USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

1.**Project Number:** NEW proposal
2.**Title:** Sustainability of Surficial Aquifer Resources on Endmember (Urbanized and Pristine) Barrier Islands near Brunswick, Georgia
3.**Focus categories:** sustainability, monitoring
4.**Keywords:** barrier islands, surficial aquifer, geophysical methods
5.**Duration:** 2 years
6.**Fiscal year 1998 Federal funds:** $20,038
7.**Non-federal 1998 funds allocated:** $40,250
8.**Principal Investigator:**

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9.**Location of institution** 5th Congressional District
10.**Location of project:** 1st Congressional District

11.**Water Resources Problem:** Sustainability and Monitoring of Water Resources in Coastal Regions

The availability and quality of freshwater resources are key factors controlling the sustainability of natural systems (e.g., maritime forests, marshes, and migratory bird habitat) and human developments on barrier islands and the continued viability of ecosystems in adjacent wetlands and estuaries. One of the most important problems facing regional planners in coastal Georgia and, indeed, in most coastal areas of the world, is the impact of urbanization (increased population and industrialization), ecosystem destruction, and predicted sea level rise on the hydrologic systems of barrier islands [*Pernetta and Milliman*, 1995]. In North America, the Southeastern U.S. is unique in having a relatively high concentration of undeveloped barrier islands on both the Atlantic and Gulf Coasts. Economic pressure to increase tourism through urbanization of as-yet undeveloped islands and through continued urbanization of already heavily developed islands will continue to threaten the quality and quantity of freshwater in the surficial aquifer for decades to come.

This proposal describes a project to couple noninvasive environmental geophysical methods and standard piezometric studies to establish a baseline for monitoring future changes in the physical and chemical characteristics of surficial aquifers on two barrier islands that represent endmembers in the spectrum from pristine to highly urbanized:

(1) Sapelo Island, a relatively pristine island where surficial aquifer dynamics are largely controlled by natural recharge/discharge and tidal forcing, is almost wholly administered

by government entities, including NOAA (National Estuarine Research Reserve program) and the State of Georgia (Department of National Resources). The proposed work on Sapelo Island will provide a much-needed baseline for the nearly undisturbed hydrologic state of Pleistocene-Holocene composite barrier islands in the Georgia Bight. Fundamentally, it will never be possible to **quantify** the impact human habitation has already had on other Georgia barrier islands to the standards demanded by regulators and the public until such a baseline can be established.

(2) St. Simons Island, a heavily urbanized island where the hydrologic cycle is disturbed by septic systems, pumping, irrigation, and disruption of natural drainages and recharge/discharge zones, is the next major barrier island south of Sapelo Island and lies just to the south of the Altamaha River outlet. Research on St. Simons Island will quantify how the hydrologic state has already been altered (relative to the Sapelo baseline and local baselines established at relatively undeveloped sites on St. Simons) by human habitation and how continued development during the study period affects the local state of the surficial aquifer.

Note that the term "baseline" is used here in two senses: First, the Sapelo Island (pristine setting) data sets serve as a baseline for the pre-development hydrologic state of many of the Pleistocene-Holocene islands in the Georgia Bight, including St. Simons Island. Second, the 1998-1999 St. Simons data set will serve as a baseline for measuring the changes in the surficial aquifer during continued urbanization in the next few years and beyond.

The surficial aquifer is not potable on any of the Georgia barrier islands, and thus the research described here does not fit within the traditional focus on sustainability of water resources for human consumption. Nonetheless, the integrity of the surficial aquifer on barrier islands is critical for the viability of ecosystems both on and adjacent to the islands and for the sustainability of human developments. As one example of direct human impact, consider the fact that increased habitation of Georgia barrier islands results in increased pumping of the Floridan aquifer. The consequent increase in freshwater recharge to the surficial aquifer (through irrigation, septic systems, etc.) will cause thickening of the Dupuit-Ghyben-Herzberg freshwater lens (e.g., *Urish and Ozbilgin*, 1980), shoaling of the water table, and unintended flooding of topographic lows and the formation of artificial wetlands. A variety of other anthropogenic and naturally-induced effects at many time scales also threaten to shoal the water table and produce flooding of barrier islands. These include absolute sea level change due to global warming, relative sea level change due to continued isostatic readjustment to the last major deglaciation, and continued reduction in the freshwater input to tidal creeks, which increases their salinity and causes the freshwater lens at the island-creek interface to have even greater buoyancy (shallower level) relative to the tidal creek waters.

Sapelo and St. Simons Island

Sapelo and St. Simons Islands, shown in Figure 1, are composite Holocene-Pleistocene barrier islands located within a mixed energy environment in the Georgia Bight [*Hayes*, 1994]. The islands' Atlantic coastlines are linear, have typical dune ridge morphology, and experience average tidal runup of several meters. Tidal creeks and sounds originating near the mouth of the Altamaha River separate the landward side of the island from the mainland. These tidal creek systems influence the distribution of *Spartina* marshlands along sides of the island not directly exposed to the ocean and play a critical role in flushing nutrients and other chemical constituents through estuaries. Tidal creeks and salt flats also separate the Pleistocene island core (landward side) from the Holocene accretionary complex (oceanward) [*Hayes*, 1994] on both islands (Figure 2). These tidal creeks provide drainage for large portions of the islands' interiors and represent a potential source of saline water input to the surficial aquifer systems of both the Holocene and Pleistocene sediment complexes. Both islands obtain drinking water from the Floridan aquifer and lie within the overlapping zones of upconing (saltwater intrusion) associated with population centers at Savannah and Brunswick [*Krause and Randolph*, 1989].

Of the barrier islands on the Georgia coast, Sapelo Island is unique in being at once fairly pristine and fairly accessible. Despite past logging and the island's relatively small size (<65 km^2), Sapelo Island is the site of 16% of the remaining maritime forest in the Southeastern U.S. [H. Hill, pers. comm., 1998]. The year-round population of Sapelo is ~70, mostly concentrated on the southern one-third of the island. A state-subsidized passenger ferry provides the only regular access, and only a few miles of paved roads are maintained for the island's residents. The island's weak economy is based on fishing and logging, but, as reported over the past year by Atlanta's popular press, increased urbanization is strongly backed by native islanders, who view tourism as critical to solving the area's economy.

In sharp contrast to Sapelo Island, St. Simons Island is a heavily urbanized island easily accessible from the mainland via causeway. The population of St. Simons fluctuates wildly with the seasonal influx of tourists, and the island's proximity to Brunswick, Georgia and northern Florida has made it a desirable location for small businesses, vacation homes, and time-share condominium developments. The island's economy is integrally connected to tourism, and development of the island continues at a rapid pace.