

Draft for TOC Review (October 9, 2001)

Principals of the Consent Decree:

Ernie Barnett, Director of Ecosystem Projects,
Florida Department of Environmental Protection
Henry Dean, Executive Director,
South Florida Water Management District
Colonel James May,
U.S. Army Corps of Engineers, Jacksonville
Mark Musaus, Manager,
ARM Loxahatchee National Wildlife Refuge
Maureen Finnerty, Superintendent,
Everglades National Park

Subject: A Water Quality Excursion from Interim Limits in the Arthur R. Marshall Loxahatchee Wildlife Refuge, October, 2000.

This letter report was requested by the Technical Oversight Committee (TOC) at the May 21, 2001 meeting. The TOC asked that Garth Redfield, TOC Chairperson, and Tim Bechtel, Supervisor of the Data Evaluation and Reporting Unit, provide a letter documenting an excursion from the total phosphorus (TP) Interim Limits for the ARM Loxahatchee Wildlife Refuge (Refuge) set forth in the Settlement Agreement (1991, Case No. 88-1886-CIV-HOEVELER). The letter should also summarize facts relevant to determining whether these occurrences are due to "error or extraordinary phenomena" or represent non-compliance with the Settlement Agreement. With this information and recommendations from TOC members, principals of the TOC from the five signatory agencies will then decide upon what actions may be appropriate.

The TP Excursion: The Interim Limit for the Refuge was effective February 1, 1999. A summary of geometric mean concentrations of TP, applicable TP limits and water depths (stages) in the Refuge since January 1999 is presented in attached **Table 1**. This letter concerns the single excursion from the Interim Limits for October, 2000 as summarized below; excursions during 1999 were discussed in a letter to the Principals dated July 14, 2000.

Month 2000	Geometric Mean (ppb TP)	Interim Limit (ppb TP)	Long Term Limit * (ppb TP)	Average Stage (ft.)
October	8.8	8.3	7.2	17.49

* Note that the Long Term Limit is effective December 31, 2006.

TOC members and interested parties were provided with water quality information, including data on the excursions, in quarterly reports to the TOC dated May 21, 2001.

Contributing Circumstances: Discussion at May 21, 2001 and October 9, 2001 TOC meetings and evaluation by District staff revealed factors that must be considered when interpreting these data and deciding upon appropriate actions. Hydrological conditions for October 2000 are important to consider. A poorly organized subtropical disturbance caused heavy rainfall in south Florida from October 2 through October 4, 2000. Rainfall recorded at S5A for these three days totaled 9.83 inches with 8.41 inches falling on October 4. Flows from S5A into the STA-1W distribution works ranged from 604 cfs on October 1 to a peak of 4275 cfs on October 5. Storm water from the distribution works was passed into the Refuge through G300 from October 1 to October 11 and through G301 from October 1 to October 13 (Table 2). Water began being removed from the Refuge to the distribution works through G301 on October 12. Water was also discharged through one or more of the S10 structures from October 4 through October 13 (Table 3). The direct rainfall in the Refuge combined with the increased flows through G300 and G301 caused the average Refuge stage to rise from 16.70 feet on October 1 to 17.50 feet by October 12, 2001.

The required monthly water quality sampling took place on October 10 and 11, 2000 at 13 of the 14 interior marsh sites. Site LOX13 was not sampled. TP concentrations ranged from 5 ppb at LOX15 to 13 ppb at LOX3. Table 1 indicates that the TP concentrations measured in October 2000 were within the ranges of previously measured concentrations, *i.e.*, there were no abnormally high TP concentrations in the October samples. TP concentrations measured at S5A from October 3 to October 17 ranged from 138 to 265 ppb (Table 4). Discharges from ACME pump stations 1 and 2 to the L40 rim canal ranged from 64 to 160 ppb during this same time period (Table 5). It appears that the rising stage in the Refuge kept most of this high TP concentration water confined to the L7 and L40 rim canals until mid October when discharges from the Refuge were initiated for water supply augmentation of Lake Okeechobee.

Longer Term Context of TP Inputs to the Refuge: Major changes in TP loading and inflow concentrations to the Refuge can be expected with the completion and full operation of STA-1W, STA-1 East and STA-2. In addition to the STAs, the EAA BMP Program has resulted in significant reductions in TP loading derived from the Everglades Agricultural Area. Reductions in EAA phosphorus loads have been estimated at approximately 50% for the last four years, compared to what would have entered the WCAs under similar rainfall periods prior to BMP implementation. Within the last year, STA-1W and STA-2 have received the regulatory authority for full flow-through operations, and significant reductions in both loads and concentrations to the Refuge are

anticipated. Prior to the STAs and the EAA BMPs, approximately 90-100 metric tons TP per year entered the Refuge from the EAA. During normal flow years, EAA BMPs, STA-1W and STA-2 should reduce phosphorus loads from the EAA to the Refuge by about 85%. In addition, STA 1 East will bring additional water into the Everglades system (via the Refuge) and is scheduled to be completed by the Corps of Engineers in early 2003.

Conclusion: The rapid rise in Refuge stage due to the storm resulted in a calculated Interim Limit 0.5 ppb greater than the geometric mean TP concentration. High stage shifted the limit downward while the ambient levels held at the low end of the range of values seen commonly in the Refuge. Based on the hydrological circumstances, the absence of any strong signal in the TP data suggesting some identified loading and the fact that TP levels have returned to less than the Interim Limits (Table 1) since October, suggests that this excursion was an event associated with hydrological dynamics and not indicative of any fundamental change in the nutrient loading to the Refuge.

Recommended Actions: Based upon a review of the above information and discussion of these facts and findings with the TOC on October 9, 2001, no immediate actions appear to be warranted.

Respectfully Submitted,

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Table 1. Loxahatchee National Wildlife Refuge TP Tracking Report

Mon-Year	geometric mean	interim limit	long term limit	average stage	n TP data	n stage data
Jan-1999	6.9	8.8	7.6	17.02	14	3
Feb-1999	6.8	10.8	9.1	16.62	11	3
Mar-1999	9.1	14.1	11.6	16.14	9	3
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	14.6	11.9	16.09	11	3
(May-2000)	11.0	15.0	12.2	16.05	14,11,13,12	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
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	NA	NA	15.42	9	3

* denotes the month of which the geometric mean concentration was higher than the interim limit.
 note: average stage is average of 3 stations on the sampling dates.

(): When Lake Ocheechee Recess special sampling data are included, May 2000 is as following:

Table 2. Daily Mean Flow in cfs at S5A and STA1W Structures.

DATE	S5A	S5AS	S5AS (to L8)	G302	G300 to WCA1	G300 to DISTRBUTION	G301 to WCA1	G301 to DISTRBUTION	G251	G310
10/1/2000	603.76	0	0	0	296.06	0	339.03	0	125.87	0
10/2/2000	1403.43	0	0	0	688.34	0	901.36	0	209.73	0
10/3/2000	1413.13	0	0	0	478.08	0	686.13	0	339.94	0
10/4/2000	3092.8	0	0	0	954.8	0	1291.81	0	338.09	628.42
10/5/2000	4275.48	0	0	0	1215.01	0	1956.17	0	332.84	465.44
10/6/2000	4273.98	0	0	364.96	1109.36	0	1965.7	0	311.7	774.93
10/7/2000	3680.23	0	0	527.62	944.94	0	1488.47	0	296.36	639.99
10/8/2000	2968.49	0	0	447.31	784.38	0	1149.21	0	292.02	639.09
10/9/2000	2381.65	0	0	0	708.8	0	1370.56	0	303.93	412.13
10/10/2000	1867.78	0	0	635.36	536.78	0	600.39	0	304.21	593.97
10/11/2000	854.68	0	0	977.25	141.73	0	1.52	0	266.61	426.41
10/12/2000	716.3	0	267.7	339.26	0	130.31	180.11	0	301.33	75.37
10/13/2000	866.87	0	253.9	498.16	0	0	104.15	0	320.29	510.27
10/14/2000	674.21	0	403.14	407.31	0	139.55	0	0	296.74	176.91
10/15/2000	314.09	0	374.65	169.56	0	183.96	0	0	250	205.59
10/16/2000	0	0	381.87	537.9	0	816.38	0	0	92.49	204.67
10/17/2000	0	0	427.76	878.58	0	985.23	0	0	0	69.52
10/18/2000	0	0	513.69	436.43	0	709.56	0	0	0	506.72
10/19/2000	0	0	693.67	0	0	544.39	0	0	0	60.3
10/20/2000	0	0	647.84	0	0	478.55	0	0	0	60.15
10/21/2000	0	0	626.26	0	0	467.15	0	0	0	0
10/22/2000	0	0	624.23	0	0	475.55	0	0	0	0
10/23/2000	0	0	608.09	0	0	470.12	0	0	0	0
10/24/2000	0	0	611.75	0	0	465.94	0	0	0	124.42
10/25/2000	0	0	557.7	0	0	448.22	0	0.27	0	118.04
10/26/2000	0	0	509.01	0	0	402.45	0	0	0	59.87
10/27/2000	0	0	584.46	0	0	416.76	0	0	0	86.28
10/28/2000	0	0	829.66	0	0	664.32	0	0	0	0
10/29/2000	0	0	844.84	0	0	679.54	0	0	0	0
10/30/2000	4.2	0	880.13	0	0	721.5	0	0	0	61.59
10/31/2000	0	0	1018.92	0	0	1094.94	0	0	0	59.44

Table 3. Daily Mean Flow (cfs) at S6 Pump and Discharges from WCA1 Into WCA2.

date	S6 pump	S10A	S10C	S10D
	15034	15261	15262	15263
10/01/2000	565	0	0	0
10/02/2000	1040	0	0	0
10/03/2000	1180	0	0	0
10/04/2000	2490	504	475	490
10/05/2000	2920	902	857	850
10/06/2000	2800	876	845	846
10/07/2000	2720	873	850	850
10/08/2000	2560	868	848	851
10/09/2000	2560	868	851	855
10/10/2000	2400	868	855	859
10/11/2000	2160	874	873	433
10/12/2000	1160	908	493	0
10/13/2000	605	399	0	0
10/14/2000	515	0	0	0
10/15/2000	386	0	0	0
10/16/2000	334	0	0	0
10/17/2000	0	0	0	0
10/18/2000	0	0	0	0
10/19/2000	0	0	0	0
10/20/2000	0	0	0	0
10/21/2000	0	0	0	0
10/22/2000	0	0	0	0
10/23/2000	0	0	0	0
10/24/2000	0	0	0	0
10/25/2000	0	0	0	0
10/26/2000	0	0	0	0
10/27/2000	0	0	0	0
10/28/2000	0	0	0	0
10/29/2000	0	0	0	0
10/30/2000	0	0	0	0
10/31/2000	0	0	0	0

Table 5. Daily Flow, TP concentration and TP load from ACME District.

date	ACME1 (VOW1)				ACME2 (VOW2)			
	flow (cfs)	composite	grab	load (kg)	flow (cfs)	composite	grab	load (kg)
10/1/2000	0	99		0	0	160		0
10/2/2000	0	99		0	0	160		0
10/3/2000	111.94	99		27.113	142.89	160		55.935
10/4/2000	260.84	99	78	63.178	285.78	160	160	111.869
10/5/2000	216.07	99		52.335	0	160		0
10/6/2000	95.54	99		23.141	285.78	160		111.869
10/7/2000	166.77	99		40.394	285.78	160		111.869
10/8/2000	0	99		0	0	160		0
10/9/2000	77.17	99	100	18.691	85.73	160	150	33.559
10/10/2000	78.79	54		10.409	85.73	160		33.559
10/11/2000	0	54		0	88.71	160		34.726
10/12/2000	0	54		0	0	160		0
10/13/2000	76.09	64		11.914	85.73	150		31.462
10/14/2000	0	64		0	0	150		0
10/15/2000	0	64		0	0	150		0
10/16/2000	0	64		0	0	150		0
10/17/2000	0	64		0	0	150		0
10/18/2000	0	64		0	0	150		0
10/19/2000	0	64		0	0	150		0
10/20/2000	0	87		0	0	70		0
10/21/2000	0	87		0	0	70		0
10/22/2000	0	87		0	0	70		0
10/23/2000	77.17	87	37	16.426	85.14	70	75	14.581
10/24/2000	0	87		0	0	70		0
10/25/2000	0	87		0	95.84	70		16.414
10/26/2000	0	87		0	0	70		0
10/27/2000	0			0	0	72		0
10/28/2000	0			0	0	72		0
10/29/2000	0			0	0	72		0
10/30/2000	0			0	0	72		0
10/31/2000	0			0	84.54	72	61	14.892