Lake Seminole Restoration: Everything but the Kitchen Sink

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For over twenty years there have been continuous efforts aimed at restoring water quality and habitat in Lake Seminole and its surrounding area. Prior to the 1940s, the Lake did not exist as it does today. At that time, it was the upper portion of Long Bayou, essentially just a shallow tidal embayment accumulating fine organic sediments in the poorly flushed backwaters for several centuries. However, in 1945 the lake was established by Pinellas County Board of County Commission resolution, with construction commencing shortly thereafter (Figure 1). During the early years (1950s and 1960s) of the lake's inception, the state of Florida experienced a population boom and the area surrounding the lake exploded with new residents. These conditions--existing nutrient-rich sediments, increased direct run-off due to urbanization, and long retention of water--provided an excellent medium for the growth of both vegetation and algae. All of this contributed to water quality and habitat declines that could be seen as far back as the 1960s and are still issues today.

Lake Seminole History and Background

Lake Seminole is a 685-acre hyper-eutrophic lake located in the west central portion of Pinellas County on the west coast of Florida, about 90 miles west of Orlando. It was created by impounding an arm of Long Bayou, a brackish water segment of Boca Ciega Bay that ultimately spills into the Gulf of Mexico. The creation of the lake was in conjunction with the planned construction of Park Boulevard by the State Public Roads Administration. There were quite a few reasons for the creation of Lake Seminole with the two major reasons being to provide irrigation of orange groves and as a potential potable water source. A fixed weir on the north end took flow into the lake from Long Creek and water flowed out of the system from a fixed weir on the south end of the lake (Figure 2). In the late 1970s, to alleviate upstream flooding and to reduce the flow of untreated stormwater into the lake, the Seminole Bypass Canal was created. This provided immediate relief from flooding but only minimally addressed the water quality degradation.

Figure 1. Lake Seminole prior to 1940's (Left) and Lake Seminole Present Day (Right)

Figure 2. Lake Seminole Outfall during Construction of lake

Today, the lake is used primarily for recreational purposes, with fishing and boating being the main activities. The lake supports a strong largemouth bass population with many large bass found in the lake, though recreational fishing in the lake has been declining over the past 30 years. Land use over time has shifted from low density residential and agricultural uses to its current status of high density residential and commercial. This rapid urbanization of the watershed is one of the main reasons for decline in ecological conditions within the lake as little advanced infrastructure existed to treat the increased, nutrient-rich stormwater runoff. In terms of vegetation, the lake was historically dominated by cattail (*Typha* sp.) which made up nearly 65% of the vegetation as well as *Hydrilla verticillata*, an invasive non-native submerged aquatic plant that is known for its rapid expansion, and eel-*grass (Vallisneria americana)*, a beneficial native submerged aquatic plant. In recent years management activities have focused on increasing a diverse native plant community, reducing cattails and controlling *Hydrilla*.

<u>Early Restoration Efforts on the Lake</u>

Early restoration efforts on the lake started back in the 1960s when state and local agencies identified pollution sources and started to eliminate them. The largest source of pollution was a City of Largo wastewater plant, which until 1971 was directing untreated waste into the lake. However, due to continued inputs of untreated run-off from the surrounding residential and commercial areas, excess nutrients were entering the lake, causing further degradation of water quality. By the 1980s the water quality was extremely poor and the nuisance vegetation, a sign of an unhealthy system, increased, primarily with an eruption of *Hydrilla*. This led to an introduction of Grass Carp in 1987 as a biological control of *Hydrilla* in order to restore the native plant population. The Grass Carp did their job, reducing the *Hydrilla* abundance, but the unintended side effect was the release of a large quantity of nutrients that were previously stored in the plant's biomass. This influx of nutrients, and the grazing by the Grass Carp, led to a system that switched from being dominated by macrophytes to one with an abundance of algae. In response to the continued degradation of water quality and lake habitat, the Pinellas County Board of Commissioners passed another resolution urging the joint development of a long-term lake management plan. This was followed by multiple studies in the 1990s aimed at gaining a greater understanding of how the lake functioned, where the major areas of concern were, and what were the best approaches to restore the lake.

The aforementioned studies formed a framework for a watershed management plan, completed in 2001, that analyzed water quality, sediment and habitat data, as well as many other lake parameters, to come up with a multifaceted approach to restoring the lake. This plan had a multitude of structural, legal, policy, outreach, and management practices, ranging from stormwater pond rehabilitations and sediment removal projects to public education and creation of redevelopment codes within the watershed. Now that a plan with restoration goals was created, it was time to start implementing the practices and projects suggested.

Reasonable Assurance Plan

Based on all of the recommendations in the prior studies on the lake, a consulting firm completed a Reasonable Assurance Plan (RAP) for Pinellas County in response to Lake Seminole being listed by the Florida Department of Environmental Protection (FDEP) as an impaired waterbody. This document outlined a plan of action to implement management practices aimed at bringing the lake into regulatory compliance. The main goals of the plan were to implement practices that would reduce chlorophyll-a concentrations, reduce existing phosphorus loads by half, and maintain current water quality standards for dissolved oxygen and pH that comply with waterbodies classified for a fishable swimmable usage.

Many of the restoration techniques listed in the RAP have been completed on lakes throughout Florida to improve water quality. Lake Seminole took a holistic approach to try to solve the system's problems and used multiple restoration techniques together to complement one another.

Components such as adopting a resolution designating the Lake Seminole Watershed as a "Nutrient Sensitive Watershed" and expanding and enforcing restricted speed zones on the lake were easily accomplished, while others, like strengthening and standardizing local ordinances for regulating stormwater treatment for redevelopment in the watershed, and developing and implementing a comprehensive public involvement program for the watershed, took more time to enact.

Of all the components (e.g. structural, management, legal, policy, etc.), the structural components of the plan have been, by far, the most costly in terms of both time and resources to implement. There were six structural components identified in the RAP and Pinellas County, along with state and federal funding partners, immediately went into action to implement them.

Work Completed

To date, several projects listed in the RAP have been completed or are nearing completion. These projects focused on cleaning up the lake shoreline and placing lake-level instrumentation on the lake. The first project completed removed organic sediments from the littoral shelf in 2006 and was a continuation of a smaller-scale project of similar scope conducted by Florida Fish and Wildlife Commission (FWC) in 2002. The work focused on removal of organic sediments from nearshore areas and tussocks. Approximately 130,000 cubic yards of organic sediments were removed, along with over 26 tons of garbage and debris (Figure 3). To visualize how much material was removed, the 130,000 cubic yards of material would create a 20-foot high pile of dirt over an entire football field, and the garbage and debris removed weighed as much as three elephants.

Figure 3. Lake drawdown for shoreline muck removal

The same time the sediment removal project was underway, a lake stage gauge was installed at the outfall control structure on the south end of the lake. This gauge is still maintained and operated by the United States Geological Survey (USGS) with the goal of providing data to aid in calculating nutrient loading models and water/nutrient budget balancing.


Figure 4. Upland revegetation after exotics removal

The next project to be undertaken was the restoration of priority wetland and upland habitats. The goal was to improve near-shore upland habitats through vegetation control. The main portions of this project were completed in 2008, though continued maintenance is still occurring on an as-needed basis. There were many areas targeted for restoration ranging from small strips of land adjacent to roadways that comprised no more than a few thousand linear feet to a large tract of wetland and upland several acres in size. The main upland species targeted were Brazilian *Pepper (Schinus terebinthifolius)* and air potato (*Dioscorea bulbifera*) and the main near-shore targeted species were cattail and willows (*Salix* sp.). The areas where nui-sance vegetation was removed were immediately revegetated with native plants (Figure 4). These three pro-jects helped to tackle the lake's issues but there was still much more work to do.

Work Still In Progress

With the previously mentioned projects completed, it was now time to take on the major issues with the lake. There are still three large projects that have not been completed but they may have the greatest impact on creating a healthier, more balanced system. These projects aim to reduce nutrient loading from stormwater runoff, reduce internal nutrient loading from sediments already in the lake, and increase lake flushing.

It was decided to first tackle the loadings coming from stormwater runoff. The Lake Seminole Regional Stormwater Retrofit project was initiated in 2004. Six systems were designed to treat stormwater run-off based on the areas around the lake that had the highest contributing pollutant loads. Construction on the first of 4 locations started in 2008 with construction of a com-bined system that treated two areas on the north end of the lake (Figure 5). Two other systems were built on separate sites on the western shoreline near the center of the lake. The last system is scheduled for completion late 2016 and is located on the northwestern side of the lake. One system could not be built as the site proved to be unsuitable for implementation.

The overall goal of the Stormwater Retrofit pro- Figure 5. Alum facility on Lake Seminole during Construction ject is to reduce nutrient loads prior to entering the lake by injecting Alum (aluminum sulfate) into the stormwater which helps to sequester nutrients and sedi-ments prior to entering the lake. Alum has long been used as a phosphorus removal tool in the wastewater treatment world and over the last 30 years it has gained acceptance as a tool to help remove nutrients and suspended sediments in surface water systems (lakes, streams, ponds, etc.). The process for treating the stormwater is relatively simple. The systems were designed to release the Alum to only treat stormwater flow after it reaches a minimum assigned level for a certain period of time, thus ensuring the flow is storm-event driven. The rate of Alum release is based on flow, so as flow increases more Alum is released to ade-quately treat the stormwater. Based on preliminary testing, it is anticipated that removal rates will be up-wards of 80% of the total phosphorus and total suspended solids in the stormwater. This reduction in nutri-ents and sediments will have a great impact on the health of the lake by reducing the annual nutrient load to the lake. This project will be completed and all of the systems will be operational by spring of 2017.

Figure 5. Alum facility on Lake Seminole during construction

The other project currently underway is the number one recommended project in the RAP, and also the most costly. The lake-wide dredging of organic sediments within the lake is a project whose goal is to re-move sediments that have accumulated in the lake over time. This will be accomplished by using a special-ized barge that will extract target sediments off the lake bottom and deposit them via piping to an upland site. Once on the upland site, the material will be separated, dried, and then shipped off to its final destina-tion (either to a landfill facility or recycled for various uses). Though this project may be costly and time con-suming, it should be highly effective in helping to reduce the lakes eutrophication problems. The project will remove approximately 900,000 cubic yards of muck which results in the removal of 416 tons of nitrogen and 77 tons of phosphorus. The design of the project began in 2010 and proposals are currently being solicited for implementation of the project. Once started, the actual dredging of the lake will take upwards of five years to complete and then it may take a few years after that to see a system-wide benefit.

The last project to be completed in this current round of restoration efforts will focus on developing an operational schedule for the outfall control structure at the south end of the lake. This will be accom-plished by diverting Alum treated water from the bypass canal at the north end of the lake into the lake dur-ing the rainy season. Water level manipulation is a long held lake management technique, used not only for water quality management via flushing and dilution, but also for the control of nuisance aquatic vegetation. This component will be implemented once all of the dredge operations and Alum systems are completed.

Where has all of this work gotten us?

Based on water quality sampling conducted by Pinellas County since the 1970s scientists have the ability to study trends in the lake. Since 2003, the lake has shown a slight, yet statistically significant, de-creasing trend in phosphorus, nitrogen and chlorophyll-a concentrations. This is good news showing that all of our efforts are working and gives us a basis to continue our work. The hope is that public outreach and education efforts on how to reduce citizen impacts on the lake will make a positive difference combined with better treatment of stormwater prior to it entering the lake and restoration of habitats will continue to in-crease the Lake's health. In the future, the goal is to complete all of our restoration projects and design more if needed, while continuing to monitor the lake and enhance community involvement to ensure that Lake Seminole is a healthy and productive system for all to enjoy!

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