

## **Enhanced Water Quality Monitoring and Modeling Program for the A.R.M. Loxahatchee National Wildlife Refuge Quarterly Update Report – July 2010**

Prepared by:

Matt Harwell, A.R.M. Loxahatchee National Wildlife Refuge

With contributions from Donatto Surratt, and Mike Waldon

### Overview

This update is a summary of activities since the previous status report of April 2010 on the implementation of the Refuge's Enhanced Water Quality Monitoring and Modeling Program. A project overview, and other detailed information about the program can be found at: [http://sofia.usgs.gov/lox\\_monitor\\_model/](http://sofia.usgs.gov/lox_monitor_model/). The primary objective of this overall program (Brandt et al. 2004) focuses on providing information for use in ecological management of the Refuge (e.g., USFWS 2007a, b).

The Refuge's monitoring component of this program also addresses one of the Consent Decree Principals recommendations (17 December 2003):

#### ***B. Enhancing Monitoring of the Refuge***

*Design and implement an enhanced monitoring program to improve spatial and temporal understanding of factors related to phosphorus dynamics.*

The Refuge's modeling component of this program also addresses several of the Consent Decree Principals recommendations (17 December 2003):

#### ***C. Modeling of the Refuge***

- 1. Develop a water quality/hydraulic model for the Refuge with a phosphorus cycling component.*
- 2. Evaluate issues associated with phosphorus loads and transports within the L-40 and L-7 canals.*
- 3. Develop and track a simple phosphorus mass-balance model for the Refuge.*

### Information Availability

Through collaboration with USGS, information from the Refuge's Enhanced Water Quality Monitoring and Modeling Program has been made available on the USGS' SOFIA web site at: [http://sofia.usgs.gov/lox\\_monitor\\_model/](http://sofia.usgs.gov/lox_monitor_model/).

Final data for monthly samples through May 2006 are publicly posted on DBHYDRO by the SFWMD at [http://my.sfwmd.gov/dbhydroplsql/show\\_dbkey\\_info.main\\_page](http://my.sfwmd.gov/dbhydroplsql/show_dbkey_info.main_page). Data for June 2006-March 2010 are posted on the Technical Oversight Committee's web site at [https://my.sfwmd.gov/portal/page/portal/pg\\_grp\\_sfwmd\\_era/pg\\_sfwmd\\_era\\_techovercommittee](https://my.sfwmd.gov/portal/page/portal/pg_grp_sfwmd_era/pg_sfwmd_era_techovercommittee). This report includes information from samples collected through June 2010.

### Water Quality Data Analyses Update

Primary efforts for this quarter involved exploring mechanisms to continue translating information from the program to aid in Refuge management decisions, and working on the program's Annual Report.

### Monitoring Update (April 2010 – June 2010)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at 34 stations in April, 29 stations in May, and 33 stations in June 2010 (**Table 1**).

Total phosphorus data available to date for July 2009 to June 2010 are presented in **Table 1**. Maps of stations where samples were collected for April 2010 through June 2010 are presented in **Figures 2-4**.

Conductivity sonde deployment information for July 2009 to June 2010 is presented in **Table 2**.

### Modeling Update

During the second quarter of 2010, the Refuge modeling team completed development of a high-water stage performance measure which is useful in addressing Refuge water quantity and timing needs. The team also initiated scenario analyses using the Refuge SRSM model in combination with this measure. Other performance measures exploring reversals and recession rates are under consideration.

### Next Steps

The next steps for this program include additional efforts on the Annual Report, and additional model development and application.

### References

- Brandt, L.A., Harwell, M., Waldon, M. (2004) Work Plan: Water Quality Monitoring and Modeling for the A.R.M. Loxahatchee National Wildlife Refuge: 2004-2006. Prepared for the A.R.M. Loxahatchee National Wildlife Refuge. April, 2004. 33 pp.
- USFWS. (2007a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Monitoring and Modeling Program – 2<sup>nd</sup> Annual Report – February 2007. LOXA06-008, U.S. Fish and Wildlife Service, Boynton Beach, FL. 183 pp.
- USFWS. (2007b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 3<sup>rd</sup> Annual Report – October 2007. LOXA07-005, U.S. Fish and Wildlife Service, Boynton Beach, FL. 116 pp.
- USFWS. (2009) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 4<sup>th</sup> Annual Report – July 2009. LOXA09-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 106 pp.

**Table 1.** Total phosphorus data (ppb) available for July 2009 – June 2010 from the Enhanced Water Quality Monitoring Program for: (a) marsh, and (b) canal stations for the A.R.M. Loxahatchee National Wildlife Refuge. Graphical representation of station locations are shown in Figure 1.

## a) Marsh stations

Marsh Station	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10
LOXA101	9	20	11	10	8	9	10	7	13	9	-	14
LOXA102	U	-	9	6	7	-	5	4	4	-	-	-
LOXA103	U	20	10	12	9	8	7	12	-	-	-	-
LOXA105	6	23	19	16	13	11	11	10	U	8	-	20
LOXA106	U	19	11	15	8	7	5	U	U	5	-	11
LOXA107	12	-	17	5	-	-	4	U	-	-	-	-
LOXA108	4	-	7	4	-	6	7	8	10	U	-	6
LOXA109	U	15	8	U	8	4	7	6	U	4	10	11
LOXA110	6	14	9	U	5	11	8	5	4	7	10	10
LOXA111	U	14	7	U	6	U	5	U	U	3	8	5
LOXA112	U	15	19	U	6	5	6	5	U	U	6	11
LOXA113	6	14	11	U	4	17	5	U	U	U	6	U
LOXA114	U	13	8	U	4	U	4	U	U	U	7	6
LOXA117	13	24	12	5	11	9	12	5	4	5	10	14
LOXA118	21	16	6	4	10	4	5	4	U	2	10	10
LOXA119	4	15	5	6	8	5	5	U	U	4	8	8
LOXA120	U	14	5	U	6	27	3	U	U	3	6	7
LOXA122	15	26	9	5	9	9	6	5	U	6	15	19
LOXA124	13	21	18	10	9	13	7	9	19	9	9	18
LOXA126	12	18	12	U	11	8	6	5	14	3	12	14
LOXA127	5	21	19	U	8	5	4	U	U	U	7	-
LOXA128	U	33	7	U	4	-	9	U	U	2	5	U
LOXA130	13	17	12	9	17	12	6	7	3	3	11	13
LOXA131	9	17	4	U	14	7	8	6	U	U	8	8
LOXA133	16	-	37	25	56	19	26	28	14	14	-	30
LOXA134	7	20	16	3	24	10	8	8	19	5	9	11
LOXA136	30	25	26	15	-	13	13	8	17	7	22	18
LOXA137	8	21	14	6	15	9	9	9	5	6	12	9
LOXA138	13	44	8	U	6	9	9	4	U	U	7	10
LOXA139	5	13	9	6	6	-	3	7	U	4	11	6
LOXA140	12	18	13	11	10	9	9	5	U	10	9	11
LOXA141	5	22	10	8	15	8	14	10	U	10	15	10
MAX	30	44	37	25	56	27	26	28	19	14	22	30
MIN	4	13	4	3	4	4	3	4	3	2	5	5

**Table 1 cont.**

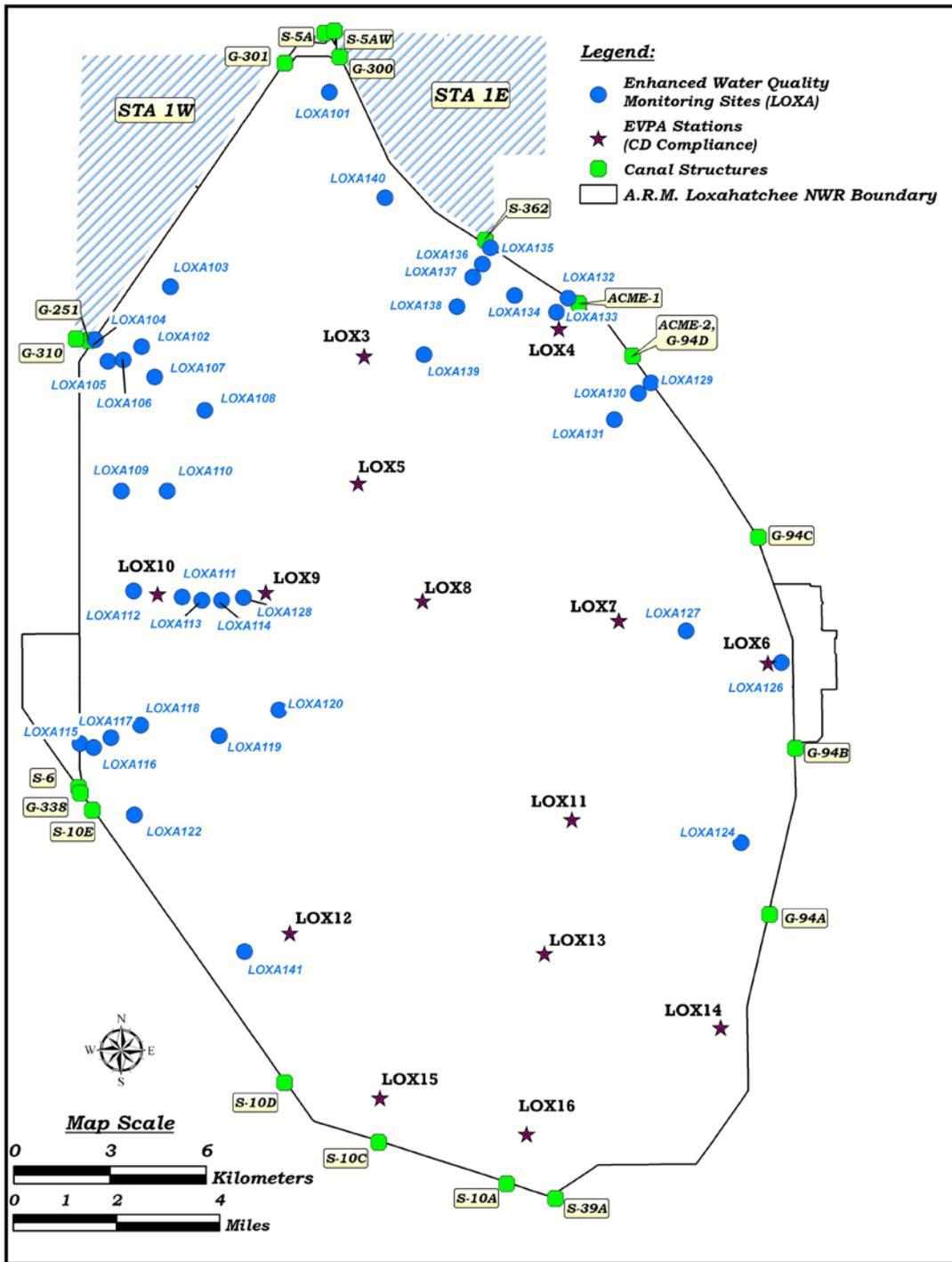
b) Canal stations

Canal Station	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10
LOXA104	42	44	47	27	37	30	27	31	27	56	42	26
LOXA115	64	41	43	26	24	28	26	22	20	37	36	29
LOXA129	33	80	42	25	50	28	32	38	54	70	49	59
LOXA132	30	77	57	36	46	31	36	37	38	71	51	53
LOXA135	61	61	43	36	57	40	28	30	32	72	46	51
MAX	64	80	57	36	57	40	36	38	54	72	51	59
MIN	30	41	42	25	24	28	26	22	20	37	36	26

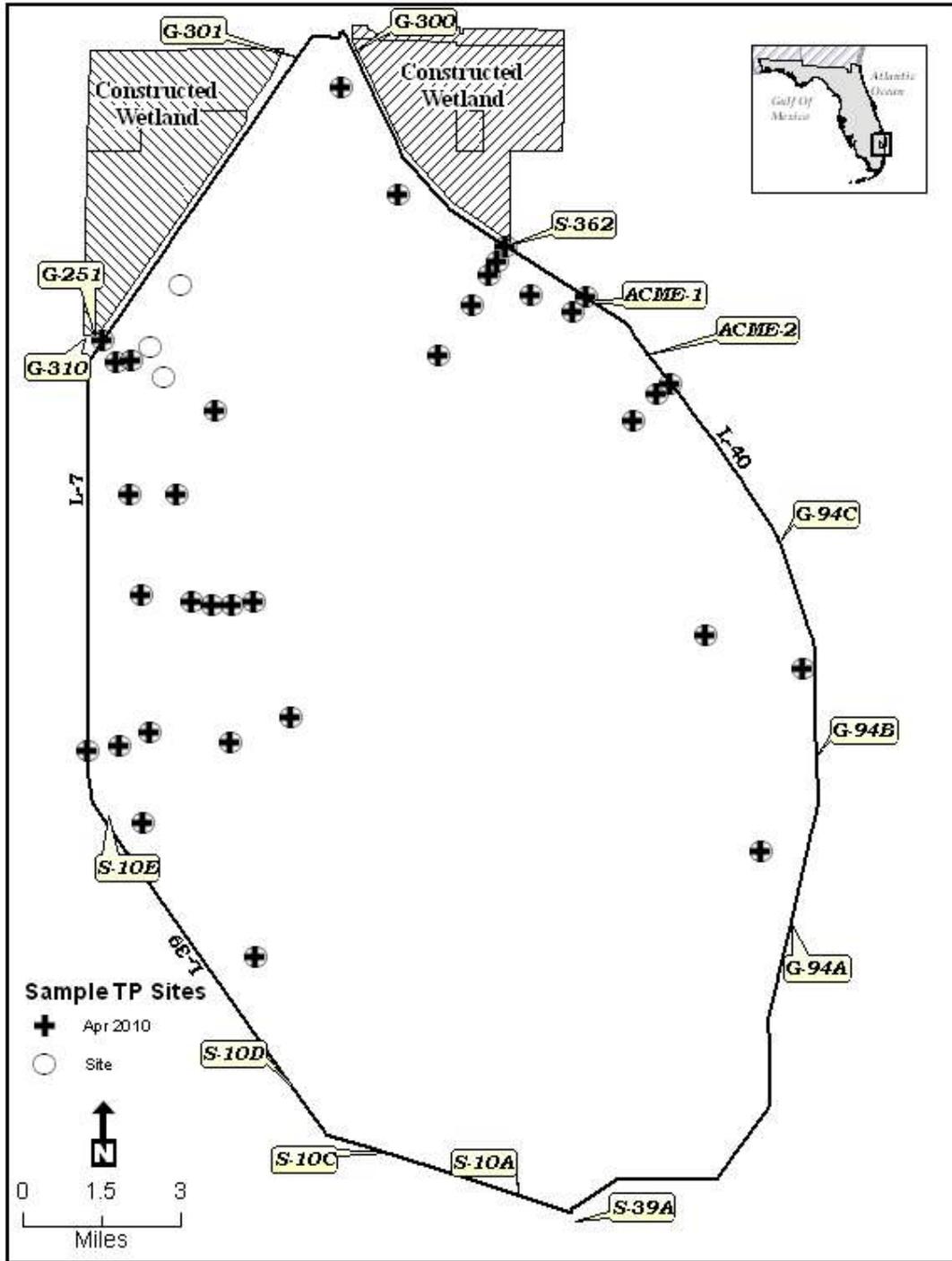
U indicates that compound was analyzed, but the concentration was below the minimum detection limit.

**Table 2.** July 2009 – June 2010 conductivity sonde deployment information, separated by transect, for the A.R.M. Loxahatchee National Wildlife Refuge. X = data collected from sonde deployment during that month. Graphical representation of station locations are shown in Figure 1.

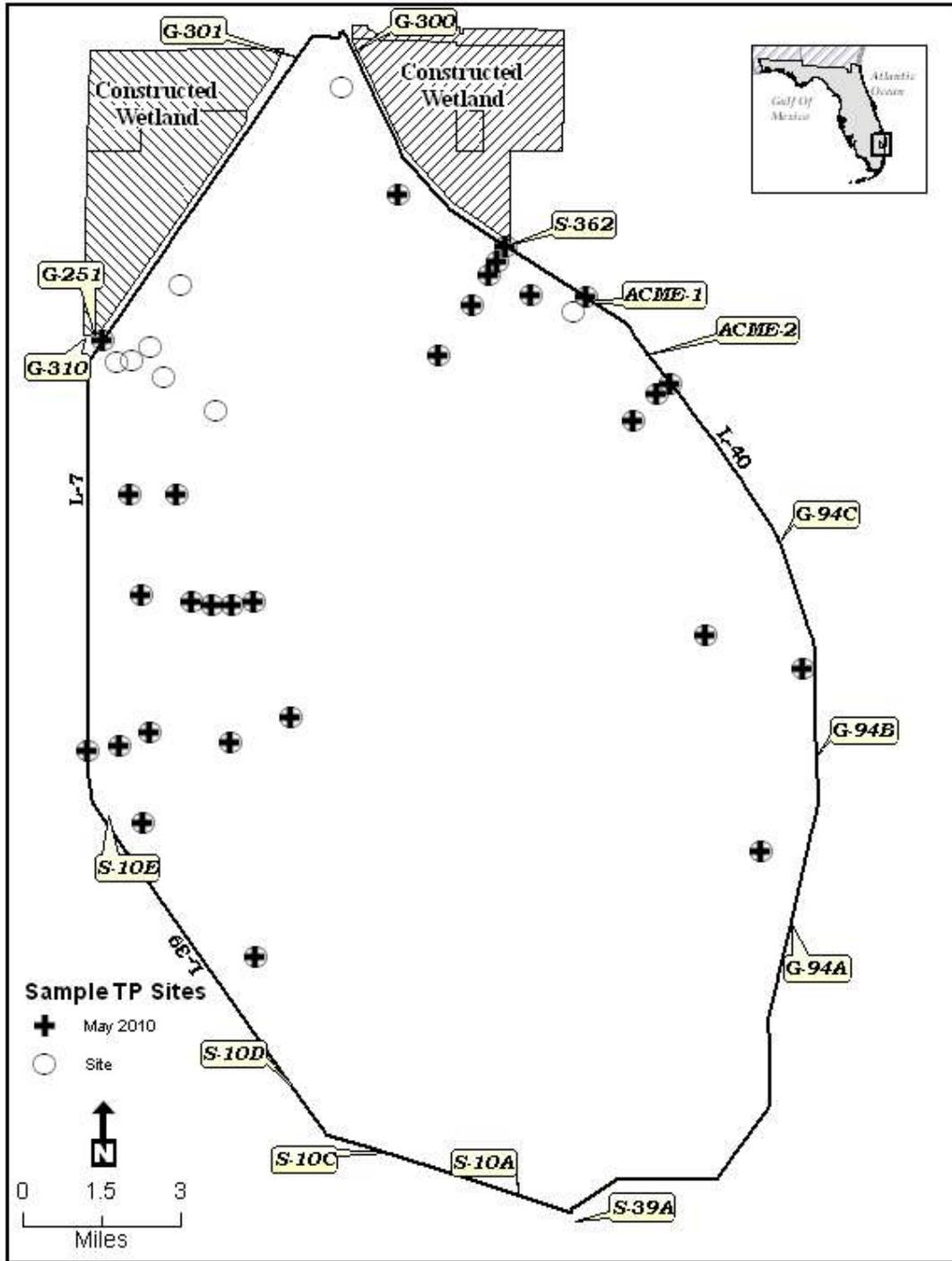
Site ID	2009						2010					
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
LOXA104	X	X	X	X	X	X	X	X	X	X	X	X
LOXA105	X		X		X		X		X		X	X
LOXA106	X		X		X		X		X		X	X
LOXA107	X		X		X		X		X		X	X
LOXA108	X		X		X		X		X		X	X
LOXA111		X		X		X		X		X		X
LOXA112		X		X		X		X		X		X
LOXA113		X		X		X		X		X		X
LOXA114		X		X		X		X		X		X
LOXA115	X	X	X	X	X	X	X	X	X		X	X
LOXA116	X		X	X		X			X		X	X
LOXA117	X		X	X		X			X		X	X
LOXA118	X		X	X		X					X	X
LOXA119	X		X	X		X			X		X	X
LOXA120	X		X	X		X			X		X	X
LOXA126		X		X		X		X		X		X
LOXA127		X		X		X		X		X		X
LOXA128		X		X		X		X		X		X
LOXA129	X	X	X	X	X	X	X	X	X		X	X
LOXA130	X		X		X		X		X		X	X
LOXA131	X		X		X		X		X		X	X
LOXA132	X	X	X	X	X	X	X	X	X		X	X
LOXA133	X		X		X		X		X		X	X
LOXA135	X	X	X	X	X	X	X	X	X		X	X
LOXA136	X		X		X		X		X		X	X
LOXA137	X		X		X		X		X		X	X
LOXA138	X		X		X		X		X		X	X
LOXA139	X		X		X		X		X		X	X
LOXA142	X	X		X		X		X	X		X	
LOXA143		X		X	X	X		X		X		X
LOXA144		X		X	X	X		X		X		X
LOXA145		X		X	X	X		X		X		X
LOXA146		X		X	X	X		X		X		X
LOXA147	X		X		X		X		X		X	
LOXA148		X		X	X	X		X		X		X
LOXA149		X		X	X	X		X		X		X
LOXA150		X		X	X	X		X		X		X
LOXA151	X	X	X	X	X	X	X	X	X		X	X
LOXA152	X	X	X	X	X	X	X	X	X		X	X
LOXA153	X	X	X	X	X	X					X	X
I-8C	X		X	X		X	X		X	X		X
LOX04	X		X		X		X		X		X	X
LOX06		X		X		X		X		X		X
LOX07		X		X		X		X		X		X
LOX08		X		X		X		X		X		X
LOX09		X		X		X		X		X		X
LOX10		X		X		X		X		X		X
LOX15		X		X		X		X		X		X



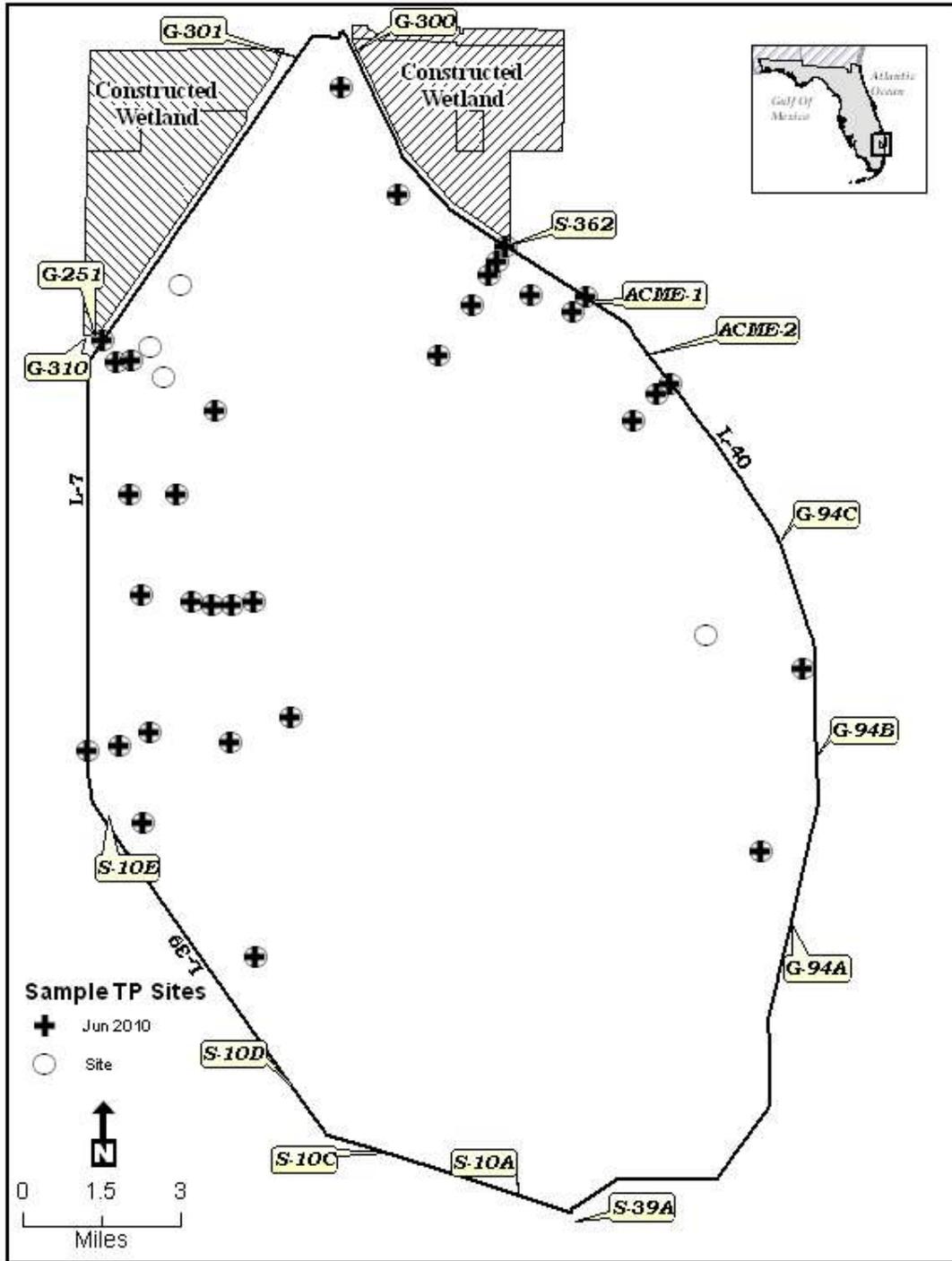
**Figure 1.** Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.



**Figure 2.** April 2010 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.



**Figure 3.** May 2010 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.



**Figure 4.** June 2010 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.