relationship in previous periods. However, TP concentrations remained relatively low; the average of the sampling event flow-weighted mean TP concentrations during the quarter was 9 ppb.

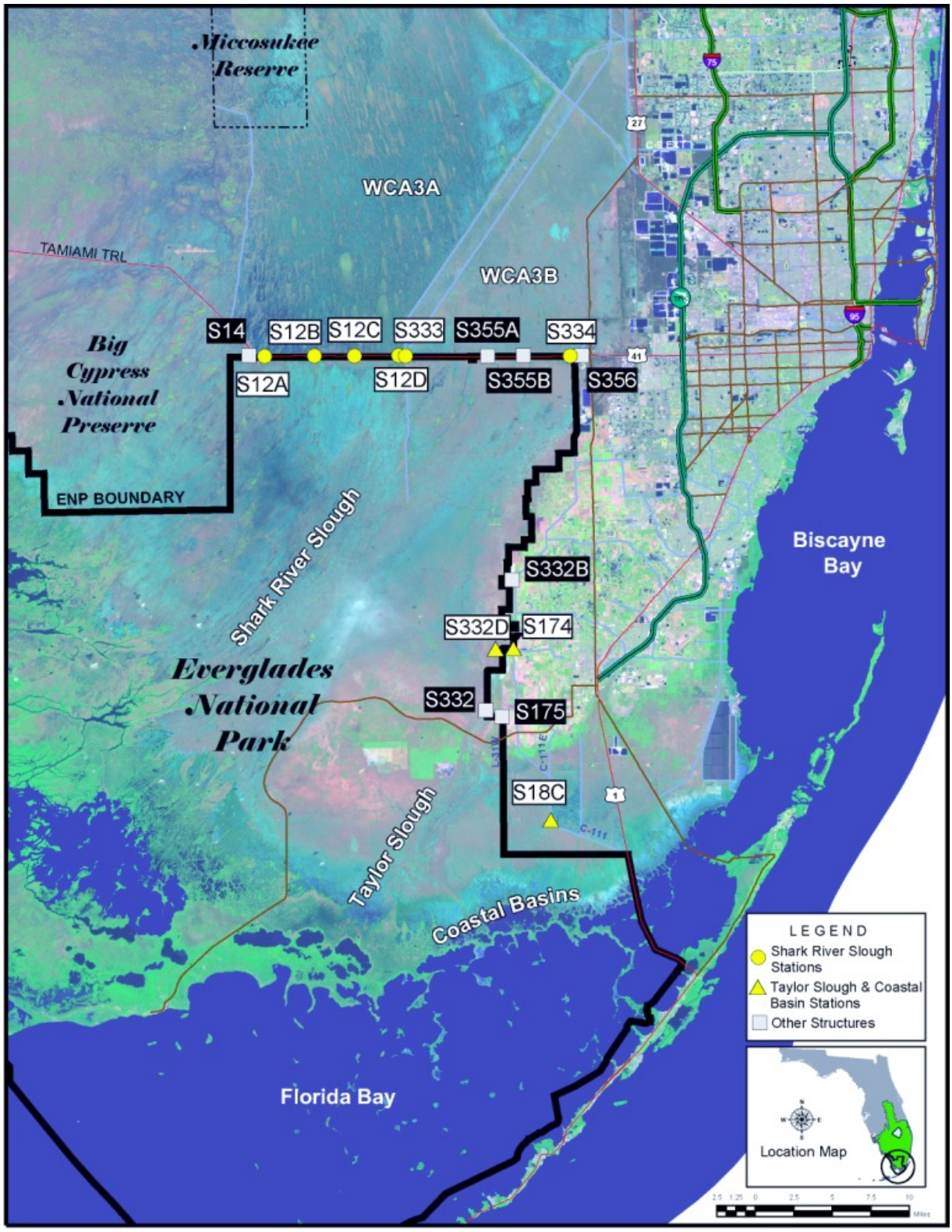

Figure 3. Everglades National Park flow structures

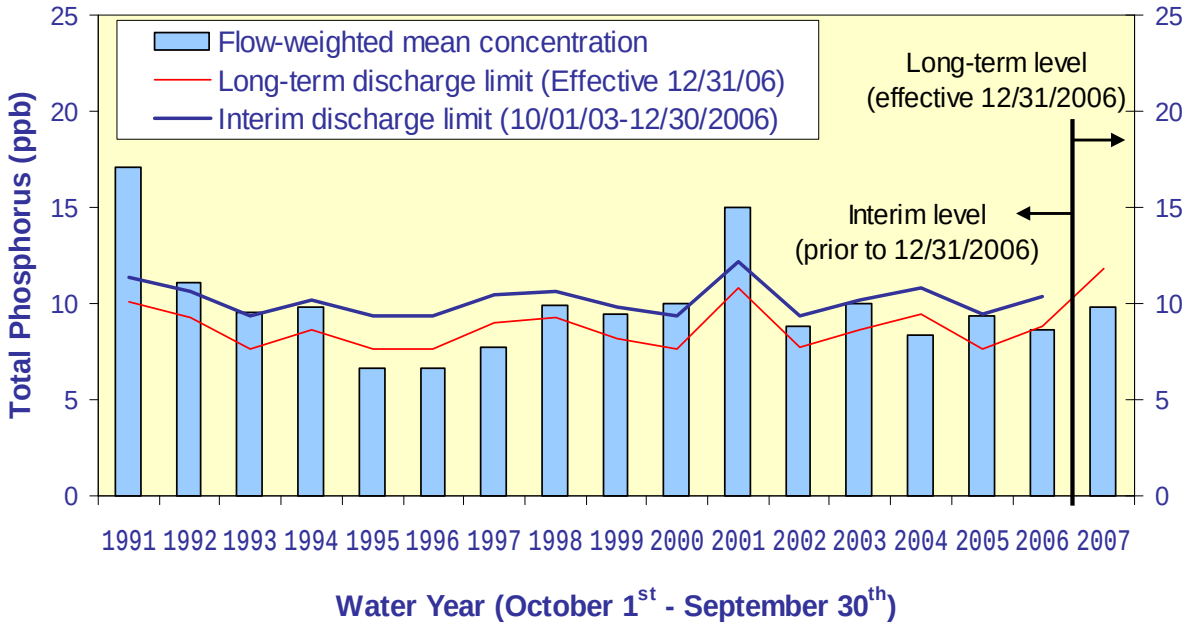

Figure 4. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the TP interim and long-term limits. The 12-month flow-weighted mean concentrations have met the interim limits since they became effective on October 1, 2003. In addition, the 12-month flow-weighted mean TP concentration for the compliance year through September 2007 was below the long-term limit, effective December 31, 2006.

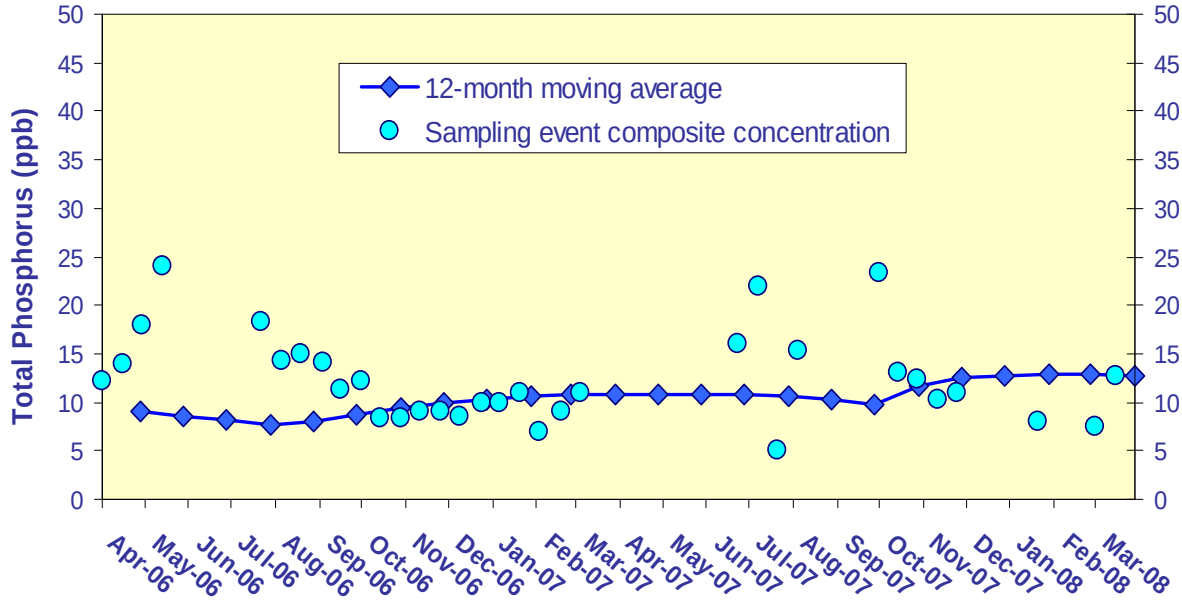

Figure 5. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for some months because there was little or no flow in those periods.

Table 2. Shark River Slough TP Concentration Compliance Tracking.

12-Month Period	Total Flow (kac-ft)	TP Flow Weighted Mean (ppb)	Interim Limit (ppb) Effective 10/1/03-12/30/06	Long-Term Limit (ppb) Effective 12/31/06	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
5/1/2005 - 4/30/2006	1436.1[a]	9.0	9.4	7.6	40.1	34.8
6/1/2005 - 5/31/2006	1395.5[a]	8.5	9.4	7.6	40.1	31.8
7/1/2005 - 6/30/2006	1326.6[a]	8.2	9.4	7.6	40.1	25.0
8/1/2005 - 7/31/2006	1113.3[a]	7.7	9.4	7.6	40.1	26.3
9/1/2005 - 8/31/2006	914.7[b]	8.1	9.9	8.3	43.5	36.8
10/1/2005 - 9/30/2006	***814.1***[b]	***8.7***	***10.3***	***8.8***	***46.0***	***45.0***
11/1/2005 - 10/31/2006	779.6[b]	9.5	10.5	9.0	46.9	***50.0***
12/1/2005 - 11/30/2006	642.8[b]	10.0	11.1	9.7	50.8	50.0
1/1/2006 - 12/31/2006	507.9[b]	10.3	11.8	10.5	55.0	50.0
2/1/2006 - 1/31/2007	446.1[b]	10.7	12.1	10.9	57.0	55.0
3/1/2006 - 2/28/2007	442.4[c]	10.8	12.1	10.9	57.2	52.4
4/1/2006 - 3/31/2007	456.0[c]	10.8	12.0	10.8	56.7	***57.1***
5/1/2006 - 4/30/2007	449.5[c]	10.8	12.1	10.8	56.9	52.6
6/1/2006 - 5/31/2007	445.5[c]	10.7	12.1	10.9	57.1	47.1
7/1/2006 - 6/30/2007	447.6[c]	10.8	12.1	10.8	57.0	50.0
8/1/2006 - 7/31/2007	444.6[c]	10.6	12.1	10.9	57.1	47.4
9/1/2006 - 8/31/2007	401.0	10.3	12.3	11.1	58.6	44.4
10/1/2006 - 9/30/2007	**289.7**	**9.8**	**13.0**	**11.8**	**62.6**	**37.5**
11/1/2006 - 10/31/2007	147.9	11.7	13.8	12.7	67.9	50.0
12/1/2006 - 11/30/2007	121.2	12.6	13.9	12.8	68.9	62.5
1/1/2007 - 12/31/2007	118.2	12.8	14.0	12.8	69.1	***71.4***
2/1/2007 - 1/31/2008	115.8	12.9[d]	14.0	12.9	69.2	69.2
3/1/2007 - 2/29/2008	106.8	12.9[d]	14.0	12.9	69.5	***81.8***
4/1/2007 - 3/31/2008	88.9	12.8[d]	14.1	13.0	70.2	***75.0***

[a] *Flow of 1.82 kac-ft in February 2006 at S355A and S355B was included for the 12-month total flows.*

[b] *Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows in addition to the flow of 1.82 kac-ft in February 2006 at S355A and S355B structures.*

[c] *Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows.*

[d] *Flow-weighted mean TP concentrations using all available weekly grab data instead of every-other-week grab data were 12.5, 12.6, and 12.4 ppb for January, February, and March 2008, respectively.*

Notes: 1) Highlighted rows indicate the end of the water year, which are the compliance points.
2) Bold italicized values exceeded the guideline percentages.

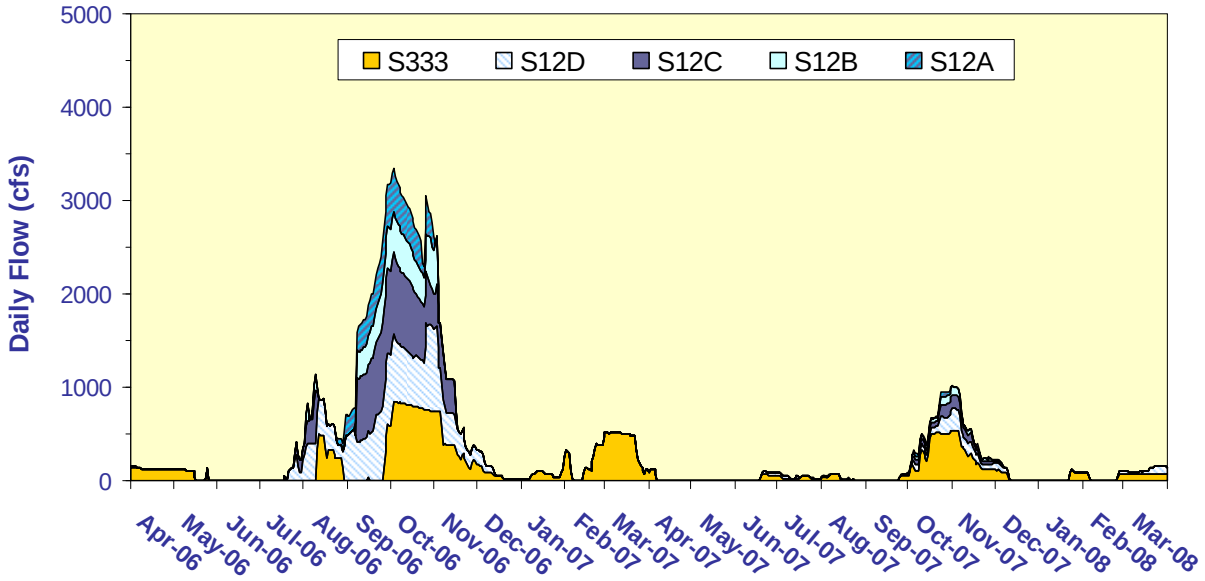

Figure 6. Daily flows into Shark River Slough by structure.

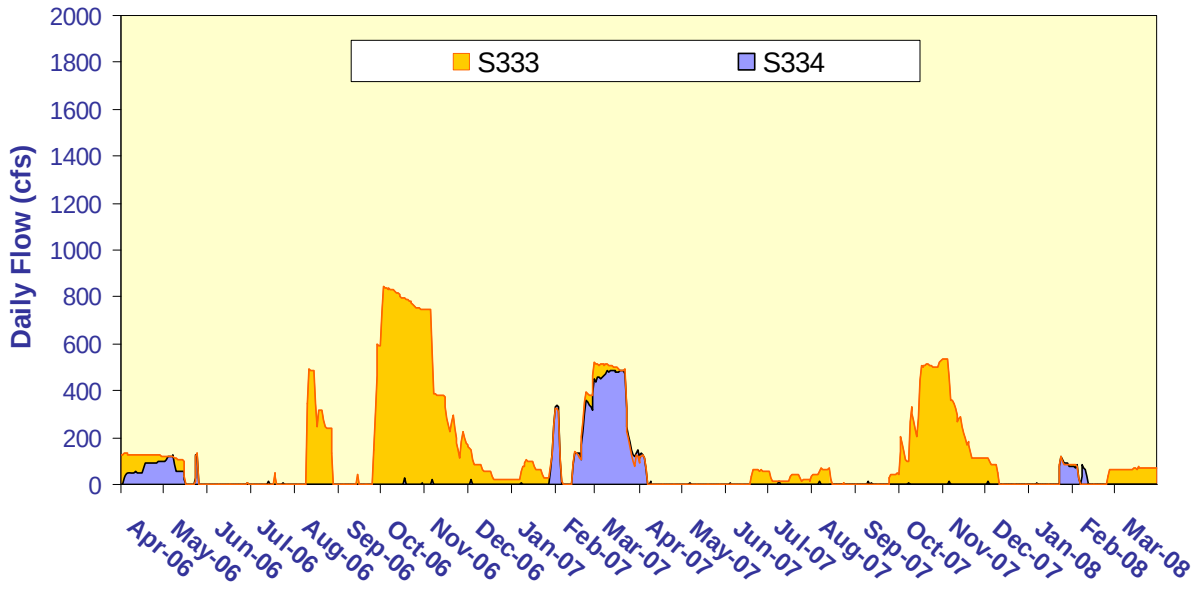

Figure 7. Daily flows comparison between S333 and S334

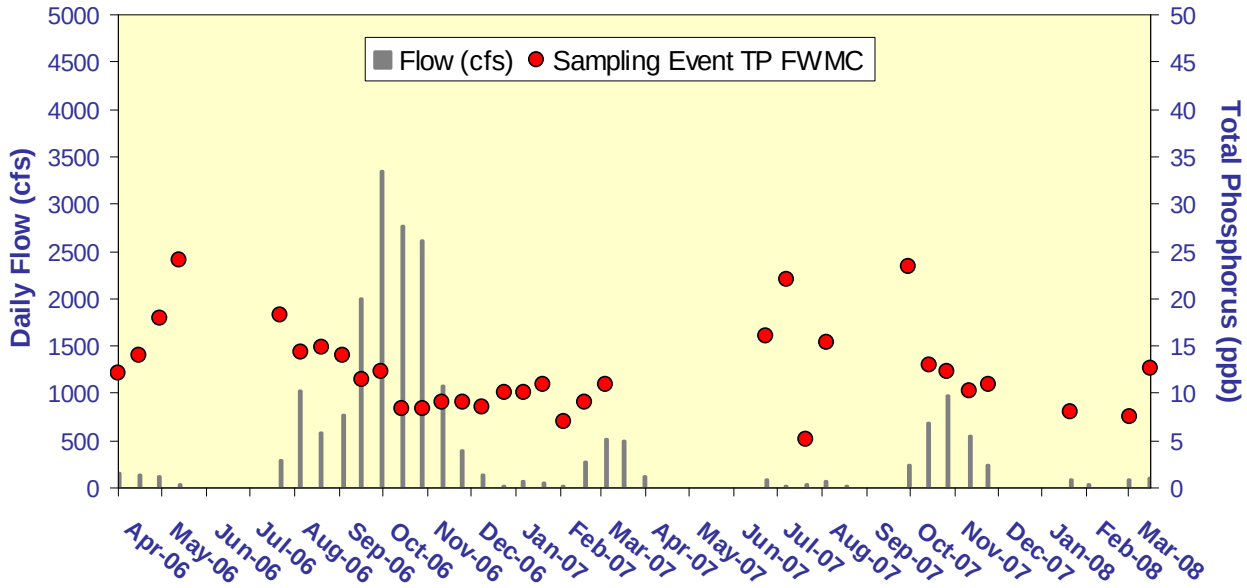

Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Taylor Slough and the Coastal Basins

Under the Consent Decree, a single total phosphorus (TP) 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 12-month flow-weighted mean concentrations have consistently been lower than the long-term limit of 11 ppb.

C-111 Project Structures and Detention Areas

Beginning in August 1999, structure S332D, a 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, Cell 1 through Cell 5, a connector cell between Cell 2 and Cell 3, a flow way cell originating at Berm 3 of Cell 5, and four diversion structures, DS1 through DS4 (**Figure 9**). The flow way cell is the only location to routinely discharge surface water into 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, has implemented 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 District started the routine sampling in September 2003.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. The diversion structures DS2 and DS4 would discharge into the ENP if utilized. Overflows periodically occurred at DS2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports.

Discharges from the diversion structures DS1 and DS3 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 groundwater seepage in an easterly direction from ENP.

S332B West was off-line and therefore Cell 2 received no discharge during the reporting quarter.

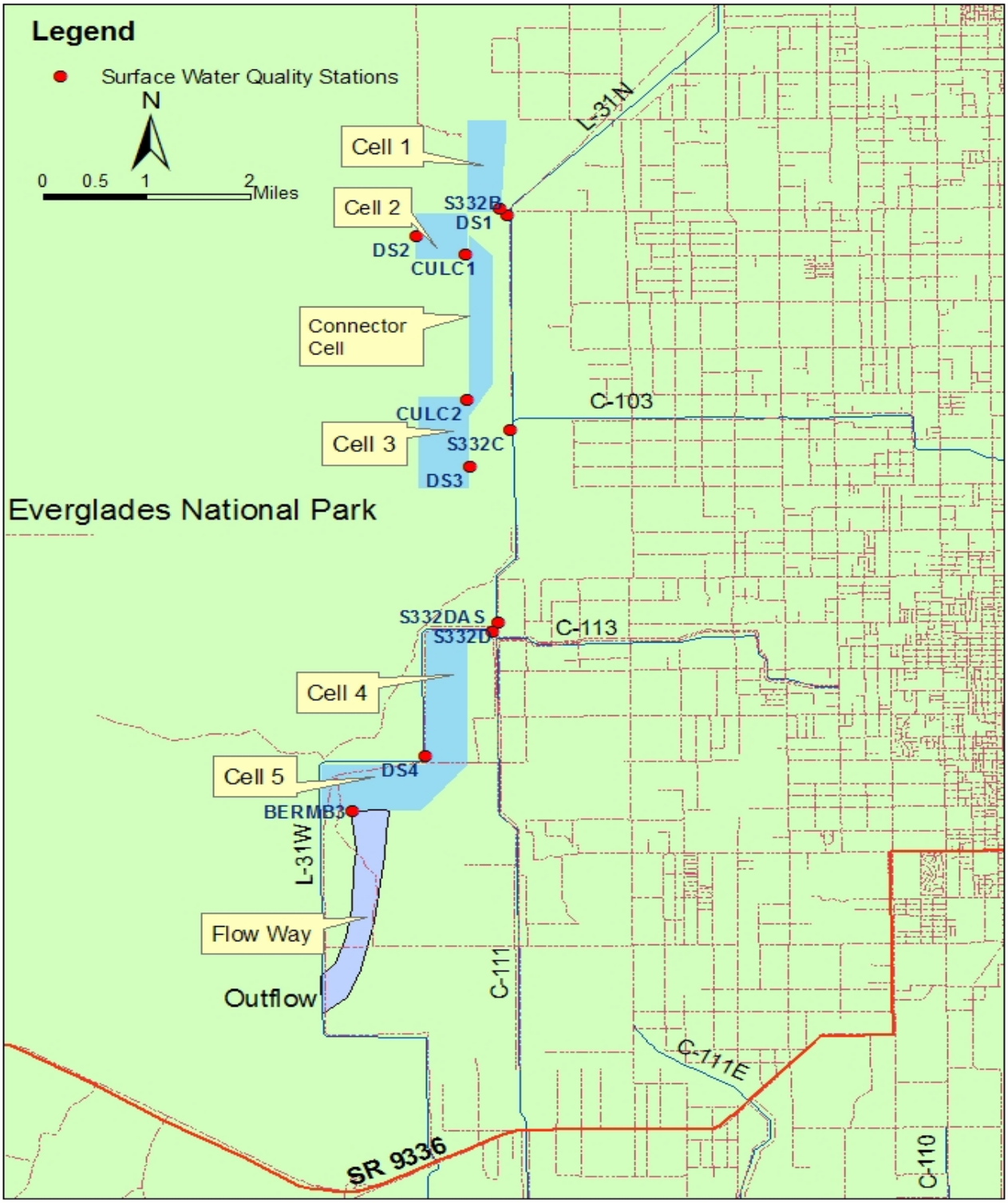

Figure 9. C-111 Project facilities.

Compliance with Consent Decree

Inflow TP concentrations to the ENP 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 10**). The bars in **Figure 10** represent the 12-month flow-weighted mean TP concentrations from S332, S175 and S18C for water years 1989 through 2002. The diamond point values for water years 1999 through 2007 represent the new combination of structures.

TP and flow data from both sets of structures presented in prior editions of this report through December 2001 (April 2002 report) showed that, beginning in 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 TP 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 10.** However, there had been almost no flow at S174 since March 2006. The site was plugged in September 2007, preventing any flow through S174.

Figure 11 presents the 12-month and individual sampling event flow-weighted mean TP concentrations at the S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the 3 sites were used for the compliance calculations.

For the 12-month periods ending in January, February, and March 2008, the 12-month flow-weighted mean TP concentration was 4.6 ppb for the combined flow through S332D and S18C (**Table 3**). The Consent Decree stipulates that the percent of flow-weighted mean TP 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 observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb for the combined flow through S332D and S18C were 2.6 and 2.5 percent for the periods ending in January and February 2008, respectively. There was no sampling event flow-weighted mean TP concentration greater than 10 ppb from April 2007 to March 2008.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 12**. There was almost no flow at S332D (9 acre-feet) and little flow at S18C (2,489 acre-feet). **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event. The sampling event flow-weighted mean concentrations remained very low, 3 to 10 ppb, since April 2007.

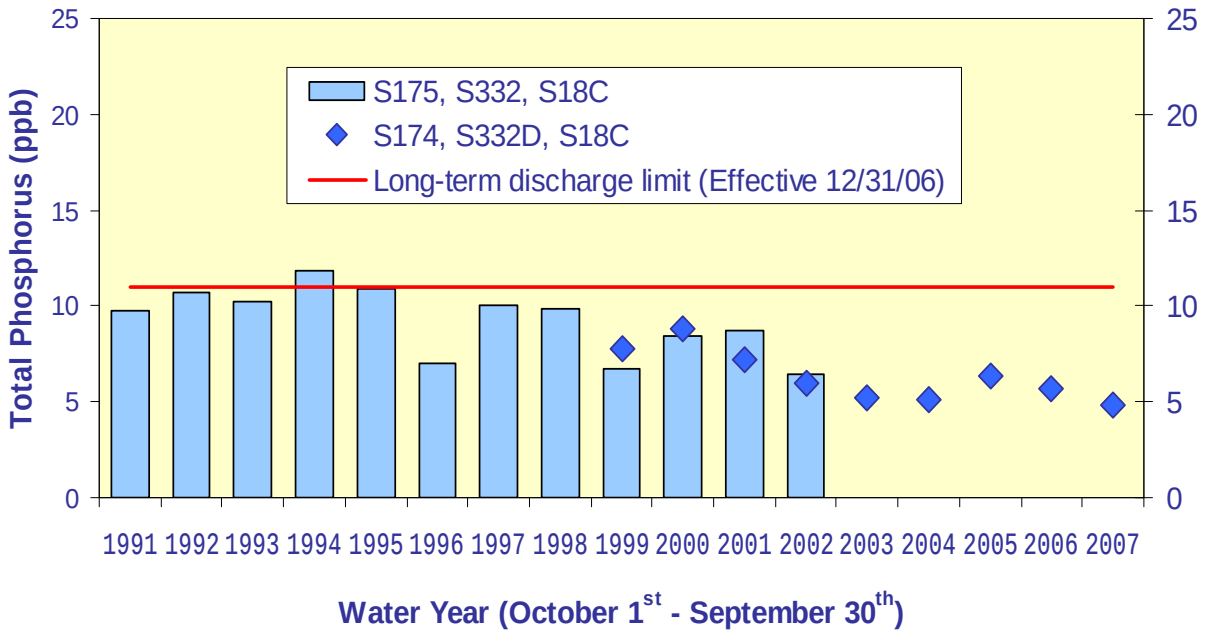

Figure 10. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term TP limit.

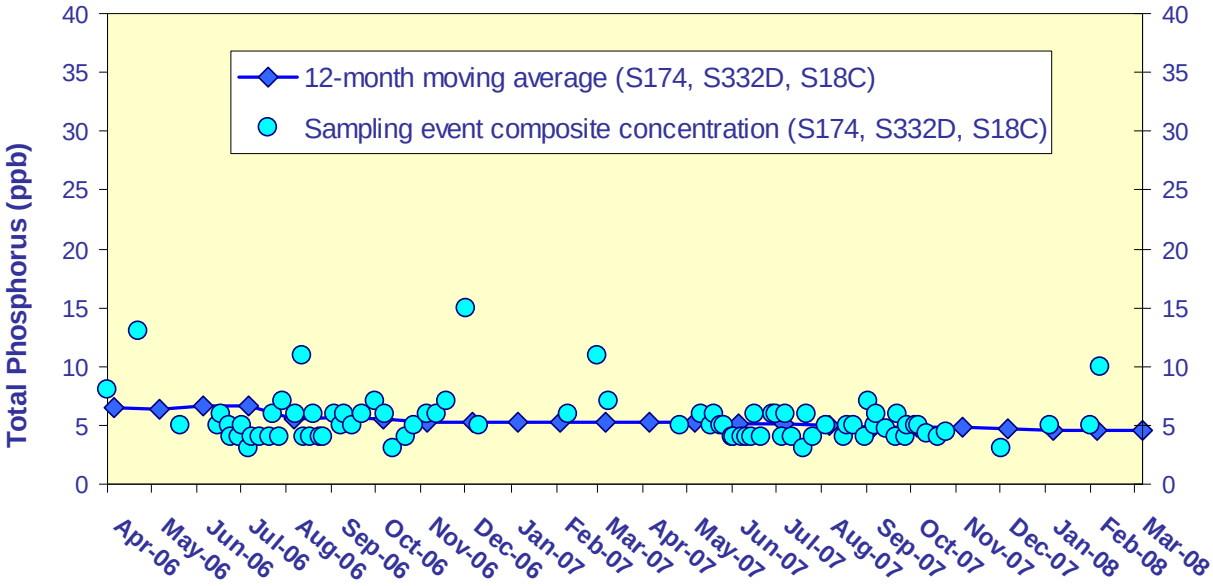

Figure 11. 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean TP concentration for each sampling event.

Table 3. Taylor Slough and the Coastal Basins TP Concentration Compliance Tracking.

12-Month Period	Total Flow (kac-ft)	TP Flow Weighted Mean (ppb)	Long-Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
5/1/2005 - 4/30/2006	351.5	6.5	11.0	53.1	10.4
6/1/2005 - 5/31/2006	343.7	6.4	11.0	53.1	4.5
7/1/2005 - 6/30/2006	295.5	6.7	11.0	53.1	4.9
8/1/2005 - 7/31/2006	280.0	6.6	11.0	53.1	4.5
9/1/2005 - 8/31/2006	227.0	5.5	11.0	53.1	2.2
10/1/2005 - 9/30/2006	**207.4**	**5.7**	**11.0**	**53.1**	**4.1**
11/1/2005 - 10/31/2006	179.5	5.6	11.0	53.1	3.9
12/1/2005 - 11/30/2006	158.8	5.3	11.0	53.1	3.9
1/1/2006 - 12/31/2006	137.4	5.2	11.0	53.1	6.0
2/1/2006 - 1/31/2007	127.6	5.2	11.0	53.1	6.4
3/1/2006 - 2/28/2007	125.4	5.2	11.0	53.1	7.0
4/1/2006 - 3/31/2007	123.8	5.2	11.0	53.1	10.0
5/1/2006 - 4/30/2007	125.4	5.2	11.0	53.1	10.0
6/1/2006 - 5/31/2007	126.1	5.2	11.0	53.1	7.5
7/1/2006 - 6/30/2007	153.0	5.1	11.0	53.1	6.5
8/1/2006 - 7/31/2007	153.4	5.1	11.0	53.1	6.4
9/1/2006 - 8/31/2007	143.6	5.0	11.0	53.1	6.4
10/1/2006 - 9/30/2007	**120.8**	**4.8**	**11.0**	**53.1**	**4.6**
11/1/2006 - 10/30/2007	150.5	4.8	11.0	53.1	4.2
12/1/2006 - 11/30/2007	155.8	4.8	11.0	53.1	4.3
1/1/2007 - 12/31/2007	154.8	4.7	11.0	53.1	2.3
2/1/2007 - 1/31/2008	155.5	4.6	11.0	53.1	2.6
3/1/2007 - 2/29/2008	156.1	4.6	11.0	53.1	2.5
4/1/2007 - 3/31/2008	155.4	4.6	11.0	53.1	0.0

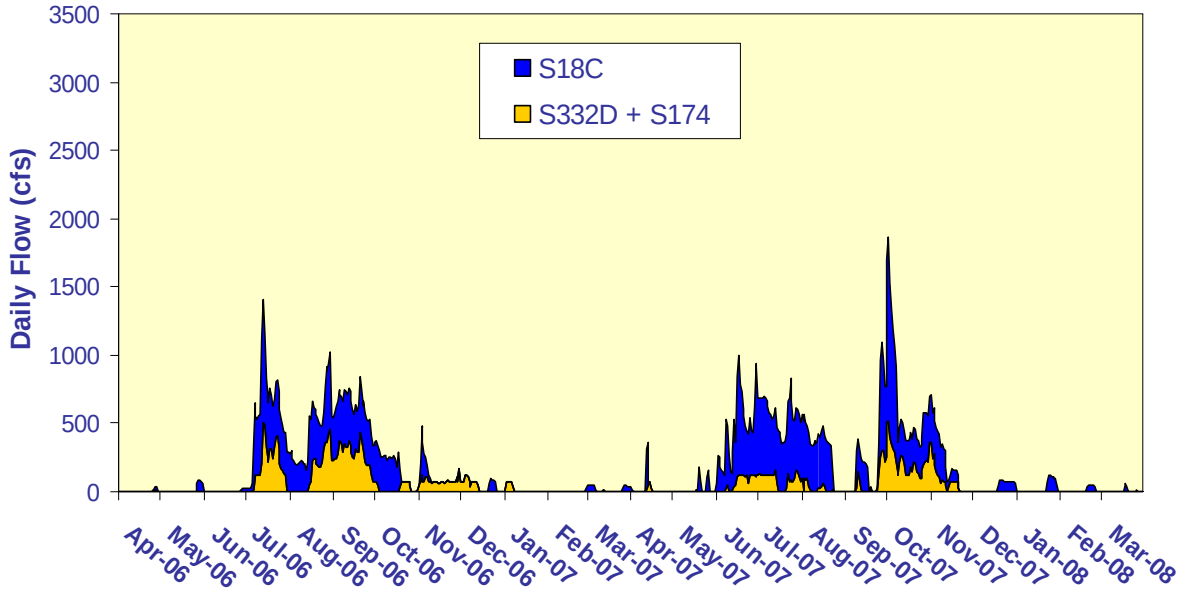

Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C; S174 was plugged in September 2007.

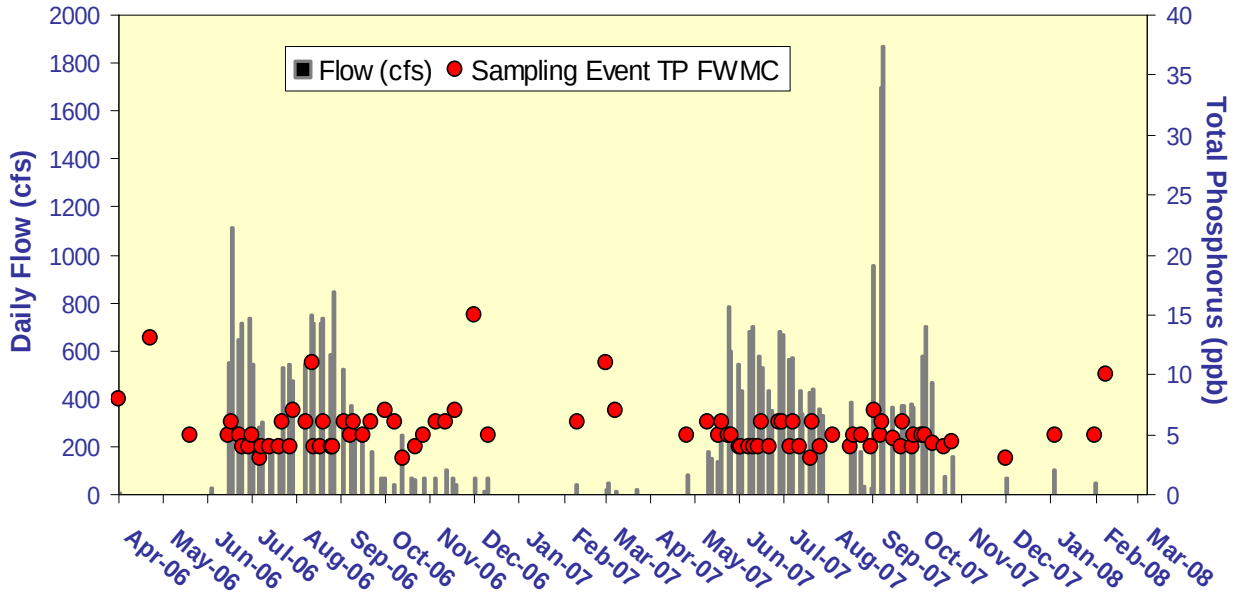

Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Settlement Agreement
April - June 2008 Report

Prepared for the
Technical Oversight Committee
August 15, 2008

Prepared by:
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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 total phosphorus (TP) concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by February 1, 1999, and December 31, 2006, respectively. Both the interim and long–term 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 in National Geodetic Vertical Datum of 1929 (NGVD29). The monthly TP 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 16.36, 15.76 and 15.68 feet in April, May, and June 2008, respectively (**Figure 2** and **Table 1**). The geometric means, calculated from TP concentrations measured in water samples collected in April, May, and June 2008 were 5.8, 9.1 and 8.9 parts per billion (ppb), respectively. The geometric means were lower than the long-term levels, which became effective on December 31, 2006, for the months of April, May, and June 2008. Because the total depth was less than 0.1 meter (m), no water samples were collected at stations LOX 3, 4, 5, 9, and 10 in May and June 2008; in addition, station LOX 6 was not sampled in June 2008.

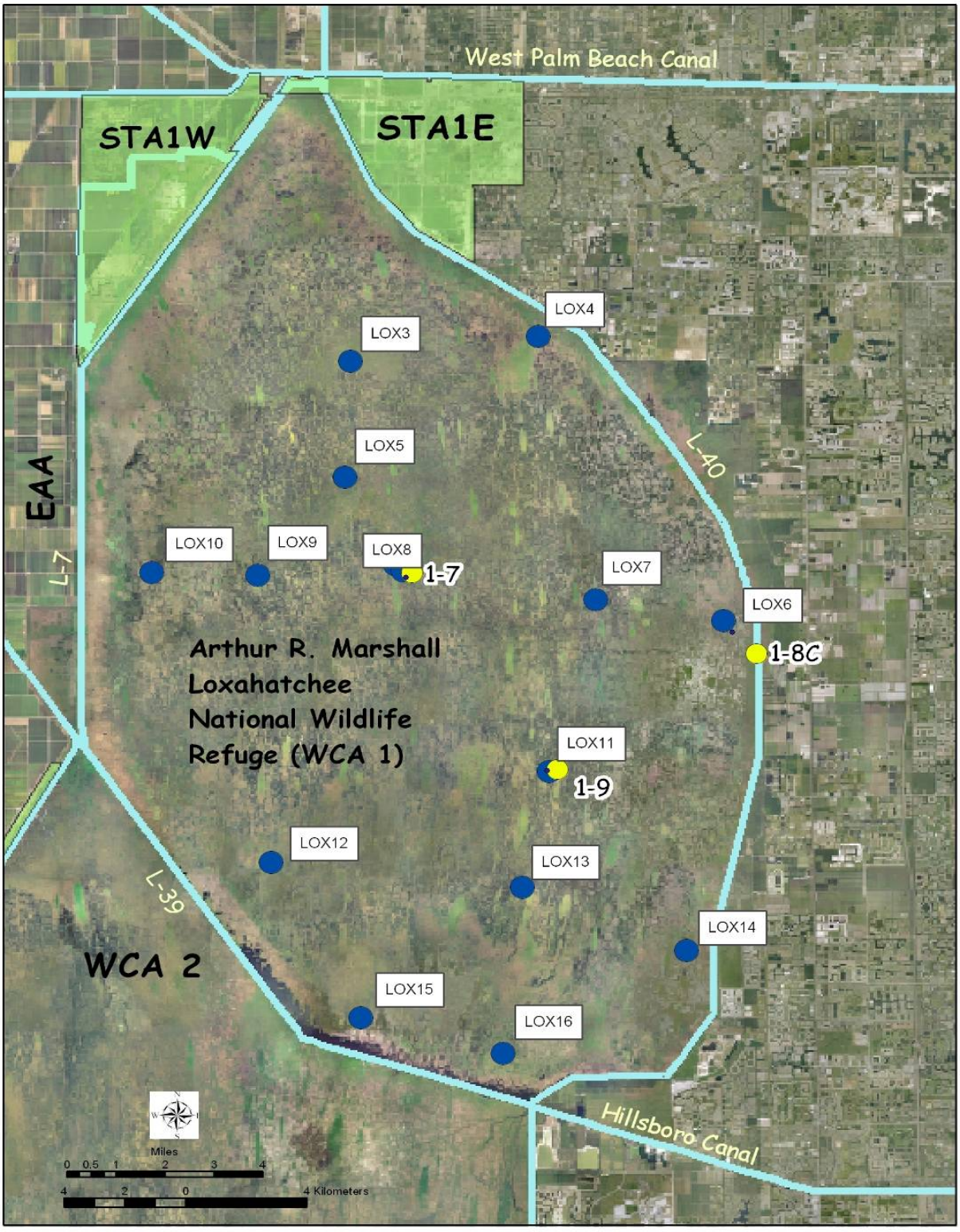

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

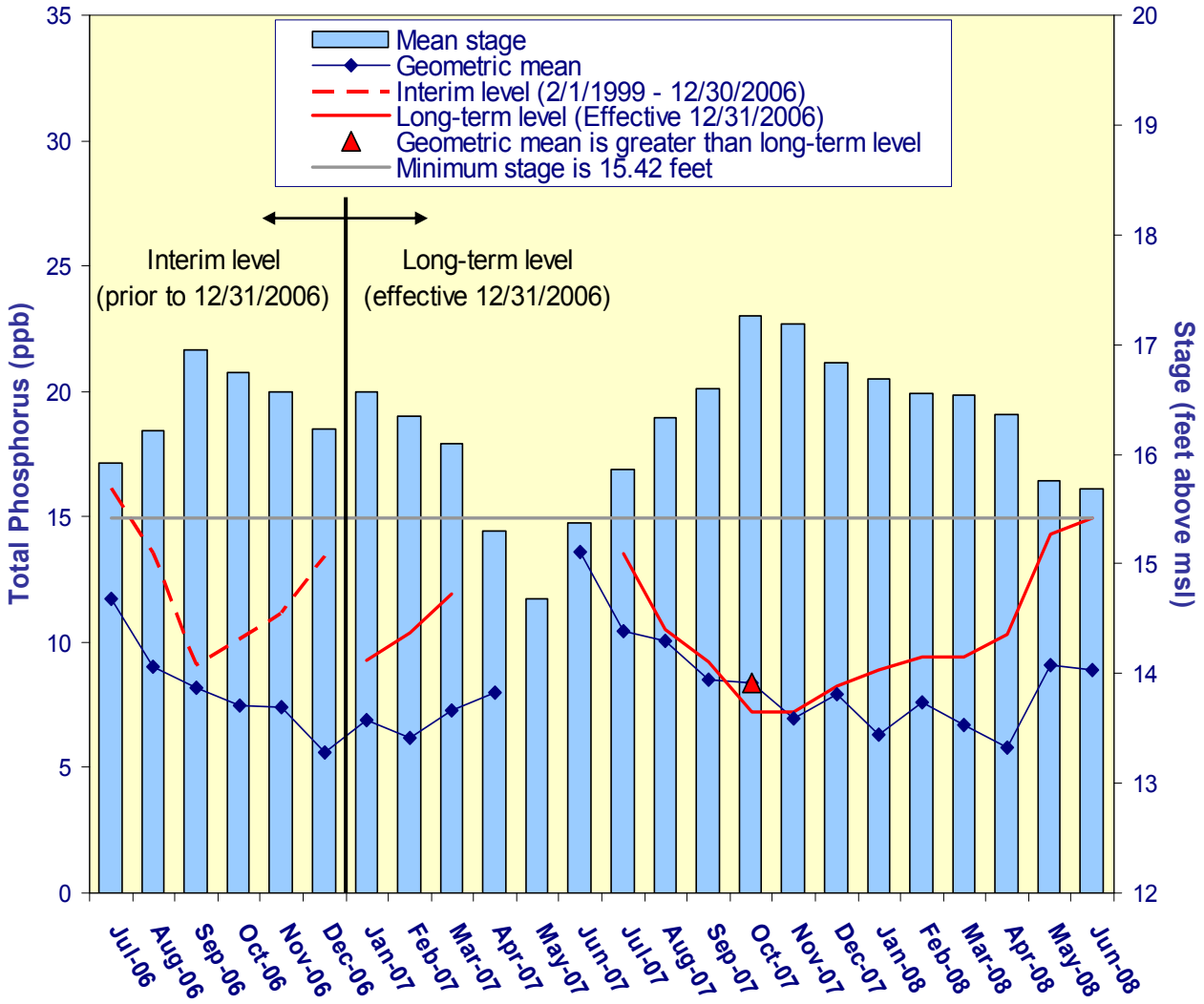

Figure 2. Monthly TP geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated concentration levels are adjusted for fluctuations in stage. The long-term levels were not applicable for April 2007 through June 2007 because the average stage was less than 15.42 feet. The geometric mean was greater than the long-term level in October 2007.

Table 1. Loxahatchee National Wildlife Refuge TP Compliance Tracking.

Month - Year	Geometric Mean Concentration (ppb)	Interim Level[a] (ppb) Effective 2/1/99-12/30/06	Long-Term Level[a] (ppb) Effective 12/31/06	Average Stage[b] (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
Jul-2006	11.7	16.1	13.0	15.92	9	3
Aug-2006	9.0	13.5	11.1	16.22	11	3
Sep-2006	8.2	9.1	7.8	16.96	14	3
Oct-2006	7.5	10.1	8.6	16.74	14	3
Nov-2006	7.4	11.1	9.4	16.56	14	3
Dec-2006	5.6	13.4	11.0	16.23	11	3
Jan-2007	6.9	11.1	9.3	16.57	14	3
Feb-2007	6.2	12.6	10.4	16.34	13	3
Mar-2007	7.3	14.5	11.8	16.10	10	3
Apr-2007	8.0	N/A	N/A	15.30	3	3
May-2007	n/a	N/A	N/A	14.68	0	3
Jun-2007	13.6	N/A	N/A	15.37	4	3
Jul-2007	10.4	16.8	13.5	15.86	13	3
Aug-2007	10.1	12.7	10.5	16.33	13	3
Sep-2007	8.5	10.9	9.2	16.59	14	3
Oct-2007	**8.4**	**8.3**	**7.2**	**17.26**	**14**	**3**
Nov-2007	7.0	8.3	7.2	17.19	14	3
Dec-2007	7.9	9.6	8.2	16.84	14	3
Jan-2008	6.3	10.5	8.9	16.68	14	3
Feb-2008	7.6	11.2	9.4	16.55	14	3
Mar-2008	6.7	11.2	9.4	16.54	14	3
Apr-2008	5.8	12.5	10.3	16.36	14	3
May-2008	9.1	17.9	14.3	15.76	9	3
Jun-2008	8.9	18.8	14.9	15.68	8	3

[a] *N/A denotes that the level was not applicable because the average stage was less than 15.42 feet.*
[b] *Average stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 on the sampling dates.*

Notes: Highlighted row indicates the month (October 2007) when an excursion over the long-term level occurred.

EVERGLADES NATIONAL PARK

Shark River Slough

The Consent Decree of 1995 specified that interim and long-term total phosphorus (TP) concentration limits for discharges into the Everglades National Park (ENP) (**Figure 3**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the TP concentrations be presented as 12-month flow-weighted means. Only the TP concentrations for the water year ending September 30th are evaluated for compliance with the Consent Decree limits. The long-term TP 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 TP 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 2007 (**Figure 4**). The 12-month flow-weighted mean TP concentration for October 2006 through September 2007 was 9.8 ppb. The corresponding long-term limit, which became effective on December 31, 2006, was 11.8 ppb.

Table 2 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding interim and long-term TP concentration limits, calculated using the 12-month period flow. Supplemental water quality samples were collected at some of the Shark River Slough monitoring sites from January 2006 through September 2007, but only the bi-weekly compliance monitoring grab concentration data were used for flow-weighted mean TP concentration calculations. Routine monitoring was changed to weekly[1] for all Shark River Slough sites beginning in October 2007. In accordance with Appendix A of the Consent Decree, only the every-other-week grab concentration data were used for the flow-weighted mean calculations from October 2007[2]. For the 12-month periods ending in April, May, and June 2008, the 12-month flow-weighted mean TP concentrations were 12.2, 12.0, and 11.7 ppb, respectively. The long-term limits were 12.9, 12.6 and 12.6 ppb, respectively. The 12-month flow-weighted mean TP concentrations were lower than the long-term limits for the months of April, May, and June 2008.

[1] *S12A and S333 are sampled weekly if flowing, otherwise monthly. S12B, S12C, and S12D are sampled weekly if flowing.*

[2] *The 12-month flow-weighted mean TP concentrations using all available weekly grab data instead of every-other-week grab data were 12.0, 11.9, and 11.7 ppb for April, May, and June 2008, respectively.*

The Consent Decree stipulates that the percentage of flow-weighted mean TP 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 April, May, and June 2008, the sampling event TP concentrations greater than 10 ppb were 73.3, 70.6 and 66.7 percent, respectively. The observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were more than the guidelines for April and May 2008 but less than the guideline for June 2008 (**Table 2**). The 12-month flow-weighted mean TP concentrations and the flow-weighted mean TP concentrations for individual sampling events are presented in **Figure 5**.

The daily flows through the individual Shark River Slough structures from July 2006 through June 2008 are presented in **Figure 6**.

The stage level at Water Conservation Area (WCA) 3A remained in Zone E1 of the Regulation Schedule throughout the quarter except for the brief period from late April to early May 2008 when it was in Zone C. The stage level rose to Zone D in late June 2008.

For additional information on the WCA 3A regulation schedule, please visit

http://www.saj.usace.army.mil/h2o/plots/wca3ahp.pdf

S12A, S12B, and S12C were closed during the reporting quarter except for the supplemental discharge at S12B from April 29 to May 7, 2008. The brief discharge at S12B followed the regulation schedule. S12D was utilized during most of the quarter. There was discharge throughout the quarter at S333 but almost none of the flow was diverted to S334 (**Figure 7**).

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean TP concentrations for individual sampling events is presented in **Figure 8**. Flow and TP concentrations for waters entering the ENP through Shark River Slough had been following an inverse relationship in previous periods. However, TP concentrations remained relatively stable during the quarter.

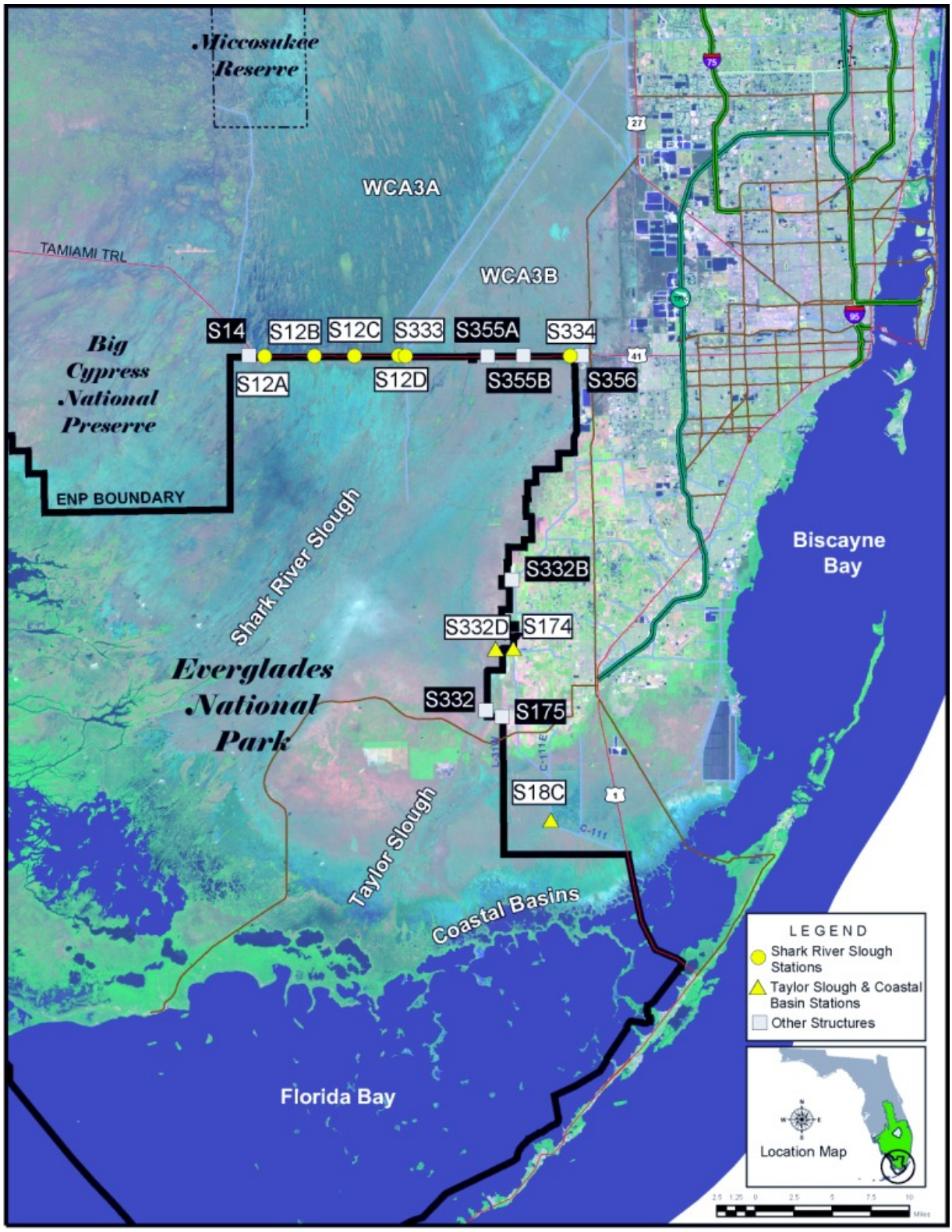

Figure 3. Everglades National Park flow structures

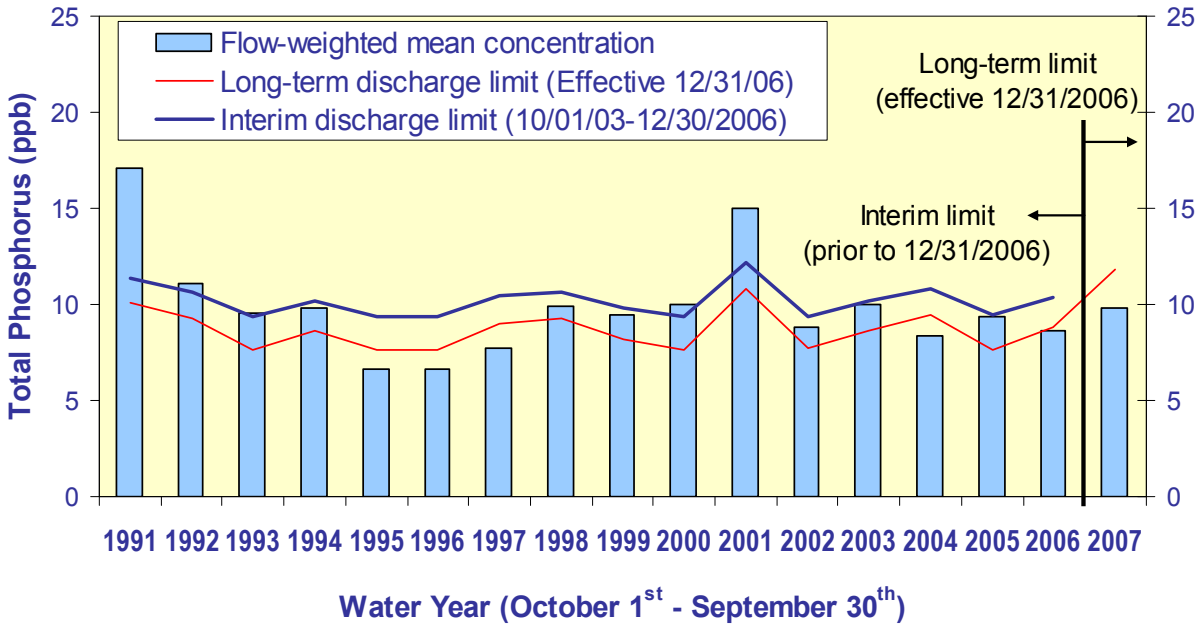

Figure 4. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the TP interim and long-term limits. The 12-month flow-weighted mean concentrations have met the interim limits since they became effective on October 1, 2003. In addition, the 12-month flow-weighted mean TP concentration for the compliance year through September 2007 was below the long-term limit, effective December 31, 2006.

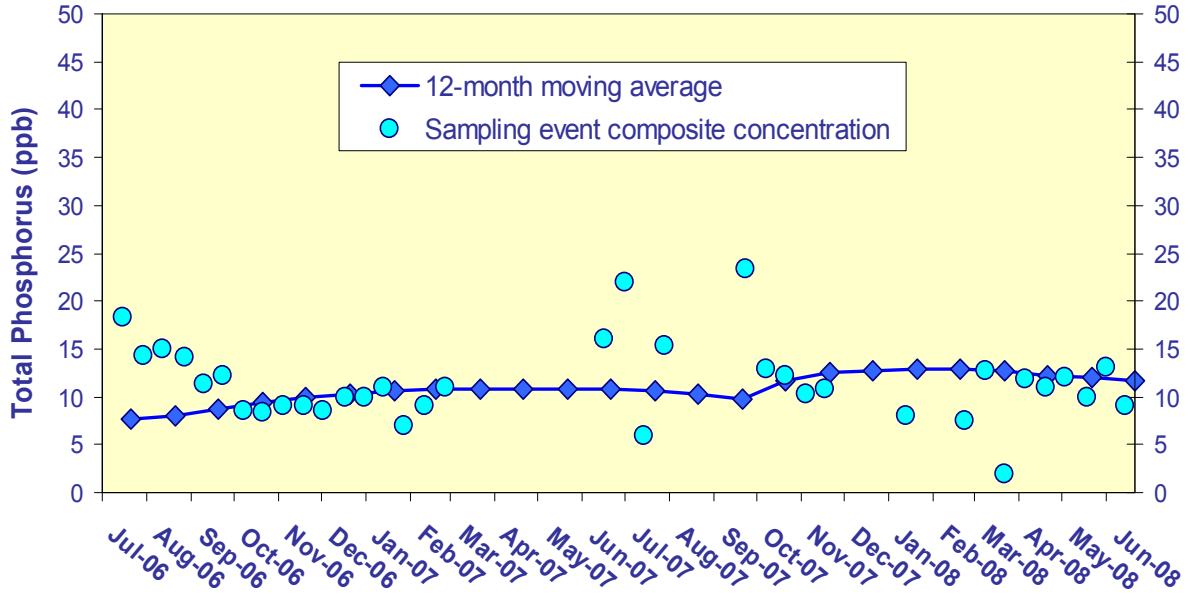

Figure 5. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for some months because there was little or no flow in those periods.

Table 2. Shark River Slough TP Concentration Compliance Tracking.

12-Month Period	Total Flow (kac-ft)	TP Flow Weighted Mean (ppb)	Interim Limit (ppb) Effective 10/1/03-12/30/06	Long-Term Limit (ppb) Effective 12/31/06	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
8/1/2005 - 7/31/2006	1113.3[a]	7.7	9.4	7.6	40.1	26.3
9/1/2005 - 8/31/2006	914.7[a,b]	8.1	9.9	8.3	43.5	36.8
10/1/2005 - 9/30/2006	**814.1[a,b]**	**8.7**	**10.3**	**8.8**	**46.0**	**45.0**
11/1/2005 - 10/31/2006	779.6[a,b]	9.5	10.5	9.0	46.9	***50.0***
12/1/2005 - 11/30/2006	642.8[a,b]	10.0	11.1	9.7	50.8	50.0
1/1/2006 - 12/31/2006	507.9[a,b]	10.3	11.8	10.5	55.0	50.0
2/1/2006 - 1/31/2007	446.1[a,b]	10.7	12.1	10.9	57.0	55.0
3/1/2006 - 2/28/2007	442.4[b]	10.8	12.1	10.9	57.2	52.4
4/1/2006 - 3/31/2007	456.0[b]	10.8	12.0	10.8	56.7	***57.1***
5/1/2006 - 4/30/2007	449.5[b]	10.8	12.1	10.8	56.9	52.6
6/1/2006 - 5/31/2007	445.5[b]	10.7	12.1	10.9	57.1	47.1
7/1/2006 - 6/30/2007	447.6[b]	10.8	12.1	10.8	57.0	50.0
8/1/2006 - 7/31/2007	444.6[b]	10.6	12.1	10.9	57.1	47.4
9/1/2006 - 8/31/2007	401.0	10.3	12.3	11.1	58.6	44.4
10/1/2006 - 9/30/2007	**289.7**	**9.8**	13.0	**11.8**	**62.6**	**37.5**
11/1/2006 - 10/31/2007	147.9	11.7	13.8	12.7	67.9	50.0
12/1/2006 - 11/30/2007	121.2	12.6	13.9	12.8	68.9	62.5
1/1/2007 - 12/31/2007	118.2	12.8	14.0	12.8	69.1	***71.4***
2/1/2007 - 1/31/2008	115.8	12.9	14.0	12.9	69.2	69.2
3/1/2007 - 2/29/2008	106.8	12.9	14.0	12.9	69.5	***81.8***
4/1/2007 - 3/31/2008	88.9	12.8	14.1	13.0	70.2	***75.0***
5/1/2007 - 4/30/2008	112.4	12.2[c]	14.0	12.9	69.3	***73.3***
6/1/2007 - 5/31/2008	149.5	12.0[c]	13.8	12.6	67.8	***70.6***
7/1/2007 - 6/30/2008	160.8	11.7[c]	13.7	12.6	67.4	66.7

[a] *Flow of 1.82 kac-ft in February 2006 at S355A and S355B was included for the 12-month total flows.*
[b] *Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows.*
[c] *Flow-weighted mean TP concentrations using all available weekly grab data instead of every-other-week grab data were 12.0, 11.9, and 11.7 ppb for April, May, and June 2008, respectively.*

Notes: 1) Highlighted rows indicate the end of the water year, which are the compliance points.
2) Bold italicized values exceeded the guideline percentages.

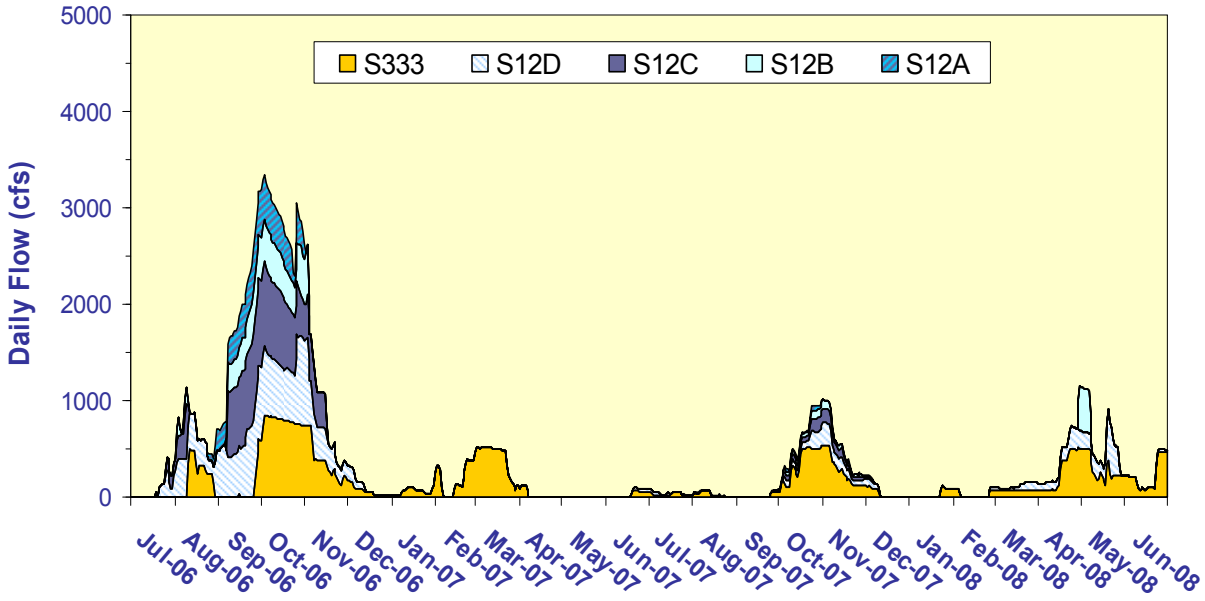

Figure 6. Daily flows into Shark River Slough by structure.

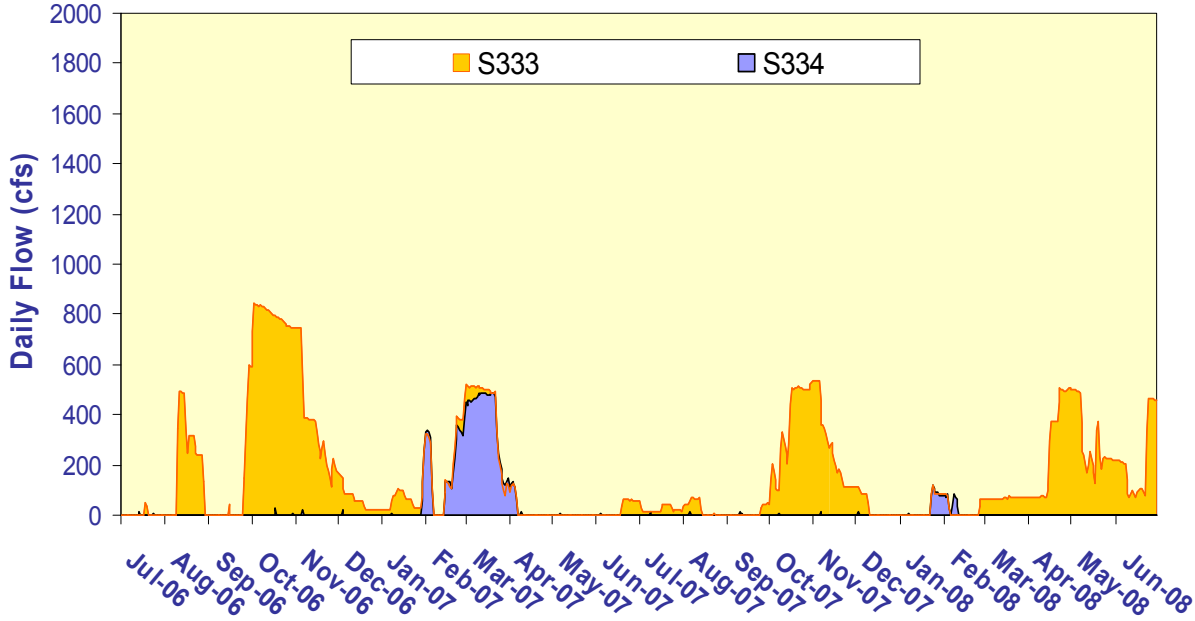

Figure 7. Daily flows comparison between S333 and S334

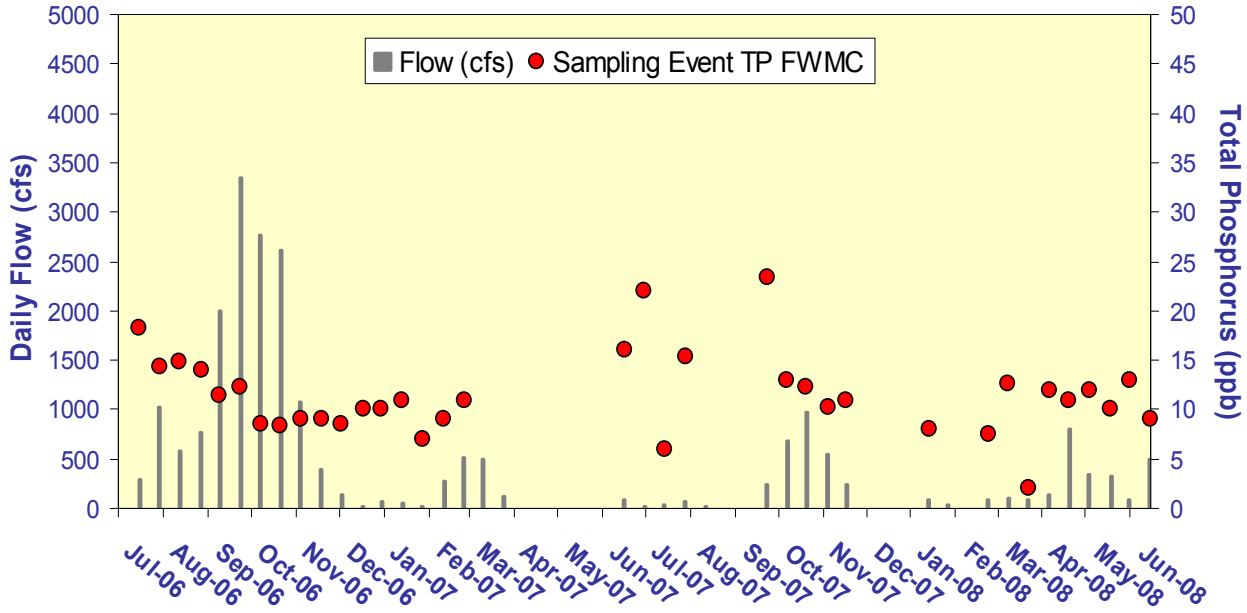

Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Taylor Slough and the Coastal Basins

Under the Consent Decree, a single total phosphorus (TP) 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 12-month flow-weighted mean concentrations have consistently been lower than the long-term limit of 11 ppb.

C-111 Project Structures and Detention Areas

Beginning in August 1999, structure S332D, a 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, Cell 1 through Cell 5, a connector cell between Cell 2 and Cell 3, a flow way cell originating at Berm 3 of Cell 5, and four diversion structures, DS1 through DS4 (**Figure 9**). The flow way cell is the only location to routinely discharge surface water into 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, has implemented 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 District started the routine sampling in September 2003.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. The diversion structures DS2 and DS4 would discharge into the ENP if utilized. Overflows periodically occurred at DS2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports.

Discharges from the diversion structures DS1 and DS3 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 groundwater seepage in an easterly direction from ENP.

S332B West (Cell 2) was off-line due to construction activities in the area during the reporting period and, therefore, there is no discharge information for the reporting quarter.

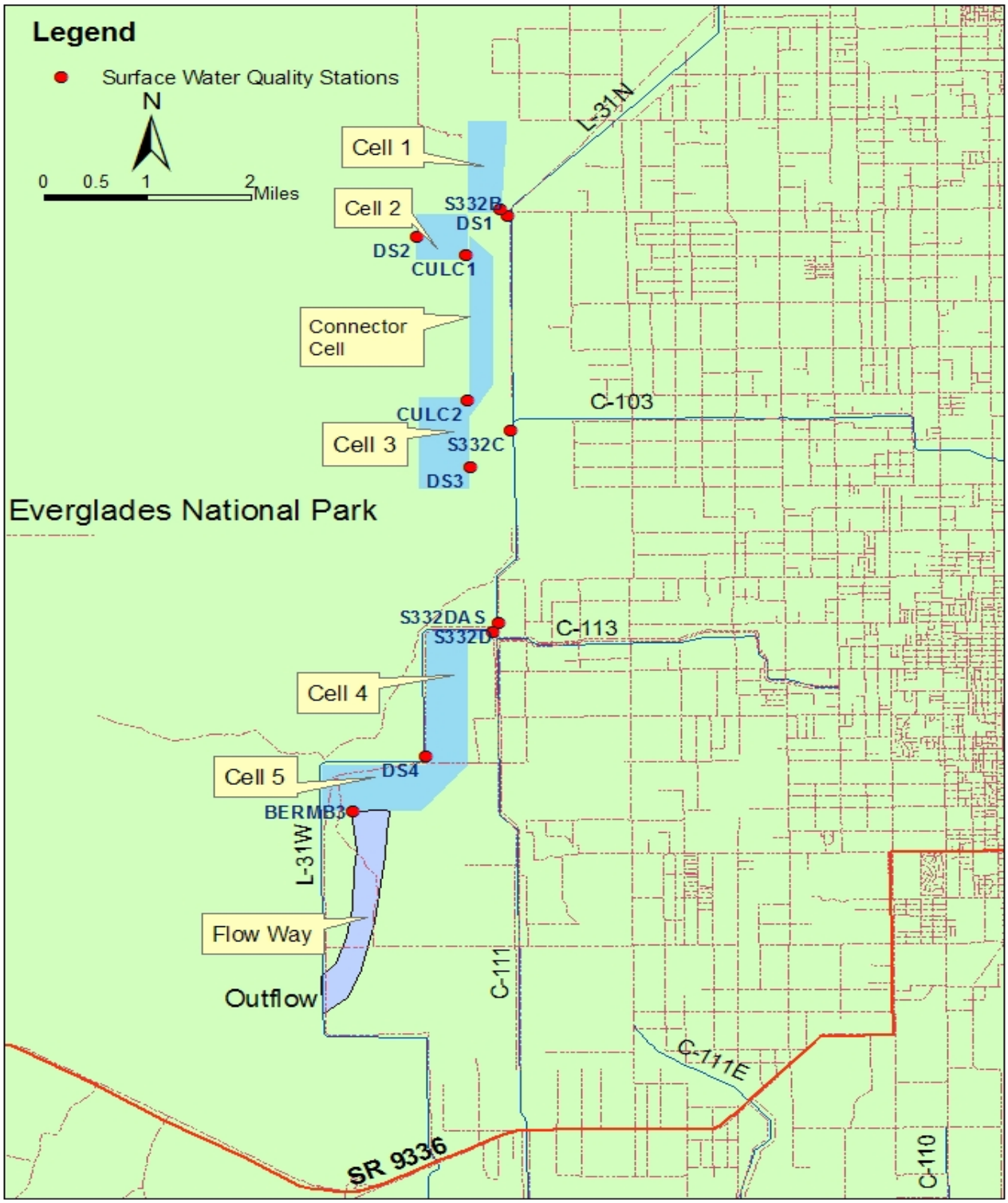

Figure 9. C-111 Project facilities.

Compliance with Consent Decree

Inflow TP concentrations to the ENP 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 10**). The bars in **Figure 10** represent the 12-month flow-weighted mean TP concentrations from S332, S175 and S18C for water years 1989 through 2002. The diamond point values for water years 1999 through 2007 represent the new combination of structures.

TP and flow data from both sets of structures presented in prior editions of this report through December 2001 (April 2002 report) showed that, beginning in 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 TP 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 10.** However, there had been almost no flow at S174 since March 2006. The site was plugged in September 2007, preventing any flow through S174.

Figure 11 presents the 12-month and individual sampling event flow-weighted mean TP concentrations at the S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the sites were used for the compliance calculations.

For the combined flow through S332D and S18C, the 12-month flow-weighted mean TP concentrations were 4.6, 4.6 and 4.8 ppb, respectively, for the 12-month periods ending in April, May, and June 2008 (**Table 3**). The Consent Decree stipulates that the percent of flow-weighted mean TP concentrations greater than 10 ppb from each sampling event in any 12-month period must not exceed a fixed guideline of 53.1 percent. There was no sampling event flow-weighted mean TP concentration greater than 10 ppb for the combined flow through S332D and S18C for the 12-month periods ending in April, May, and June 2008.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 12**. The sampling event flow-weighted mean concentrations remained very low. There was no sampling event flow-weighted mean TP concentration greater than 10 ppb since March 2008. **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event.

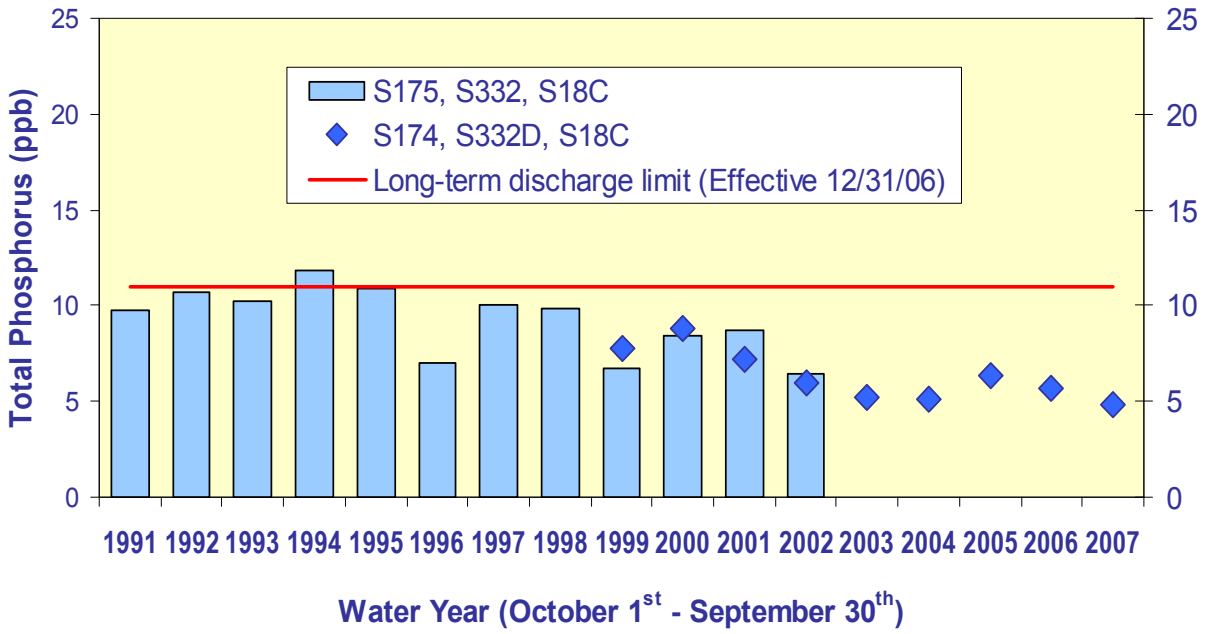

Figure 10. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term TP limit.

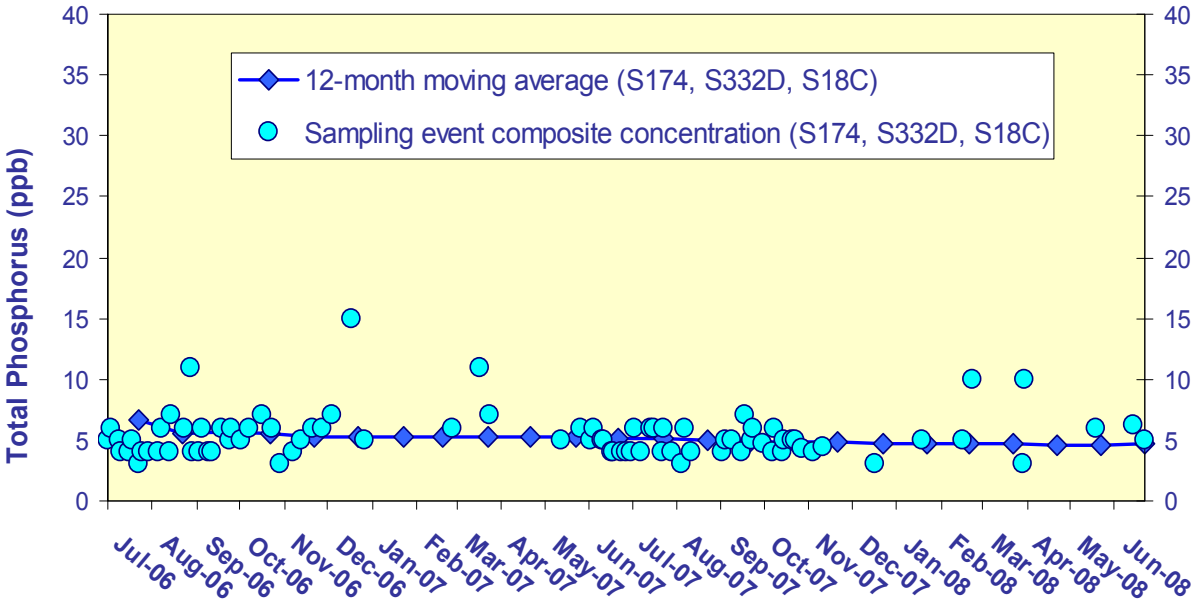

Figure 11. 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean TP concentration for each sampling event.

Table 3. Taylor Slough and the Coastal Basins TP Concentration Compliance Tracking.

12-Month Period	Total Flow (kac-ft)	TP Flow Weighted Mean (ppb)	Long-Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
8/1/2005 - 7/31/2006	280.0	6.6	11.0	53.1	4.5
9/1/2005 - 8/31/2006	227.0	5.5	11.0	53.1	2.2
10/1/2005 - 9/30/2006	**207.4**	**5.7**	**11.0**	**53.1**	**4.1**
11/1/2005 - 10/31/2006	179.5	5.6	11.0	53.1	3.9
12/1/2005 - 11/30/2006	158.8	5.3	11.0	53.1	3.9
1/1/2006 - 12/31/2006	137.4	5.2	11.0	53.1	6.0
2/1/2006 - 1/31/2007	127.6	5.2	11.0	53.1	6.4
3/1/2006 - 2/28/2007	125.4	5.2	11.0	53.1	7.0
4/1/2006 - 3/31/2007	123.8	5.2	11.0	53.1	10.0
5/1/2006 - 4/30/2007	125.4	5.2	11.0	53.1	10.0
6/1/2006 - 5/31/2007	126.1	5.2	11.0	53.1	7.5
7/1/2006 - 6/30/2007	153.0	5.1	11.0	53.1	6.5
8/1/2006 - 7/31/2007	153.4	5.1	11.0	53.1	6.4
9/1/2006 - 8/31/2007	143.6	5.0	11.0	53.1	6.4
10/1/2006 - 9/30/2007	**120.8**	**4.8**	**11.0**	**53.1**	**4.6**
11/1/2006 - 10/30/2007	150.5	4.8	11.0	53.1	4.2
12/1/2006 - 11/30/2007	155.8	4.8	11.0	53.1	4.3
1/1/2007 - 12/31/2007	154.8	4.7	11.0	53.1	2.3
2/1/2007 - 1/31/2008	155.5	4.7	11.0	53.1	2.3
3/1/2007 - 2/29/2008	156.1	4.7	11.0	53.1	2.3
4/1/2007 - 3/31/2008	155.4	4.7	11.0	53.1	0.0
5/1/2007 - 4/30/2008	157.1	4.6	11.0	53.1	0.0
6/1/2007 - 5/31/2008	155.9	4.6	11.0	53.1	0.0
7/1/2007 - 6/30/2008	145.0	4.8	11.0	53.1	0.0

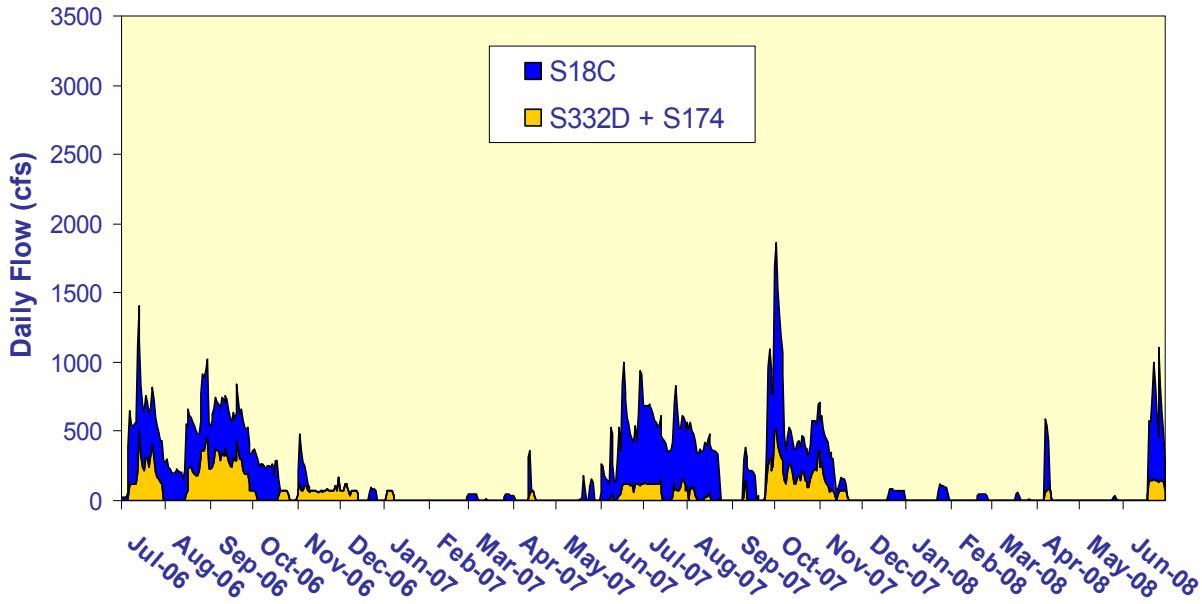

Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C; S174 was plugged in September 2007.

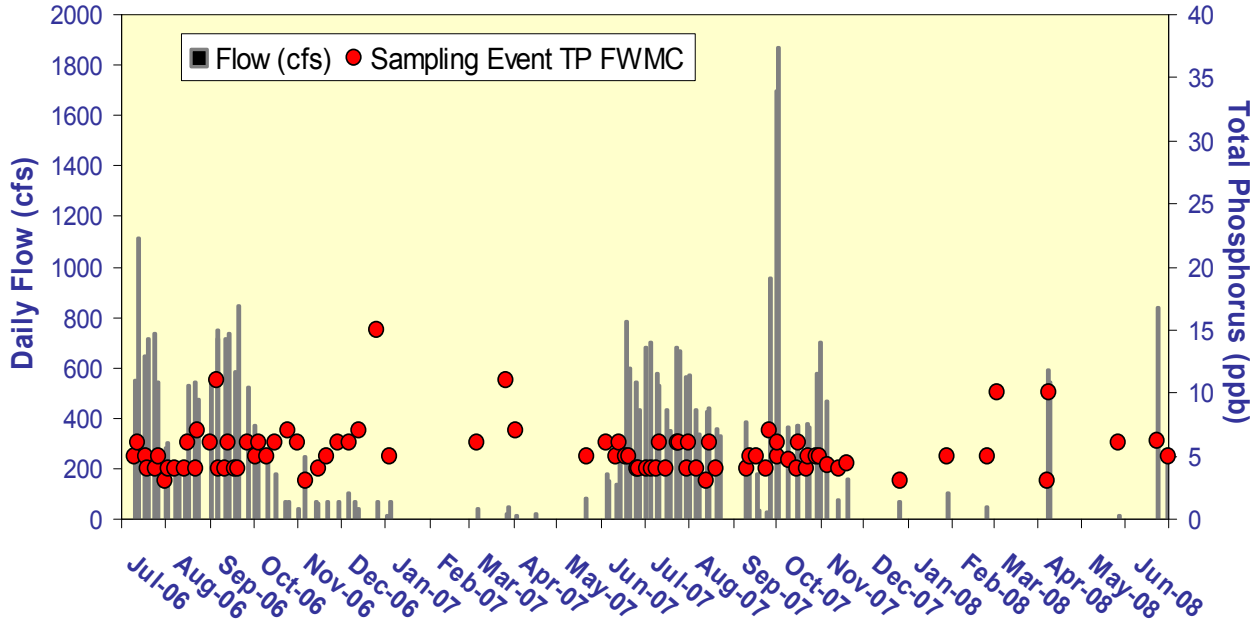

Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Settlement Agreement
July - September 2008 Report

Revisions were made to this document on the following dates:
March 28, 2011: Note added to cover page
January 26, 2009: See pages 5 and 6
December 23, 2008: See page 9, Table 2

Prepared for the
Technical Oversight Committee
December 9, 2008

Prepared by:
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March 28, 2011: Based on a recommendation by the Special Master in his January 4, 2011 report, the Water Year 2008 Compliance Calculation (12-month flow weighted mean) was revised from 10.2 ppb to 10.6 ppb for Shark River Slough. The revised value was published in the Settlement Agreement Report, October – December 2010, Figure 5, page 10 and Table 3, page 11. At the March 1, 2011 meeting, the TOC determined substantial evidence indicates this exceedance was due to error as described on page A-4 of Appendix A of the 1995 Amended Consent Decree.

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 total phosphorus (TP) concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by February 1, 1999, and December 31, 2006, respectively. Both the interim and long–term 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 in National Geodetic Vertical Datum of 1929 (NGVD29). The monthly TP 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 16.37, 16.39 and 16.81 feet in July, August, and September 2008, respectively (**Figure 2** and **Table 1**). The geometric means, calculated from TP concentrations measured in water samples collected in July, August, and September 2008 were 9.2, 8.6 and 7.7 parts per billion (ppb), respectively. The geometric means were lower than the long-term levels, which became effective on December 31, 2006, for the months of July, August, and September 2008.

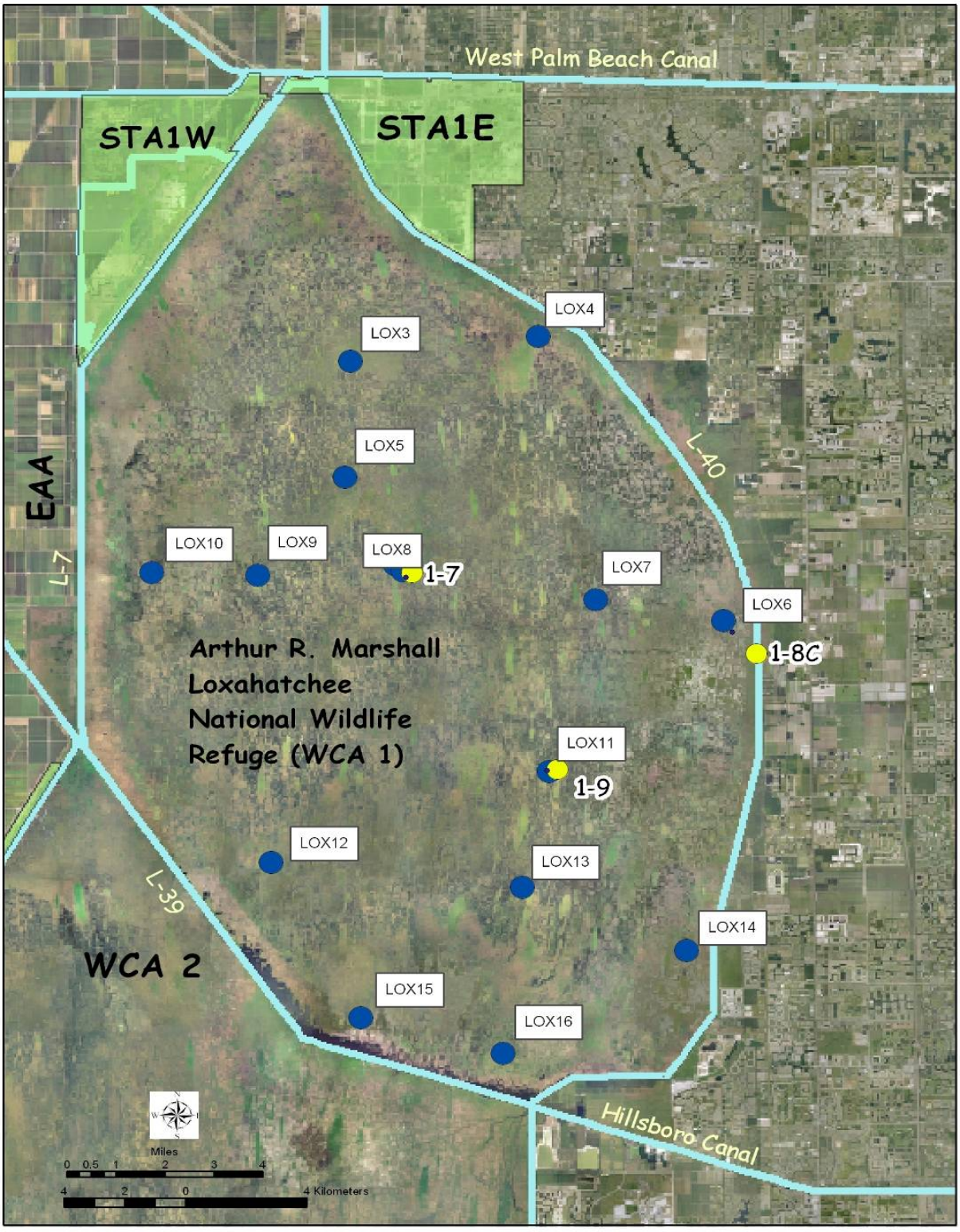

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

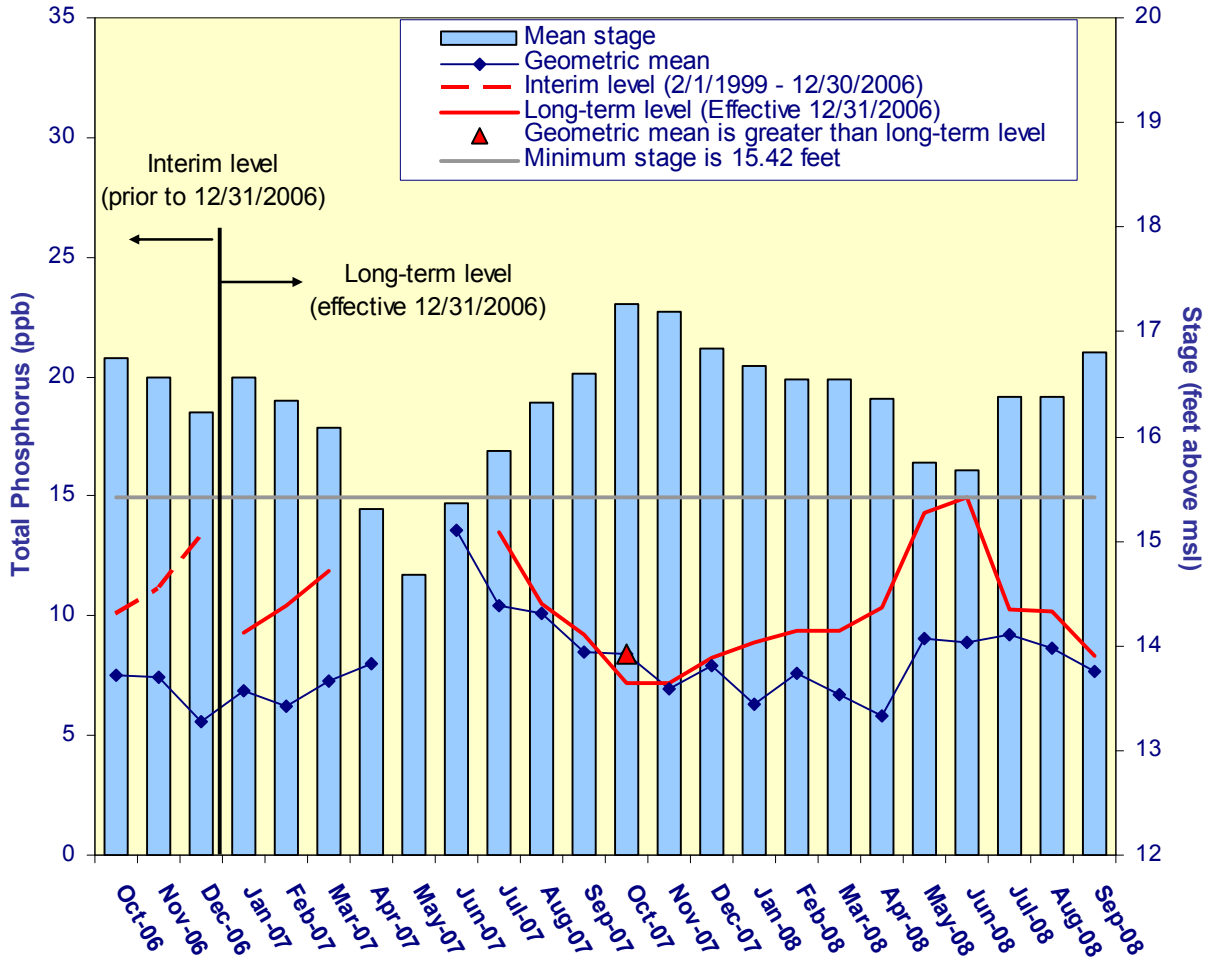

Figure 2. Monthly TP geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the interim and long-term levels. The calculated concentration levels are adjusted for fluctuations in stage. The long-term levels were not applicable for April 2007 through June 2007 because the average stage was less than 15.42 feet. The geometric mean was greater than the long-term level in October 2007.

Table 1. Loxahatchee National Wildlife Refuge TP Compliance Tracking.

Month - Year	Geometric Mean Concentration (ppb)	Interim Level[a] (ppb) Effective 2/1/99-12/30/06	Long-Term Level[a] (ppb) Effective 12/31/06	Average Stage[b] (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
Oct-2006	7.5	10.1	8.6	16.74	14	3
Nov-2006	7.4	11.1	9.4	16.56	14	3
Dec-2006	5.6	13.4	11.0	16.23	11	3
Jan-2007	6.9	11.1	9.3	16.57	14	3
Feb-2007	6.2	12.6	10.4	16.34	13	3
Mar-2007	7.3	14.5	11.8	16.10	10	3
Apr-2007	8.0	N/A	N/A	15.30	3	3
May-2007	n/a	N/A	N/A	14.68	0	3
Jun-2007	13.6	N/A	N/A	15.37	4	3
Jul-2007	10.4	16.8	13.5	15.86	13	3
Aug-2007	10.1	12.7	10.5	16.33	13	3
Sep-2007	8.5	10.9	9.2	16.59	14	3
Oct-2007	**8.4**	**8.3**	**7.2**	**17.26**	**14**	**3**
Nov-2007	7.0	8.3	7.2	17.19	14	3
Dec-2007	7.9	9.6	8.2	16.84	14	3
Jan-2008	6.3	10.5	8.9	16.68	14	3
Feb-2008	7.6	11.2	9.4	16.55	14	3
Mar-2008	6.7	11.2	9.4	16.54	14	3
Apr-2008	5.8	12.5	10.3	16.36	14	3
May-2008	9.1	17.9	14.3	15.76	9	3
Jun-2008	8.9	18.8	14.9	15.68	8	3
Jul-2008	9.2	12.4	10.3	16.37	14	3
Aug-2008	8.6	12.3	10.2	16.39	14	3
Sep-2008	7.7	9.8	8.3	16.81	14	3

[a] *N/A denotes that the level was not applicable because the average stage was less than 15.42 feet.*
[b] *Average stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 on the sampling dates.*

Notes: Highlighted row indicates the month (October 2007) when an excursion over the long-term level occurred.

EVERGLADES NATIONAL PARK

Shark River Slough

The Consent Decree of 1995 specified that interim and long-term total phosphorus (TP) concentration limits for discharges into the Everglades National Park (ENP) (**Figure 3**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the TP concentrations be presented as 12-month flow-weighted means. Only the TP concentrations for the water year ending September 30th are evaluated for compliance with the Consent Decree limits. The long-term TP 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 TP 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 2008 (**Figure 4**). The 12-month flow-weighted mean TP concentration for October 2007 through September 2008 was 10.2 ppb. The corresponding long-term limit, which became effective on December 31, 2006, was also 10.2 ppb.

Table 2 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding interim and long-term TP concentration limits, calculated using the 12-month period flow. Supplemental water quality samples were collected at some of the Shark River Slough monitoring sites from January 2006 through September 2007, but only the bi-weekly compliance monitoring grab concentration data were used for flow-weighted mean TP concentration calculations. Routine monitoring was changed to weekly[1] for all Shark River Slough sites beginning in October 2007. In accordance with Appendix A of the Consent Decree, only the every-other-week grab concentration data were used for the flow-weighted mean calculations from October 2007 forward[2]. For the 12-month periods ending in July, August, and September 2008, the 12-month flow-weighted mean TP concentrations were 12.4, 12.0 and 10.2[3] ppb, respectively. The long-term limits were 12.1, 11.3 and 10.2 ppb, respectively. The 12-month flow-weighted mean TP concentrations were higher than the long-term limits for the month of July and August 2008; but the 12-month flow-weighted mean TP concentration was equal to the limit for the month of September 2008.

[1] *S12A and S333 are sampled weekly if flowing, otherwise monthly. S12B, S12C, and S12D are sampled weekly if flowing.*

[2] *The 12-month flow-weighted mean TP concentrations using all available weekly grab concentration data instead of bi-weekly grab data were 12.2, 11.6, and 10.2 ppb for July, August, and September 2008, respectively; the 12-month flow-weighted mean TP concentrations using the alternative set of bi-weekly grab concentration data were 12.1, 11.3, and 9.9 ppb for July, August, and September 2008, respectively.*

[3] *See Appendix A for details.*

The Consent Decree stipulates that the percentage of flow-weighted mean TP 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 July, August, and September 2008, the sampling event TP concentrations greater than 10 ppb were 73.0, 72.5 and 67.4 percent, respectively. The observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were more than the guidelines for July and August 2008, but less than the guideline for September 2008 (**Table 2**). The 12-month flow-weighted mean TP concentrations and the flow-weighted mean TP concentrations for individual sampling events are presented in **Figure 5**.

The daily flows through the individual Shark River Slough structures from July 2006 through September 2008 are presented in **Figure 6**.

For additional information on the WCA 3A regulation schedule, please visit

http://www.saj.usace.army.mil/h2o/plots/wca3ahp.pdf

S12A, S12B, and S12C were closed until mid-July 2008. S12D was utilized during most of the quarter. There was discharge throughout the quarter at S333 but almost none of the flow was diverted to S334 until mid-September 2008 (**Figure 7**).

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean TP concentrations for individual sampling events is presented in **Figure 8**. Flow and TP concentrations for waters entering the ENP through Shark River Slough had been following an inverse relationship in previous periods. TP concentrations continuously declined as flow was increased during the quarter.

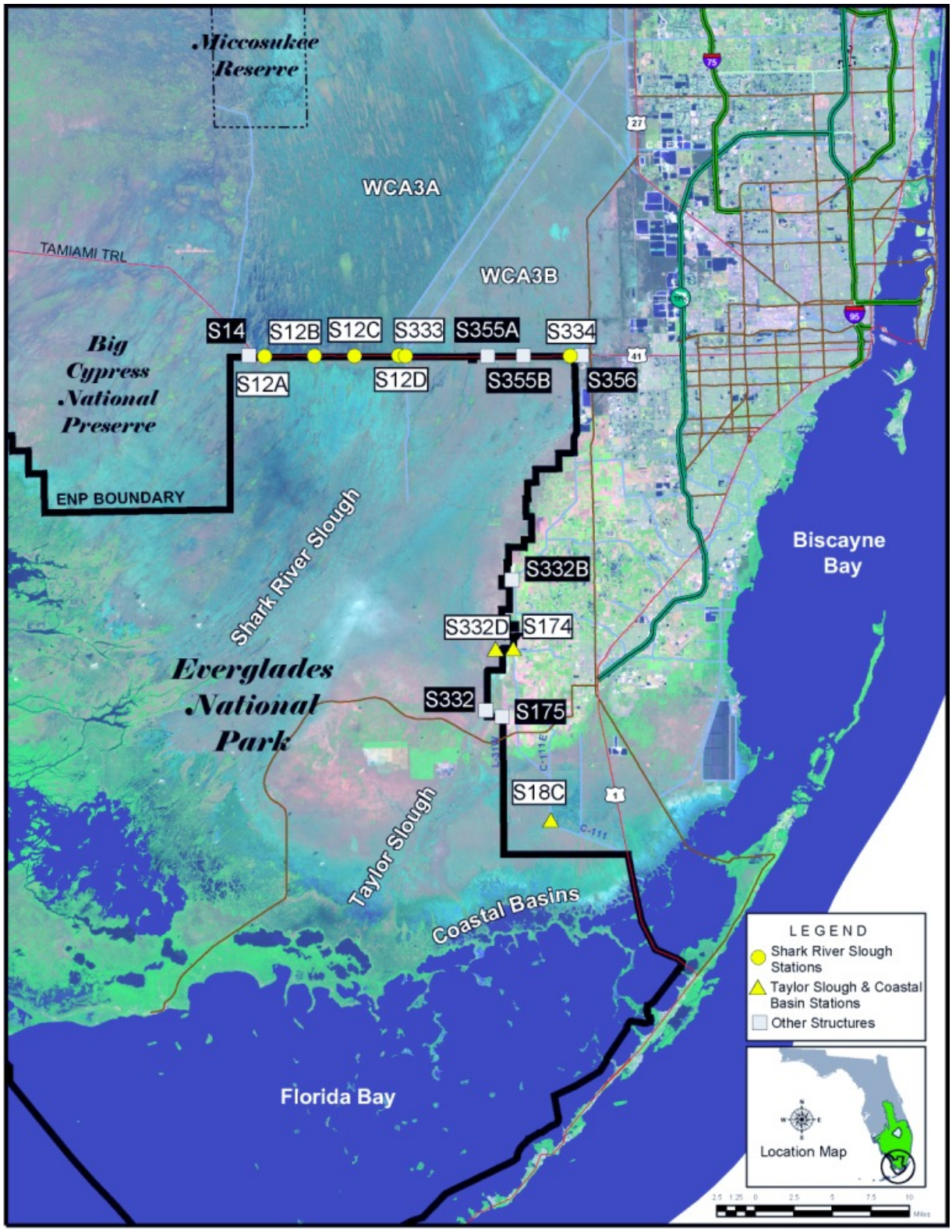

Figure 3. Everglades National Park flow structures

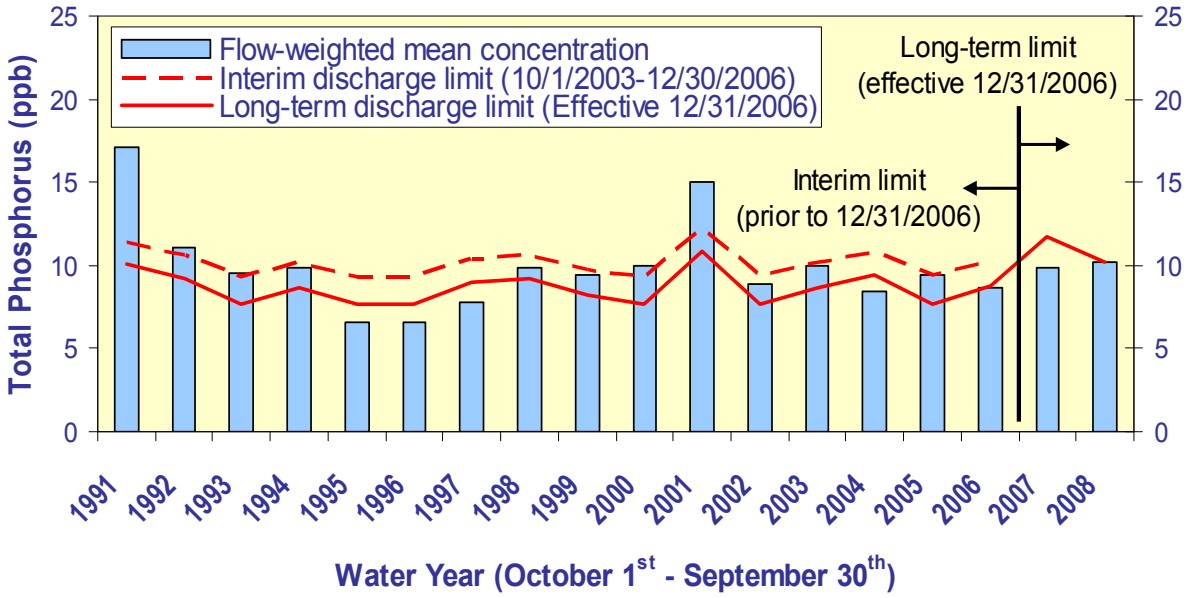

Figure 4. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the TP interim and long-term limits. The 12-month flow-weighted mean concentrations had met the interim limits since they became effective on October 1, 2003. The 12-month flow-weighted mean TP concentration for the compliance year through September 2008 was 10.2 ppb and equal to the long-term limit.

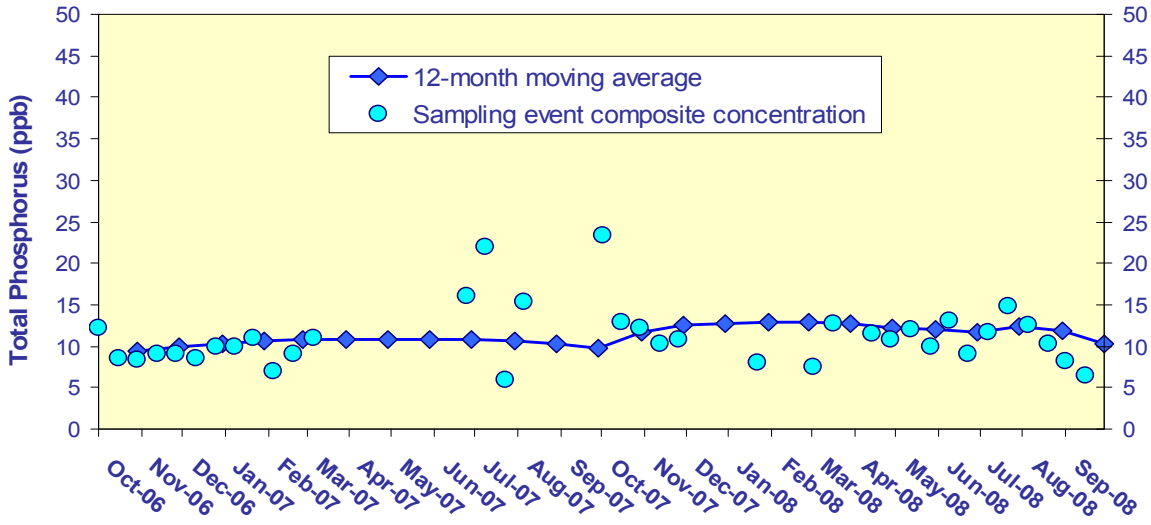

Figure 5. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for some months because there was little or no flow in those periods.

Table 2. Shark River Slough TP Concentration Compliance Tracking.

12-Month Period	Total Flow (kac-ft)	TP Flow Weighted Mean (ppb)	Interim Limit (ppb) Effective 10/1/03-12/30/06	Long-Term Limit (ppb) Effective 12/31/06	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
11/1/2005 - 10/31/2006	779.6[a,b]	9.5	10.5	9.0	46.9	***50.0***
12/1/2005 - 11/30/2006	642.8[a,b]	10.0	11.1	9.7	50.8	50.0
1/1/2006 - 12/31/2006	507.9[a,b]	10.3	11.8	10.5	55.0	50.0
2/1/2006 - 1/31/2007	446.1[a,b]	10.7	12.1	10.9	57.0	55.0
3/1/2006 - 2/28/2007	442.4[b]	10.8	12.1	10.9	57.2	52.4
4/1/2006 - 3/31/2007	456.0[b]	10.8	12.0	10.8	56.7	***57.1***
5/1/2006 - 4/30/2007	449.5[b]	10.8	12.1	10.8	56.9	52.6
6/1/2006 - 5/31/2007	445.5[b]	10.7	12.1	10.9	57.1	47.1
7/1/2006 - 6/30/2007	447.6[b]	10.8	12.1	10.8	57.0	50.0
8/1/2006 - 7/31/2007	444.6[b]	10.6	12.1	10.9	57.1	47.4
9/1/2006 - 8/31/2007	401.0	10.3	12.3	11.1	58.6	44.4
10/1/2006 - 9/30/2007	**289.7**	**9.8**	13.0	**11.8**	**62.6**	**37.5**
11/1/2006 - 10/31/2007	147.9	11.7	13.8	12.7	67.9	50.0
12/1/2006 - 11/30/2007	121.2	12.6	13.9	12.8	68.9	62.5
1/1/2007 - 12/31/2007	118.2	12.8	14.0	12.8	69.1	***71.4***
2/1/2007 - 1/31/2008	115.8	12.9	14.0	12.9	69.2	69.2
3/1/2007 - 2/29/2008	106.8	12.9	14.0	12.9	69.5	***81.8***
4/1/2007 - 3/31/2008	88.9	12.8	14.1	13.0	70.2	***75.0***
5/1/2007 - 4/30/2008	112.4	12.4	14.0	12.9	69.3	***78.6***
6/1/2007 - 5/31/2008	149.5	12.2	13.8	12.6	67.8	***75.0***
7/1/2007 - 6/30/2008	160.8	11.8	13.7	12.6	67.4	***70.6***
8/1/2007 - 7/31/2008	234.7	12.4	13.3	12.1	64.6	***76.5***
9/1/2007 - 8/31/2008	364.1	12.0	12.5	11.3	59.9	***77.8***
10/1/2007 - 9/30/2008	**569.2**	**10.2[c]**	11.5	**10.2**	**53.0**	***70.0***

[a] *Flow of 1.82 kac-ft in February 2006 at S355A and S355B was included for the 12-month total flows.*
[b] *Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows.*
[c] *See Appendix A for details.*

Notes: 1) Highlighted rows indicate the end of the water year, which are the compliance points.
2) Bold italicized values exceeded the guideline percentages.

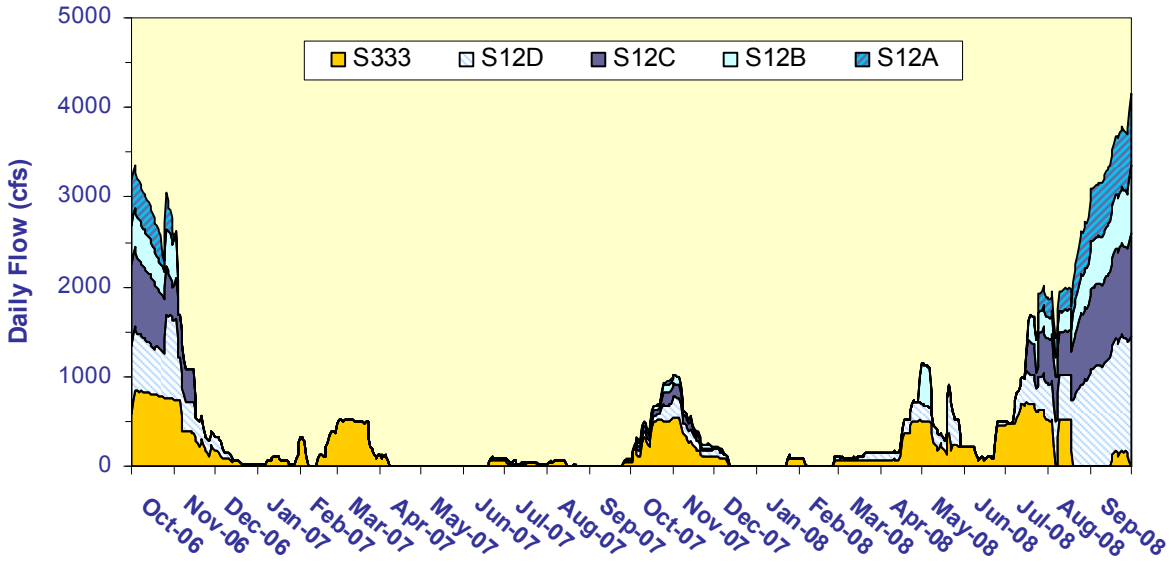

Figure 6. Daily flows into Shark River Slough by structure.

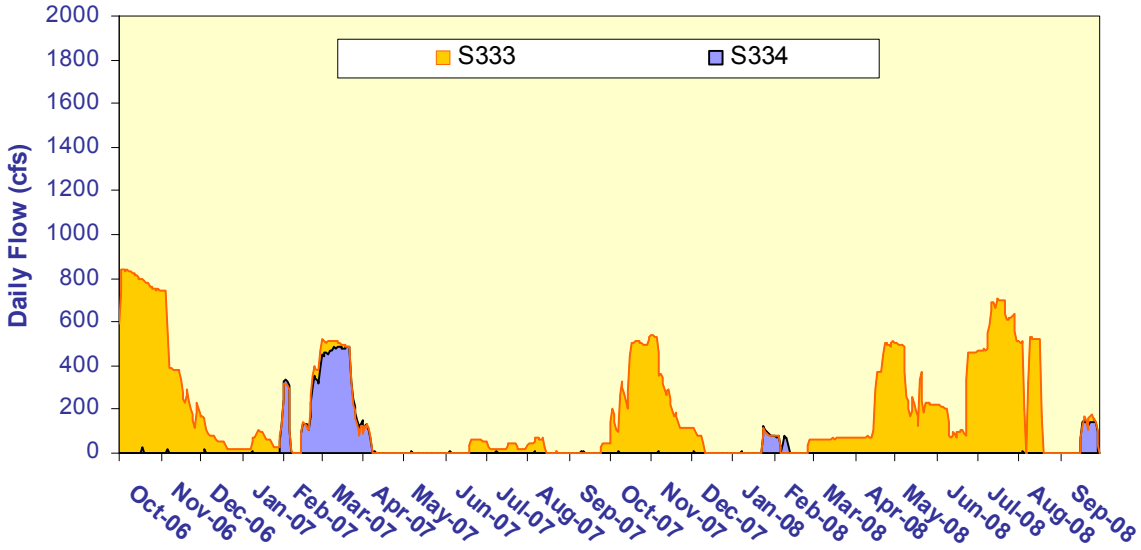

Figure 7. Daily flows comparison between S333 and S334

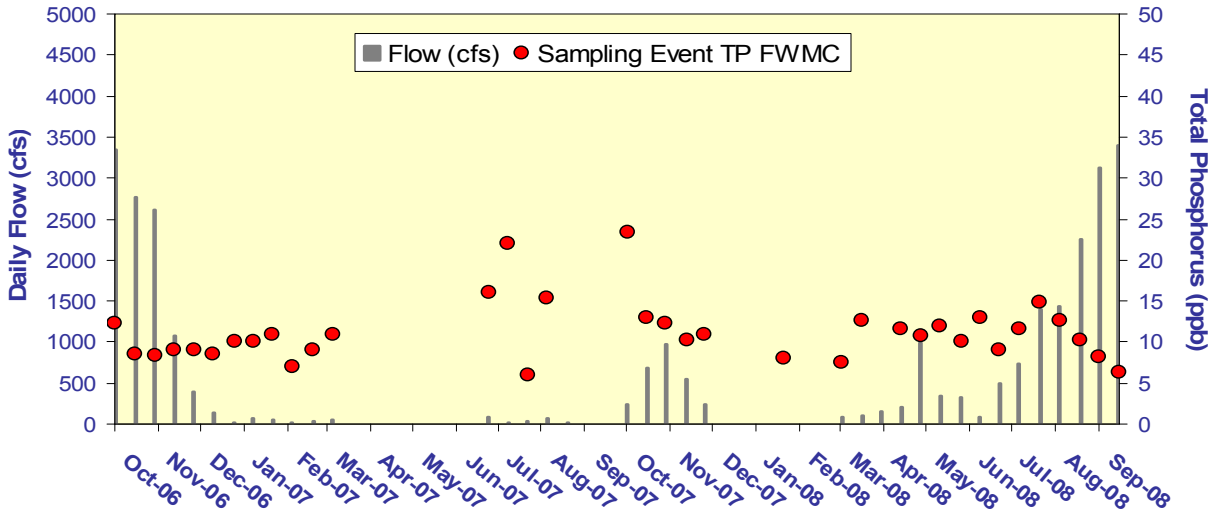

Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Taylor Slough and the Coastal Basins

Under the Consent Decree, a single total phosphorus (TP) 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 12-month flow-weighted mean concentrations have consistently been lower than the long-term limit of 11 ppb.

C-111 Project Structures and Detention Areas

Beginning in August 1999, structure S332D, a 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, Cell 1 through Cell 5, a connector cell between Cell 2 and Cell 3, a flow way cell originating at Berm 3 of Cell 5, and four diversion structures, DS1 through DS4 (**Figure 9**). The flow way cell is the only location to routinely discharge surface water into 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, has implemented 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 District started the routine sampling in September 2003.

The monitoring plan treats the detention areas as a single project with five cells, three inflows and a single outflow to ENP. The diversion structures DS2 and DS4 would discharge into the ENP if utilized. Overflows periodically occurred at DS2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports.

Discharges from the diversion structures DS1 and DS3 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 groundwater seepage in an easterly direction from ENP.

The stage gauge at S332B West (Cell 2) was off-line due to construction activities in the area since last quarter. No information was available regarding any potential overflow in Cell 2 for the reporting quarter.

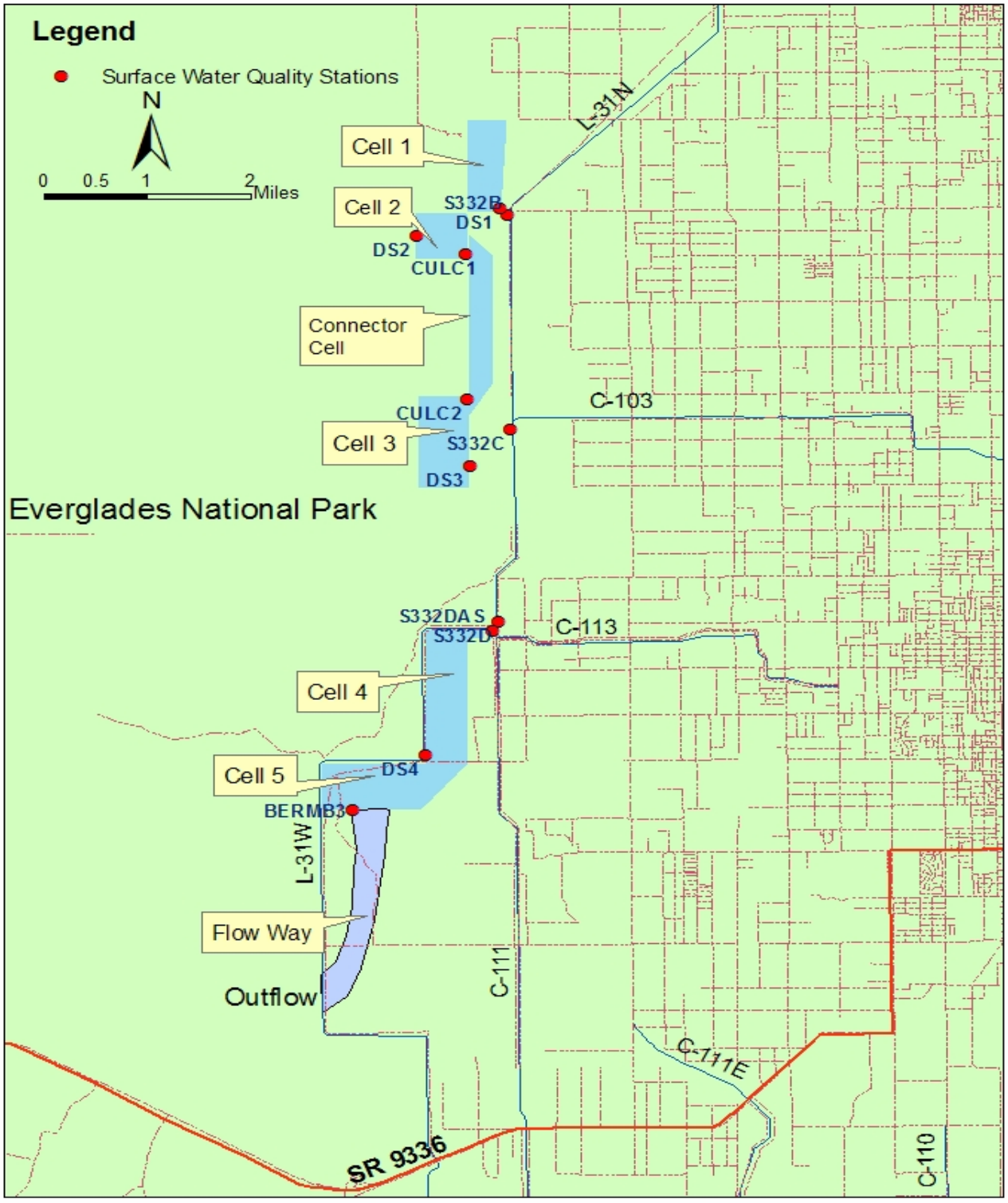

Figure 9. C-111 Project facilities.

Compliance with Consent Decree

Inflow TP concentrations to the ENP 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 10**). The bars in **Figure 10** represent the 12-month flow-weighted mean TP concentrations from S332, S175 and S18C for water years 1989 through 2002. The diamond point values for water years 1999 through 2008 represent the new combination of structures.

TP and flow data from both sets of structures presented in prior editions of this report through December 2001 (April 2002 report) showed that, beginning in 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 TP 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 10.** However, there had been almost no flow at S174 since March 2006. The site was plugged in September 2007, preventing any flow through S174.

Figure 11 presents the 12-month and individual sampling event flow-weighted mean TP concentrations at the S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the sites were used for the compliance calculations.

For the combined flow through S332D and S18C, the 12-month flow-weighted mean TP concentrations were 5.0, 5.5 and 5.6 ppb, respectively, for the 12-month periods ending in July, August and September 2008 (**Table 3**). The Consent Decree stipulates that the percent of flow-weighted mean TP concentrations greater than 10 ppb from each sampling event in any 12-month period must not exceed a fixed guideline of 53.1 percent. There was no sampling event flow-weighted mean TP concentration greater than 10 ppb for the combined flow through S332D and S18C for the 12-month periods ending in July, August and September 2008.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 12**. The sampling event flow-weighted mean concentrations remained very low. There was no sampling event flow-weighted mean TP concentration greater than 11 ppb since December 2006 except 23 ppb on July 14th, 2008 taken at S18C. **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event.

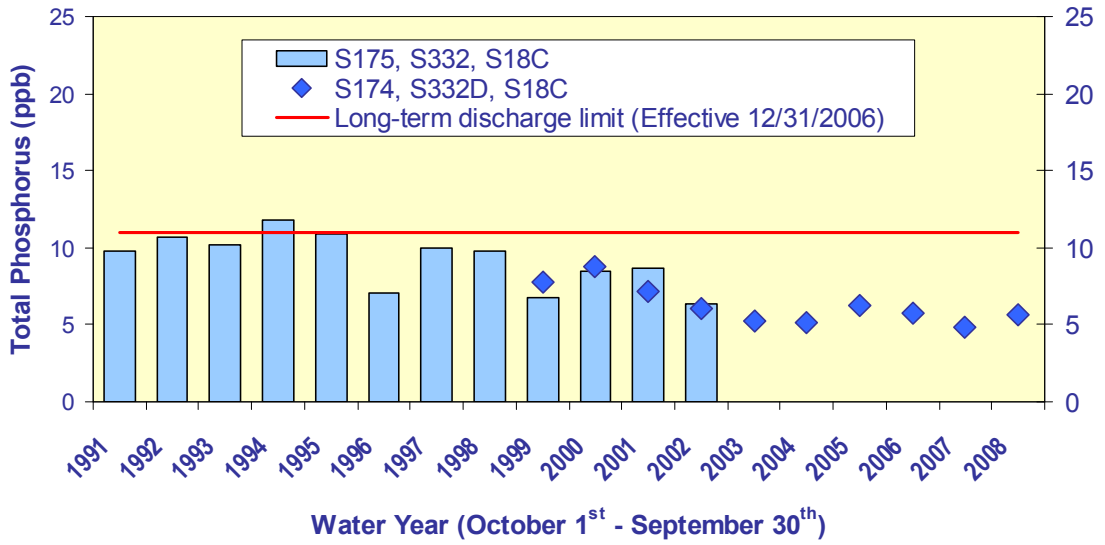

Figure 10. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term TP limit.

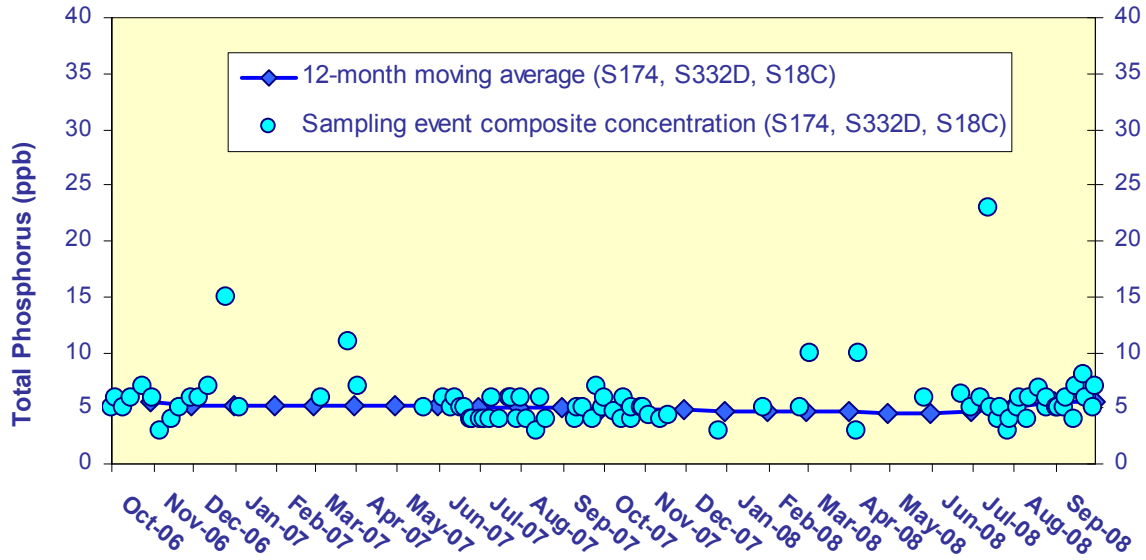

Figure 11. 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean TP concentration for each sampling event.

Table 3. Taylor Slough and the Coastal Basins TP Concentration Compliance Tracking.

12-Month Period	Total Flow (kac-ft)	TP Flow Weighted Mean (ppb)	Long-Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
11/1/2005 - 10/31/2006	179.5	5.6	11.0	53.1	3.9
12/1/2005 - 11/30/2006	158.8	5.3	11.0	53.1	3.9
1/1/2006 - 12/31/2006	137.4	5.2	11.0	53.1	6.0
2/1/2006 - 1/31/2007	127.6	5.2	11.0	53.1	6.4
3/1/2006 - 2/28/2007	125.4	5.2	11.0	53.1	7.0
4/1/2006 - 3/31/2007	123.8	5.2	11.0	53.1	10.0
5/1/2006 - 4/30/2007	125.4	5.2	11.0	53.1	10.0
6/1/2006 - 5/31/2007	126.1	5.2	11.0	53.1	7.5
7/1/2006 - 6/30/2007	153.0	5.1	11.0	53.1	6.5
8/1/2006 - 7/31/2007	153.4	5.1	11.0	53.1	6.4
9/1/2006 - 8/31/2007	143.6	5.0	11.0	53.1	6.4
10/1/2006 - 9/30/2007	**120.8**	**4.8**	**11.0**	**53.1**	**4.6**
11/1/2006 - 10/30/2007	150.5	4.8	11.0	53.1	4.2
12/1/2006 - 11/30/2007	155.8	4.8	11.0	53.1	4.3
1/1/2007 - 12/31/2007	154.8	4.7	11.0	53.1	2.3
2/1/2007 - 1/31/2008	155.5	4.7	11.0	53.1	2.3
3/1/2007 - 2/29/2008	156.1	4.7	11.0	53.1	2.3
4/1/2007 - 3/31/2008	155.4	4.7	11.0	53.1	0.0
5/1/2007 - 4/30/2008	157.1	4.6	11.0	53.1	0.0
6/1/2007 - 5/31/2008	155.9	4.6	11.0	53.1	0.0
7/1/2007 - 6/30/2008	145.0	4.8	11.0	53.1	0.0
8/1/2007 - 7/31/2008	130.0	5.0	11.0	53.1	2.6
9/1/2007 - 8/31/2008	165.6	5.5	11.0	53.1	2.5
10/1/2007 - 9/30/2008	**207.7**	**5.6**	**11.0**	**53.1**	**2.2**

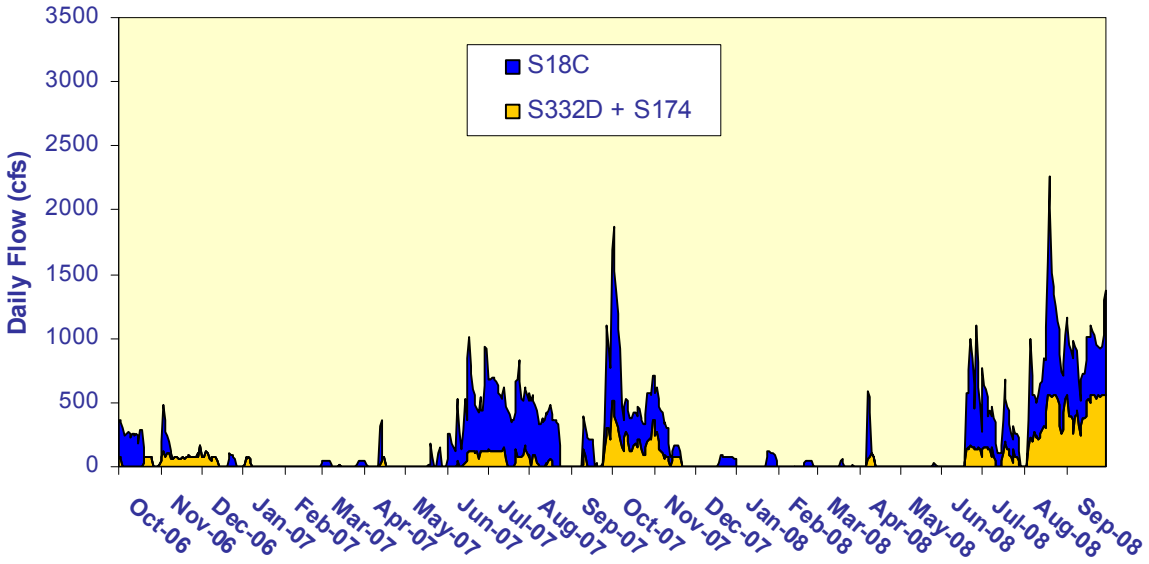

Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C; S174 was plugged in September 2007.

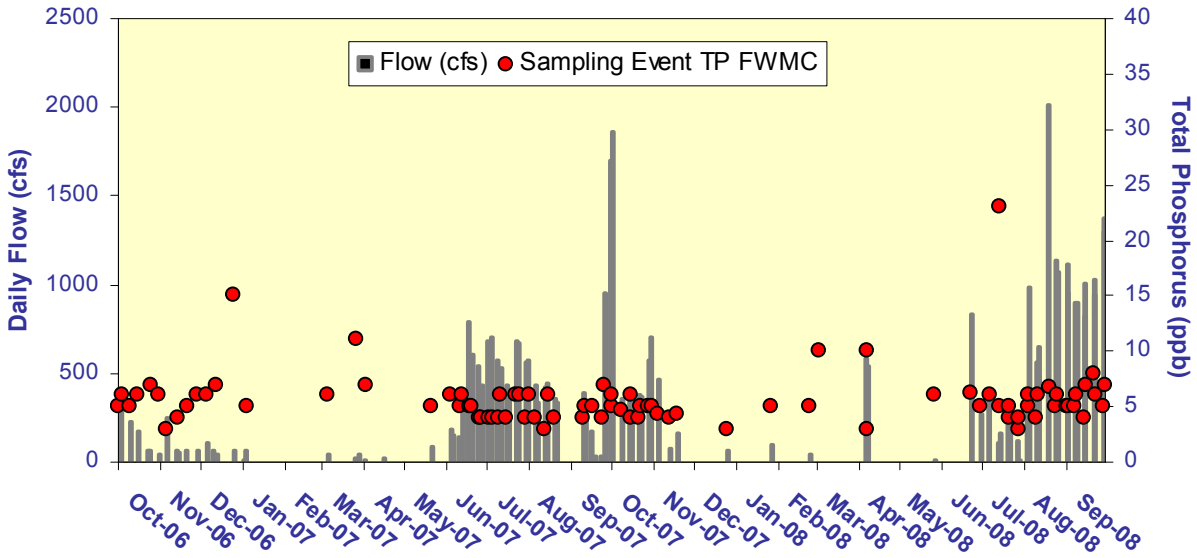

Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Appendix A

12-Month Flow-Weighted Mean TP Concentrations for Shark River Slough (October 1, 2007 – September 30, 2008)

Compliance with the Settlement Agreement's long-term phosphorus limits for inflows to Shark River Slough is based on the12-month, flow-weighted mean concentration (FWMC) for the water year ending on September 30. Inflow concentrations are measured bi-weekly at structures S12A, S12B, S12C, S12D, and S333 - S334 (e.g., net flow for S333 minus S334).

Preliminary data for the 2008 water year indicated that inflow concentrations were 10.2 ppb, which equaled the long-term limit of 10.2 ppb. It was subsequently discovered, however, that the field-cleaned equipment blank (FCEB) used during the September 3, 2008, sampling event had a TP concentration of 3 ppb and, as a result, that data was qualified. If the September 3, 2008, data is excluded, the FWMC for water year 2008 increases to 10.6 ppb -- exceeding the long-term limit by 0.4 ppb.

As discussed below, a review of other, contemporaneously collected data reflect that the September 3, 2008, data is accurate. In addition, if, in fact, the samples were exposed to any extraneous phosphorus (as suggested by the FCEB), this would mean that the September 3, 2008, reported concentrations would potentially be over-estimated to some extent.

Background

The field-cleaned equipment blank (FCEB) for the Shark River Slough sampling trip on September 3, 2008, had a TP concentration of 3 ppb, one ppb over the District laboratory's Method Detection Limit (MDL). FCEB's are used to assure that field equipment is properly rinsed with deionized water and used following standard protocols. The District's laboratory protocol specifies that if the FCEB has a detected TP concentration above the MDL then the associated samples should be qualified unless the sample concentration is more than 5 times the FCEB concentration (so that any bias that may have been introduced is essentially trivial in the sample itself). Contamination detected in a FCEB indicates the possibility that associated samples may also be contaminated and the data user should proceed with caution in using the data.

The measured TP concentrations for the Shark River stations ranged from 7 to 13 ppb for the September 3, 2008, sampling event, with an average concentration of 9 ppb. Table A-1 depicts the September 3, 2008, TP concentrations collected by grab samples at the S12A and S333 stations and by the autosamplers on the same day. As indicated, substantial evidence exists demonstrating that the initially reported concentrations for September 3, 2008, were accurate.

Table A-1. Shark River Slough Grab TP Concentration Data in August and September 2008 and Daily Time Composite Autosampler Data around 9/3/2008

Date	Sample Type	S12A	S12B	S12C	S12D	S333
8/6/2008	Grab	8	9	15	14	10
8/13/2008	Grab	7	7	9	13	13
8/21/2008	Grab	6	7	10	14	12
8/27/2008	Grab	6	6	9	12	10
9/2/2008	Daily Autosampler	8				10
9/3/2008	Grab**	7	6	8	10	13
9/3/2008	Daily Autosampler	8				11
9/10/2008	Grab	6	6	9	9	8
9/17/2008	Grab	6	5	8	6	9
9/24/2008	Grab	6	5	6	8	10

**** Results for the September 3, 2008 sampling event grabs were qualified based on the District's laboratory protocol for detections in the associated FCEB.**

Flows into Shark River Slough were well below normal for most of the 2008 federal water year, October 1, 2007, through September 30, 2008, with the majority of flow for the year occurring in August and September 2008. As a result, the year-long FWMC is strongly influenced by the status of the September data.

Alternative Compliance Scenarios

Historically, the District collected bi-weekly, grab samples at the Shark River Slough stations to calculate the 12-month FWMC for Settlement Agreement compliance. This year, however, the sampling frequency at the stations was changed from bi-weekly to weekly to accommodate other District program needs as described in the TOC-approved monitoring plans known as the PIE and PIN. In addition, daily autosamplers have been installed at the S12A and S333 inflow stations to Shark River Slough. This additional data provides useful information with which to analyze the accuracy of the September 3, 2008, sampling results.

Table A-2 depicts the 2008 federal water year 12-month FWMC with, and without, the September 3, 2008, results, plus four alternative scenarios using the weekly sampling results stemming from the PIN monitoring regime.

Table A-2. WY2008 12-month FWMC Calculations for Shark River Slough

Scenario	Description	Qualified 9/3/2008 Data Used?	12-month TP FWMC (ppb)	Met Long-Term Limit (10.2 ppb)?	Comments
1	Bi-weekly with 9/3/2008 data	Yes	10.2	Yes	Standard compliance calculation with 9/3/2008 data
2	Bi-weekly without 9/3/2008 data	No	10.6	No	Standard compliance calculation without 9/3/2008 data
3	Bi-weekly with 8/27/2008 and 9/10/2008 data	No	10.2	Yes	Used average TP from 8/27/2008 and 9/10/2008 events
4	Alternate bi-weekly data	No	9.9	Yes	Used alternate sampling events normally excluded from compliance calculations
5	Weekly data	No	10.2	Yes	Used all unqualified data for weekly sampling events

Recommendations

Although the September 3, 2008, TP results were qualified based on the District's current data validation protocol for FCEB's, the District recommends inclusion of these data as reflecting the best available data and most representative FWMC for the following reasons:

- TP concentrations for the September 3, 2008 sampling event were consistent with results for adjacent weeks and the historical period of record.
- TP concentrations for the September 3, 2008 sampling event were consistent with the autosampler TP concentrations at S12A (8 ppb) and S333 (11 ppb) for the same day.
- If any contamination was introduced during sampling, the sample results would be biased high (e.g., actual TP concentrations would be less than or equal to the reported values).
- Unusual flow patterns associated with the 2007-2008 drought resulted in most of the annual flow occurring in August and September 2008. Therefore, excluding one sampling event in September has a significant impact on the annual 12-month FWMC calculation and produces unwarranted bias in the resulting FWMC.
- The TP concentration detected in the FCEB (3 ppb) was slightly above the District's MDL (2 ppb) but in the range of substantial likelihood of occurring by chance.

Settlement Agreement
October - December 2008 Report

Prepared for the
Technical Oversight Committee
March 18, 2009

Prepared by:
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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 total phosphorus (TP) concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by February 1, 1999, and December 31, 2006, respectively. Both the interim and long–term 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 in National Geodetic Vertical Datum of 1929 (NGVD29). The monthly TP 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 17.42, 17.22 and 16.95 feet in October, November, and December 2008, respectively (**Figure 2** and **Table 1**). The geometric means, calculated from TP concentrations measured in water samples collected in October, November, and December 2008 were 7.2, 7.4 and 6.3 parts per billion (ppb), respectively. The geometric mean was equal to the long-term level, which became effective on December 31, 2006, for the month of October 2008; higher than the long-term level for the month of November 2008; and lower than the long-term level for the month of December 2008.

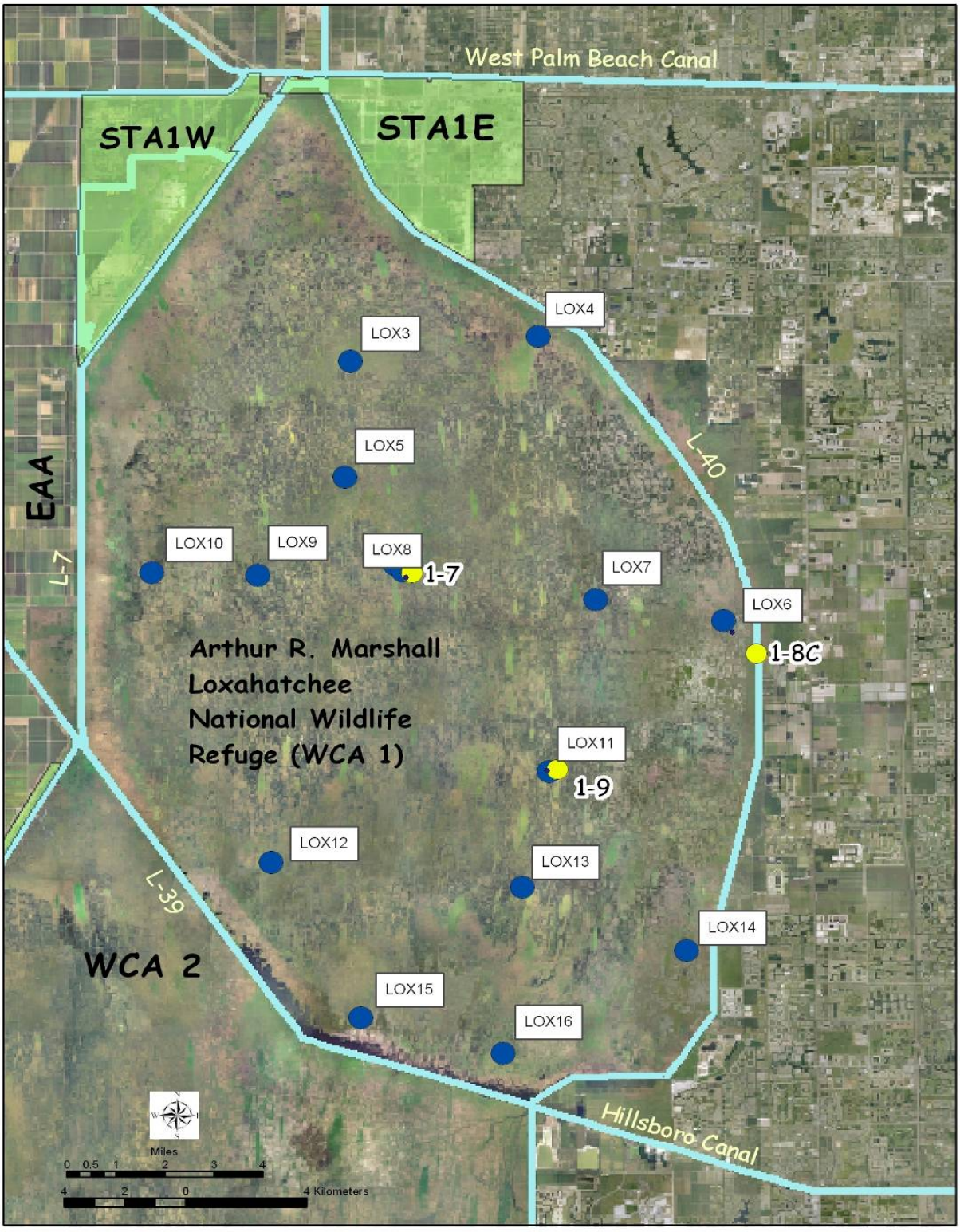

Figure 1. A.R.M. Loxahatchee National Wildlife Refuge Water Quality Sampling and Stage Measurement Sites

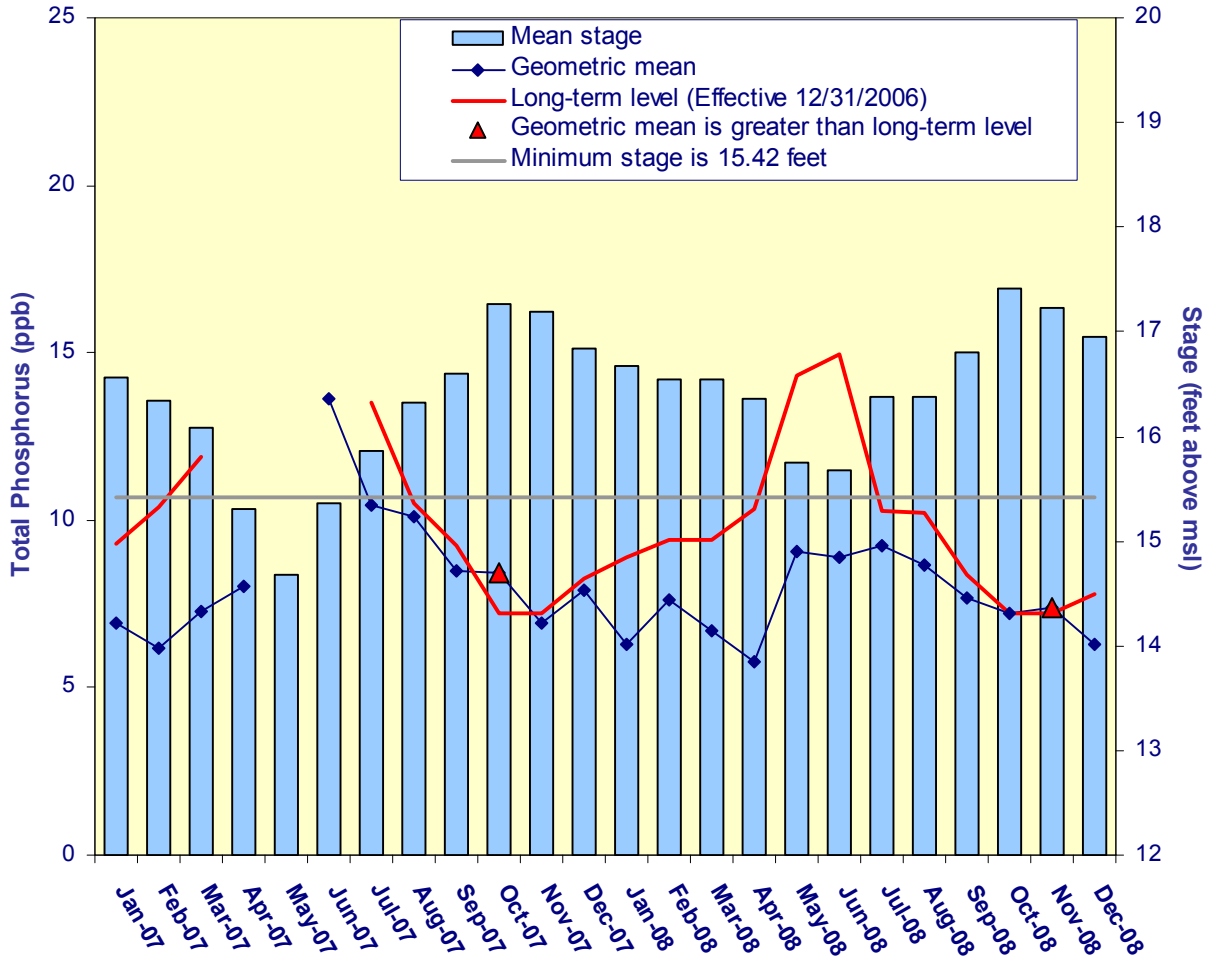

Figure 2. Monthly TP geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to the long-term levels. The calculated long-term levels are adjusted for fluctuations in stage. The long-term levels were not applicable for April 2007 through June 2007 because the average stage was less than 15.42 feet. The geometric mean was greater than the long-term level in October 2007 and in November 2008.

Table 1. Loxahatchee National Wildlife Refuge TP Compliance Tracking.

Month - Year	Geometric Mean Concentration (ppb)	Long-Term Level[a] (ppb) Effective 12/31/06	Average Stage[b] (ft NGVD)	Number of TP Samples	Number of Stage Measure-ments
Jan-2007	6.9	9.3	16.57	14	3
Feb-2007	6.2	10.4	16.34	13	3
Mar-2007	7.3	11.8	16.10	10	3
Apr-2007	8.0	N/A	15.30	3	3
May-2007	n/a	N/A	14.68	0	3
Jun-2007	13.6	N/A	15.37	4	3
Jul-2007	10.4	13.5	15.86	13	3
Aug-2007	10.1	10.5	16.33	13	3
Sep-2007	8.5	9.2	16.59	14	3
Oct-2007	**8.4**	**7.2**	**17.26**	**14**	**3**
Nov-2007	7.0	7.2	17.19	14	3
Dec-2007	7.9	8.2	16.84	14	3
Jan-2008	6.3	8.9	16.68	14	3
Feb-2008	7.6	9.4	16.55	14	3
Mar-2008	6.7	9.4	16.54	14	3
Apr-2008	5.8	10.3	16.36	14	3
May-2008	9.1	14.3	15.76	9	3
Jun-2008	8.9	14.9	15.68	8	3
Jul-2008	9.2	10.3	16.37	14	3
Aug-2008	8.6	10.2	16.39	14	3
Sep-2008	7.7	8.3	16.81	14	3
Oct-2008	7.2	7.2	17.42	14	3
Nov-2008	**7.4**	**7.2**	**17.22**	**14**	**3**
Dec-2008	6.3	7.8	16.95	14	3

[a] *N/A denotes that the level was not applicable because the average stage was less than 15.42 feet.*
[b] *Average stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 on the sampling dates.*

Notes: Highlighted rows indicate the months when excursions over the long-term levels occurred.

EVERGLADES NATIONAL PARK

Shark River Slough

The Consent Decree of 1995 specified that interim and long-term total phosphorus (TP) concentration limits for discharges into the Everglades National Park (ENP) (**Figure 3**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the TP concentrations be presented as 12-month flow-weighted means. Only the TP concentrations for the water year ending September 30th are evaluated for compliance with the Consent Decree limits. The long-term TP 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 TP 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 2008 (**Figure 4**). The 12-month flow-weighted mean TP concentration for October 2007 through September 2008 was 10.2 ppb[1]. The corresponding long-term limit, which became effective on December 31, 2006, was also 10.2 ppb.

Table 2 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding interim and long-term TP concentration limits, calculated using the 12-month period flow. Supplemental water quality samples were collected at some of the Shark River Slough monitoring sites from January 2006 through September 2007, but only the bi-weekly compliance monitoring grab concentration data were used for flow-weighted mean TP concentration calculations. Routine monitoring was changed to weekly[1] for all Shark River Slough sites beginning in October 2007. In accordance with Appendix A of the Consent Decree, only the every-other-week grab concentration data were used for the flow-weighted mean calculations from October 2007 forward[2]. For the 12-month periods ending in October, November, and December 2008, the 12-month flow-weighted mean TP concentrations were 8.0, 7.6 and 7.6 ppb, respectively. The long-term limits were 9.0, 8.2 and 7.9 ppb, respectively. The 12-month flow-weighted mean TP concentrations were lower than the long-term limits for October, November, and December 2008.

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[1] *The 12-month flow-weighted mean TP concentration for September 2008 using all available weekly grab concentration data instead of bi-weekly grab data was 10.2 ppb; the 12-month flow-weighted mean TP concentration for September 2008 using the alternative set of bi-weekly grab concentration data was 9.9 ppb.*

[2] *S12A and S333 are sampled weekly if flowing, otherwise monthly. S12B, S12C, and S12D are sampled weekly if flowing.*

The Consent Decree stipulates that the percentage of flow-weighted mean TP 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 2008, the sampling event TP concentrations greater than 10 ppb were 55.0, 45.0 and 42.9 percent, respectively. The observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were more than the guidelines for October, November, and December 2008 (**Table 2**). The 12-month flow-weighted mean TP concentrations and the flow-weighted mean TP concentrations for individual sampling events are presented in **Figure 5**.

The daily flows through the individual Shark River Slough structures from January 2007 through December 2008 are presented in **Figure 6**.

The stage level at Water Conservation Area (WCA) 3A remained in Zone A of the Regulation Schedule until early December 2008. All S12s were utilized fully except that S12A was closed from November 2, 2008 through the end of reporting period. Stage level was dropped to Zone C in early December 2008 and flow at the system was reduced to a much lower level on December 10, 2008. About 62 percent of discharge through S333 was diverted through S334 (**Figure 7**).

For additional information on the WCA 3A regulation schedule, please refer to: http://www.saj.usace.army.mil/h2o/plots/wca3ahp.pdf

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean TP concentrations for individual sampling events is presented in **Figure 8**. Flow and TP concentrations for waters entering the ENP through Shark River Slough had been following an inverse relationship in previous periods. TP concentrations continued to decline since last quarter as flow was increased; then, started to increase very slightly as flow was decreased, beginning in late October 2008. However, the sampling event flow-weighted mean concentrations remained very low. The sampling event flow-weighted mean TP concentrations were from 6 to 7 ppb during the quarter.

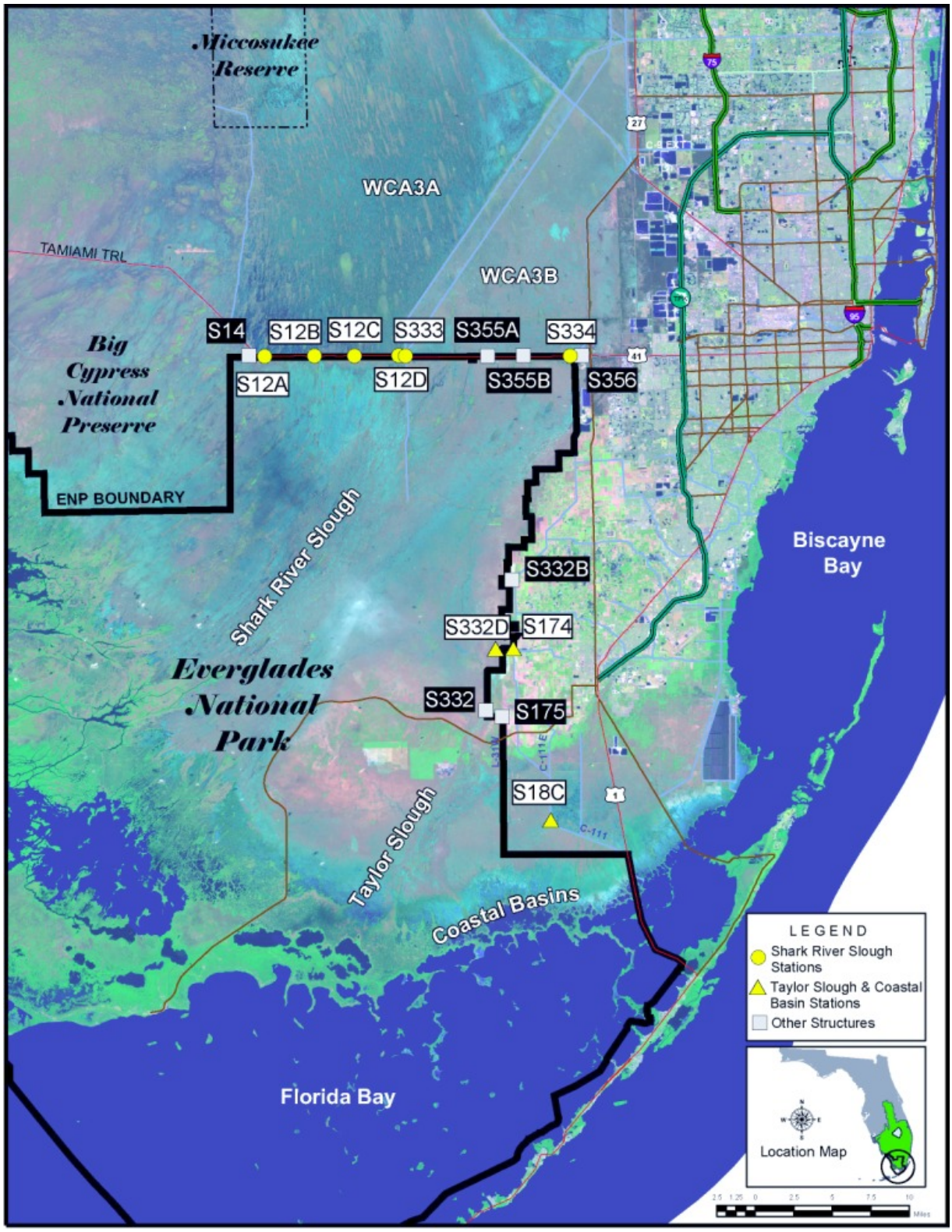

Figure 3. Everglades National Park flow structures

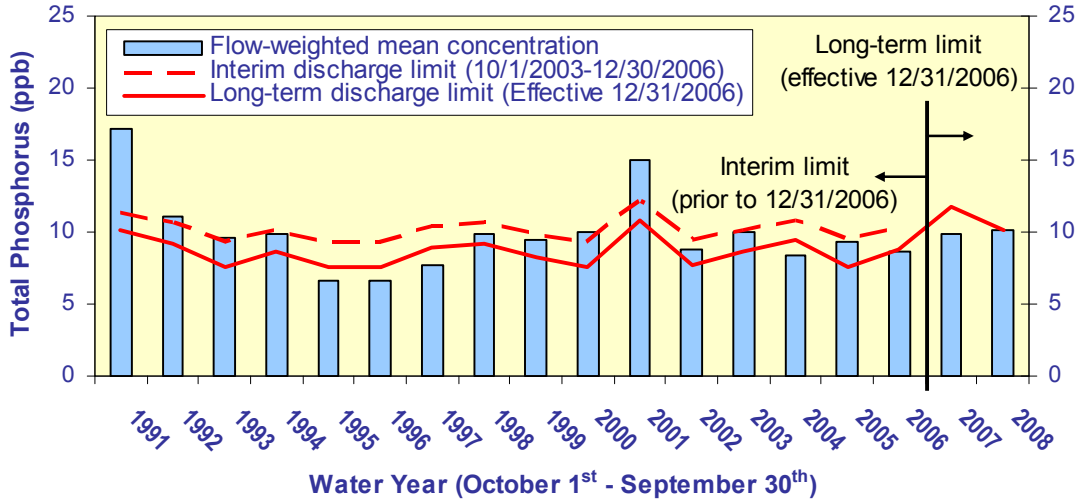

Figure 4. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each water year compared to the TP interim and long-term limits. The 12-month flow-weighted mean concentrations had met the interim limits since they became effective on October 1, 2003. The 12-month flow-weighted mean TP concentration for the compliance year through September 2008 was 10.2 ppb and equal to the long-term limit.

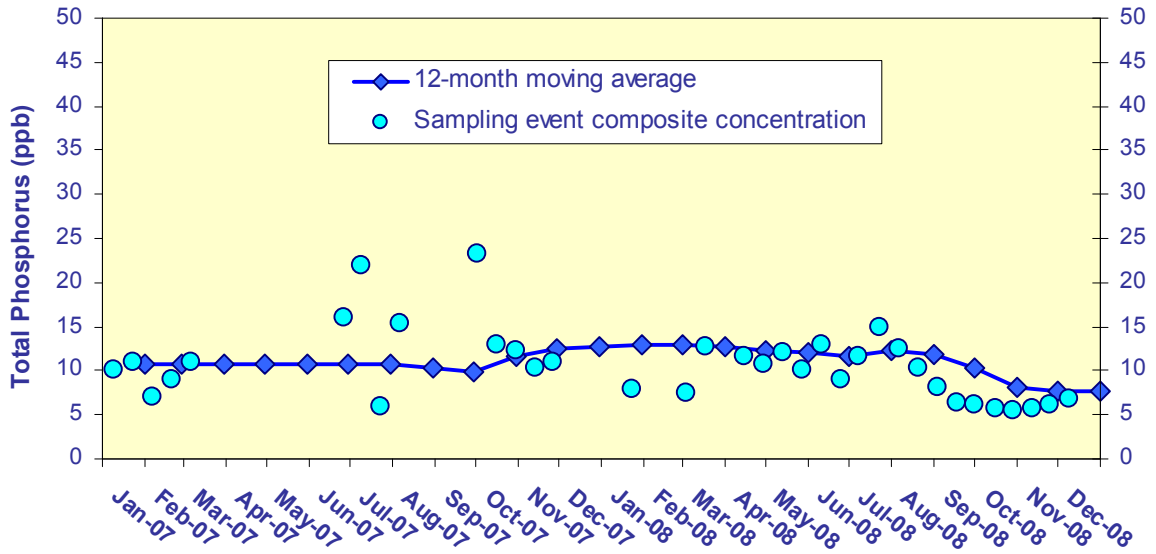

Figure 5. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for some months because there was little or no flow in those periods.

Table 2. Shark River Slough TP Concentration Compliance Tracking.

12-Month Period	Total Flow (kac-ft)	TP Flow Weighted Mean (ppb)	Long-Term Limit (ppb) Effective 12/31/06	Percent of Sampling Events Greater than 10 ppb (%) Guideline	Observed
2/1/2006 - 1/31/2007	446.1[a,b]	10.7	10.9	57.0	55.0
3/1/2006 - 2/28/2007	442.4[b]	10.8	10.9	57.2	52.4
4/1/2006 - 3/31/2007	456.0[b]	10.8	10.8	56.7	***57.1***
5/1/2006 - 4/30/2007	449.5[b]	10.8	10.8	56.9	52.6
6/1/2006 - 5/31/2007	445.5[b]	10.7	10.9	57.1	47.1
7/1/2006 - 6/30/2007	447.6[b]	10.8	10.8	57.0	50.0
8/1/2006 - 7/31/2007	444.6[b]	10.6	10.9	57.1	47.4
9/1/2006 - 8/31/2007	401.0	10.3	11.1	58.6	44.4
10/1/2006 - 9/30/2007	**289.7**	**9.8**	**11.8**	**62.6**	**37.5**
11/1/2006 - 10/31/2007	147.9	11.7	12.7	67.9	50.0
12/1/2006 - 11/30/2007	121.2	12.6	12.8	68.9	62.5
1/1/2007 - 12/31/2007	118.2	12.8	12.8	69.1	***71.4***
2/1/2007 - 1/31/2008	115.8	12.9	12.9	69.2	69.2
3/1/2007 - 2/29/2008	106.8	12.9	12.9	69.5	***81.8***
4/1/2007 - 3/31/2008	88.9	12.8	13.0	70.2	***75.0***
5/1/2007 - 4/30/2008	110.9	12.4	12.9	69.4	***78.6***
6/1/2007 - 5/31/2008	142.3	12.2	12.7	68.1	***75.0***
7/1/2007 - 6/30/2008	153.6	11.8	12.6	67.7	***70.6***
8/1/2007 - 7/31/2008	227.4	12.4	12.2	64.9	***76.5***
9/1/2007 - 8/31/2008	356.8	12.0	11.4	60.1	***77.8***
10/1/2007 - 9/30/2008	**562.0**	**10.2**	**10.2**	**53.3**	***70.0***
11/1/2007 - 10/31/2008	775.9	8.0	9.0	47.0	***55.0***
12/1/2007 - 11/30/2008	935.4	7.6	8.2	43.0	***45.0***
1/1/2008 - 12/31/2008	1003.1	7.6	7.9	41.4	***42.9***

[a] *Flow of 1.82 kac-ft in February 2006 at S355A and S355B was included for the 12-month total flows.*
[b] *Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows.*

Notes: 1) Highlighted rows indicate the end of the water year, which are the compliance points.
2) Bold italicized values exceeded the guideline percentages.

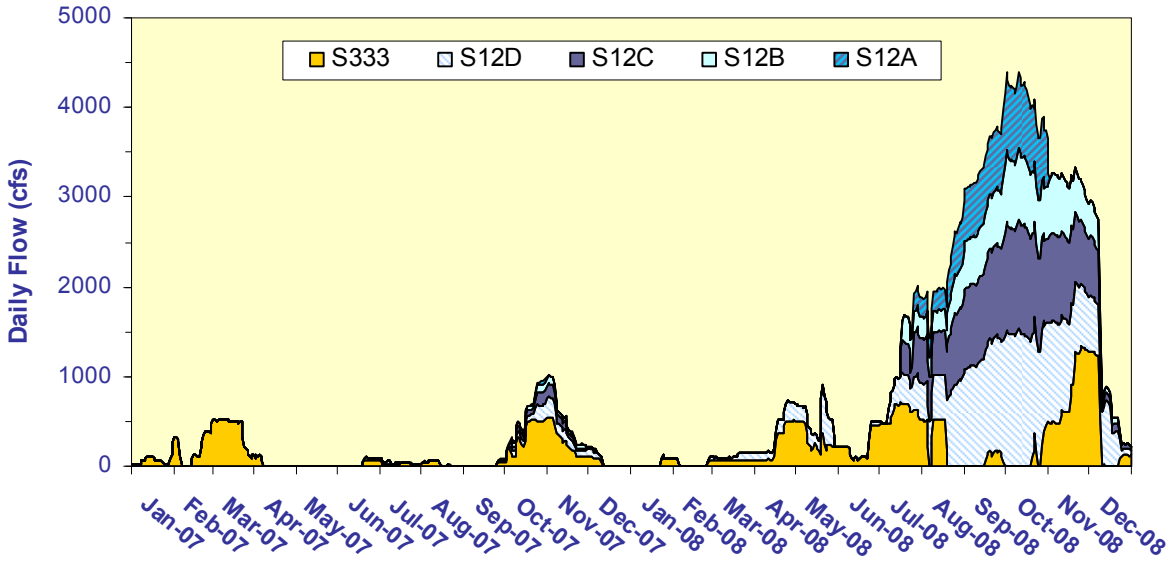

Figure 6. Daily flows into Shark River Slough by structure.

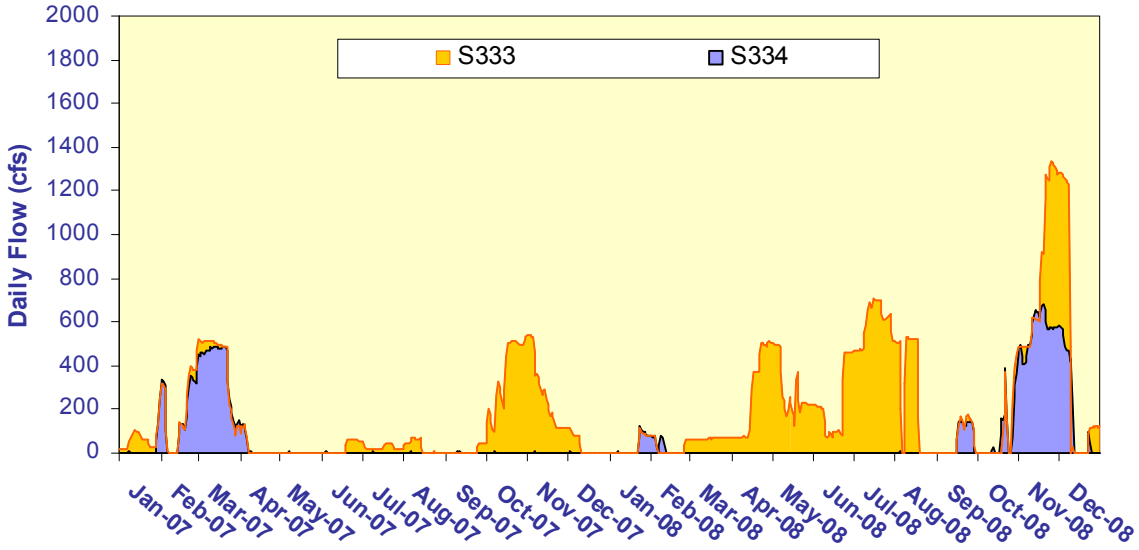

Figure 7. Daily flows comparison between S333 and S334.

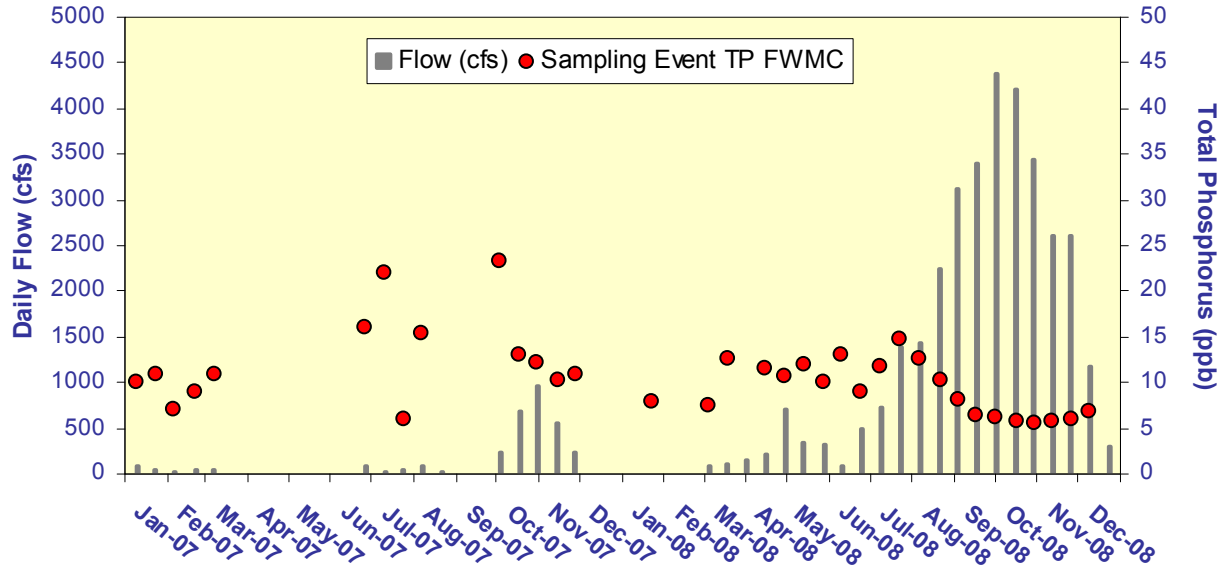

Figure 8. The relationship between daily flow at Shark River Slough structures and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Taylor Slough and the Coastal Basins

Under the Consent Decree, a single total phosphorus (TP) 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 12-month flow-weighted mean concentrations have consistently been lower than the long-term limit of 11 ppb.

C-111 Project Structures and Detention Areas

Beginning in August 1999, structure S332D, a 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. However, there had been almost no flow at S174 since March 2006. The site was plugged in September 2007, preventing any flow through S174.

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, Cell 1 through Cell 5, a connector cell between Cell 2 and Cell 3, a flow way cell originating at Berm 3 of Cell 5, and four diversion structures, DS1 through DS4 (**Figure 9**). The flow way cell is the only location to routinely discharge surface water into 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, has implemented 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 District started the routine sampling in September 2003.

The diversion structures DS2 and DS4 would discharge into the ENP if utilized. Overflows periodically occurred at DS2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports.

Discharges from the diversion structures DS1 and DS3 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 groundwater seepage in an easterly direction from ENP.

A total of 16,792 acre-feet water was pumped from S332B to West Pond (Cell 2) during the 4th quarter. However, the maximum stage for the quarter was 7.92 feet, well below the weir elevation of 8.36 feet at Cell 2. Therefore, there was no overflow at the diversion structures.

That overflow weir was the only surface water discharge point into the ENP for the S332B and S332C features. However, the levees are being rebuilt or raised to have the same height as the rest of the C-111 features. The emergency overflow weir is being demolished as well.

The S332B area construction tasks are the final pieces for the current C-111 Project, which is expected to be finished in 2009. When the project is finished, there will be a continuous detention cell from S332B to the single surface water outflow into the ENP at Berm B3.

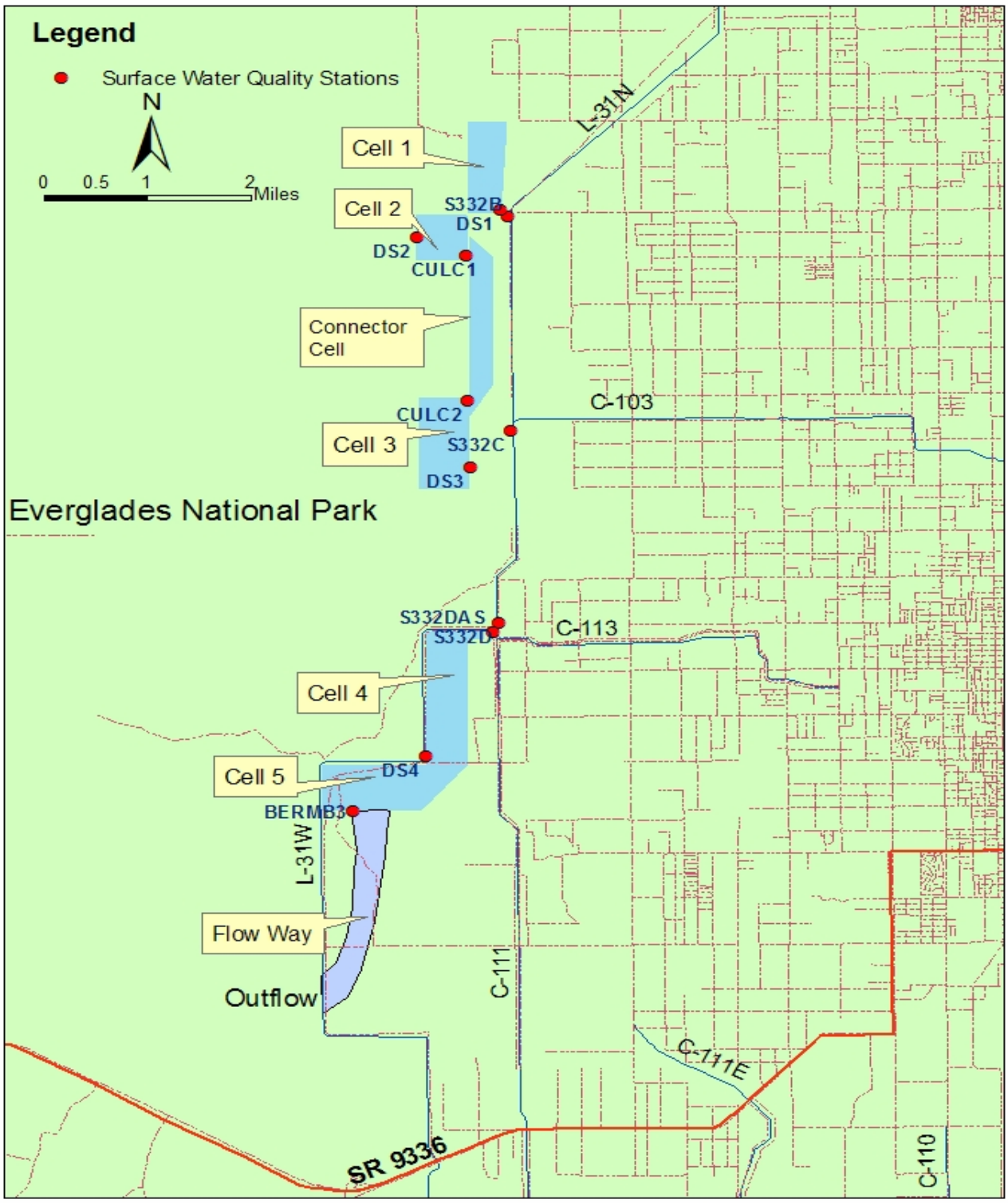

Figure 9. C-111 Project facilities.

Compliance with Consent Decree

Inflow TP concentrations to the ENP 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 10**). The bars in **Figure 10** represent the 12-month flow-weighted mean TP concentrations from S332, S175 and S18C for water years 1989 through 2002. The diamond point values for water years 1999 through 2008 represent the new combination of structures.

TP and flow data from both sets of structures presented in prior editions of this report through December 2001 (April 2002 report) showed that, beginning in 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 TP 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 10.** However, there had been almost no flow at S174 since March 2006. The site was plugged in September 2007, preventing any flow through S174.

Figure 11 presents the 12-month and individual sampling event flow-weighted mean TP concentrations at the S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the sites were used for the compliance calculations.

The daily flows into the ENP through S332D, S174 and S18C are presented in **Figure 12**.

For the combined flow through S332D and S18C, the 12-month flow-weighted mean TP concentrations were 5.7, 5.7 and 5.6 ppb, respectively, for the 12-month periods ending in October, November, and December 2008 (**Table 3**).

The Consent Decree stipulates that the percent of flow-weighted mean TP 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 sampling event flow-weighted mean concentrations remained very low. There was no sampling event flow-weighted mean TP concentration greater than 11 ppb since December 2006 except 23 ppb at S18C on July 14th, 2008. **Figure 13** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event.

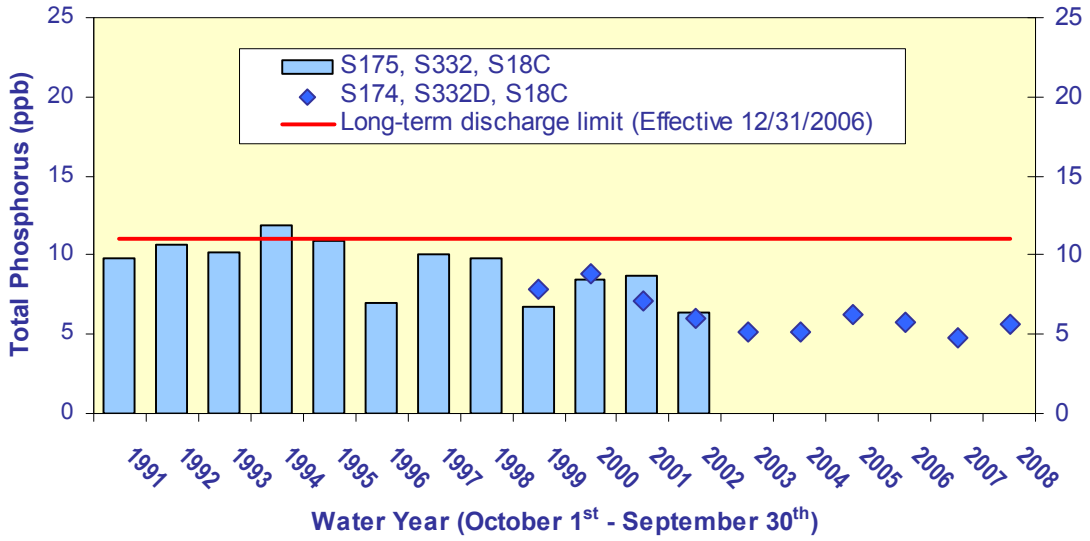

Figure 10. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term TP limit.

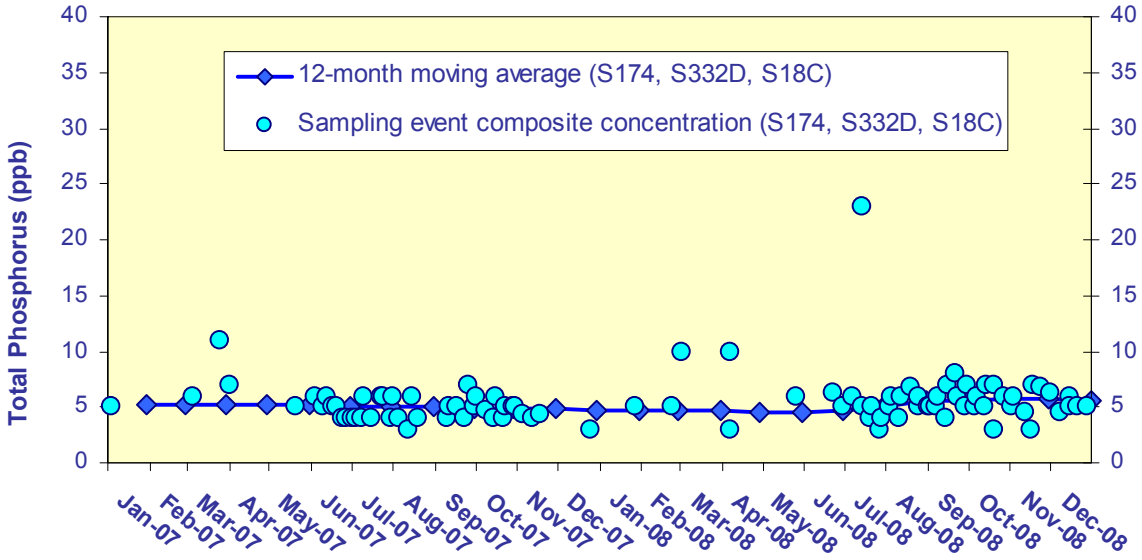

Figure 11. 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean TP concentration for each sampling event.

Table 3. Taylor Slough and the Coastal Basins TP Concentration Compliance Tracking.

12-Month Period	Total Flow (kac-ft)	TP Flow Weighted Mean (ppb)	Long-Term Limit (Effective 12/31/06) (ppb)	Percent of Sampling Events Greater than 10 ppb (%)	
				Guideline	Observed
2/1/2006 - 1/31/2007	127.6	5.2	11.0	53.1	6.4
3/1/2006 - 2/28/2007	125.4	5.2	11.0	53.1	7.0
4/1/2006 - 3/31/2007	123.8	5.2	11.0	53.1	10.0
5/1/2006 - 4/30/2007	125.4	5.2	11.0	53.1	10.0
6/1/2006 - 5/31/2007	126.1	5.2	11.0	53.1	7.5
7/1/2006 - 6/30/2007	153.0	5.1	11.0	53.1	6.5
8/1/2006 - 7/31/2007	153.4	5.1	11.0	53.1	6.4
9/1/2006 - 8/31/2007	143.6	5.0	11.0	53.1	6.4
10/1/2006 - 9/30/2007	**120.8**	**4.8**	**11.0**	**53.1**	**4.6**
11/1/2006 - 10/30/2007	150.5	4.8	11.0	53.1	4.2
12/1/2006 - 11/30/2007	155.8	4.8	11.0	53.1	4.3
1/1/2007 - 12/31/2007	154.8	4.7	11.0	53.1	2.3
2/1/2007 - 1/31/2008	155.5	4.7	11.0	53.1	2.3
3/1/2007 - 2/29/2008	156.1	4.7	11.0	53.1	2.3
4/1/2007 - 3/31/2008	155.4	4.7	11.0	53.1	0.0
5/1/2007 - 4/30/2008	157.1	4.6	11.0	53.1	0.0
6/1/2007 - 5/31/2008	155.9	4.6	11.0	53.1	0.0
7/1/2007 - 6/30/2008	145.0	4.8	11.0	53.1	0.0
8/1/2007 - 7/31/2008	130.0	5.0	11.0	53.1	2.6
9/1/2007 - 8/31/2008	165.6	5.5	11.0	53.1	2.5
10/1/2007 - 9/30/2008	**207.7**	**5.6**	**11.0**	**53.1**	**2.2**
11/1/2007 - 10/31/2008	234.8	5.7	11.0	53.1	2.3
12/1/2007 - 11/30/2008	273.0	5.7	11.0	53.1	2.2
1/1/2008 - 12/31/2008	308.8	5.6	11.0	53.1	2.0

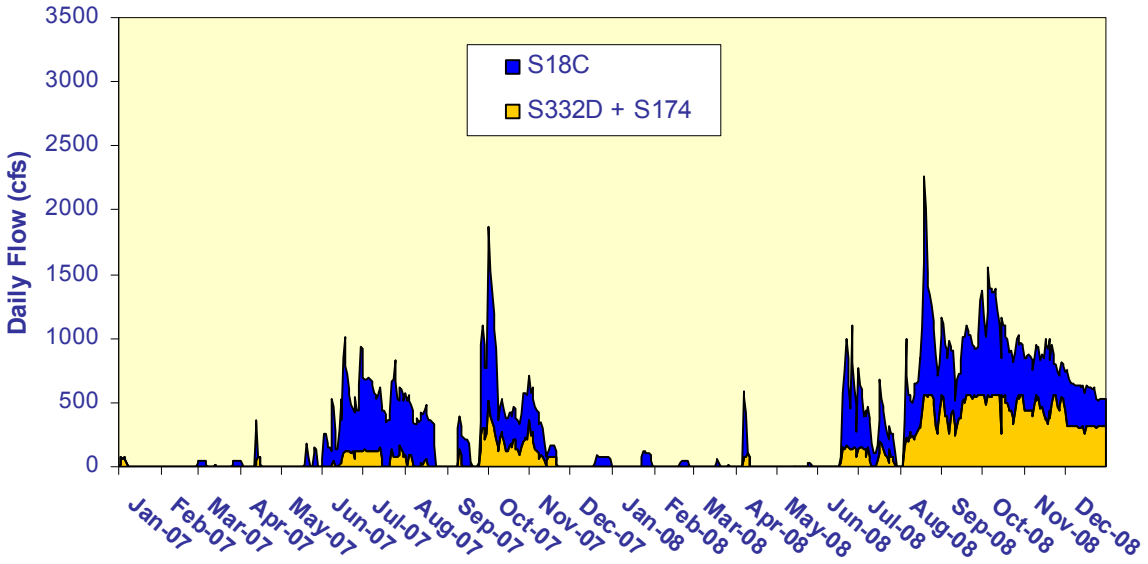

Figure 12. Daily flows into Everglades National Park through Taylor Slough (S332D+S174) and S18C; S174 was plugged in September 2007.

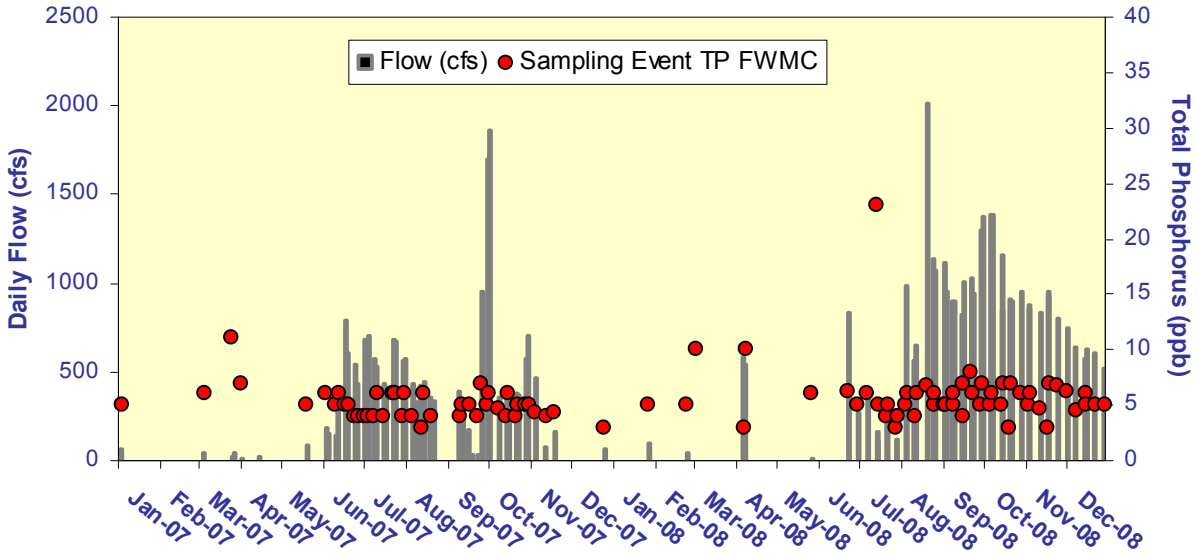

Figure 13. The relationship between daily flows at Taylor Slough structures (S332D + S174) and S18C and the corresponding flow-weighted mean TP concentrations for individual sampling events.

Settlement Agreement Report

First Quarter
January – March 2009

Prepared for the
Technical Oversight Committee
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Posted: June 17, 2009

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West Palm Beach, FL 33406

PURPOSE

The South Florida Water Management District has prepared this report to provide a quarterly update to the Technical Oversight Committee on the compliance status with total phosphorus levels or limits defined in the 1991 Settlement Agreement entered as a Consent Decree in 1992 and modified in 1995. The areas of interest in this report include the interior marsh stations in Arthur R. Marshall Loxahatchee National Wildlife Refuge and two discharges to Everglades National Park: inflows to Shark River Slough and inflows to Taylor Slough and the Coastal Basins.

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ACRONYMS AND ABBREVIATIONS

ENP	Everglades National Park
FDEP	Florida Department of Environmental Protection
IOP	Interim Operational Plan
kac-ft	thousand acre-feet
NGVD 29	National Geodetic Vertical Datum of 1929
OFW	Outstanding Florida Waters
ppb	parts per billion
Refuge	Arthur R. Marshall Loxahatchee National Wildlife Refuge
SFWMD	South Florida Water Management District
STA	Stormwater Treatment Area
TOC	Technical Oversight Committee
TP	total phosphorus
µg/L	micrograms per liter
USACE	United States Army Corps of Engineers
WCA	Water Conservation Area

EXECUTIVE SUMMARY

This report fulfills the South Florida Water Management District's reporting requirements under the 1991 Settlement Agreement, entered as a Consent Decree in 1992 and modified in 1995, for the first quarter of 2009 (January - March 2009). Total phosphorus (TP) compliance highlights for this period are summarized below for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) and Everglades National Park, including Shark River Slough, Taylor Slough and the Coastal Basins (**Table 1** and **Figure 1**):

- **Refuge**: The geometric mean TP concentrations were below the long-term level for the first quarter; all 14 stations were sampled in January 2009; 12 stations were sampled in February 2009; and 9 stations were sampled in March 2009.
- **Shark River:** The 12-month flow-weighted mean TP concentration was below the long-term limit for each month of the quarter.
- **Taylor Slough and the Coastal Basins**: The 12-month flow-weighted mean TP concentration was below the annual long-term limit for each month of the quarter.

Table 1. Total phosphorus compliance, first quarter 2009.

Arthur R. Marshall Loxahatchee National Wildlife Refuge				
Month	**Geometric Mean TP Concentration (ppb)**	**Long-Term Level (ppb)**	**Mean Stage (ft NGVD 29)**	**Number of Samples**
Jan-2009	7.0	8.8	16.68	14
Feb-2009	4.7	10.4	16.35	12
Mar-2009	7.5	13.5	15.86	9

Everglades National Park – Shark River Slough					
12-Month Period Ending	**Total Flow (kac-ft)**	**12-Month Flow-Weighted Mean TP Concentration (ppb)**	**Long-Term Limit (ppb)**	**Percent of Sampling Events Greater than 10 ppb**	
				Guideline	**Observed**
Jan-2009	1007.1	7.6	7.9	41.3	40.9
Feb-2009	1021.5	7.6	7.8	41.0	37.5
Mar-2009	1030.3	7.6	7.8	40.8	36.0

Everglades National Park – Taylor Slough and the Coastal Basins					
12-Month Period Ending	**Total Flow (kac-ft)**	**12-Month Flow-Weighted Mean TP Concentration (ppb)**	**Long-Term Limit (ppb)**	**Percent of Sampling Events Greater than 10 ppb**	
				Guideline	**Observed**
Jan-2009	317.1	5.6	11.0	53.1	1.9
Feb-2009	316.5	5.6	11.0	53.1	1.9
Mar-2009	320.0	5.6	11.0	53.1	1.8

Notes:
- ppb = parts per billion. Values are actually in µg/L (micrograms per liter), which, for the purposes of this report, is equivalent to ppb.
- ft NGVD 29 = elevation in feet related to the National Geodetic Vertical Datum of 1929.
- kac-ft = thousand acre feet.
- Compliance for inflows to Everglades National Park (Shark River Slough, Taylor Slough and the Coastal Basins) is evaluated annually based on the 12-month flow-weighted mean TP concentration for the federal water year ending in September.

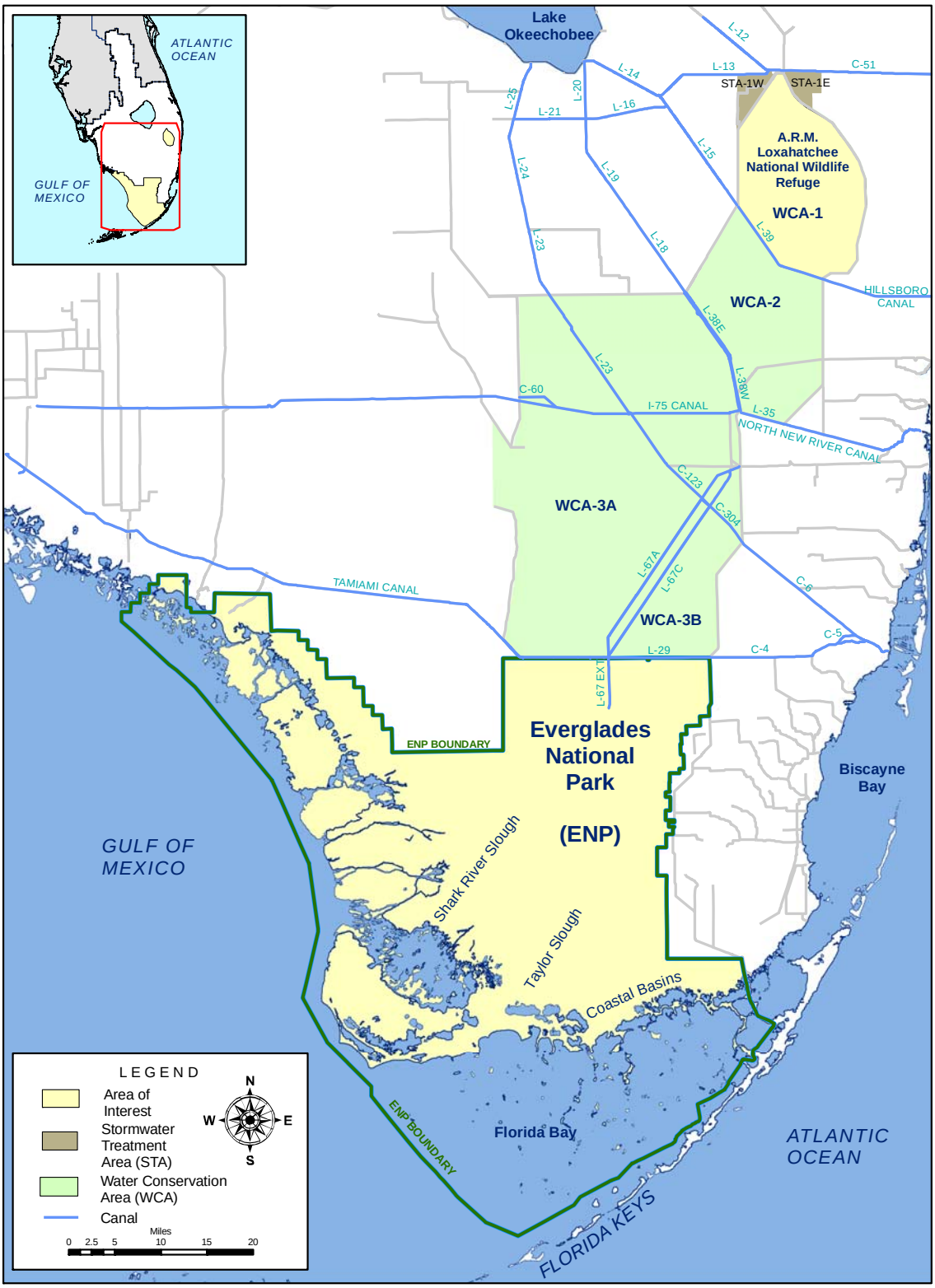

Figure 1. Areas of interest.

ARTHUR R. MARSHALL LOXAHATCHEE NATIONAL WILDLIFE REFUGE

Background

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 total phosphorus (TP) concentration levels for the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) must be met by February 1, 1999, and December 31, 2006, respectively. Both the interim and long-term 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 relative to the National Geodetic Vertical Datum of 1929 (NGVD 29). The monthly TP concentrations are determined from water samples collected at 14 interior marsh stations, LOX3 through LOX16 (**Figure 2**). 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. Monthly TP data for each station for the past 12 months are provided in **Appendix A**. The calculation methods specified in the Consent Decree are provided in **Appendix B**.

Reporting Period Update

Average stages in the Refuge were 16.68, 16.35, and 15.86 feet in January, February, and March 2009, respectively (**Figure 3** and **Table 2**). The geometric means, calculated from TP concentrations measured in water samples collected in January, February, and March 2009 were 7.0, 4.7, and 7.5 parts per billion (ppb), respectively. The geometric mean was lower than the long-term level, which became effective on December 31, 2006, for January, February, and March 2009.

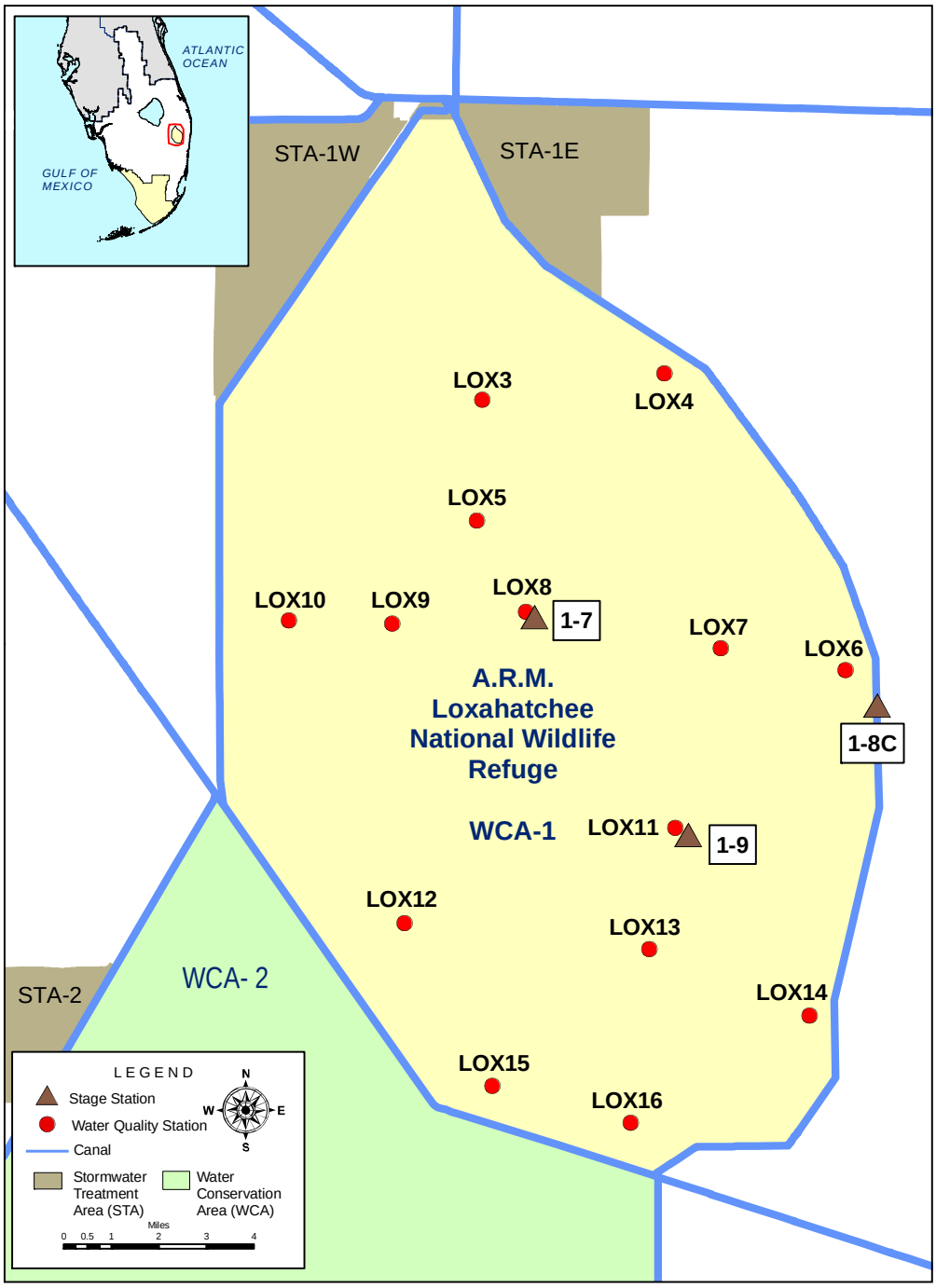

Figure 2. Arthur R. Marshall Loxahatchee National Wildlife Refuge water quality sampling and stage measurement sites.

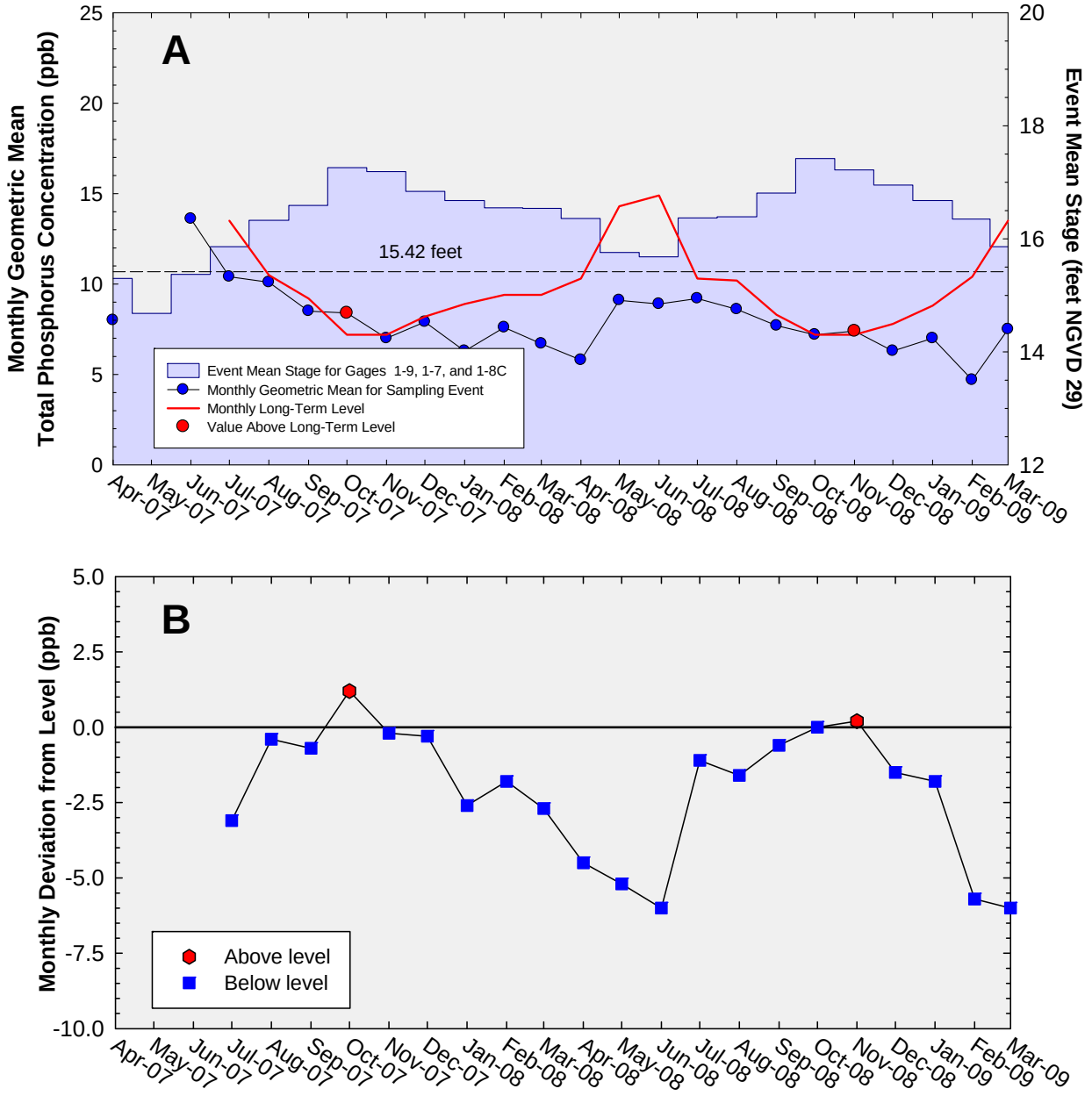

Figure 3. (A) Monthly total phosphorus geometric mean concentrations for the Arthur R. Marshall Loxahatchee National Wildlife Refuge compared to calculated long-term levels. These calculated long-term total phosphorus levels are adjusted for fluctuations in stage. The long-term levels were not applicable for April 2007 through June 2007 because the average stage was less than 15.42 feet. The geometric mean was greater than the long-term level in October 2007 and November 2008.

(B) Deviation of monthly geometric mean total phosphorus concentrations with calculated long-term levels. Values greater than zero suggest that the geometric mean was greater than the long-term level.

Table 2. Loxahatchee National Wildlife Refuge total phosphorus compliance tracking.

Month	Geometric Mean TP Concentration (ppb)	Long-Term Level (ppb)	Average Stage[a] (ft NGVD 29)	Number of Samples
Apr-2007	8.0	N/A[b]	15.30	3
May-2007	---	N/A[b]	14.68	0
Jun-2007	13.6	N/A[b]	15.37	4
Jul-2007	10.4	13.5	15.86	13
Aug-2007	10.1	10.5	16.33	13
Sep-2007	8.5	9.2	16.59	14
Oct-2007	***8.4***	***7.2***	***17.26***	***14***
Nov-2007	7.0	7.2	17.19	14
Dec-2007	7.9	8.2	16.84	14
Jan-2008	6.3	8.9	16.68	14
Feb-2008	7.6	9.4	16.55	14
Mar-2008	6.7	9.4	16.54	14
Apr-2008	5.8	10.3	16.36	14
May-2008	9.1	14.3	15.76	9
Jun-2008	8.9	14.9	15.68	8
Jul-2008	9.2	10.3	16.37	14
Aug-2008	8.6	10.2	16.39	14
Sep-2008	7.7	8.3	16.81	14
Oct-2008	7.2	7.2	17.42	14
Nov-2008	***7.4***	***7.2***	***17.22***	***14***
Dec-2008	6.3	7.8	16.95	14
Jan-2009	7.0	8.8	16.68	14
Feb-2009	4.7	10.4	16.35	12
Mar-2009	7.5	13.5	15.86	9

Notes:
- ppb = parts per billion. Values are actually in µg/L (micrograms per liter), which, for the purposes of this report, is equivalent to ppb.
- ft NGVD 29 = elevation in feet related to the National Geodetic Vertical Datum of 1929.
- Highlighted rows with bold, italicized text indicate when an excursion over the long-term level occurred.

[a] Average stage is calculated using stage elevations at stations 1-7, 1-8C, and 1-9 for a given sampling date.
[b] N/A denotes that the level was not applicable because the average stage was less than 15.42 feet.

EVERGLADES NATIONAL PARK

Shark River Slough

Background

The Settlement Agreement/Consent Decree (1995) specified that interim and long-term TP concentration limits for discharges into the Everglades National Park (ENP) (**Figure 4**) through Shark River Slough be met by October 1, 2003, and December 31, 2006, respectively. It was specified that the TP concentrations be presented as 12-month flow-weighted means. Only the TP concentrations for the water year ending September 30 are evaluated for compliance with the Consent Decree limits (**Appendix B**). The long-term TP 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 TP through Shark River Slough are compared to the interim and long-term limits at the end of each water year (October 1 through September 30) from 1991 to 2008 (**Figure 5**). The 12-month flow-weighted mean TP concentration for October 2007 through September 2008 was 10.2 ppb[1]. The corresponding long-term limit, which became effective on December 31, 2006, was also 10.2 ppb.

Reporting Period Update

Table 3 presents the 12-month flow-weighted mean concentrations for each month as well as the corresponding long-term TP concentration limits, calculated using the 12-month period flow. Supplemental water quality samples were collected at some of the Shark River Slough monitoring sites from January 2006 through September 2007, but only the bi-weekly compliance monitoring grab concentration data were used for flow-weighted mean TP concentration calculations. Routine monitoring was changed to weekly for all Shark River Slough sites beginning in October 2007. In accordance with Appendix A of the Consent Decree, only the every-other-week grab concentration data were used for the flow-weighted mean calculations from October 2007 forward[2]. For the 12-month periods ending in January, February, and March 2009, the 12-month flow-weighted mean TP concentrations were 7.6 ppb. The long-term limits were 7.9, 7.8, and 7.8 ppb, respectively. The 12-month flow-weighted mean TP concentrations were lower than the long-term limits for January, February, and March 2009.

[1] The 12-month flow-weighted mean TP concentration for September 2008 using all available weekly grab concentration data instead of bi-weekly grab data was 10.2 ppb; the 12-month flow-weighted mean TP concentration for September 2008 using the alternative set of bi-weekly grab concentration data was 9.9 ppb.

[2] S12A and S333 are sampled weekly if flowing, otherwise monthly. S12B, S12C, and S12D are sampled weekly if flowing.

The Consent Decree stipulates that the percentage of flow-weighted mean TP 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 2009, the sampling event TP concentrations greater than 10 ppb were 40.9, 37.5, and 36.0 percent, respectively. The observed percentages of the sampling event flow-weighted mean TP concentrations greater than 10 ppb were lower than the guidelines for January, February, and March 2009 (**Table 3**). The 12-month flow-weighted mean TP concentrations and the flow-weighted mean TP concentrations for individual sampling events are presented in **Figure 6**.

The daily flows through the individual Shark River Slough structures from April 2007 through March 2009 are presented in **Figures 7 and 9.**

There was very little flow through the system except at S333 during the first quarter of 2009. S12A and S12B remained closed during the quarter and S12C was closed beginning January 14, 2009 in accordance with the Interim Operational Plan (IOP) for protection of the Cape Sable Seaside Sparrow. S12D was closed beginning January 28, 2009.

The stage levels at Water Conservation Area (WCA) 3A remained in Zone E, below the regulation schedule, through the quarter and the S12s and S333 were utilized only to meet the target discharges described in the Shark River Slough "Rain Driven Water Deliveries to Everglades National Park" and S333 for water supply discharges to the East Coast and ENP-South Dade Conveyance System.

A total of 35,131 acre-feet of water was discharged through S333; 20,584 acre-feet was diverted to S334 during the quarter (**Figure 8)**.

For additional information on the WCA-3A regulation schedule, please refer to the U.S. Army Corps of Engineers (USACE) – Jacksonville District's web site (http://www.saj.usace.army.mil/h2o/plots/wca3ahp.pdf).

The relationship between the sum of the daily flows at Shark River Slough structures and corresponding flow-weighted mean TP concentrations for individual sampling events is presented in **Figure 10**. Flow and TP concentrations for waters entering the ENP through Shark River Slough had been following an inverse relationship in previous periods. However, TP concentrations remained relatively low; all measured sampling event flow-weighted mean TP concentrations were equal to or less than 11 ppb during the quarter.

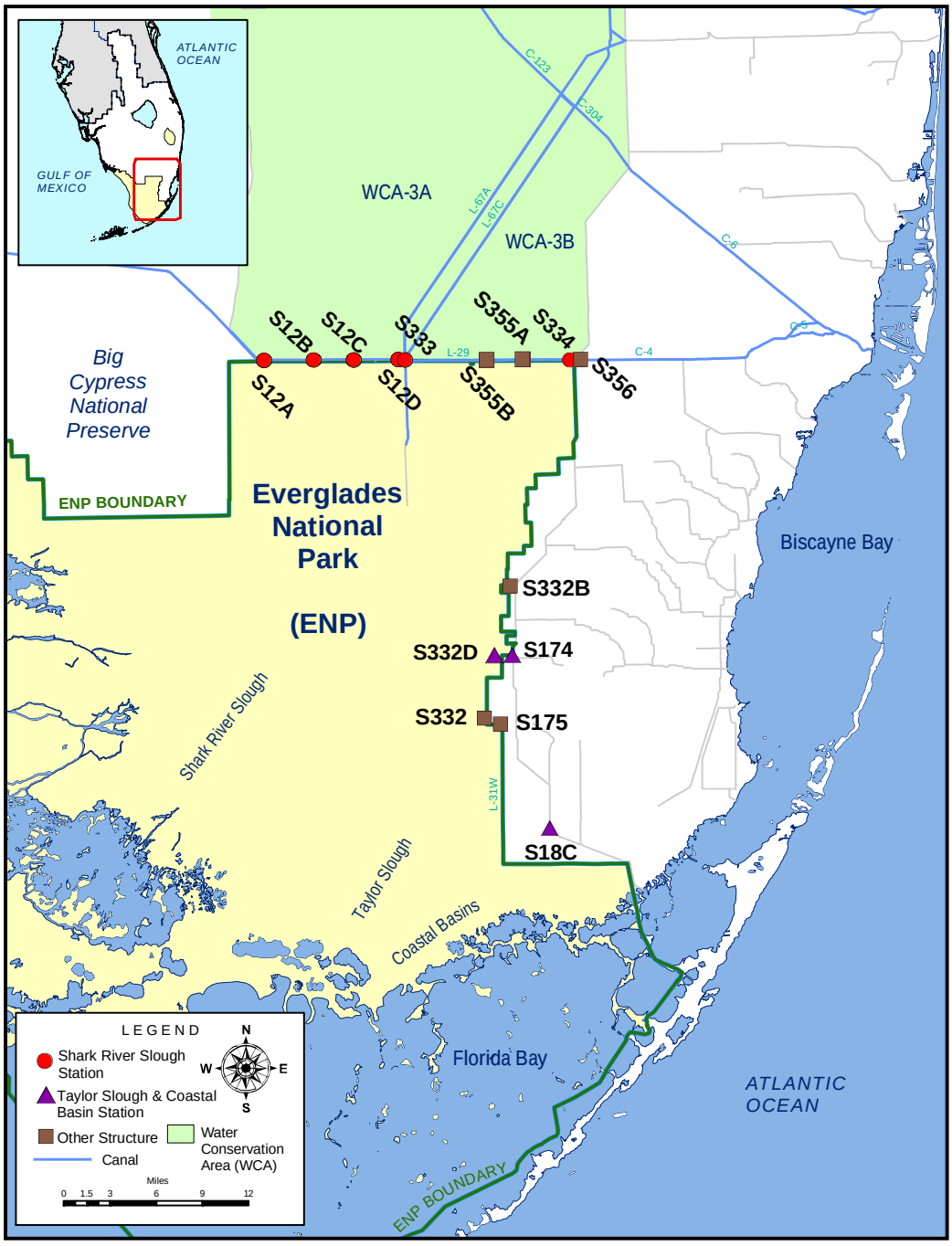

Figure 4. Everglades National Park flow structures.

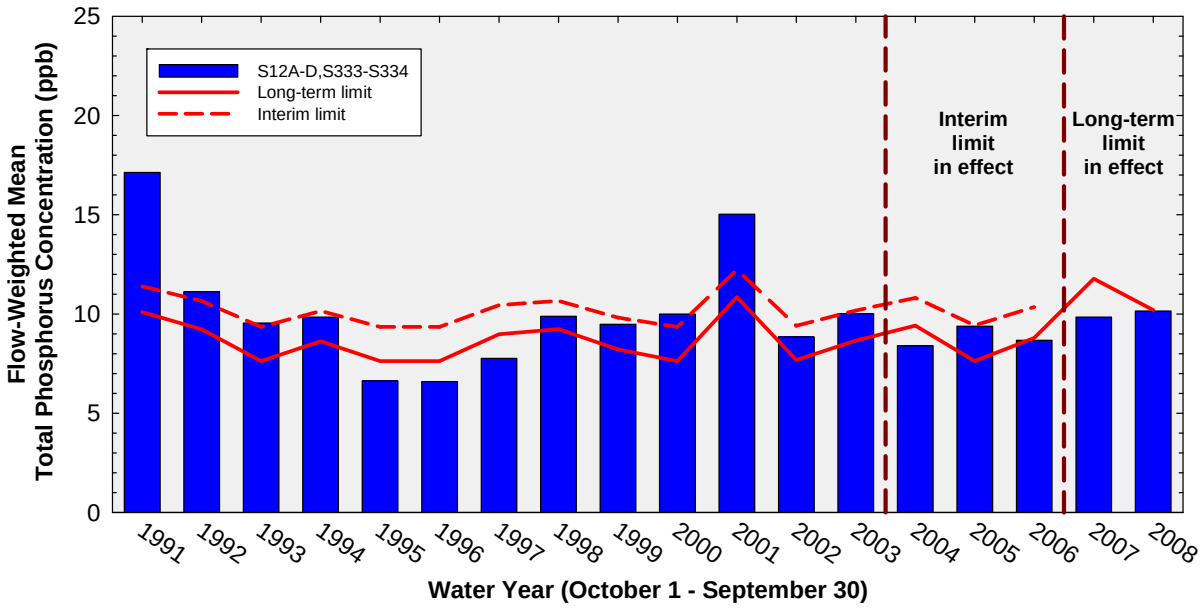

Figure 5. The 12-month flow-weighted mean total phosphorus concentrations at inflows to the Everglades National Park through Shark River Slough at the end of each water year compared to the interim and long-term total phosphorus limits. The 12-month flow-weighted mean concentrations have met the interim limits since they became effective on October 1, 2003. The 12-month flow-weighted mean TP concentration for the compliance year through September 2008 was 10.2 ppb and equal to the long-term limit.

Table 3. Shark River Slough total phosphorus compliance tracking.

12-Month Period	Total Flow (kac-ft)	Flow-Weighted Mean TP Concentration (ppb)	Long-Term Limit (ppb) *Effective 12/31/2006*	Percent of Sampling Events Greater than 10 ppb	
				Guideline	Observed
May 2006 - Apr 2007	449.5[b]	10.8	10.8	56.9	52.6
Jun 2006 - May 2007	445.5[b]	10.7	10.9	57.1	47.1
Jul 2006 - Jun 2007	447.6[b]	10.8	10.8	57.0	50.0
Aug 2006 - Jul 2007	444.6[b]	10.6	10.9	57.1	47.4
Sep 2006 - Aug 2007	401.0	10.3	11.1	58.6	44.4
Oct 2006 - Sep 2007	***289.7***	***9.8***	***11.8***	***62.6***	***37.5***
Nov 2006 - Oct 2007	147.9	11.7	12.7	67.9	50.0
Dec 2006 - Nov 2007	121.2	12.6	12.8	68.9	62.5
Jan 2007 - Dec 2007	118.2	12.8	12.8	69.1	71.4[c]
Feb 2007 - Jan 2008	115.8	12.9	12.9	69.2	69.2
Mar 2007 - Feb 2008	106.8	12.9	12.9	69.5	81.8[c]
Apr 2007 - Mar 2008	88.9	12.8	13.0	70.2	75.0[c]
May 2007 - Apr 2008	110.9	12.4	12.9	69.4	78.6[c]
Jun 2007 - May 2008	142.3	12.2	12.7	68.1	75.0[c]
Jul 2007 - Jun 2008	153.6	11.8	12.6	67.7	70.6[c]
Aug 2007 - Jul 2008	227.4	12.4	12.2	64.9	76.5[c]
Sep 2007 - Aug 2008	356.8	12.0	11.4	60.1	77.8[c]
Oct 2007 - Sep 2008	***562.0***	***10.2***	***10.2***	***53.3***	***70.0[c]***
Nov 2007 - Oct 2008	775.9	8.0	9.0	47.0	55.0[c]
Dec 2007 - Nov 2008	935.4	7.6	8.2	43.0	45.0[c]
Jan 2008 - Dec 2008	1003.1	7.6	7.9	41.4	42.9[c]
Feb 2008 - Jan 2009	1007.1	7.6	7.9	41.3	40.9
Mar 2008 - Feb 2009	1021.5	7.6	7.8	41.0	37.5
Apr 2008 - Mar 2009	1030.3	7.6	7.8	40.8	36.0

Notes:
- kac-ft = thousand acre feet.
- ppb = parts per billion. Values are actually in µg/L (micrograms per liter), which, for the purposes of this report, is equivalent to ppb.
- Compliance is evaluated annually based on the 12-month flow-weighted mean TP concentration for the federal water year ending in September. The compliance periods are shown as highlighted rows with bold, italicized text.
- Flow data for S12B from April 29, 2008 to May 7, 2008, were updated for consistency with the DBHYDRO database on December 23, 2008.

[a] Flow of 1.82 kac-ft in February 2006 at S355A and S355B was included for the 12-month total flows.
[b] Flow of 3.33 kac-ft in August 2006 at S356 structure was included for the 12-month total flows.
[c] Value exceeded the guideline percentage.

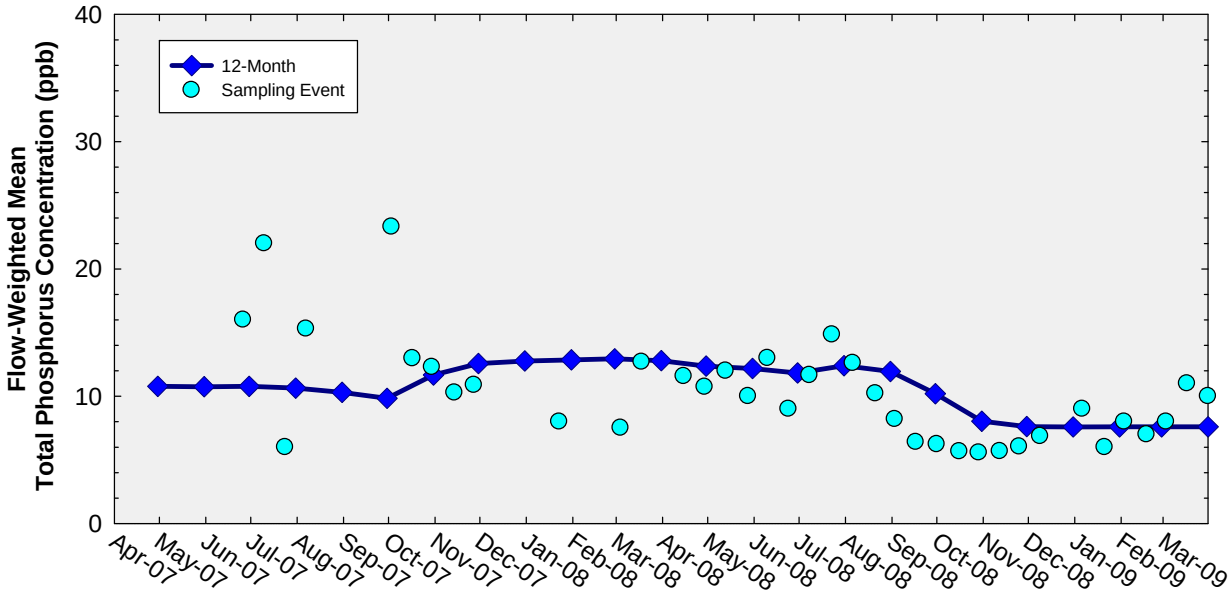

Figure 6. The 12-month flow-weighted mean TP concentrations in inflows to Everglades National Park through Shark River Slough at the end of each month and the flow-weighted mean concentration for each sampling event. There are no sampling event values for some months because there was little or no flow in those periods.

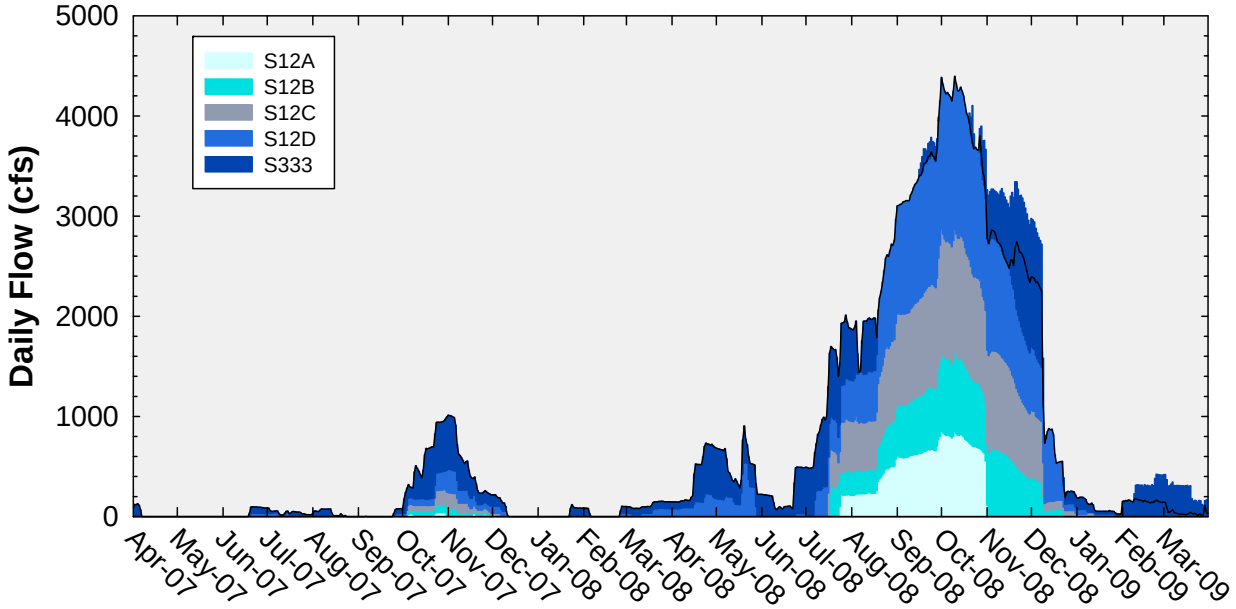

Figure 7. Daily flows at Shark River Slough structures as a stacked sum of five inflows.

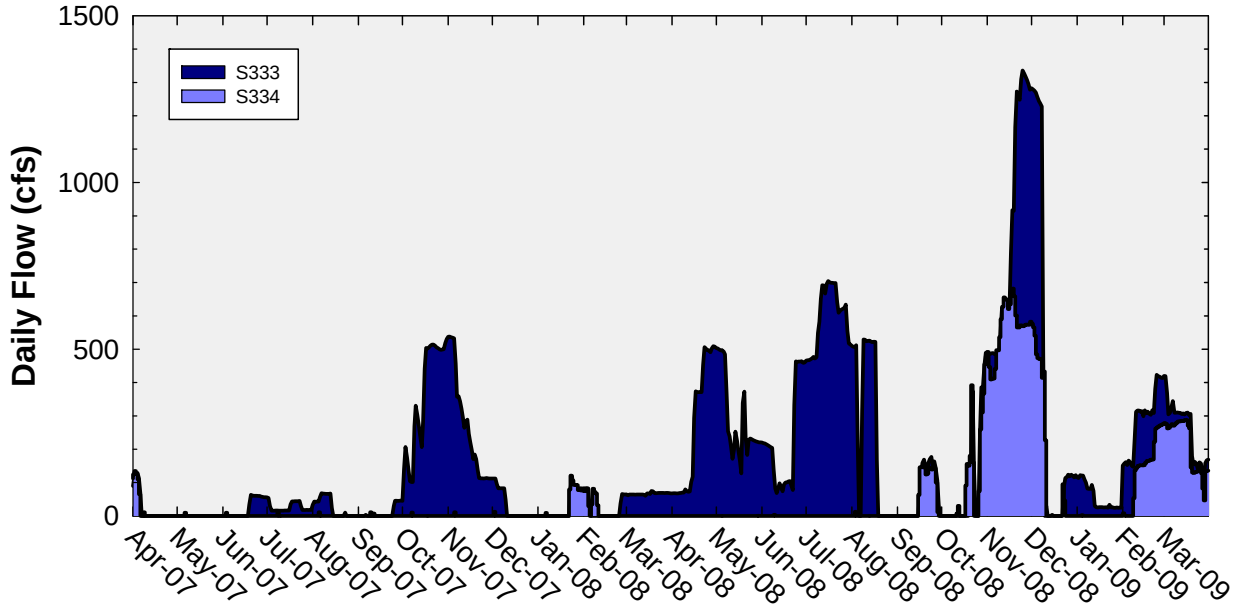

Figure 8. Daily flows at structures S333 and S334.

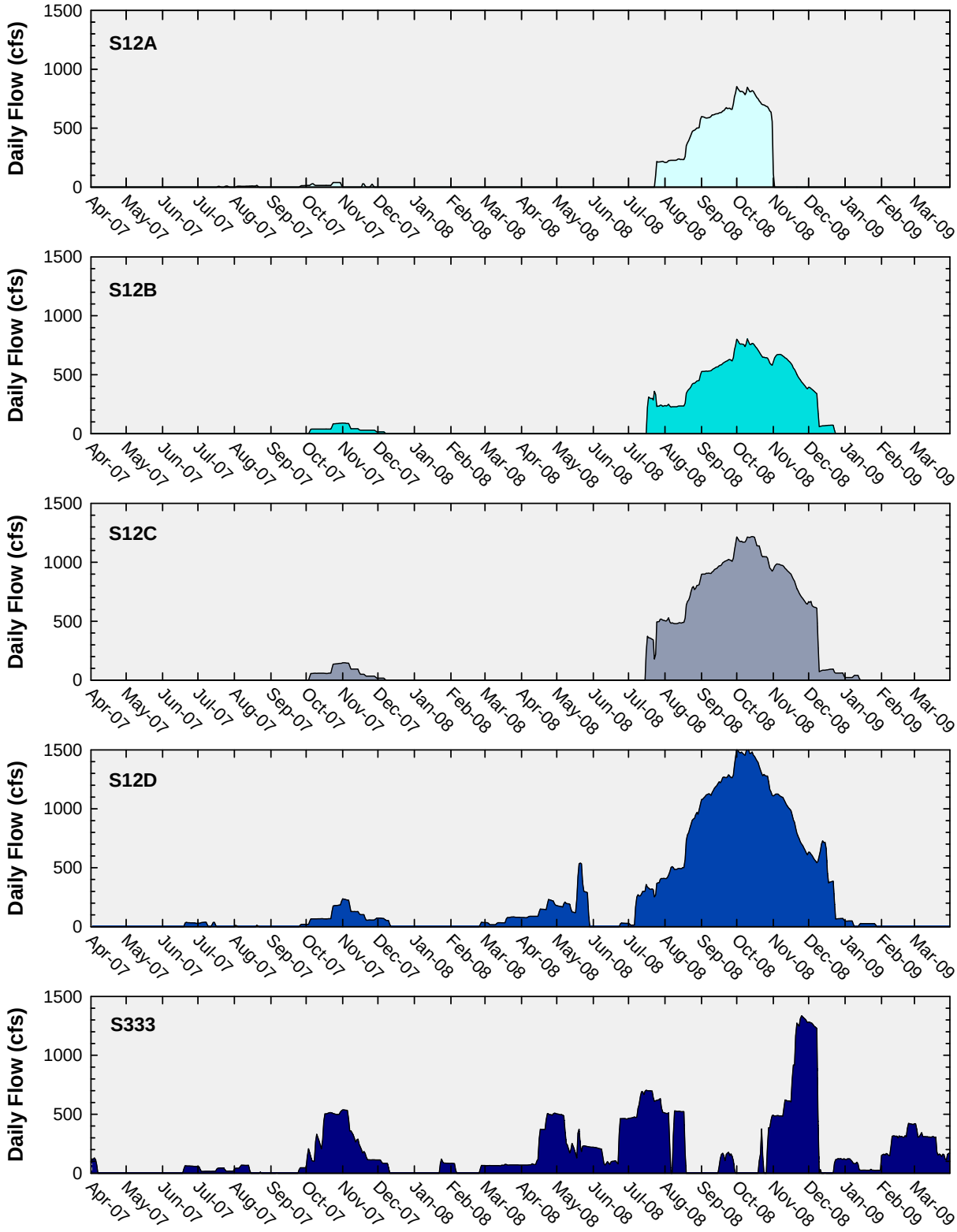

Figure 9. Daily flows at individual inflow structures to Shark River Slough. This figure includes most of the data illustrated in **Figures 7** and **8**.

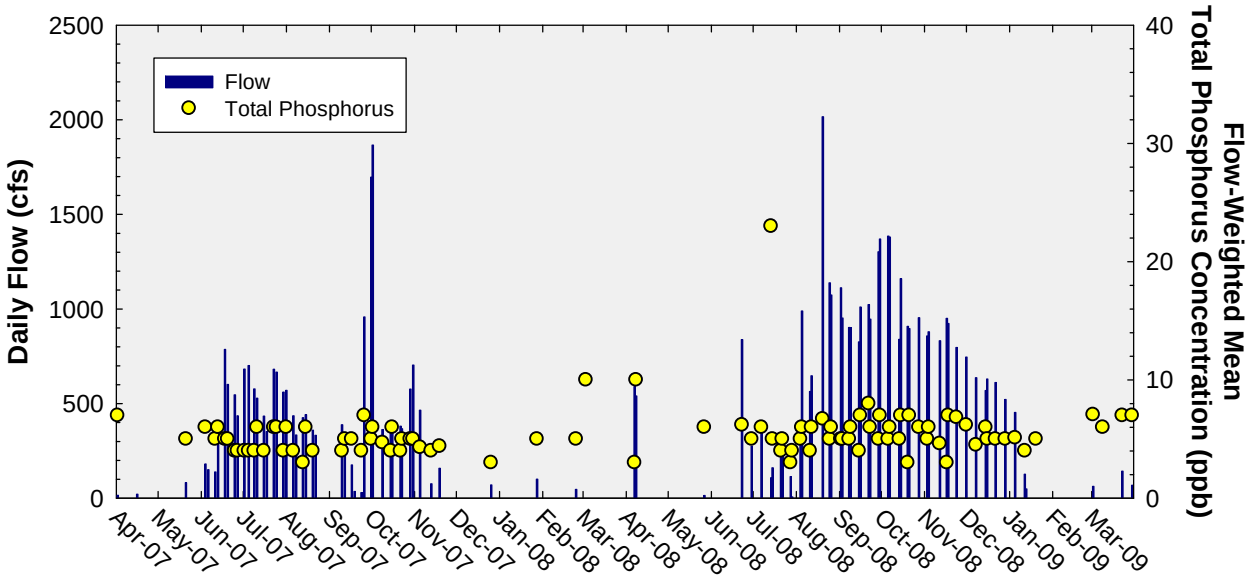

Figure 10. Total daily flow at Shark River Slough structures and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

Taylor Slough and Coastal Basins

Background

Under the Consent Decree, a single TP 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)(see **Appendix B**). The 12-month flow-weighted mean concentrations have consistently been lower than the long-term limit of 11 ppb.

Inflow TP concentrations to the ENP 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 11**). The narrow bars in **Figure 11** represent the 12-month flow-weighted mean TP concentrations from S332, S175, and S18C for water years 1989 through 2002. The wider bars for water years 1999 through 2008 represent the new combination of structures.

TP and flow data from both sets of structures presented in prior editions of this report through December 2001 (April 2002 report) showed that, beginning in 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 TP 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 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 11**. However, almost no flow passed through S174 from March 2006 to September 2007. The site was plugged in September 2007, preventing any additional flow.

Reporting Period Update

Figure 12 presents the 12-month and individual sampling event flow-weighted mean TP concentrations at the S332D and S18C structures. All TP grab sample concentrations taken on positive flow days reported for surface water monitoring at the sites were used for the compliance calculations.

The daily flows into the ENP through S332D, S174, and S18C are presented in **Figures 13** and **14**.

For the combined flow through S332D and S18C, the 12-month flow-weighted mean TP concentrations was 5.6 ppb, for the 12-month periods ending in January, February, and March 2009 (**Table 4**).

The Consent Decree stipulates that the percent of flow-weighted mean TP 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 sampling event flow-weighted mean concentrations

remained very low. There was no sampling event flow-weighted mean TP concentration greater than 11 ppb since December 2006 except 23 ppb at S18C on July 14, 2008. **Figure 15** shows the relationship between the daily inflows and the corresponding flow-weighted mean TP concentrations for each sampling event.

The USACE authorized the C-111 project 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.

The original project facilities consisted of pump stations (S332B, S332C and S332D), detention cells (Cell 1 through Cell 5), a connector cell between Cell 2 and Cell 3, a flow-way cell originating at Berm 3 of Cell 5, and four diversion structures (DS1 through DS4). Upon completion of a USACE construction project in 2009, an interconnected detention system now exists, starting at S-332B west discharge and continuing to the S-332D high head cell.

More details of the C-111 project and a site map are provided in **Appendix C**.

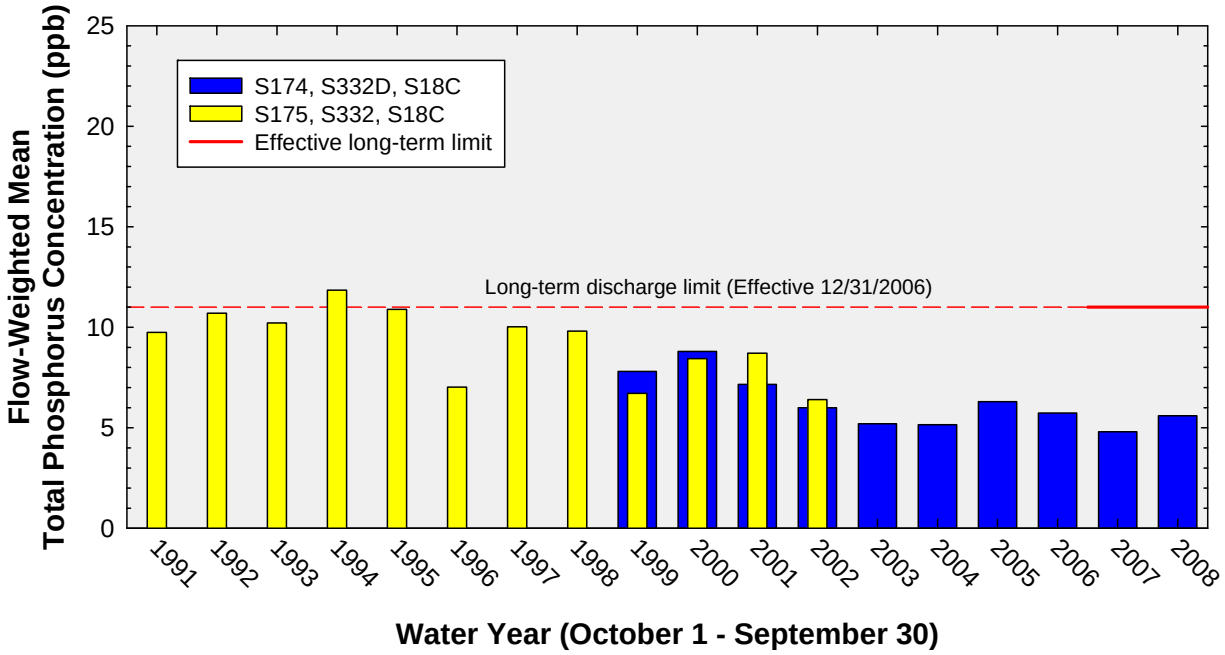

Figure 11. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each water year compared to the 11 ppb long-term total phosphorus limit.

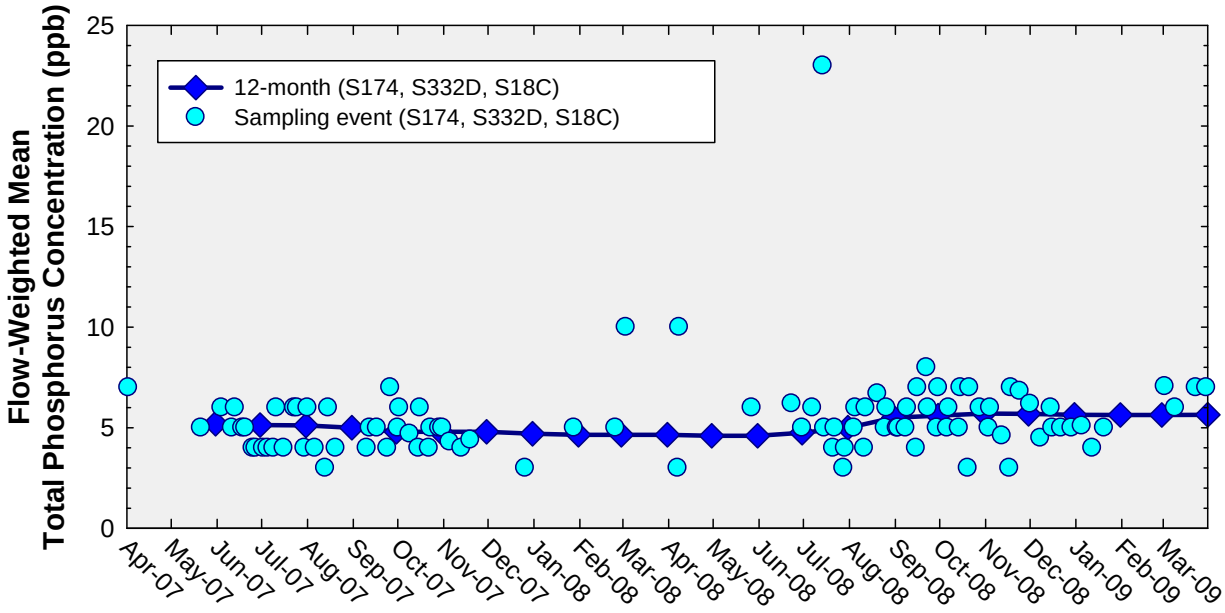

Figure 12. The 12-month flow-weighted mean total phosphorus concentrations in inflows to Everglades National Park through Taylor Slough and the Coastal Basins at the end of each month and the flow-weighted mean total phosphorus concentration for each sampling event.

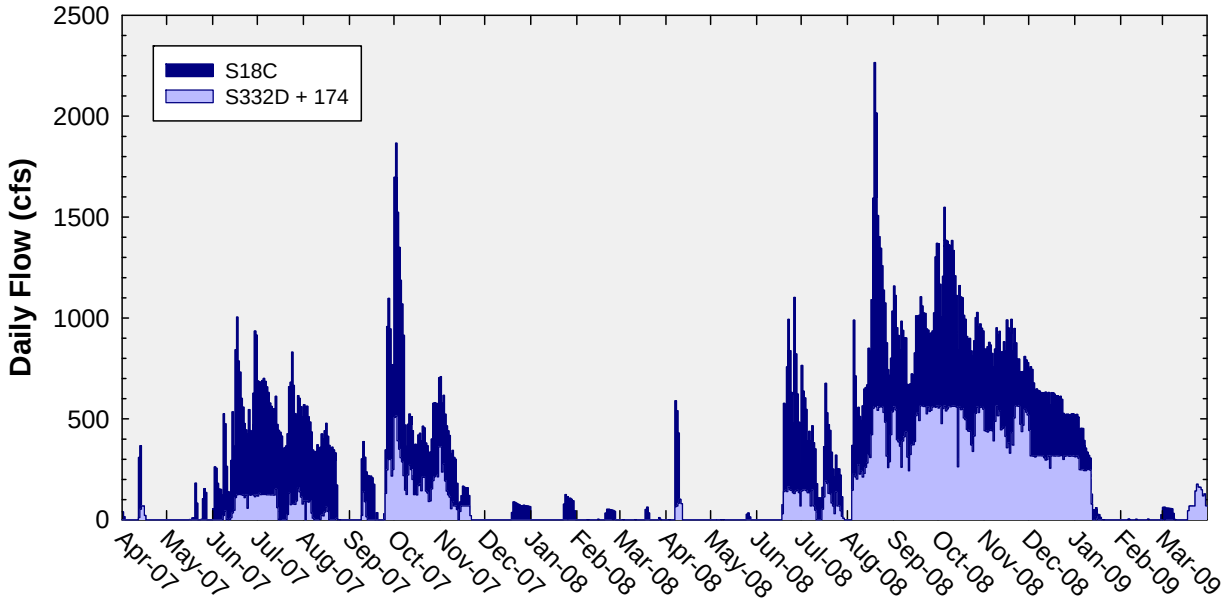

Figure 13. Daily flows into Everglades National Park through Taylor Slough as a stacked total of structures S332D + S174 and S18C. Structure S174 was plugged in September 2007 and is no longer used.

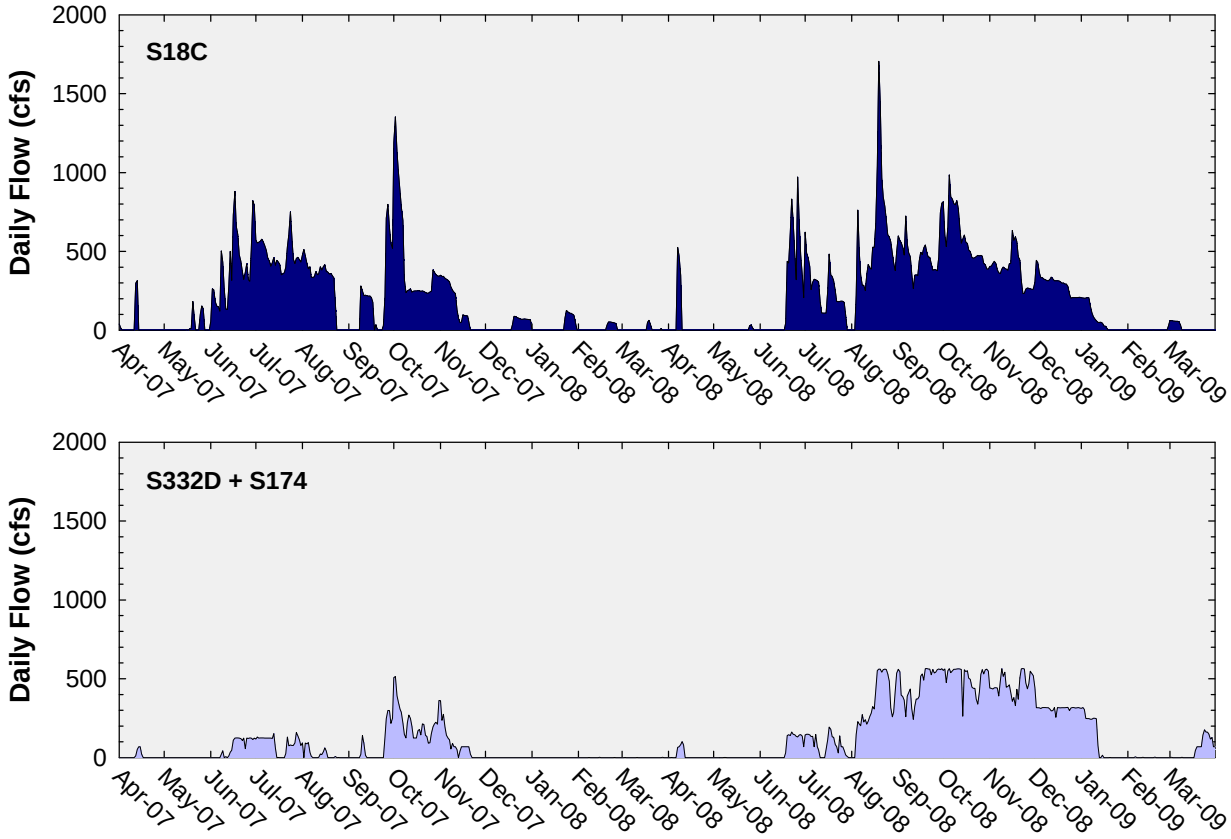

Figure 14. Daily flows at individual Taylor Slough structures (S332D + S174 and S18C) into the Everglades National Park.

Table 4. Taylor Slough and the Coastal Basins total phosphorus compliance tracking.

12-Month Period	Total Flow (kac-ft)	Flow-Weighted Mean TP Concentration (ppb)	Long-Term Limit (ppb) *Effective 12/31/2006*	Percent of Sampling Events Greater than 10 ppb	
				Guideline	Observed
May 2006 - Apr 2007	125.4	5.2	11.0	53.1	10.0
Jun 2006 - May 2007	126.1	5.2	11.0	53.1	7.5
Jul 2006 - Jun 2007	153.0	5.1	11.0	53.1	6.5
Aug 2006 - Jul 2007	153.4	5.1	11.0	53.1	6.4
Sep 2006 - Aug 2007	143.6	5.0	11.0	53.1	6.4
Oct 2006 - Sep 2007	***120.8***	***4.8***	***11.0***	***53.1***	***4.6***
Nov 2006 - Oct 2007	150.5	4.8	11.0	53.1	4.2
Dec 2006 - Nov 2007	155.8	4.8	11.0	53.1	4.3
Jan 2007 - Dec 2007	154.8	4.7	11.0	53.1	2.3
Feb 2007 - Jan 2008	155.5	4.7	11.0	53.1	2.3
Mar 2007 - Feb 2008	156.1	4.7	11.0	53.1	2.3
Apr 2007 - Mar 2008	155.4	4.7	11.0	53.1	0.0
May 2007 - Apr 2008	157.1	4.6	11.0	53.1	0.0
Jun 2007 - May 2008	155.9	4.6	11.0	53.1	0.0
Jul 2007 - Jun 2008	145.0	4.8	11.0	53.1	0.0
Aug 2007 - Jul 2008	130.0	5.0	11.0	53.1	2.6
Sep 2007 - Aug 2008	165.6	5.5	11.0	53.1	2.5
Oct 2007 - Sep 2008	***207.7***	***5.6***	***11.0***	***53.1***	***2.2***
Nov 2007 - Oct 2008	234.8	5.7	11.0	53.1	2.3
Dec 2007 - Nov 2008	273.0	5.7	11.0	53.1	2.2
Jan 2008 - Dec 2008	308.8	5.6	11.0	53.1	2.0
Feb 2008 - Jan 2009	317.1	5.6	11.0	53.1	1.9
Mar 2008 - Feb 2009	316.5	5.6	11.0	53.1	1.9
Apr 2008 - Mar 2009	320.0	5.6	11.0	53.1	1.8

Notes:
- kac-ft = thousand acre feet.
- ppb = parts per billion. Values are actually in µg/L (micrograms per liter), which, for the purposes of this report, is equivalent to ppb.
- Compliance is evaluated annually based on the 12-month flow-weighted mean TP concentration for the federal water year ending in September. The compliance periods are shown as highlighted rows with bold, italicized text.

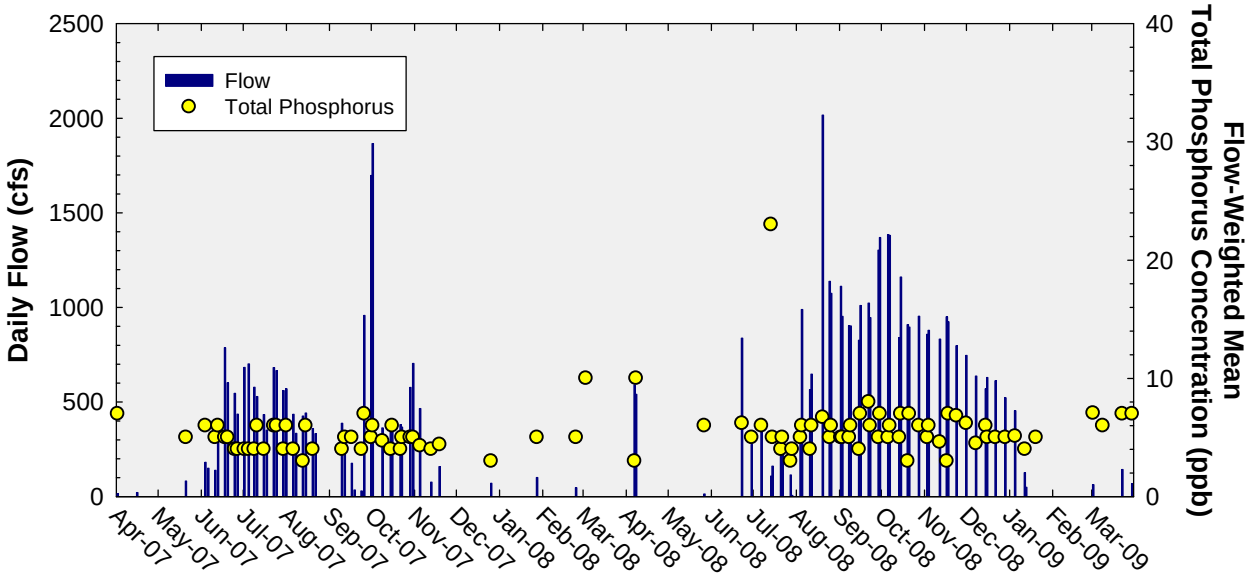

Figure 15. Total daily flow from Taylor Slough structures (S332D + S174 and S18C) and the corresponding flow-weighted mean total phosphorus concentrations for individual sampling events.

APPENDIX A

MONTHLY TOTAL PHOSPHORUS CONCENTRATION DATA FOR THE ARTHUR R. MARSHALL LOXAHATCHEE NATIONAL WILDLIFE REFUGE

Table A-1. Refuge Monthly TP Data (ppb)

Date	LOX3	LOX4	LOX5	LOX6	LOX7	LOX8	LOX9	LOX10	LOX11	LOX12	LOX13	LOX14	LOX15	LOX16
Apr-2007	---	---	---	---	---	---	---	---	8	8	8	---	---	---
May-2007	---	---	---	---	---	---	---	---	---	J5	---	---	---	---
Jun-2007	---	---	---	---	---	15	---	---	13	---	16	11	---	---
Jul-2007	10	13	11	10	9	9	11	---	9	13	9	9	11	13
Aug-2007	9	17	8	10	10	8	8	15	10	12	---	9	8	11
Sep-2007	8	17	8	6	8	8	10	9	6.5*	10	7	7	8	11
Oct-2007	8	11	7	6	9	10	8	8	10	9	8	8	8	9
Nov-2007	9	7	7	4	8	9	7	7	7	6	7	6	7	8
Dec-2007	11	9	8	5	9	11	8	8	7	9	7	7	8	6
Jan-2008	8	8	7	4	6	9	7	7	5	6	6	5	6	6
Feb-2008	10	8	8	5	7	11	8	8	7	8	7	7	7	7
Mar-2008	8	6	8	5	7	10	6	7	7	6	6	6	7	6
Apr-2008	7	7	8	4	6	13	8	8	4	4	4	4	6	4
May-2008	---	---	---	12	10	14	---	---	8	9	8	6	9	8
Jun-2008	---	---	---	---	10	10	---	---	8	6	10	9	10	9
Jul-2008	10	21	8	7	8	18	7	10	8	9	8	8	6	10
Aug-2008	7	11	7	18	8	12	6	9	7	6	8	7	11	10
Sep-2008	9	6	9	5	7	9	7	10	7	9	8	8	7	8
Oct-2008	8	15	7	6	9	9	6	8	7	7	5	6	5	7
Nov-2008	8	7	7	7	6	10	6	8	8	6	9	7	8	8
Dec-2008	8	9	6	4	7	8	4	7	6	7	6	6	6	6
Jan-2009	9	10	9	6	7	10	4	7	6	7	7	6	6	7
Feb-2009	---	5	---	4	5	9	4	6	5	4	5	3	4	5
Mar-2009	---	---	---	22	11	13	---	---	5	6	5	5	5	6

Notes:
--- indicates no sample was collected due to insufficient water depth.
J5 = The datum is qualified with the J5 code, which indicates improper laboratory or field protocols.
* Average of two values: 6 and 7 ppb.

APPENDIX B

CALCULATION METHODS

Long Term Marsh Concentration Levels for Loxahatchee National Wildlife Refuge

Long Term Marsh Concentration Levels:

$$C = 10.7172 - 0.541156S + 1.372\sqrt{7.5819 - 0.9310S + 0.02902216\,S^2}$$

Terms:

C = the natural log of the geometric mean total phosphorus concentration across 14 marsh stations.

S = average stage measured at gauges CA1-9, CA1-7, and CA1-8C on sampling date (feet).

This equation is applicable over a stage range of 15.42 to 17.14 feet. If the stage on any sampling date exceeds 17.14 feet, a stage of 17.14 feet should be used in calculating the long term concentration levels. The equation shall not apply to dates when the average stage is less than 15.42 feet.

(*1991 Settlement Agreement entered as a Consent Decree in 1992 and modified in 1995, Exhibit B, Appendix B, Attachment II, page B-7*)

Discharge Limits and OFW Standards for Shark River Slough

Interim Discharge Limit:

$$C = 11.16 - 0.00465Q + 1.397\sqrt{6.377 - 0.00591Q + 0.00000436Q^2}$$

Long-Term Discharge Limit & OFW Standard:

$$C = 11.38 - 0.00538Q + 1.397\sqrt{2.493 - 0.00231Q + 0.00000170Q^2}$$

Frequency Exceedance:

$$F = 48.411 - 0.02896Q + 1.397\sqrt{330.1 - 0.3071Q + 0.0002254Q^2}$$

Terms:

Water Year = October through September

Q = total inflow to Shark River Slough for water year, S-12s + S-333 + any additional inflow from the WCAs established in the future, thousand acre-ft/yr (Kac-ft/yr).

C = limit on maximum flow-weighted-mean inflow concentration for any Water Year, composite of all inflows to Shark Slough (ppb).

F = exceedance for maximum frequency (percent) of inflow concentrations exceeding 10 ppb, computed from the time series of concentrations composited across all inflow structures on each sampling date with positive flow in a given Water Year.

The range of flow (Q) used in deriving the limits is 117 to 1061 Kac-ft/yr. If the total flow for any water year exceeds 1061 Kac-ft/yr, a flow of 1061 Kac-ft/yr should be used in calculating the discharge limits.

(*1991 Settlement Agreement entered as a Consent Decree in 1992 and modified in 1995, Exhibit B, Appendix A, Attachment I, page A-5*)

Discharge Limits and OFW Standards for Taylor Slough and Coastal Basins

Long-Term Flow-Weighted Discharge Limit & OFW Standard = 11.0 ppb

Frequency Exceedance:

Frequency of values > 10 ppb must be less than 53.1%.

Terms:

Limits are defined on a Water Year basis, October through September.

Basin flow is the total flow through structures S-332, S-175, S-18C, plus any new release points from this basin established in the future, thousand acre-ft/yr (Kac-ft/yr).

Limits apply to the flow-weighted-mean concentration for any Water Year, composite of all inflows to Taylor Slough (S-332) and Coastal Basin (S-18C).

Frequency exceedance is the exceedance for maximum frequency (percent) of inflow concentrations exceeding 10 ppb, computed from the time series of concentrations composited across all inflow structures on each sampling date with positive flow in a given Water Year.

(*1991 Settlement Agreement entered as a Consent Decree in 1992 and modified in 1995, Exhibit B, Appendix A, Attachment II, page A-6*)

APPENDIX C

C-111 PROJECT STRUCTURES AND DETENTION AREAS

C-111 Project Structures and Detention Areas

The C-111 project was authorized by the U.S. Army Corps of Engineers (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 (Cell 1 through Cell 5), a connector cell between Cell 2 and Cell 3, a flow-way cell originating at Berm 3 of Cell 5, and four diversion structures (DS1 through DS4) (**Figure C-1**). The flow-way cell is the only location to routinely discharge surface water into Everglades National Park (ENP) from this project.

Pump station S332D began operation in August 1999 and the USACE completed the remaining C-111 project structures and detention areas along the eastern boundary of the ENP in June 2002. Construction was accelerated to respond to U.S. Fish and Wildlife requirements to give immediate relief to water conditions that threaten the endangered Cape Sable seaside sparrow.

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 (SFWMD) monitor the implementation of the IOP under the terms and conditions of the C-111 Project Cooperation Agreement executed in 1995. The SFWMD, on behalf of the USACE, has implemented 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 SFWMD started the routine sampling in September 2003.

Monitoring activity is dependent on movement between parts of the C-111 project system. Pump station S332D 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. However, almost no flow passed through S174 from March 2006 to September 2007. The site was plugged in September 2007, preventing any additional flow.

The diversion structures DS2 and DS4 discharge into the ENP when utilized. Overflows periodically occurred at DS2 between September 2001 and September 2003. Data from these overflows were presented graphically in previous reports. When they occur, discharges from the diversion structures DS1 and DS3 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 groundwater seepage in an easterly direction from ENP.

The overflow weir at Cell 2 was the only surface water discharge point into the ENP for the S332B and S332C features. However, the levees have been rebuilt or raised to have the same height as the rest of the C-111 features. As part of these changes, the emergency overflow weir has been demolished as well to provide a continuous detention cell from S332B to the single surface water outflow into ENP at Berm B3.

The USACE construction work, conducted under the work package identified as Contract 7, was started in 2007 and completed in 2009. Upon completion of Contract 7, an interconnected detention system now exists from the S-332B West Discharge to the S-332D High Head Cell.

Contract 7 included several construction items. The existing S-332B west detention area was degraded and the northern and western levees were reconstructed at a higher elevation of 13 feet NGVD 29. The levee work continued south from the S-332B western and eastern levees and connected to the S-332C detention cell. The north and south S-332C levees were removed.

The levee construction continued from the S-332C west and east levees to the S-332D high head cell. The partial connector between the south discharge of S-332B and north discharge of S-332C west connected with the completion of the westernmost levee. The south partial connection levee from S-332B and the north partial connection from S-332B were removed to complete the partial connector levee. S-332DX1 was constructed between the east and west levee tie-ins to the S-332D high head cell. The L-31W levee canal was backfilled because the levees crossed the canal to connect to the C-111 high head cell.

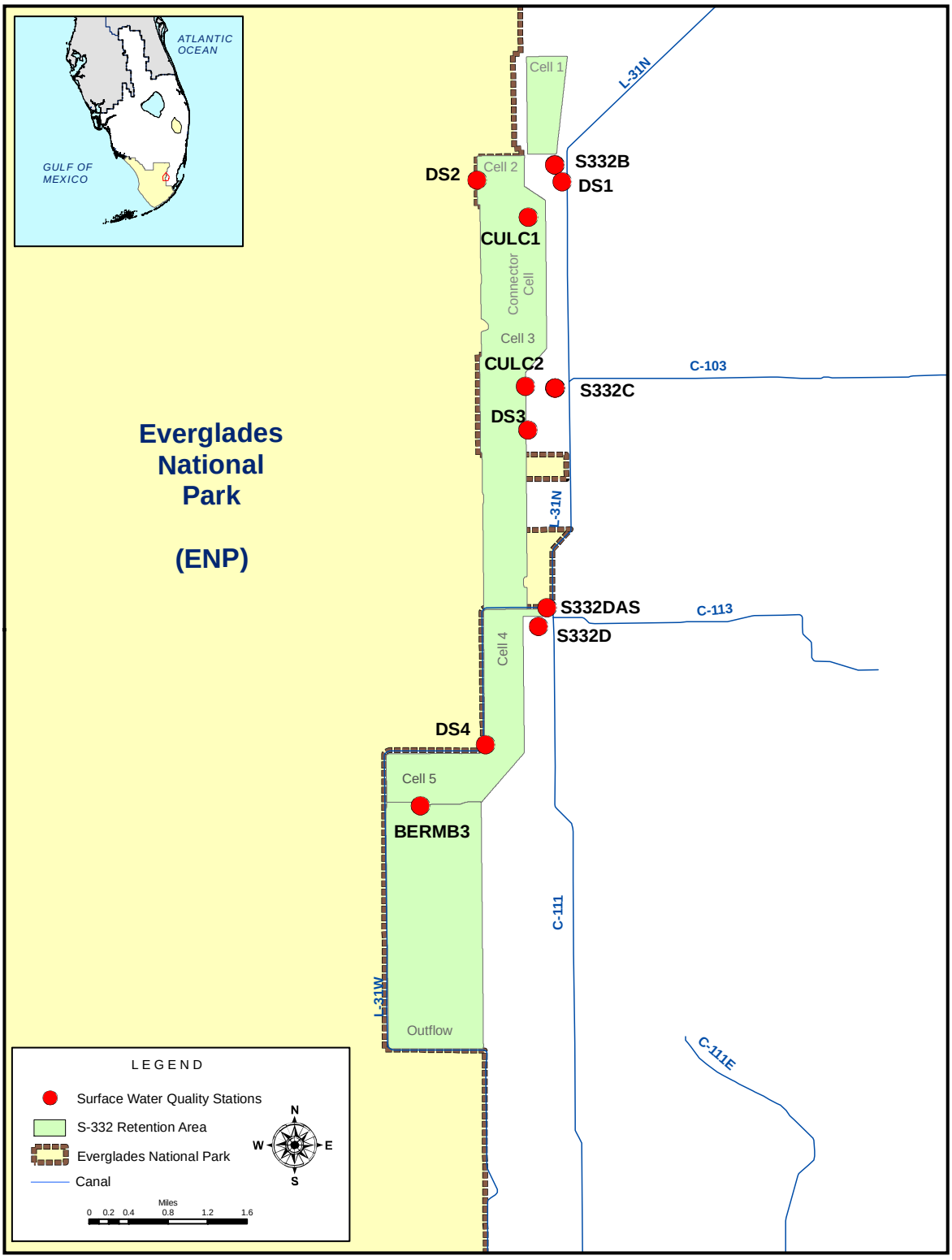

Figure C-1. C-111 project facilities.