

Addressing Data Needs for Ecosystem Management: Enhancing an Existing Long-Term Water Quality Monitoring Network for the Northern Everglades

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Monitoring is an important component of any restoration or management program. It provides the necessary feedback to determine if desired results are achieved and if unanticipated impacts are occurring. In the Everglades, routine water quality monitoring has been conducted since the 1970s, often for monitoring permit compliance and compliance with a Federal Consent Decree. Although the network of stations set up for permit compliance has utility for assessment of impacts of Everglades restoration, it does not meet all restoration monitoring needs. In particular, permit monitoring is not designed to test causal relationships or hypotheses about water management decisions - information needed to guide restoration. Water quality monitoring at the Arthur R. Marshall Loxahatchee National Wildlife Refuge provides a case study of these observations. Although routine water quality monitoring has occurred since the late 1970s, the monitoring is inadequate for supporting management decisions that must be addressed. The existing monitoring program has focused on inflow and outflow structures, and on the water quality in the interior, the most pristine component of the refuge. The most impacted marsh, that adjacent to the canals and inflows, is the least understood and the most likely area to be positively or negatively impacted by water management decisions.

Historically, the Refuge developed as a rainfall-driven system with surface waters low in nutrients, especially phosphorus, and inorganic ions such as chloride, sodium, and calcium (low conductivity), making it a unique component of the remaining Everglades. The Refuge is surrounded by canals transporting agriculture and urban runoff. As such, there is concern that increases in canal water intrusion into the Refuge interior may cause negative ecological consequences because research demonstrated that changes in major ions may cause undesirable ecological changes in flora and fauna.

In FY04, Congress specifically appropriated funds for a multi-year enhanced water quality monitoring effort and for development of water quality models. This project will address management related questions, including: (1) When does canal water move into the marsh? (2) How far does water from the canal move into the marsh? (3) What water management operations minimize movement of canal water into the interior of the Refuge? (4) What are the ecological effects of canal water on Refuge resources? Combined with historic monitoring, data collected during this project will make public an unusually extensive wetland hydrology and water quality dataset, statistical analyses, and models. In addition to meeting the management related goals of the project, this project can provide a foundation for other independent or collaborative Everglades research.

The opinions expressed herein do not necessarily reflect those of the U.S. Department of Interior.

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Stage monitoring site



Tree Islands

USFWS Photo by S.D. Jewell

Perimeter Canal & Levee



Interior Wetlands



Prescribed Fire



1. History

The Arthur R. Marshall Loxahatchee National Wildlife Refuge includes Water Conservation Area number 1 (WCA-1), one of three WCAs that were built to maintain water storage and flood control as well as provide a protected refuge for the remnant Everglades ecosystem. In the 1950s and 1960s, WCA-1 was completely surrounded by perimeter canals and hydrologically isolated from its watershed by levees. These hydrologic modifications caused alterations in flow direction and more than an order-of-magnitude reduction in marsh water velocity.

Much of the Everglades, including the refuge, developed as a rainfall-driven system with surface waters low in nutrients, especially phosphorus, and inorganic ions such as chloride, sodium, and calcium (low conductivity). Information from the refuge and other wetlands indicates that changes in major ions may cause undesirable ecological changes in flora and fauna. Canal water intrusion into the refuge interior can cause eutrophication, loss of the periphyton community, other shifts in the aquatic community, and have other negative ecological consequences.

2. Background

Stormwater runoff primarily from the Everglades Agricultural Area, but also from urban sources, is now pumped into perimeter canals where it may flow to discharge structures or mix into the rainwater-dominated interior wetland. Relative to the rainwater-dominated interior, the pumped stormwater has elevated concentrations of a number of constituents. Although total phosphorus has been of greatest concern, chloride, sodium, calcium, sulfate, conductivity, and total nitrogen are also elevated. A pollutant-impacted fringe of marsh has developed between the relatively pristine interior marsh and the perimeter canals. This impacted fringe marsh extends over a significant fraction of the total WCA-1 area.

In FY 04, Congress appropriated funds for an enhanced water quality monitoring network to provide information that can be incorporated into water management decisions to better protect refuge resources.

3. Historic And Current Monitoring

Monitoring has been conducted by the South Florida Water Management District (SFWMD), US Geological Survey (USGS), US Army Corps of Engineers (Corps), university researchers, and the US Fish and Wildlife Service (USFWS). Most historic data have been collected by the SFWMD for permit compliance, compliance with consent decree requirements, and research. Stage monitoring has been performed by the USGS in cooperation with the Corps, and by the SFWMD at structure headwater and tailwater sites. Additional supporting data from special studies are also available.

4. Previous Monitoring Network

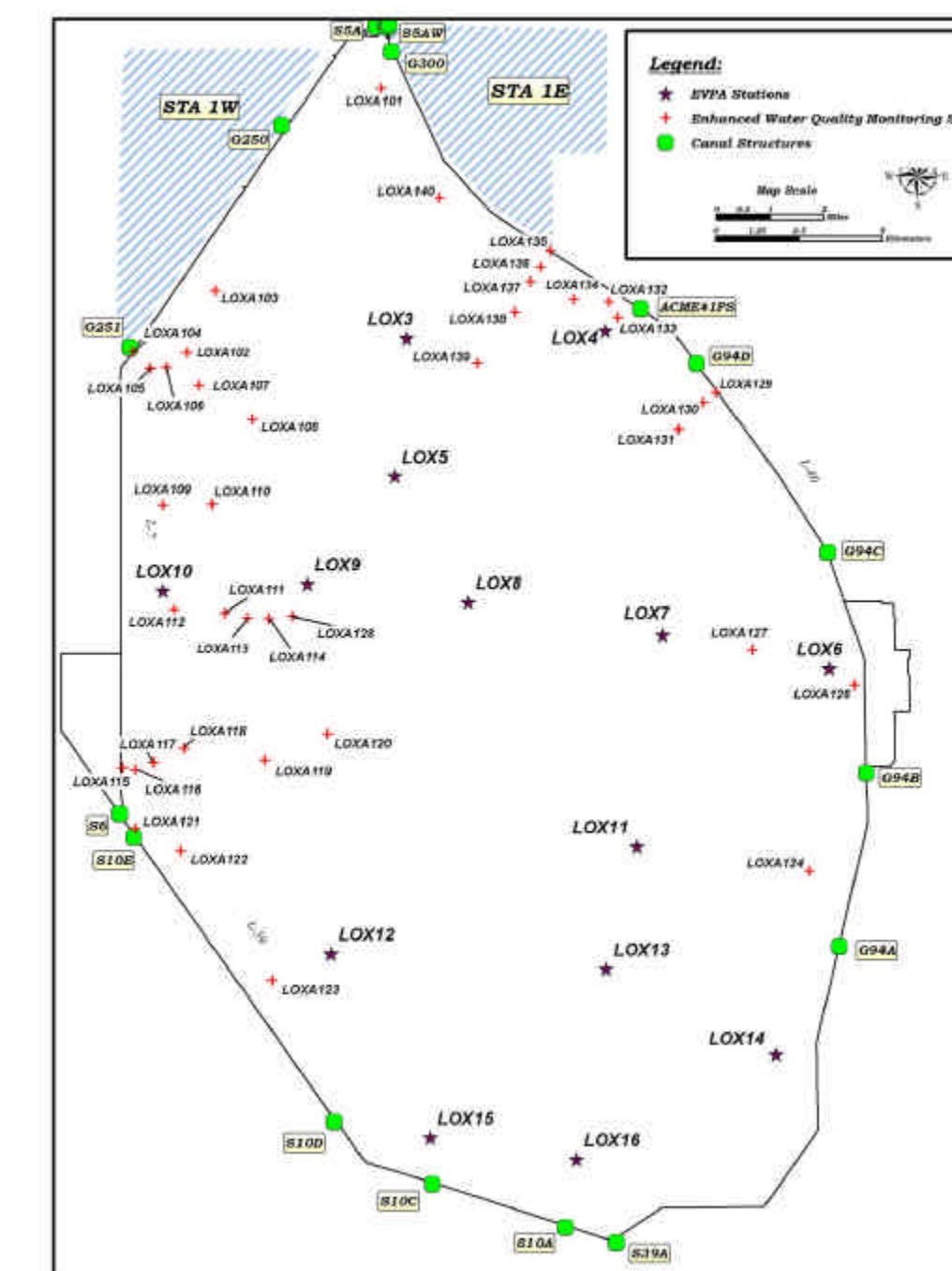
- 14 Consent Decree interior marsh compliance stations – LOX3-LOX16
- Inflow and outflow structures – related to permits and consent decree
- Research transects – 11 stations, 2 in L-7 Canal
- No monitoring near inflows in impacted zone
- Interior stage – 5 USGS sites, other staff gages
- Canal stage – 1 USGS site, structure head/tail water

5. USFWS Enhanced Monitoring Network

(deployment began in June 2004)

The enhanced network augments existing monitoring by adding sites in the canal and in the marsh bordering the canal. Sites are concentrated near pumped stormwater inflows. The network includes:

- 40 additional water quality monthly sites in canal and impacted fringe marsh – LOXA101-LOXA140
- 10 water level recorders logging hourly readings
- 27 datalogging sondes for conductivity and temperature
- Synoptic water quality surveys planned for L-40 Canal
- Fire related water quality studies



6. Join Us?

Researchers from other governmental agencies and academic institutions base their research in the refuge. The refuge collaborates with researchers performing projects that are compatible with our goals. Contact the refuge manager or the authors for more information.