A Plan to Restore the Lower Suwannee River Springs
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Background

Over 300 artesian springs discharge groundwater from the Upper Floridan Aquifer into the Suwannee, Santa Fe, and Withlacoochee rivers. Under pre-development conditions, these springs provided over half of the average daily flows to these rivers. Combined with surface inflows from uplands and wetlands, spring and river flows are truly the lifeblood of North Florida.

Exploitation of North Florida’s abundant groundwater resources is taking a toll on Florida’s natural aquatic ecosystems. Groundwater, once plentiful and clean, is becoming progressively more depleted and polluted. Excessive reliance on groundwater for agricultural irrigation, and the associated use of nitrogen-containing fertilizers and land-applied animal waste, are resulting in lower spring flows contaminated with nitrate nitrogen. This groundwater depletion and pollution, in turn, causes a declining baseflow of nitrogen-polluted water to the Suwannee River and the adjacent Gulf of Mexico. Depleted river flows to the estuary result in rising salinities that severely affect tidal, freshwater wetlands; and the thousands of tons of nitrogen from the river contribute to deadly red tide events in the near-shore waters of the Gulf.

The Howard T. Odum Florida Springs Institute has prepared a comprehensive restoration plan for the springs that feed the Lower Suwannee River. The full plan is available on the Institute’s website at www.floridaspringsinstitute.org.

This document provides an executive-level summary of the full Lower Suwannee River Springs Restoration Plan.
Florida’s Artesian Springs are Endangered

Springs and spring runs are a unique class of freshwater ecosystems. They differ from most fresh water aquatic communities in several significant ways. Springs maintain relatively minor variation in flows (hydrostatic) compared to the majority of streams and rivers. They exhibit high water clarity (transparent) unlike most streams and rivers, with optimal light availability for primary productivity; and springs have consistent chemistry (chemostatic) and water temperature (thermostatic) due to their dependence on groundwater inflows.

This unique combination of physical and chemical properties serves to optimize ecological efficiency and wildlife habitat in Florida’s springs and spring runs. Highly stable environmental conditions in springs promote the evolution of complex, adapted plant and animal communities. The efficient use of available light by spring ecosystems translates into high productivity of fish and other wildlife. In addition, the resulting export of internally produced organic matter in spring runs augments downstream aquatic ecosystems and attracts the upstream migration of important fauna such as Gulf sturgeon, striped mullet, and West Indian manatees.

For these and other important reasons, springs and spring-fed rivers like the Lower Suwannee are among the most productive freshwater aquatic ecosystems on earth.

Springs Restoration

Although springs along the Lower Suwannee River are currently impaired, reducing groundwater pumping and fertilizer use in the surrounding springshed can restore their health. Since intensive agriculture dominates the human land uses in the area that drains to the Lower Suwannee River springs, successful restoration must focus on converting the land to less impactful farming methods. Based on water and nitrogen mass balances prepared by the Florida Springs Institute, regional groundwater pumping and nitrogen loading must be reduced by more than 50 and 70%, respectively. Implementation of “advanced” best management practices for agriculture, advanced nitrogen treatment for human and confined animal wastewater disposal systems, and an overall increase in the efficiency of groundwater and nitrogen utilization can achieve these proposed reductions.

The Lower Suwannee River Springs Restoration Plan and this Executive Summary summarize the facts about the health of the spring and river ecosystems that comprise the Lower Suwannee River. Based on a review of current conditions through 2014, this plan recommends general and specific actions to restore the water resource functions damaged by human activities. Existing laws are already in place to protect these resources in perpetuity. The Lower Suwannee River springs need leaders with the fortitude to take the necessary steps to achieve a sustainable springs future.

Little Fanning Springs (photo by John Moran, Spring Eternal Project)
Regional Perspective

“Way Down Upon the Suwannee River”

The Suwannee River is the second largest river in Florida, with a historic mean flow of about 6.3 billion gallons per day. A very large watershed of about 9,930 square miles (mi²), including the Okefenokee Swamp in Southeast Georgia, feeds water to the Suwannee River (Figure 1). The principal tributaries to the Suwannee River, starting upstream, are the Alapaha River, Withlacoochee River, and Santa Fe River. The Suwannee River ultimately discharges to the Gulf of Mexico near the town of Suwannee, Florida.

Rainfall and resulting runoff of surface waters nourish the streams that flow into the Upper Suwannee and Santa Fe rivers. Tea-colored tannins that originate in forested and marshy floodplain wetlands stain these streamflows.

Spring flows strongly influence the middle and lower portions of the Suwannee River, with some tributaries such as the Withlacoochee and Ichetucknee rivers dominated by springflow. However, like many of its feeder streams, the main stem of the Suwannee River retains the characteristics of blackwater inputs from its upstream reaches, especially during periods of high rainfall. Groundwater inflows that sustain the springs of the Suwannee, Santa Fe, and Withlacoochee rivers account for most of the baseflow in the Suwannee River during periods of low rainfall.
Lower Suwannee River Springs Restoration Area

The focus of this restoration plan is the 67-mile Lower Suwannee River segment and all tributary springs from its confluence with the Santa Fe River downstream to the Gulf of Mexico. The closest gauging station on the Suwannee River is at Branford, about nine miles upstream of its confluence with the Santa Fe River. The dominant hydrologic and water quality influence on the Lower Suwannee River is the inflow of water from the Upper and Middle Suwannee River, and the Santa Fe River drainages. At least twenty-three named springs also contribute groundwater to the Lower Suwannee River.

The Lower Suwannee River Springs Restoration Area is entirely within the boundaries of the Suwannee River Water Management District. Counties that border the Lower Suwannee River include Lafayette, Gilchrist, Dixie, and Levy. These counties have a combined area of 2,714 mi².

The Lower Suwannee River and the underlying Upper Floridan Aquifer System are the most important freshwater resources in this region of Florida. The river and its feeder springs are essential habitat for a diversity of aquatic plants and animals, including rare and endangered species. Water flow in the Lower Suwannee River maintains the proper balance of freshwater and saltwater to the estuary where the river empties into the Gulf of Mexico. The Lower Suwannee River provides numerous recreational opportunities and important aesthetic benefits to the region. Groundwater from the Upper Floridan Aquifer also supplies all of the water for drinking, irrigation, and commercial uses in the Lower Suwannee River Basin.

Water flow in the Lower Suwannee River and its springs largely depends on groundwater levels in the contiguous Upper Floridan Aquifer. When groundwater levels are elevated relative to river stage, groundwater flows out of the limestone aquifer through springs into the river, sustaining high river flows. As groundwater levels decline relative to river stages, groundwater inflow to the river declines and the flow in the river drops accordingly. When groundwater levels fall even further, below river stages, springs backflow, serving as a conduit for tea-colored river water to enter the aquifer. Several factors, most notably rainfall, groundwater pumping, and spring discharge, influence groundwater levels.

From the mouth of the Lower Suwannee River, to approximately 28 river miles upstream, tides affect river stages and flows. Mean tidal range in the Suwannee Estuary is 3.4 feet. The Suwannee River Estuary consists of the lower reach of the river, two major branches (East and West passes), Suwannee Sound, numerous tidal creeks, and the adjacent coastal waters from Horseshoe Beach to the Cedar Keys. Extensive tidal freshwater wetlands border the lower river and are included in the Lower Suwannee River National Wildlife Refuge.
Figure 1. Surface watershed and groundwater basins (springsheds) that feed the Suwannee River and springs.
Springs of the Lower Suwannee River

Along the Lower Suwannee River, between its confluence with the Santa Fe River and its mouth at the Gulf of Mexico, there are twenty-three springs and spring groups (Figure 2). These springs had a combined historic average flow of about 470 million gallons per day (MGD). A review of historic river flows indicates that another 800 MGD of additional groundwater previously entered this part of the Suwannee River through undocumented submarine springs and diffuse inflows.

Florida manages two springs-focused state parks bordering the Lower Suwannee River (Fanning Springs and Manatee Springs) to protect critical wildlife habitat from development. Four smaller spring groups along the Lower Suwannee River are located in county parks, while others are on land owned and managed by the Suwannee River WMD.

Springshed Characteristics

A large surface watershed basin of about 422,000 acres (659 mi²) contributes surface runoff to the Lower Suwannee River Springs Restoration Area. The groundwater basin or springshed for this portion of the Suwannee River is about 377,600 acres (590 mi²). The combined area of the overlapping springshed/watershed is 485,050 acres (758 mi²).

Springshed Land Use and Aquifer Vulnerability

In 2011, the dominant land uses within the Lower Suwannee River springshed were commercial forestry (44%), agriculture and rangeland (27%), water and wetlands (18%), and urban/commercial (10%) (Figure 3). Commercial forestry consists of highly managed and fertilized pine plantations and pine mulch harvesting sites.

According to the Florida Geological Survey, a large percentage of the springshed surrounding the Lower Suwannee River Springs Restoration Area is vulnerable to groundwater pollution due to human activities on the land surface.
Human Population

Compared to other areas in Florida, the Lower Suwannee River Springshed is sparsely populated. Based on 2014 data, approximately 82,000 people reside in the four counties that comprise the springshed, and most of those residents live in unincorporated areas. The largest incorporated town is Chiefland in Levy County with about 2,150 residents, while the smallest incorporated town is Otter Creek in Levy County with 129 persons. Prison inmates comprise an estimated 5% of the area’s population. Population density in the Lower Suwannee River Springshed in 2014 was about 34 people/mi$^2$, compared to the Florida average of 353 people/mi$^2$.

Groundwater Use

Groundwater is the sole source of water supply within the Lower Suwannee River Springshed. Figure 4 summarizes the locations and quantity of permitted water uses in the Suwannee and Santa Fe drainage basins. In 2010, almost 3,000 groundwater use permits in the region authorized the withdrawal of more than 280 MGD. In addition to these large water withdrawals, tens of thousands of private (domestic self-supply) groundwater wells pump groundwater from the Floridan Aquifer. Total estimated groundwater withdrawals in the springshed increased by about 1,600% from 1965 to 2010.

Estimated Water and Nitrogen Budgets

A water and nutrient budget or mass balance is an inventory of all inflows, outflows, and storages affecting an aquatic system. Water and nitrogen budgets for the Lower Suwannee River Springs Restoration Area were estimated for two periods:

- 1970 to 1979, representing a period of lower intensity water supply development, and
- 2000 to 2009, representing more current water withdrawal conditions.

Figure 5 summarizes the water and nitrogen budget estimates for recent (post-2000) conditions in the Lower Suwannee River Springs Restoration Area. Since the 1970s, the Lower Suwannee River has lost 38% of its average surface and groundwater inflows. The springs and diffuse groundwater inputs feeding the Lower Suwannee River segment have declined by 63% since the 1970s. These declines are due to a dramatic increase in regional groundwater pumping and a long-term decline in rainfall totals. At the same time that these flow reductions have occurred, nitrate-nitrogen concentrations in the river have increased by 1,500% above historic baseline conditions. Average downstream nitrate-nitrogen loads discharging from the Lower Suwannee River into the adjacent Gulf of Mexico have increased from an historic value of 600 tons per year to 5,500 tons per year (820% increase) during the past three decades.
Figure 4. Principal springsheds (red lines) and consumptive use permits in the Florida portion of the entire Suwannee River springshed. The size of each dot is proportional to the permitted groundwater withdrawal rate. Blue dots are in the Suwannee River Water Management District and green dots are in the St. Johns River Water Management District.
Natural resource economists evaluated the direct and indirect economic benefits and ecosystem services provided by 15 public and private recreational springs that feed the Santa Fe, Ichetucknee, and Lower Suwannee rivers. Ten of the springs are on public land with six of those in state parks (Fanning, Ichetucknee, Lafayette Blue, Manatee, Troy, and Wes Skiles Peacock), and four in county parks (Hart, Little River, Poe, and Rum Island). The study also included five privately owned spring sites: Blue Grotto, Gilchrist Blue Springs, Devil’s Den, Ginnie Springs, and Hornsby Springs.

Total recreational use at all fifteen springs, including related activities, averaged over one million visitor-days annually. Average annual attendance exceeded 100,000 visitor-days each at Manatee Springs State Park, Fanning Springs State Park, Ichetucknee Springs State Park, and Ginnie Springs Outdoors. The number of scuba diving visitor-days was 57,000 annually, with over 10,000 visitor-days each at Peacock Springs, Ginnie Springs, and Blue Grotto. Average annual visitor spending in the study area attributed to springs recreation was $84 million, including $45 million by non-local visitors. The estimated total annual economic contributions of recreational spending included the creation of 1,160 full and part-time jobs. Springs filled with too much tannic water and filamentous algae are not popular tourist attractions.

These estimates of Florida spring economic contributions only include the value of recreational activities. In addition to recreation, spring sites and related hydrologic systems provide a variety of other monetary and non-monetary ecosystem services, including provisioning services (e.g., spring water bottling), support services (e.g., hydrologic and nutrient cycling), regulating services (e.g., flood control), and cultural services (e.g., inspiration, art, cultural heritage, scientific knowledge, environmental education, existence value for endangered species, etc.).
Regulatory Protections

Like most of Florida’s surface waters, the springs along the Lower Suwannee River are protected through existing federal, state, and local ordinances that are intended to limit or prevent ecological impairment. The intention of these laws is to protect the springshed and the health of the springs that nourish the Suwannee River and the nearshore estuarine waters of the Gulf of Mexico. However, piecemeal and lax enforcement of existing regulations has not curtailed the continuing decline in the health of these springs or the Floridan Aquifer they depend on for nourishment.

Designated Uses and Water Quality Standards

The legally designated use classification for the Suwannee River is recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Tidal creeks and coastal waters in the adjacent Gulf of Mexico are designated for shellfish propagation and harvesting. The entire Suwannee River is an Outstanding Florida Water, a classification for waterbodies worthy of protection because of their natural attributes.

Groundwater Quality

Existing laws at both the federal and state levels protect groundwater quantity and quality. The U.S. Environmental Protection Agency is responsible for groundwater protection through the Safe Drinking Water Act, which requires maximum contaminant level standards for drinking water. The Florida Department of Environmental Protection (FDEP) administers Florida’s Aquifer Protection and Groundwater Management programs that are responsible for evaluating and addressing groundwater resources that adversely affect surface water quality.

Background nitrate-nitrogen concentrations in Florida’s groundwater prior to modern development were less than 0.05 milligrams per liter (mg/L). FDEP has established a numeric limit for nitrate nitrogen in springs of 0.35 mg/L to protect sensitive plants and animals. Groundwater nitrate concentrations are currently well above this springs standard due to human activities at the land surface. Elevated nitrate in drinking water is also a human health risk.

Impaired Waters, TMDLs and BMAPs

Florida law requires FDEP to conduct water quality assessments and to clean up nutrient-impaired water bodies. FDEP has adopted a Total Maximum Daily Load (TMDL) for excessive nitrogen in the Lower Suwannee River and springs. However, FDEP has not taken the mandatory next step of developing a Basin Management Action Plan (BMAP) to achieve the nutrient TMDL.
Water Withdrawals

The Suwannee River Water Management District regulates all water uses within its boundaries. A water use permit is required prior to the withdrawal or diversion of water quantities generally greater than 100,000 gallons per day. An applicant must meet three conditions in order to receive a water use permit: (1) the use must be reasonable and beneficial, (2) the use must not cause harm to other users, and (3) the use must be consistent with the public interest. Florida statutes require the Suwannee River Water Management District to assess water supplies every five years to determine if natural systems will be able to maintain a healthy condition and meet human demands for water.

Minimum Flows and Levels

Minimum Flows and Levels are defined as the minimum flow for a watercourse, or the minimum water level for groundwater in an aquifer, or the minimum water level for a surface water body, that is the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area. In 2008, the Suwannee River Water Management District adopted minimum flows and levels for the Lower Suwannee River and springs.

A review of recent data (2001 to 2013) determined that the mandatory minimum flows and levels for the Lower Suwannee River and springs are not being met. For example, the minimum flow standard for Fanning and Manatee Springs requires maintenance of at least 90% of their historic flows. Spring discharge data indicate that minimum flows at both Fanning and Manatee springs have only been achieved 73 and 62% of the time, respectively. In addition, Fanning Springs has a minimum level set to protect manatee passage into the spring during critical cold weather periods. This manatee passage goal is required to be met 85% of the time. Data review indicates this level has only been achieved 42% of the time between 2001 and 2013. Finally, the standard for the Lower Suwannee River is a flow greater than 7,600 cfs at least 50% of the time. Since 2001, this minimum flow standard has only been met 23% of the time. The fact is that flows in the Lower Suwannee River and springs have declined below the regulatory standards intended to protect them from significant harm.
Restoration Goals

A comparison of existing and historic conditions indicates that the principal environmental changes that have occurred in the Lower Suwannee River Springs Restoration Area over the past century are:

- Decreased spring and river flows, including more frequent occurrence of tannin-stained and green-tinted water, along with reduced water clarity and transparency;

- Elevated nitrate-nitrogen concentrations at the spring boils and in the spring runs;

- Replacement of native submerged aquatic plants by invasive and noxious filamentous algae; and

- Reduction in populations of adapted species, including invertebrates and vertebrates.

In quantitative terms, a few general recommendations can achieve a restored Lower Suwannee River and springs:

- Reduce regional groundwater extractions to restore average spring flows to 95% of their historic levels, and

- Reduce nitrogen loadings to the springshed from fertilizer and human/animal wastewater disposal to achieve the springs nitrate numerical standard of 0.35 mg/L.
Water Quantity Restoration

The preliminary water quantity goal for the Lower Suwannee River and springs is to restore at least half of the estimated clear groundwater that has been lost. This goal will require a regional reduction in average groundwater use of more than 100 MGD. The following proactive measures will reduce groundwater pumping without devastating effects on agricultural and urban development:

- Increased water use efficiency;
- Increased water conservation; and
- Increased reliance on surface water supplies.

It is reasonable to assume that all existing groundwater users will need to reduce their pumping by an equal percentage. Public and domestic self-supplies could achieve this water use reduction goal by eliminating the use of groundwater for landscape and lawn irrigation. Also, commercial/industrial and recreational water users need to reduce their reliance on groundwater supplies.

Agricultural production in North Florida has relatively recently developed a dependency on crop irrigation using groundwater. The most practical first step to restore spring flows is for the Suwannee River Water Management District to stop issuing any new groundwater use permits for crop irrigation. The next step is to revise existing agricultural permits to restrict water uses to the most necessary and efficient cropping methods and to meter and charge a nominal fee for all groundwater uses. Conversion of a large percentage of crops grown on over-drained, highly vulnerable lands to non-irrigated crops, such as long-leaf pine plantations, will be necessary to attain the ultimate restoration goal.

Water Quality Restoration

Human activities load about 2,700 tons per year of nitrogen to the Lower Suwannee River Springshed. Crops and soils assimilate much of this nitrogen. Nevertheless, fertilizer use still contributes about 770 tons of nitrogen per year to the springs along the Lower Suwannee River.

Other important nitrogen sources to the area’s springs include concentrated animal-feeding operations, with an estimated 139 tons per year, and septic tank effluents, with an estimated annual load of about 34 tons. Achieving compliance with FDEP’s springs nitrate standard will require an estimated 73% reduction in all nitrogen loads to the springshed.

Eliminating agricultural and residential fertilizer uses would provide the greatest reduction of nitrogen inputs to the Lower Suwannee River and springs. Achieving the nitrate reduction goal will also require significant reduction in livestock populations. Humans can reduce their wastewater nutrient contributions by implementing existing advanced nitrogen removal technologies at central wastewater plants and by providing centralized collection and wastewater treatment for all high-density septic tank areas.
Holistic Ecological Restoration

The effects of declining spring and river flows, increasing concentrations of nitrate nitrogen, and invasions by nuisance plants are long-term changes to the natural flora and fauna of the region. Ecological restoration will require a holistic approach to address all sources of impairment simultaneously, rather than a piecemeal approach of divided responsibilities by state and local agencies.

Lower Suwannee River Springs Restoration Challenges and Solutions

The Challenges

- Stakeholders are not aware of the problems or what will be needed to accomplish restoration of Lower Suwannee River and its springs.
- Groundwater in North Florida has always been free and used like an unlimited resource.
- Fertilization and wastewater disposal practices need to be improved to reduce the load of nitrogen leaching into the aquifer.
- Agriculture in North Florida has been treated like a sacred cow with minimal responsibility for its harmful actions.

The Solutions

- The public and local, state, and federal leaders need to be educated about the importance of restoring the Lower Suwannee River Springs Restoration Area and protecting its natural biodiversity.
- A phased plan for cutting back on consumptive uses of groundwater within and outside of the springshed should be developed and enforced.
- Consequential improvements in fertilization and wastewater disposal practices in the Lower Suwannee River Springs Restoration Area should be funded and implemented.
- Environmental monitoring of the Lower Suwannee River Springs Restoration Area should be conducted to document the success of restoration efforts and to provide feedback to guide adaptive management.

In Closing

Eventual restoration and long-term protection of the Lower Suwannee River Springs Restoration Area will require a shift from focusing on short-term needs of individuals and businesses, to taking a longer view for conservation and protection of clean and abundant groundwater for the public and for Florida’s natural environment as a whole.

Groundwater is one of the most important natural resources in Florida. Currently, the groundwater that feeds the Lower Suwannee River Springs Restoration Area is neither clean nor abundant. The deteriorating water quality and declining flows of the Lower Suwannee River and springs provide ample evidence that North Florida’s groundwater resources are also on a declining trajectory. Fortunately, as long as it rains, groundwater is a renewable resource. Hope for the future health of the Lower Suwannee River Springs Restoration Area and for Florida’s springs in general is in the hands of all people who appreciate the unique value of these public resources and who are willing to invest time and energy to ensure their protection.
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The Florida Springs Institute mission is to document the health of Florida’s springs and to educate the public about their wise conservation and management. The Florida Springs Institute accepts full responsibility for any errors or omissions in this executive summary.

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