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Suwannee River Basin and Estuary Initiative: Executive Summary

Management of the nation's freshwater resources must address water supply and water quality for urban growth, food production, and industry. It is also widely recognized that the timing, duration, and distribution of water flow is essential to natural ecosystem function, as has been powerfully illustrated in the Florida Everglades. Attention has been drawn to the basin of the Suwannee River, following proposals to divert water to fulfill demands in the populous counties of Pinellas and Hillsborough. In 1994, a mandate was issued to the Suwannee River Water Management District (SRWMD) to set minimum flow requirements for the river.

> *Minimum flow is defined as "…the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area." (Florida Water Resources Act; Chapter 373.042, F.S.)*

In response to the growing number of environmental threats in the Suwannee River Basin (SRB), the States of Florida and Georgia, the federal government, and other local organizations have identified the Suwannee River as an ecosystem in need of protection because of its unique biota and important water resources. Organizations with vested interests in the region formed a coalition, the Suwannee Basin Interagency Alliance (SBIA), to promote interagency management of water and related natural resources throughout the basin.

The goals of the SBIA include improved coordination in the identification, management, and scientific knowledge of the natural resources in the basin. To date, however, an integrated assessment of the physical, biological, and water resources has not been completed. The U.S. Geological Survey (USGS) is well situated to address the larger concerns of the basin by addressing specific research questions linking water supply and quality to ecosystem function and health across county and state boundaries.

The USGS is tasked with providing reliable scientific information to describe and understand the Earth, to

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manage natural resources, and to enhance the quality of life. It is to this end that the combined forces of the USGS Florida Integrated Science Center (FISC) have embarked on the Suwannee River Basin and Estuary Initiative to provide timely and appropriate scientific information prior to serious impairment of the SRB and its various components.

SUWANNEE RIVER BASIN

The Suwannee River drainage basin of southeastern Georgia and north central Florida is one of the largest (28,600 km^2) and most ecologically unique blackwater river systems of the Southeast. Originating in the Okeefenokee Swamp, the Suwannee River meanders over 400 km through southern Georgia and the Florida peninsula before emptying into the eastern Gulf of Mexico just north of Cedar Key. It is the only major drainage basin entirely within the Coastal Plain and its expansive estuary provides among the most significant near-shore habitats in the northeastern Gulf of Mexico. In drainage area and total discharge it is the second largest river in Florida, and is designated an "Outstanding Florida Water" by the Florida Department of Environmental Protection. The Suwannee River is unimpounded, undiverted, and relatively unpolluted, and has been referred to as one of the most pristine and undeveloped river systems in the United States. The entire watershed harbors a rich assemblage of exceptional biological, geological, and hydrological resources. The Suwannee River provides an unparalleled opportunity for studying its natural resources and for demonstrating how to proactively manage them successfully. The knowledge gained can serve as a model for other, more disturbed, river systems.

Photo courtesy of P. Carmichael

HYDROLOGY AND GEOLOGY

The hydrogeology in the SRB is highly varied in terms of underlying geology, complicated karst-dominated flow regime, water quality, and endemic aquatic habitats. The SRB includes the Okeefenokee Swamp, many small streams, large rivers, a multitude of springs, extensive tidal salt marshes, and a productive estuary. The character of the Suwannee River changes dramatically as it progresses downstream, reflecting the hydrogeology, physiography, and land cover of the region it drains. Surface drainage characteristics dominate the upper two-thirds of the SRB, where soils contain clays and fine sediments that are resistant to surface water infiltration to the subsurface. Streams, lakes, and wetlands are abundant in the upper SRB and its tributary basins.

In the southern third of the SRB, a relatively thin layer of highly porous sands overlies the Floridan aquifer system, and the water of the Suwannee River exhibits strong ground-water characteristics. Here, the Floridan aquifer system is the principal source of water supply, and the relative absence of surface-water features such as streams, lakes, and wetlands is indicative of direct recharge of rainfall to the aquifer. The physiographic transition between the highlands and lowlands includes stream-to-sink sub-basins, where stream flow is abruptly captured by sinkholes and routed to the aquifer. The Suwannee River is the only stream in the SRB flowing across the transition that is not fully captured by sinkholes. The transition area

and the numerous springs along the lower river are points of interaction between surface water and ground water.

Streamflow in the SRB has been continuously monitored for nearly 100 years at one of the first gages that was established at White Springs, Florida, in 1906. The USGS and the Suwannee River Water Management District monitor river levels at more than 60 additional gages through Federal-State cooperative programs. Flow in the SRB varies annually with rainfall, but typically is highest in March-April due to runoff from spring storms, and lowest in November-December due to drier fall weather. The largest widespread floods in the SRB occurred during the month of April (1948, 1973, and 1998). Tropical storms also can cause flooding in the summer and fall, as occurred in September 1964 from Hurricane Dora. Record droughts in the SRB occurred in 1954-56 and 1999-2001, when record low flows were recorded throughout the basin.

Why special concern about Suwannee River Basin?

- *Water supply and quality*
- *Recreational and commercial fishing*
- *Ecotourism*
- *Silviculture and agriculture*
- *Critical aquatic and terrestrial habitat*

WATER QUALITY

The natural resources of the Suwannee River ecosystem are vulnerable to a growing number of water quality issues. Research on threats to water quality is critically needed by local, state, and federal agencies responsible for protection of basin resources. Increased use of pesticides and fertilizers, run-off from dairy and poultry farms, and contaminants from pulp mills and phosphate mines are of growing concern due to effects on air and water quality and fragile aquatic species.

Water-quality conditions in the Suwannee River and its tributaries reflect the physical setting of the SRB. The highland areas, which are dominated by surface drainage, typically have more acidic water, higher levels of sediment and particulate matter, and higher variability in flow. Downstream of White Springs, Florida, the Suwannee River receives ground-water inflow from over 200 known springs. The relatively constant influx of clear mineral-rich

Photo courtesy of US Geological Survey

water from the Floridan aquifer buffers the acidity and darker color of the predominantly surface water from the upper two-thirds of the basin.

Select sites along the Suwannee River and tributaries are currently monitored for water quality and limited benthic sampling by the USGS and National Water Quality Assessment Program (NAWQA), the SRWMD (State of Florida), and the Florida Fish and Wildlife Conservation Commission (FFWCC).

Although research studies in the basin indicate generally good overall water quality, human health and ecological concerns have arisen recently because of the large nitrogen inputs to the land surface from fertilizers, animal wastes, and atmospheric deposition. This problem occurs primarily in the middle and lower Suwannee and lower Santa Fe Rivers in Florida, where spring-water and diffuse upward leakage of ground water contribute substantial loads of nitrate-N. Nitrate concentrations in ground water and spring waters have increased substantially from near background concentrations of less than 0.1 mg/L in the 1960s and 1970s to more than 5 mg/L in the late 1990s. In some areas of the basin, nitrate-N concentrations in ground water from the Upper Floridan aquifer exceed the Federal and State maximum contaminant level of 10 mg/L for drinking water.

Elevated nitrate concentrations in rivers can cause eutrophication, resulting in algal blooms and depletion of oxygen that can lead to fish kills. An increase in periphyton biomass along the middle and lower reaches of the Suwannee River may be another indication of increased nitrate concentrations. Also of concern are the effects of high nitrate concentrations downstream in the Suwannee River estuary.

Other contaminants, such as pharmaceuticals and antibiotics, originate from concentrated animal feeding operations and waste disposal systems. Animal wastes can be a source of bacteria and infectious waterborne pathogens. The introduction of chemical compounds and their metabolites, associated with pesticides, fertilizers, and industrial activities, can also pose ecological and human health risks. In addition, atmospheric deposition is a significant source of nitrogen and potentially toxic contaminants, including mercury and organic chemicals. Water-quality conditions dictate the health of aquatic ecosystems, and in turn, affect human health.

Photo courtesy of US Geological Survey

WATER SUPPLY

Competing demands on the natural resources of the Suwannee River ecosystem require a better understanding of the effects of contamination, water withdrawals, and climate change, and the interactions of these stressors. Climate variation alone can result in significant changes in rainfall, with subsequent impacts on surface and groundwater supply. Natural fluctuation in water supply, coupled with water consumption can place added stress on biological communities. Intermittent droughts in Florida over the last two decades have heightened concerns about management of water resources within the watershed.

Adequate ground water is especially important in the Lower Suwannee spring system. Demands for ground water from urban development and extensive agricultural activities in the basin have resulted in increased withdrawals from the Upper Floridan aquifer. As an example of water-supply related problems, some springs in the SRB have essentially stopped flowing during certain times of the year.

Consumptive use of water resources is increasing in the Suwannee River basin due to farm irrigation requirements and to increasing demands of a rapidly growing human population. Although the Suwannee is undiverted, water is already being mined for bottling at several spring sources, with more than a million gallons/day being withdrawn. Changes in flow regime can have impacts on stream ecosystems by changing in-stream flow characteristics and water temperature. Higher water temperatures reduce oxygen solubility and thus tend to reduce dissolved oxygen concentrations. Further, increased water temperatures increase the rate of metabolic activity in natural waters, which in turn can increase oxygen consumption by aquatic organisms.

Proposals for diverting water from the Suwannee River to help satisfy the domestic water needs of the greater Tampa metropolitan area have been considered over the last decade. However, the effects of such withdrawals on riverine or estuarine habitats and fauna are inadequately known and cannot be predicted without further study of the ecosystem.

ECOSYSTEM FUNCTION

A suite of well-integrated multi-disciplinary studies on the physical, chemical, and biological processes in the basin is needed to understand complex interactions of the system's components. The Suwannee basin contains a unique mixture of subtropical forests, wetlands and swamps, springs, tidal and blackwater rivers, and a productive estuary. A comprehensive research plan to identify how these habitats are linked to each other, to water quality, to surface and ground water supply, to underlying geology, and to human activities will aid management and conservation of basin resources.

The Suwannee River is one of only a few rivers within the U.S. that has suffered negligible damage from human activities such as damming, channeling, redirection, and the introduction of large quantities of contaminants. The variety of habitats in the basin supports important biological communities and several federally or state protected species including the threatened Gulf Sturgeon, the endangered West Indian Manatee, and rare freshwater mussel species. Tree species richness in wetland forests of the lower Suwannee River floodplain is among the highest of North American river floodplains. The Suwannee River spring system also contains the greatest diversity of obligate, subterranean decapod crustaceans in the world. Yet, little is known about this fauna regarding their distribution, abundance, ecological requirements, and

Photo courtesy of US Geological Survey

sensitivity to changes in water quality and other abiotic stressors.

The Suwannee River Estuary System (SRES) is a productive and relatively unaltered natural estuary where the Suwannee meets the Gulf of Mexico. The SRES harbors shallow habitat, sea grass, and low-salinity conditions along the coast from Horseshoe Beach to Cedar Key. The estuary has been designated an Outstanding Florida Water, and is also a State Aquatic Preserve and a National Wildlife Refuge. SRES contains large areas of oyster reefs, sand bars, tidal creeks, salt marsh, and submerged aquatic vegetation. These estuarine habitats support ecologically important and valued fish species, many during breeding, nursery, and juvenile phases. At present a USGS multi-disciplinary study is underway to better understand fish habitat suitability and utilization, and the influence of tidal marine and freshwater flow on habitats in the estuary. Data are being evaluated on hydrologic processes, multispectral habitat mapping, and fish utilization of the SRES.

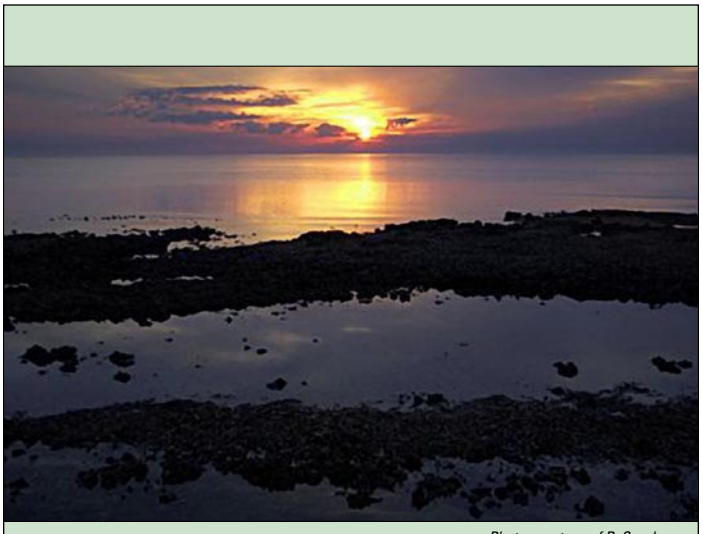

Photo courtesy of R. Sparkman

SOCIO-ECONOMIC FORCES

Effective management of water resources in the SRB would benefit from increased knowledge about the interactions between climate variability, hydrologic processes, ecological function, and human activities. Population growth and development within the SRB has been steady since the 1960s. Basin population increased from 384,000 in 1990 to about 430,000 in 2000. Growth projections in and around the SRB indicate a similar increase in population over the coming decade. Agriculture accounts for most of the developed land uses within the SRB in both Georgia and Florida, including silviculture, row crops, and pasture. Irrigated acreage has increased considerably in the SRB over the last several decades as technologies have improved and market conditions have changed. Water sources are primarily from basin-wide precipitation and runoff, small surface-water reservoirs in Georgia, and as ground water from the Floridan aquifer in Florida. Trends over the last decade indicate a general shift towards more intensive production of food, forage crops and livestock. Agricultural crops and products from the SRB include dairy, poultry, fruits and vegetables, grains, pasture, and forestry products. Silviculture, primarily pine plantations, covers large areas of the SRB and provides timber and fiber for mills.

Issues related to water supply are a major concern in the basin. The SRB contains an abundance of water that is sought by more developed parts of the state. The SRB also supports fisheries, both commercial and recreational, a productive shellfish industry at Cedar Key, hunting, boating, diving and other recreational activities. Ichetucknee Springs State Park alone accounts for a quarter of a million visitors who spend $17 million annually in that community. Ecotourism is a thriving business in Florida, attracting national and international visitors to springs and other scenic locations in the SRB.

ACTION PLAN

A holistic, multi-disciplinary approach is needed to address the SRB's research needs and to provide supportive data for meeting management objectives of the entire ecosystem. The USGS has completed statistical summaries on stream flow history and groundwater levels, water quality monitoring, spring monitoring, biological assessments, reduced flow impact on lowland forests, habitat mapping, and estuarine links between habitat,

Photo courtesy of US Geological Survey

Why should the USGS be involved?

- *USGS possesses unique technical and scientific capability*
- *USGS scientists have expertise in hydrology, geology, biology, and geography*
- *USGS specializes in integrated science and unbiased products*
- *A comprehensive, integrated approach is required in the Suwannee Basin*
- *USGS can partner with federal and state agencies to provide the holistic effort that is needed*

biological communities and water supply. Long-term biological assessments by the USGS have been limited to individual species. While important, protection of individual species cannot guarantee broad conservation of the Suwannee River's biological resources.

The white paper to follow will include a list of proposed action plans and research priorities that USGS scientists are considering for the future. The success of any or all of these plans depends on continued broadly based interest and fiscal support.

The USGS is interested in developing a strategic plan in cooperation with federal, state and local agencies to identify and implement studies addressing the most compelling research issues and management questions, and to conduct fundamental monitoring studies. The USGS plans to convene a meeting with concerned agencies to discuss cooperative science efforts in the basin.

Potential Cooperators and Partners

Florida Dept. of Agriculture and Consumer Services
Florida Department of Environmental Protection
Florida Department of Health
Florida Fish and Wildlife Conservation Commission
Florida Geological Survey
Georgia Department of Natural Resources
Mote Marine Laboratory
Suwannee River Water Management District
U.S. Department of Agriculture
U.S. Fish and Wildlife Service
U.S. Forest Service
University of Florida
University of Georgia
University of South Florida

Environmental consortia:

Ichetucknee Springs Water Quality Working Group
National Wildlife Federation
The Nature Conservancy
Santa Fe Springs Water Quality Working Group
Save our Suwannee

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