

## **Enhanced Water Quality Monitoring and Modeling Program for the A.R.M. Loxahatchee National Wildlife Refuge Quarterly Update Report – July 2007**

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 2007 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 focuses on providing information for use in ecological management of the Refuge (Brandt et al. 2004; Harwell et al. 2005; USFWS 2007).

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://www.sfwmd.gov/org/ema/dbhydro/index.html>. Data for June 2006-June 2007 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 June 2007.

Presentations were made as part of a special session on water quality issues in the Everglades at the 2007 annual meeting of the North American Benthological Society held in June 2007 in Columbia, SC (see: <http://www.benthos.org/Meeting>).

#### Water Quality Data Analyses Update

Primary efforts from this quarter focused on preparing the Third Annual Report. This report focuses on extending the period of record captured in the Second Annual Report to December 2006.

#### Monitoring Update (April 2007 – June 2007)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at 6 stations in April 2007, 5 stations in May 2007, and 12 stations in June 2007 (**Table 1**).

Total phosphorus data available to date for October 2006 to June 2007 are presented in **Table 1**. Maps of stations where samples were collected for April 2007 through June 2007 are presented in **Figures 2-4**.

Conductivity sonde deployment information for October 2006 to June 2007 is presented in **Table 2**.

#### Modeling Update

Model development continues with intensive effort by the modeling team. The modeling team held their first model results workshop on June 18<sup>th</sup> in Delray Beach, where more than two dozen people across multiple agencies attended. The workshop covered the water budget and simple constituents modeling efforts, as well as some preliminary information on the complex hydrodynamic modeling. Information from this workshop is tentatively available at: <http://loxmodel.mwaldon.com/>. A second workshop is planned for August 2007.

#### Next Steps

The next steps for this program include exploring mechanisms to present information from the Annual Report – in particular the modeling efforts – to a larger audience, continuation of data collection and analysis, additional model development and implementation.

#### References

[http://sofia.usgs.gov/lox\\_monitor\\_model/](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.

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.

Report No. LOXA07-007

USFWS. (2007) 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.

**Table 1.** 2006 Total phosphorus data (ppb) available for October 2006 – June 2007 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	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	May-07	June-07
LOXA101	9	13	5	13	12	-	-	-	-
LOXA102	6	6	U	-	-	-	-	-	-
LOXA103	8	-	2	4	-	-	-	-	-
LOXA105	-	14	-	16	10	-	-	-	-
LOXA106	8	7	-	5	-	-	-	-	-
LOXA107	7	5	-	-	-	-	-	-	-
LOXA108	5	3	-	-	-	-	-	-	-
LOXA109	8	5	U	5	-	-	-	-	-
LOXA110	11	4	-	U	-	-	-	-	-
LOXA111	4	6	-	7	U	-	-	-	-
LOXA112	6	8	-	6	5	-	-	-	-
LOXA113	4	6	-	U	U	-	-	-	9
LOXA114	6	4	-	U	5	-	-	-	-
LOXA116	86	-	8	20	-	-	-	-	-
LOXA117	19	11	13	7	5	-	-	-	-
LOXA118	8	4	6	10	4	-	-	-	-
LOXA119	U	4	U	8	9	-	-	-	-
LOXA120	6	5	6	6	U	12	16	-	11
LOXA121	-	X	X	X	X	X	X	X	X
LOXA122	7	7	9	12	6	-	-	-	-
LOXA123	-	X	X	X	X	X	X	X	X
LOXA124	3	14	8	6	7	-	-	-	24
LOXA126	U	5	8	6	6	-	-	-	-
LOXA127	U	13	7	6	U	-	-	-	-
LOXA128	5	3	2	4	U	-	-	-	-
LOXA130	U	18	6	9	5	-	-	-	-
LOXA131	U	3	9	6	5	-	-	-	-
LOXA133	-	20	-	17	55	-	-	-	-
LOXA134	12	9	11	7	6	-	-	-	44
LOXA136	18	15	13	37	21	-	-	-	-
LOXA137	5	9	6	5	6	-	-	-	20
LOXA138	4	4	-	3	U	-	-	-	9
LOXA139	4	4	-	-	-	-	-	-	11
LOXA140	6	9	-	6	U	-	-	-	-
LOXA141		8	3	13	6	8	-	-	-
MAX	86	20	13	37	55	12	16	-	44
MIN	3	3	3	3	4	8	16	-	9

U indicates that compound was analyzed but not detected.  
X indicates station no longer sampled.

**Table 1 cont.**

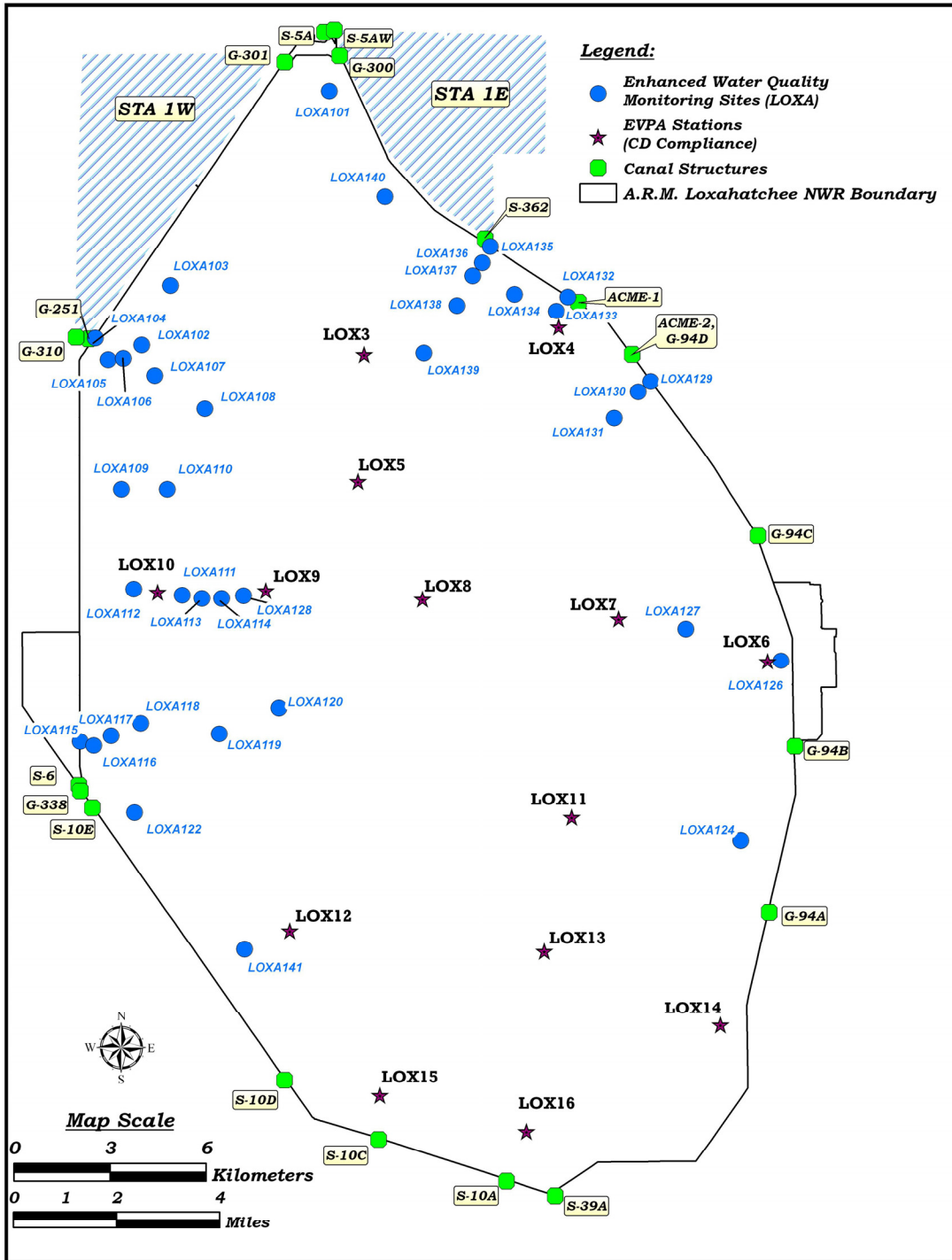
b) Canal stations

Canal Station	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07
LOXA104	43	60	37	24	27	100	50	54	29
LOXA115	60	34	25	23	47	25	32	29	14
LOXA129	19	51	35	36	36	84	82	52	270
LOXA132	43	43	41	39	36	54	70	65	200
LOXA135	46	48	34	35	46	48	75	72	130
MAX	60	60	41	39	47	100	82	72	270
MIN	19	34	25	23	27	25	32	29	14

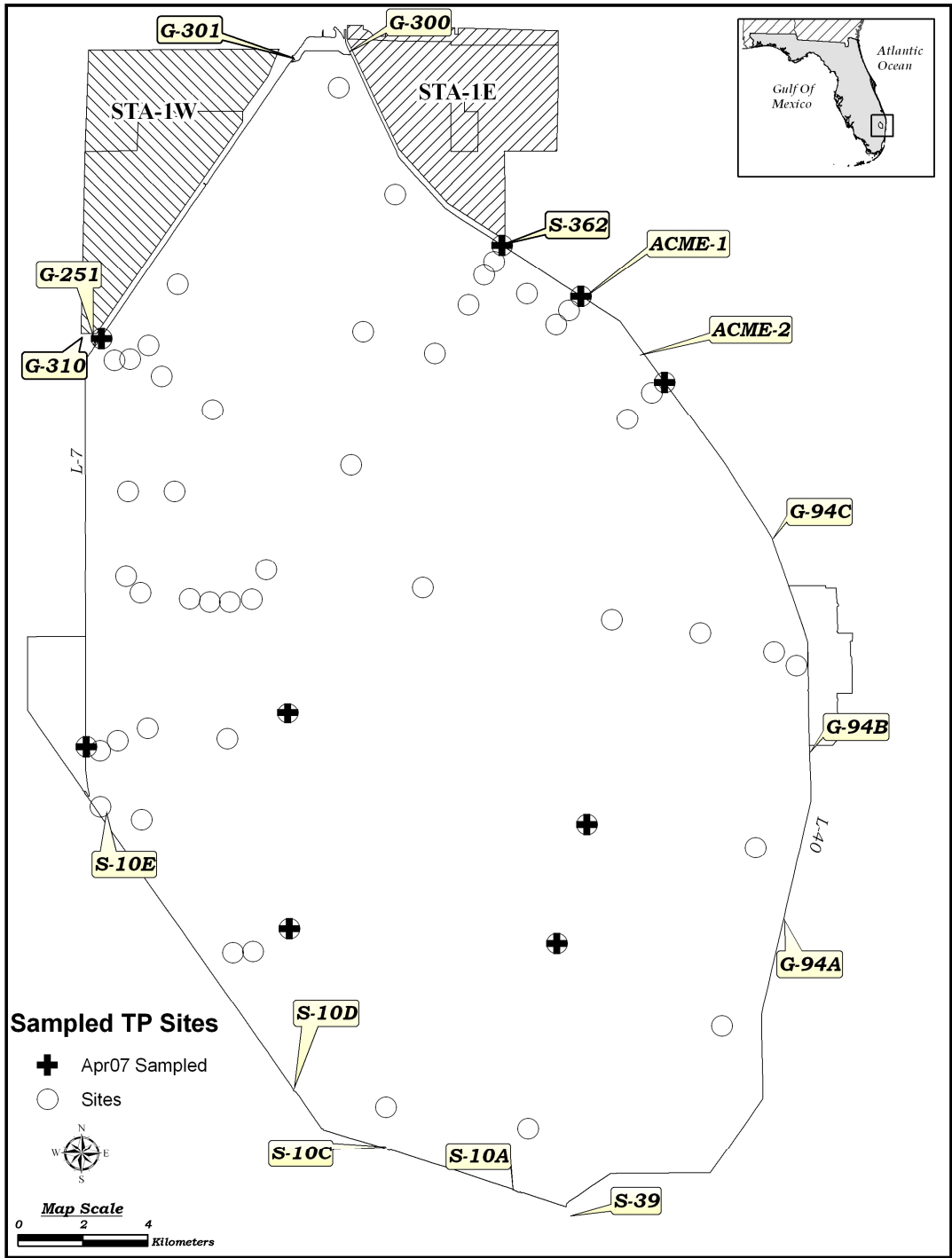
U indicates that compound was analyzed but not detected.

**Table 2.** October 2006 – June 2007 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	Description	2006			2007					
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
LOXA104	NW Transect 0 (canal)	X		X					X	X
LOXA105	NW Transect 0.5		X		X		X		X	
LOXA106	NW Transect 1		X		X		X		X	
LOXA107	NW Transect 2		X		X		X		X	
LOXA108	NW Transect 4		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	SW Transect 0 (canal)	X		X			X		X	X
LOXA116	SW Transect 0.5		X				X	X		
LOXA117	SW Transect 1		X				X	X		
LOXA118	SW Transect 2		X			X		X		X
LOXA119	SW Transect 4		X			X		X		X
LOXA120	SW Transect- X5		X			X		X		X
LOXA126		X	X	X		X		X	X	X
LOXA127		X	X	X		X		X	X	X
LOXA128		X	X			X		X	X	X
LOXA129	NE Transect S 0 (canal)		X			X	X	X	X	X
LOXA130	NE Transect S		X						X	
LOXA131	NE Transect S		X						X	
LOXA132	NE Transect N 0 (canal)		X			X	X	X	X	X
LOXA133	NE Transect N		X						X	
LOXA135	NE Transect STA1E 0 (canal)		X			X	X	X	X	X
LOXA136	NE Transect STA1E 0.5		X		X		X		X	
LOXA137	NE Transect STA1E 1		X		X		X		X	
LOXA138	NE Transect STA1E 2		X		X		X		X	
LOXA139	NE Transect STA1E 4		X				X		X	
LOX6	EVPA site	X	X	X		X		X	X	X
LOX7	EVPA site		X	X		X		X	X	X
LOX8	EVPA site	X	X	X		X		X	X	X
LOX9	EVPA site	X	X	X		X		X	X	X
LOX10	EVPA site	X		X		X		X	X	X

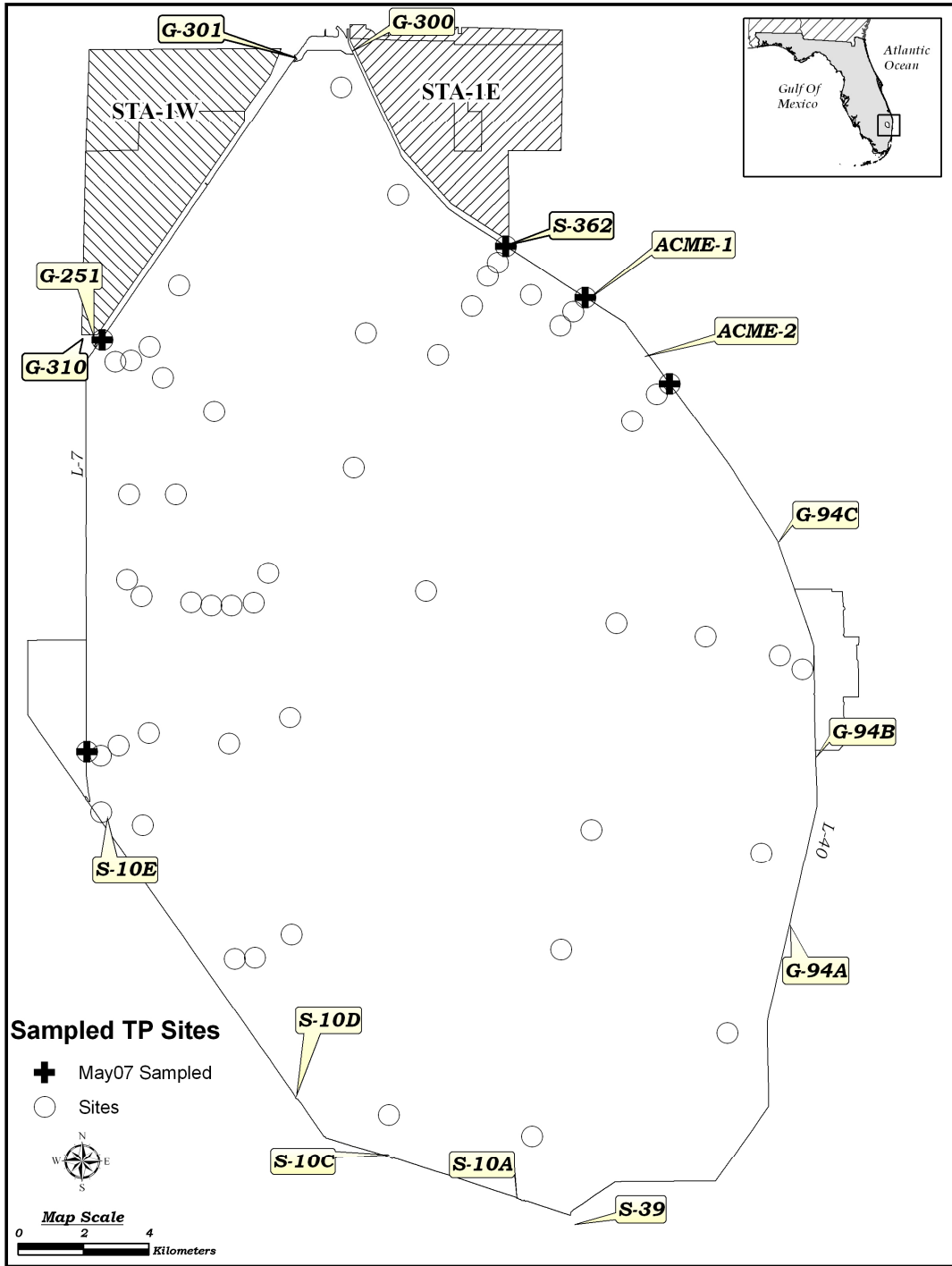


**Figure 1.** Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

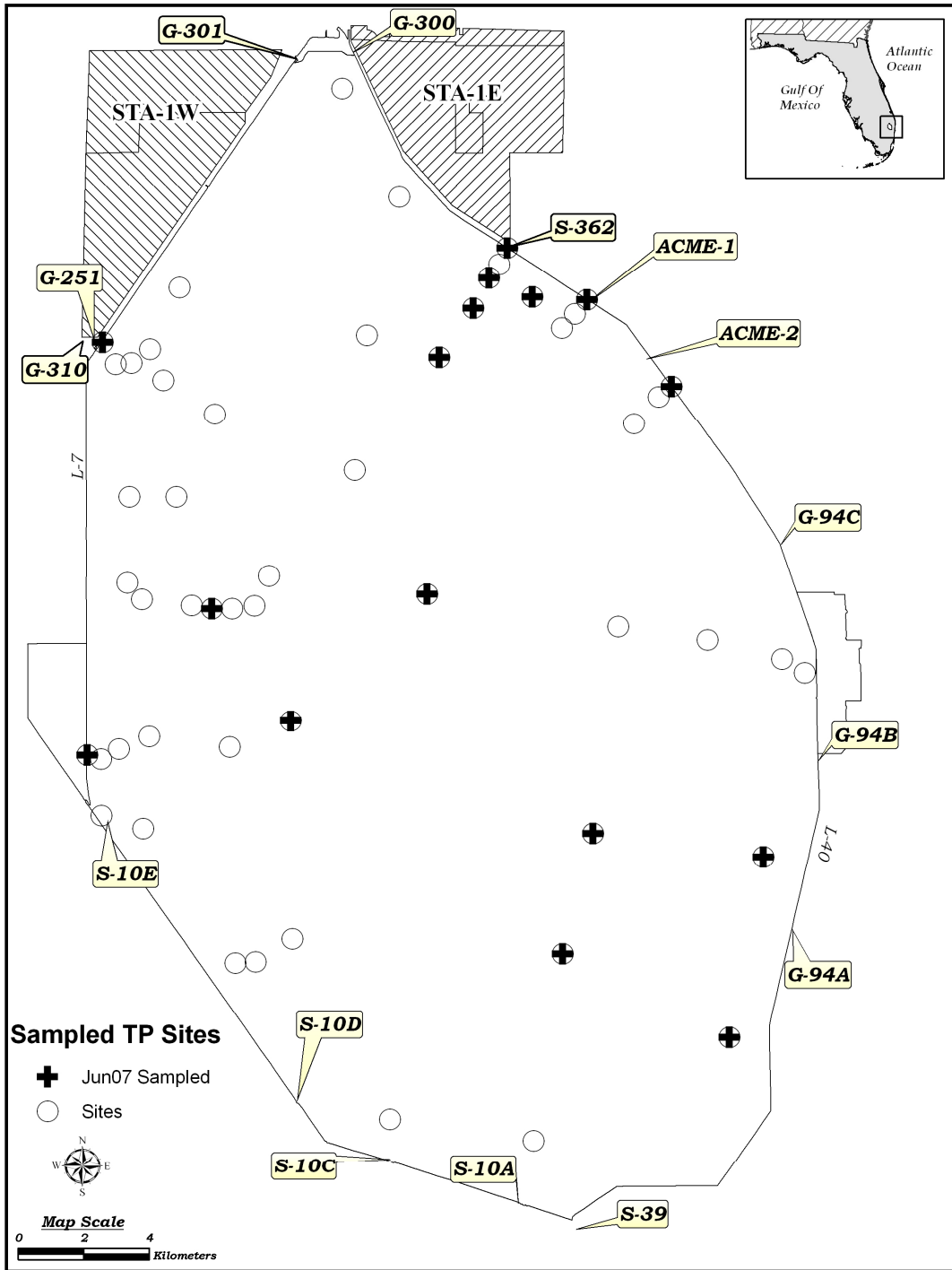


**Figure 2.** April 2007 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.





**Figure 3.** May 2007 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 2007 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.