Enhanced Water Quality Monitoring and Modeling Program for the A.R.M. Loxahatchee National Wildlife Refuge Quarterly Update Report – December 2015

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Overview

This update is a summary of activities since the previous status report of September 2015 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 (Brandt et al. 2004) focuses on providing information for use in ecological management of the Refuge (e.g., USFWS 2007a, b; USFWS 2009; USFWS 2010a, b; USFWS 2012a; USFWS 2012b; USFWS 2013; USFWS 2014; USFWS 2015).

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.*

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://my.sfwmd.gov/dbhydroplsql/show_dbkey_info.main_page. Data for June 2006-December 2015 are posted on the Technical Oversight Committee's web site at http://www.sfwmd.gov/toc/. This report includes information from samples collected through December 2015.

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 (October – December 2015)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at 37 stations in October, 37 in November, and 37 in December 2015 (**Table 1**).

Total phosphorus data available to date for January 2015 through December 2015 are presented in **Table 1**. Maps of stations where samples were collected for the months from October through December 2015 are presented in **Figures 2-4**.

Conductivity sonde deployment information for January through December 2015 is presented in **Table 2**.

Next Steps

The next steps for this program include additional efforts on the Annual Report.

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 – 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.

USFWS. (2009) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 4th Annual Report – July 2009. LOXA09-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 106 pp.

USFWS. (2010a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 5th Annual Report – September 2010. LOXA08-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 43 pp.

USFWS. (2010b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 6th Annual Report – October 2010. LOXA09-011, U.S. Fish and Wildlife Service, Boynton Beach, FL. 42 pp.

USFWS. (2012a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 7th Annual Report – February 2012. LOXA12-001, U.S. Fish and Wildlife Service, Boynton Beach, FL. 115 pp.

USFWS. (2012b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 8th Annual Report – October 2012. LOXA12-004, U.S. Fish and Wildlife Service, Boynton Beach, FL. 68 pp.

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USFWS (2014) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Program – 10th Annual Report for calendar year 2013 – June 2014. LOXA14-002, U.S. Fish and Wildlife Service, Boynton Beach, FL. 71 pp.

USFWS (2015) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Program – 11th Annual Report for calendar year 2014 – June 2015. LOXA15-002, U.S. Fish and Wildlife Service, Boynton Beach, FL. 81 pp.

Table 1. Total phosphorus data (ppb) available for January – December 2015 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	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
LOXA101	18	5	16	-	-	-	-	-	46	17	19	11
LOXA102	15	4	9	-	-	-	-	-	32	14	10	10
LOXA103	12	2	9	-	-	-	-	-	28	15	10	13
LOXA105	18	5	U	6	-	-	-	-	44	23	22	13
LOXA106	16	5	7	-	-	-	-	-	24	14	13	9
LOXA107	13	2	-	-	-	-	-	-	13	12	11	10
LOXA108	12	4	9	-	-	-	-	-	12	9	8	5
LOXA109	10	11	10	6	-	-	-	12	13	13	9	8
LOXA110	8	8	3	5	-	-	-	4	13	6	10	5
LOXA111	9	6	6	-	-	-	-	-	19	8	10	9
LOXA112	11	11	7	5	-	-	-	-	14	13	10	6
LOXA113	9	6	8	7	-	-	-	-	14	11	9	8
LOXA114	9	8	8	8	12	13	-	-	13	10	9	11
LOXA117	12	11	13	9	-	-	-	-	25	20	13	10
LOXA118	U	8	11	13	-	-	-	-	15	16	10	11
LOXA119	U	8	10	5	15	-	-	15	11	12	7	5
LOXA120	U	6	11	6	16	23	-	11	10	8	10	8
LOXA122	10	14	13	12	-	-	-	-	18	22	17	12
LOXA124	13	12	17	-	-	-	-	-	50	19	24	33
LOXA126	U	4	7	U	15	-	-	9	13	12	9	9
LOXA127	U	6	9	5	9	-	-	15	10	11	8	9
LOXA128	8	7	8	5	-	-	-	-	11	8	7	8
LOXA130	13	8	8	69	13	25	-	14	23	13	8	12
LOXA131	7	U	5	8	6	13	-	8	13	11	7	8
LOXA133	23	10	18	12	-	-	-	36	29	22	14	18
LOXA134	11	6	10	8	10	-	-	17	16	14	7	12
LOXA136	32	17	15	61	-	-	-	-	32	20	14	12
LOXA137	12	12	8	6	-	-	-	-	19	14	10	9
LOXA138	10	4	9	16	-	-	-	-	17	11	6	6
LOXA139	7	7	11	12	-	-	-	-	12	12	11	8
LOXA140	13	6	U	-	-	-	-	-	21	14	9	8
LOXA141	90	15	14	9	42	17	-	17	13	16	5	9
MAX	90	17	18	69	42	25	0	36	50	23	24	33
MIN	7	2	3	5	6	13	0	4	10	6	5	5

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

Table 1 cont.

b) Canal stations

Canal Station	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
LOXA104	22	14	26	25	26	18	25	20	24	27	20	18
LOXA115	21	12	25	18	20	22	15	18	27	28	16	20
LOXA129	24	14	23	18	23	20	17	51	17	13	19	14
LOXA132	21	13	31	20	22	24	16	42	19	15	17	15
LOXA135	31	17	26	20	18	21	18	25	17	18	14	16
MAX	31	17	31	25	26	24	25	51	27	28	20	20
MIN	21	12	23	18	18	18	15	18	17	13	14	14

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

Table 2. January – December 2015 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.

	2015											
Site ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
LOXA104	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
LOXA115	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		X
LOXA119		X	X		X		X		X	X		X
LOXA120		X	X		X		X		X	X		X
LOXA129	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		
LOXA133	X		X			X		X		X		X
LOXA135	X	X	X	X	X		X	X		X	X	
LOXA136	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		
LOXA144		X		X			X			X		
LOXA145		X		X			X			X		
LOXA146		X		X			X			X		
LOXA147		X	X	X	X	X	X		X			X
LOXA148		X		X		X		X		X		X
LOXA149		X		X		X		X		X		X
LOXA150		X		X		X		X		X		X
LOXA151	X	X	X	X	X		X	X		X	X	
LOXA152	X	X	X	X	X		X	X		X	X	
LOXA153	X	X	X	X	X		X	X		X	X	
I-8C	X	X	X	X	X	X	X	X			X	
LOX04	X		X			X	X		X	X		X
LOX15		X		X		X		X		X		X

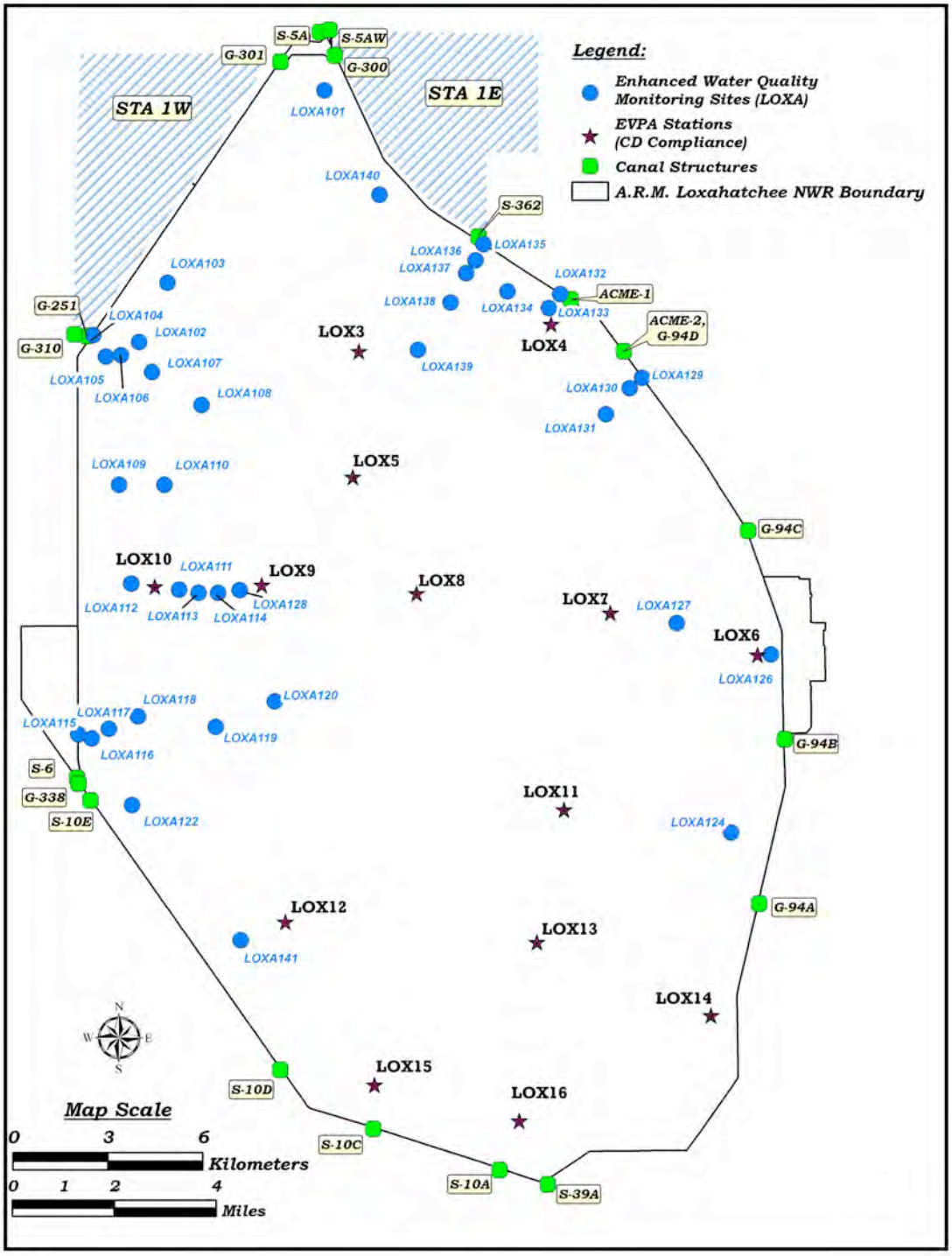

Figure 1. Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

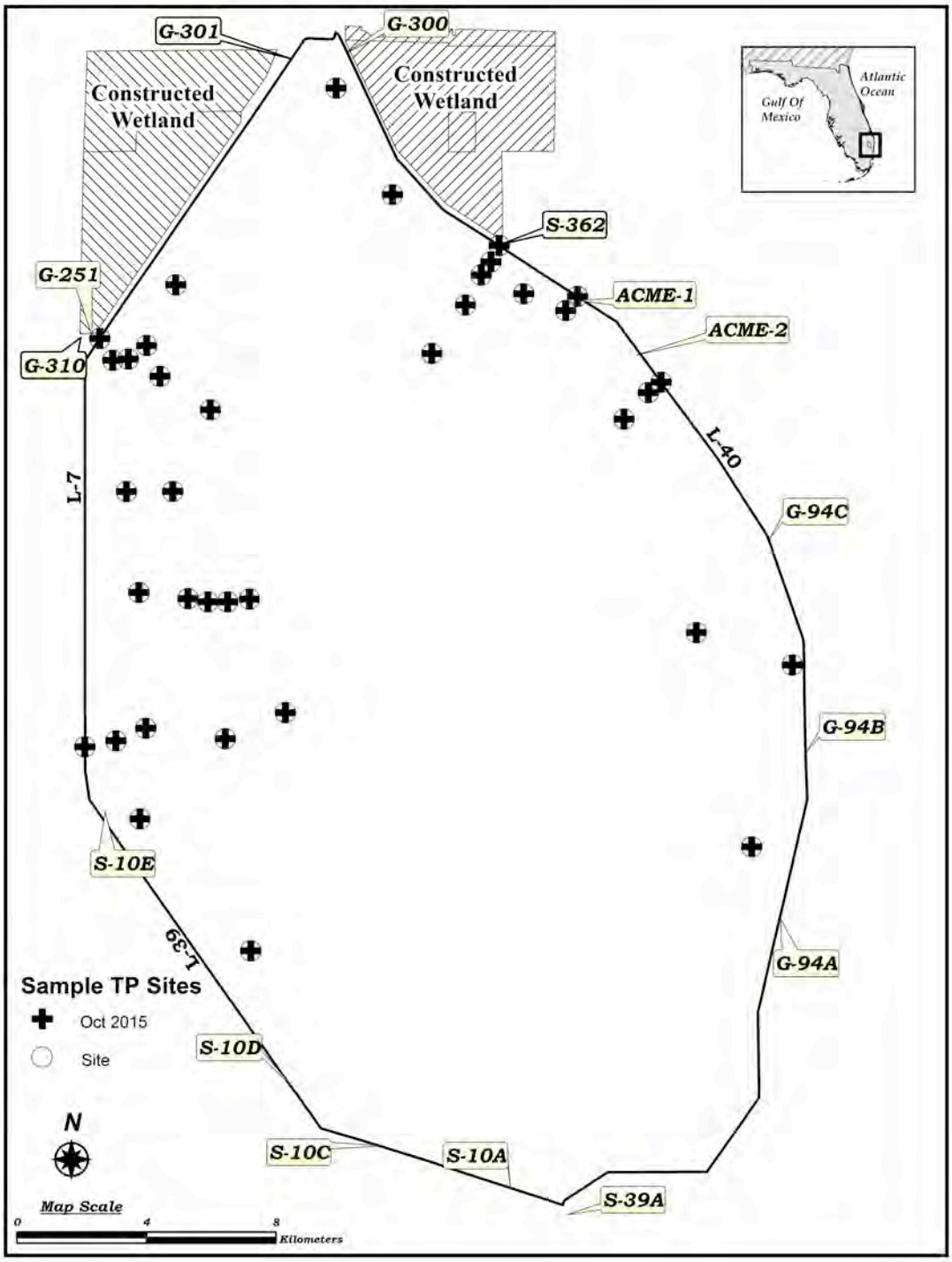

Figure 2. October 2015 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

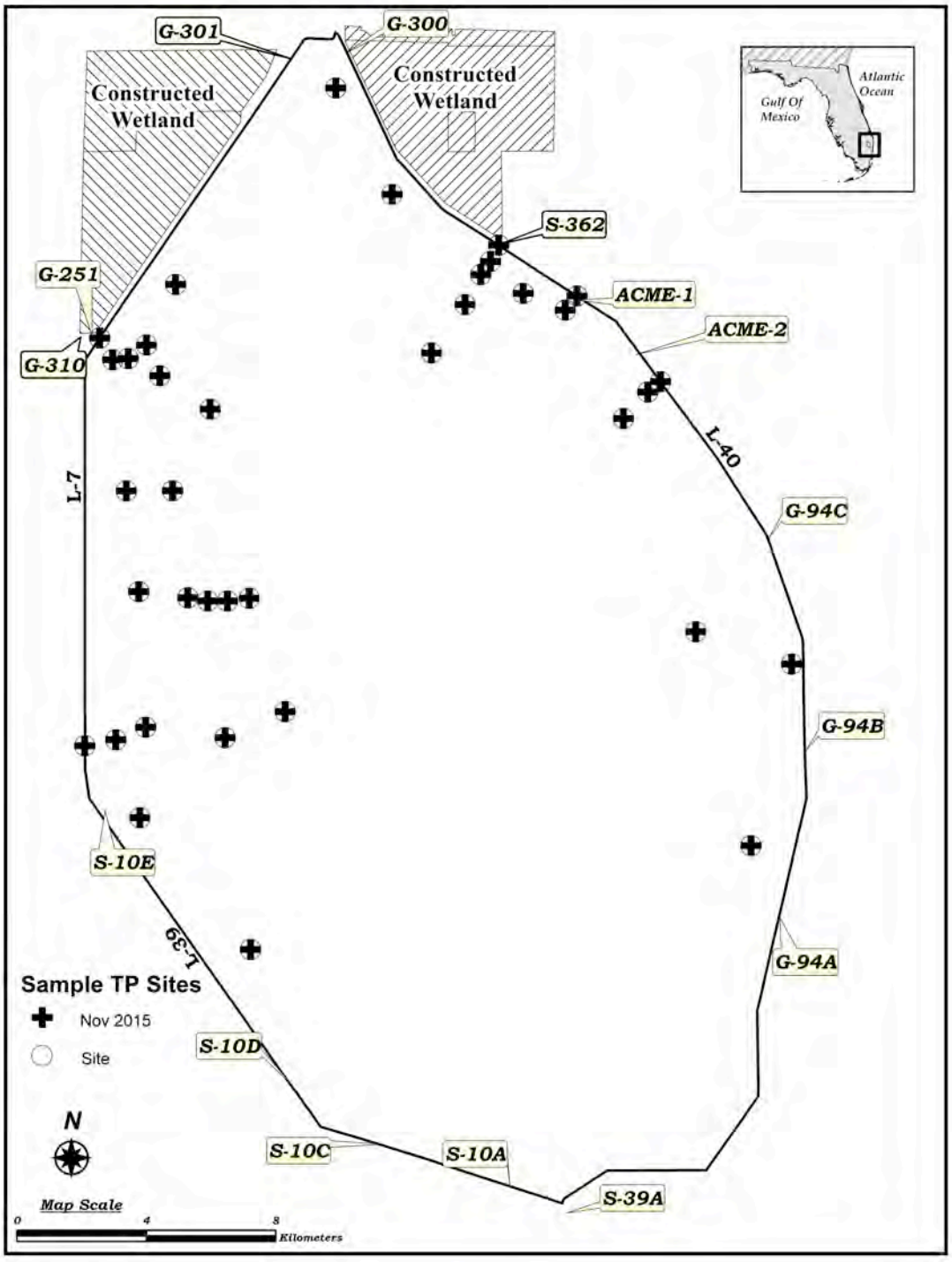

Figure 3. November 2015 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

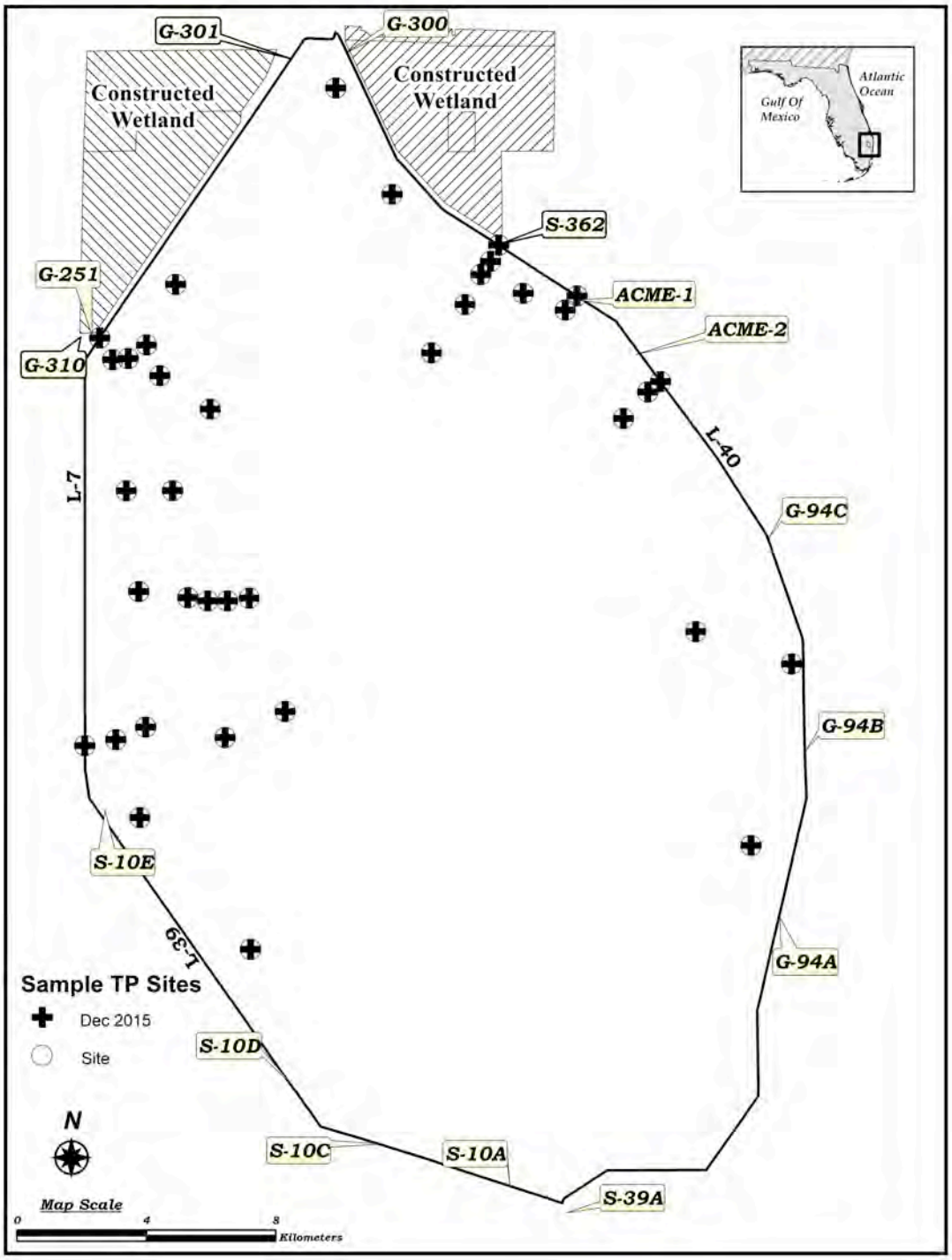

Figure 4. December 2015 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.