

Enhanced Water Quality Monitoring and Modeling Program for the A.R.M. Loxahatchee National Wildlife Refuge Quarterly Update Report – April 2008

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 January 2008 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/. The primary objective of this overall program focuses on providing information for use in ecological management of the Refuge (Brandt et al. 2004; Harwell et al. 2005; 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/.

Final data for monthly samples through May 2006 are publicly posted on DBHYDRO by the SFWMD at <http://www.sfwmd.gov/org/ema/dbhydro/index.html>. Data for June 2006-March 2008 are posted on the Technical Oversight Committee's web site at <http://www.sfwmd.gov/org/ema/toc/index.html>. This report includes information from samples collected through March 2008.

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.

Monitoring Update (January 2008 – March 2008)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at 38 stations in January 2008, 38 stations in February 2008, and 37 stations in March 2008 (**Table 1**).

Total phosphorus data available to date for July 2007 to March 2008 are presented in **Table 1**. Maps of stations where samples were collected for January 2008 through March 2008 are presented in **Figures 2-4**.

Conductivity sonde deployment information for July 2007 to March 2008 is presented in **Table 2**.

Modeling Update

Significant progress was made during this quarter in calibrating the total phosphorus concentration component of the spatially-explicit MIKE-FLOOD Refuge model. The Refuge modeling team was invited to participate in the 2nd USGS Modeling Conference held in Orange Beach, Alabama, February 10 – 14. Drs. Hongqing Wang, Chunfang Chen, and Michael Waldon attended. Posters describing Refuge hydrodynamic and water quality modeling (Chen et al. 2008), and modeling of sulfate in the Refuge (Wang et al. 2008) were presented. Drs. William Walker, Robert Kadlec, and Matthew Harwell visited the University of Louisiana at Lafayette campus from March 31 to April 2 to review modeling progress, and provide advice on future development. Sherif Abdou, a graduate student working with the team, began a student project implementing the MIKE-SHE linked surface-groundwater model for the Refuge.

Next Steps

The next steps for this program include continuation of data collection and analysis, initiating the next Annual Reporting cycle, and additional model development and application.

References

http://sofia.usgs.gov/lox_monitor_model/

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.

Chen, C., Meselhe, E. A., Waldon, M. G., Wang, H., and Harwell, M. C. (2008). "Hydrodynamic and Water Quality Modeling of the A.R.M. Loxahatchee Refuge, North Everglades, Florida." *2nd USGS Modeling Conference*, Orange Beach, Alabama.

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Harwell, M. Surratt, D., Waldon, M., Walker, B., Brandt, L. (2005) A.R.M. Loxahatchee National Wildlife Refuge Enhanced Water Quality Monitoring and Modeling Interim Report. April, 2005. 106 pp.

USFWS. (2007a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Monitoring and Modeling Program – 2nd 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 – 3rd Annual Report – October 2007. LOXA07-005, U.S. Fish and Wildlife Service, Boynton Beach, FL. 116 pp.

Wang, H., Waldon, M. G., Meselhe, E. A., Arceneaux, J. C., Chen, C., and Harwell, M. C. (2008). "Modeling Surface Water Sulfate Dynamics in a Northern Everglades Wetland." *2nd USGS Modeling Conference*, Orange Beach, Alabama.

Table 1. Total phosphorus data (ppb) available for July 2007 – March 2008 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 is shown in Figure 1.

a) Marsh stations

Marsh Station	July-07	Aug-07	Sept-07	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08
LOXA101	-	20	16	4	R	4	6	11	15
LOXA102	-	-	-	U	R	5	10	10	9
LOXA103	-	-	9	5	R	U	5	9	8
LOXA105	-	24	27	12	R	8	8	16	17
LOXA106	-	6	16	U	R	5	7	10	10
LOXA107	-	-	-	11	R	U	U	6	-
LOXA108	-	-	-	U	R	U	U	9	6
LOXA109	16	6	17	U	R	7	10	8	20
LOXA110	-	U	8	U	R	U	U	7	6
LOXA111	-	U	9	U	R	11	U	11	5
LOXA112	14	U	10	6	R	U	8	9	15
LOXA113	6	U	8	U	R	13	U	3	11
LOXA114	4	U	12	U	R	5	5	4	6
LOXA116	-	99	130*	59*	R	110	46	48	120
LOXA117	-	10	21	12	R	18	12	13	14
LOXA118	-	7	16	U	R	11	6	9	9
LOXA119	-	U	9	4	R	8	7	12	7
LOXA120	9	U	10	5	R	9	6	6	7
LOXA121	X	X	X	X	X	X	X	X	X
LOXA122	13	12	13	6	R	15	8	9	13
LOXA123	X	X	X	X	X	X	X	X	X
LOXA124	12	19	12	7	R	13	9	8	7
LOXA126	14	13	8	U	R	11	16	7	8
LOXA127	-	13	U	U	R	8	5	6	11
LOXA128	-	6	5	U	R	5	U	15	12
LOXA130	11	11	20	7	R	11	10	8	12
LOXA131	8	10	5	U	R	7	7	7	8
LOXA133	-	29	-	120*	R	35	19	29	16
LOXA134	7	18	15	6	R	13	8	18	11
LOXA136	19	13	25	18	R	20	9	17	13
LOXA137	10	U	14	10	R	12	6	16	10
LOXA138	16	U	8	U	R	4	5	8	8
LOXA139	-	U	12	U	R	8	U	9	4
LOXA140	-	U	9	53*	R	10	6	10	10
LOXA141	29	7	12	6	R	6	6	10	16
MAX	29	99	130	120		110	46	48	120
MIN	4	6	5	4		4	5	3	4

U indicates that compound was analyzed but not detected; - = no sample collected
 X indicates station no longer sampled; R = data rejected
 * sample was re-analyzed sample. Second value: LOXA116, Sept-07 = 120 ppb,
 Oct-07 = 81 ppb; LOXA133, Oct-07 = 120 ppb; LOXA140, Oct-07 = 12 ppb.

Table 1 cont.

b) Canal stations

Canal Station	July-07	Aug-07	Sept-07	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08
LOXA104	41	26	46	35	R	37	26	37	35
LOXA115	54	57	36	34	R	20	22	27	27
LOXA129	110	55	37	13	R	41	24	40	18
LOXA132	78	59	27	13	R	36	28	35	21
LOXA135	18	43	27	9	R	34	25	33	19
MAX	110	59	46	35		41	28	40	35
MIN	18	26	27	9		20	22	27	18

U indicates that compound was analyzed but not detected.

Table 2. July 2007 – March 2008 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 is shown in Figure 1.

Site ID	2007						2008		
	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
LOXA104	X	X	X	X	X		X	X	X
LOXA105	X	X	X		X		X		X
LOXA106	X	X	X		X		X		X
LOXA107	X		X		X		X		X
LOXA108	X	X	X		X		X		X
LOXA111		X		X		X		X	
LOXA112		X		X		X		X	
LOXA113		X		X		X		X	
LOXA114		X		X		X		X	
LOXA115	X	X	X	X	X		X		X
LOXA116	X			X		X		X	X
LOXA117	X			X		X		X	X
LOXA118				X		X		X	X
LOXA119				X		X		X	X
LOXA120				X		X		X	X
LOXA126		X		X		X		X	
LOXA127		X		X		X		X	
LOXA128		X		X		X		X	
LOXA129	X	X	X	X	X		X	X	X
LOXA130	X		X		X		X		X
LOXA131	X		X		X		X		X
LOXA132	X	X	X	X	X		X	X	X
LOXA133	X		X		X		X		X
LOXA135	X	X	X	X	X		X	X	X
LOXA136	X		X		X		X		X
LOXA137	X		X		X		X		X
LOXA138	X		X		X		X		X
LOXA139	X		X		X		X		X
LOXA141									
LOXA142	X	X				X	X		
LOXA143		X		X		X		X	
LOXA144		X		X		X		X	
LOXA145		X		X		X		X	
LOXA146		X		X		X		X	
LOXA147		X		X		X		X	
LOXA148		X		X		X		X	
LOXA149		X		X		X		X	
LOXA150		X		X		X		X	
LOXA151		X	X	X	X	X	X		X
LOXA152		X	X	X	X	X	X		X
LOXA153		X	X	X	X	X	X		
I-8C		X		X	X		X	X	X
LOX04	X		X				X		
LOX06		X		X	X	X		X	
LOX07		X		X	X	X		X	
LOX08		X		X	X	X		X	
LOX09		X		X	X	X		X	
LOX10		X		X	X	X		X	
LOX15		X		X	X	X		X	

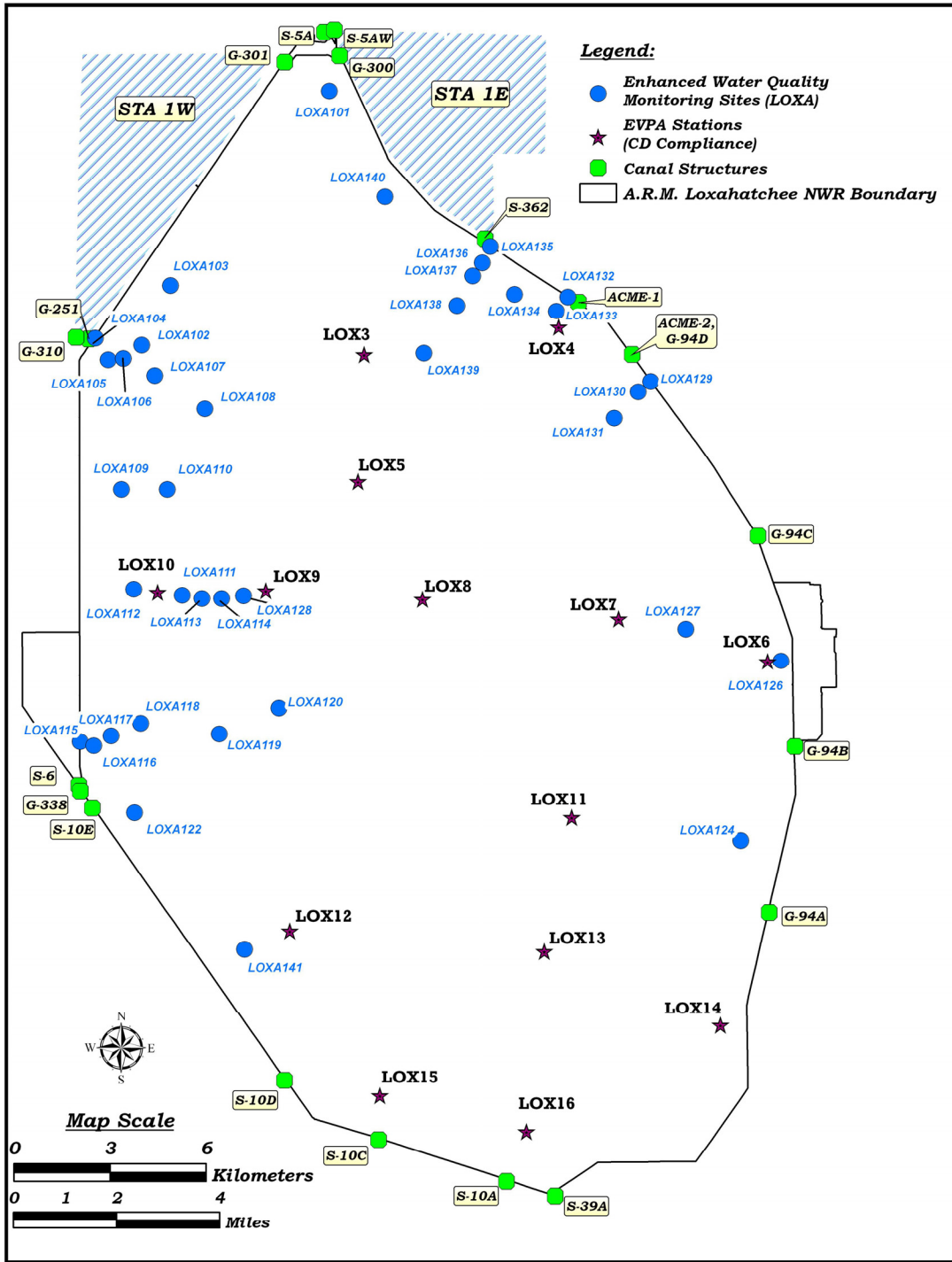


Figure 1. Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

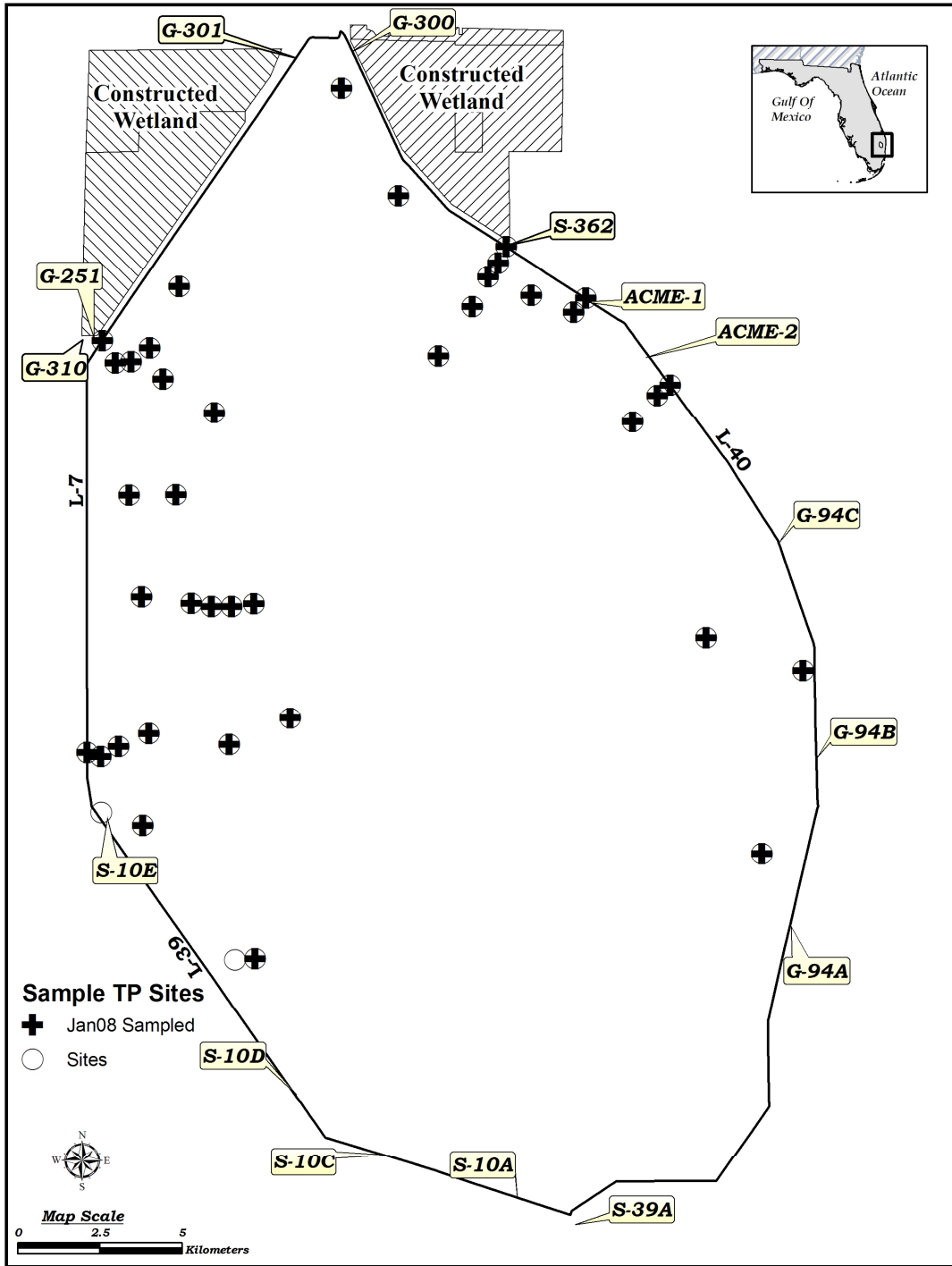


Figure 2. January 2008 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

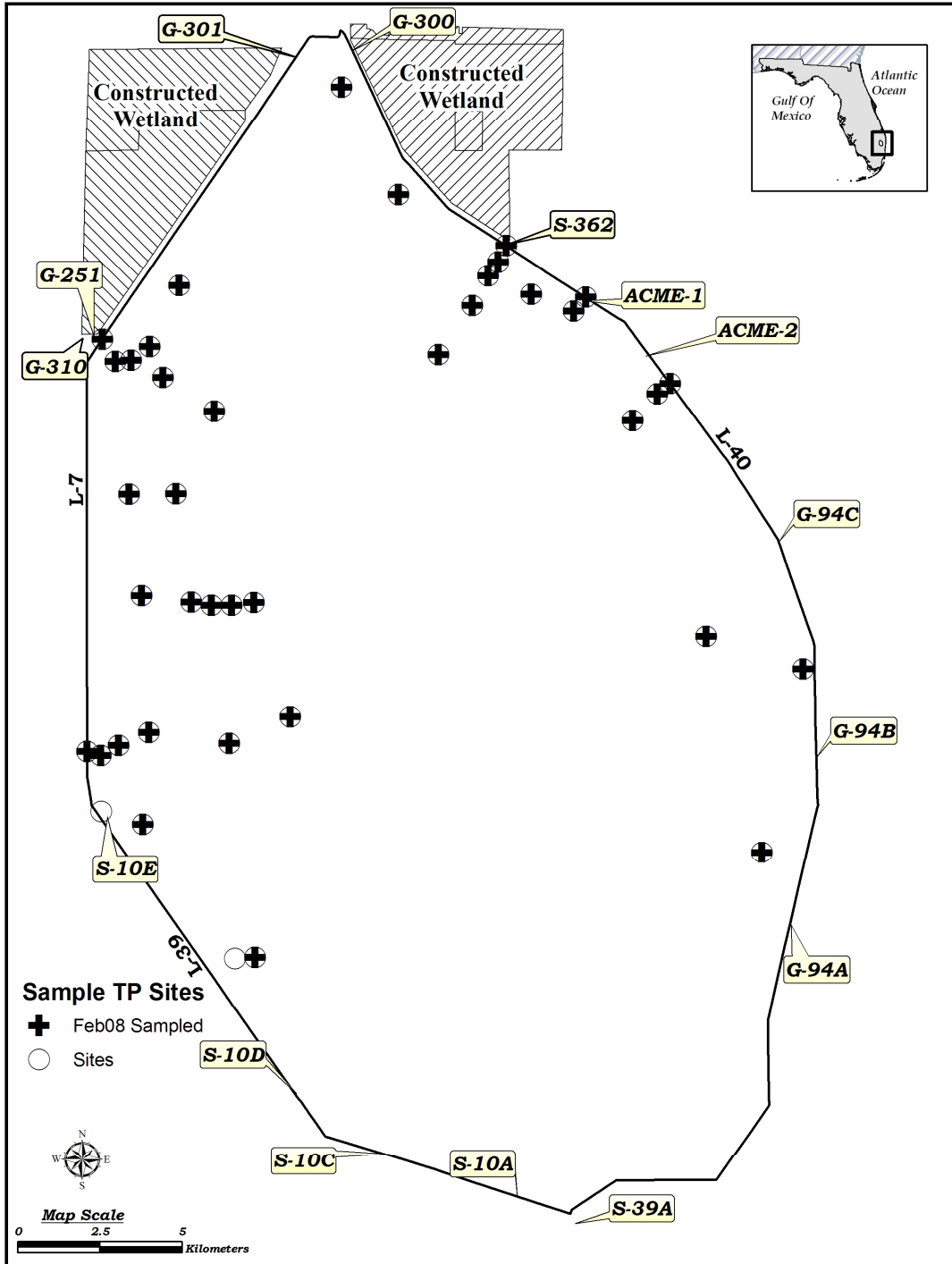


Figure 3. February 2008 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

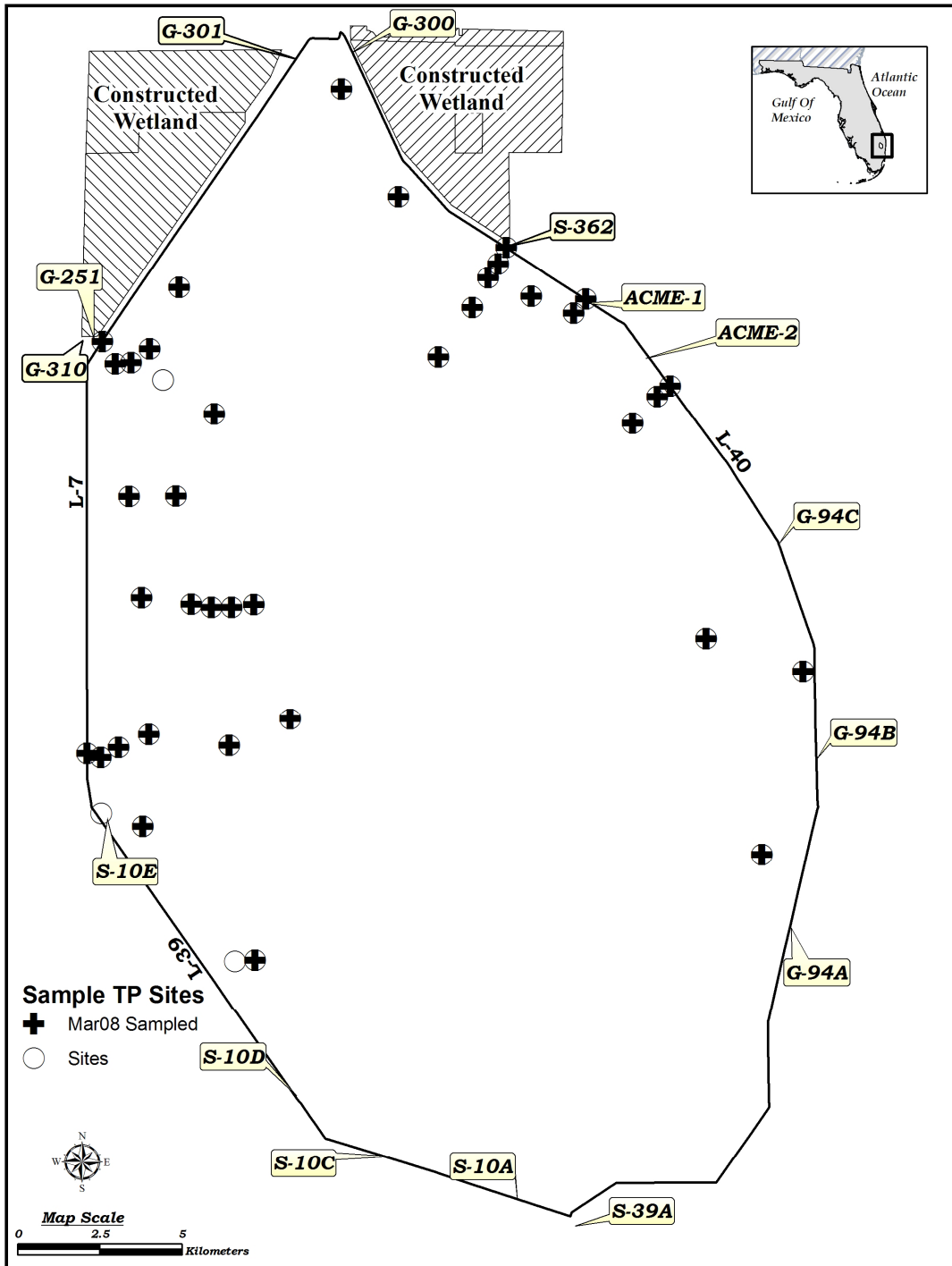


Figure 4. March 2008 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.