

Great swamp natural effluent management system – a summary of thirteen years of operations



R.L. Knight^a, R.A. Clarke^{a,*}, C.H. Keller^a, S.L. Knight^a, C. Petry^b

^a Wetland Solutions, Inc., 2809 NW 161 Court, Gainesville, FL 32609, United States

^b Beaufort-Jasper Water and Sewer Authority, 6 Snake Rd, Okatie, SC 29909, United States

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ABSTRACT

Beaufort-Jasper Water & Sewer Authority has discharged reclaimed wastewater continuously for thirteen years to a 194 ha natural swamp forest in coastal South Carolina (USA). Wastewater inputs have increased from an average of 363 m³/d in 1999 to an average of 8823 m³/d in 2011. Natural inflows of rainfall and runoff to the swamp forest, averaging 9757 m³/d exceed anthropogenic inputs. Wastewater inputs have increased the swamp's inundation frequency in the lowest areas from 43 to 100%. Reclaimed water receives advanced secondary pretreatment with concentrations averaging 2.9 mg/L five-day biochemical oxygen demand (BOD₅), 2.8 mg/L total suspended solids (TSS), 0.5 mg/L ammonium nitrogen (NH₄-N), 6.7 mg/L total nitrogen (TN), and 2.2 mg/L total phosphorus (TP). A variable percentage of these pollutants are assimilated within the swamp. Concentrations of chlorides, specific conductance, and TP are the only downstream water quality evidence of discharge. The dominant gum (*Nyssa* spp.) and baldcypress (*Taxodium distichum*) trees are thriving; however, red maple (*Acer rubrum*) trees have reduced dominance primarily due to increased hydroperiod. Macroinvertebrate and fish populations in the swamp forest have increasing biomass in response to increased wetted area. The Great Swamp Effluent Management System is an example of adaptive ecological engineering, protecting downstream recreational and shellfish waters by creating a productive interface between reclaimed wastewaters and natural wetlands.

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1. Introduction

High seasonal rainfall, shallow groundwater, slow-flowing rivers, and sensitive coastal environments result in challenging issues for wastewater management in coastal South Carolina. These challenges are exacerbated as more and more people move into the area. Direct discharges of treated wastewaters to surface waters are severely limited by low flow conditions and the need to protect shellfish resources in the area's coastal rivers. While land application of treated effluent is the preferred alternative for effluent reuse and ultimate disposal, application rates to area "uplands" are often limited by marginal soil drainage and inadequate unsaturated soil depth, especially during rainy periods.

Limited wastewater disposal capacity has led the area to a wastewater management solution that integrates urban development and the area's abundant natural aquatic resources. Pioneered at the nearby Sea Pines Plantation Forest Preserve on Hilton Head Island beginning in 1983, wet weather backup wastewater disposal incorporates compatible natural freshwater wetlands into an overall effluent management system (Knight and Ferda, 1989). This solution to the area's increasing need for wastewater management helps to conserve natural wetland habitat in public ownership and restore previously impacted wetlands while providing an environmental reuse option for recycling treated wastewater. Furthermore, the area's coastal waterways remain attractive for recreation while wastewater is managed in a cost-effective manner.

2. Project description

2.1. Treatment system and operating permit

BJWSA owns and operates the 28390 cubic meters per day (m³/d) Cherry Point/Okatie Area Water Reclamation Facility (WRF) in southern Jasper County, South Carolina. This oxidation

* Corresponding author. Tel.: +1 3864629286; fax: +386 462 3196.

E-mail addresses: bknight@wetlandsolutionsinc.com (R.L. Knight), rclarke@wetlandsolutionsinc.com (R.A. Clarke), ckeller@wetlandsolutionsinc.com (C.H. Keller), sknight@wetlandsolutionsinc.com (S.L. Knight), chriscp@bjwsa.org (C. Petry).

ditch/activated sludge/filtration facility provides a high level of treatment for five-day biochemical oxygen demand (BOD₅), total suspended solids (TSS), and ammonium nitrogen (NH₄-N), with long-term average permitted effluent concentrations less than 5, 5, and 2 mg/L, respectively. Following UV disinfection, reclaimed water (highly treated municipal effluent) from the Cherry Point/Okatie WRF is stored in a holding pond before discharge to a number of land application sites including twelve golf courses and a variety of residential reuse sites, as well as to the Great Swamp Effluent Management System (EMS).

The Great Swamp EMS includes approximately 194 hectares (ha) of riverine floodplain wetlands that are part of the much larger Great Swamp (about 12,151 ha), the headwater source of the New River. The BJWSA's Great Swamp EMS is permitted under a National Pollution Discharge Elimination System (NPDES) surface water discharge permit, issued by the South Carolina Department of Health and Environmental Control (SCDHEC). This permit allows the use of the swamp forest for management of reclaimed water subject to strict requirements related to protection of ambient water quality as well as the ecological structure and function of the natural Great Swamp ecosystem.

2.2. Site description

The Great Swamp proper and associated floodplain swamp meanders through portions of Jasper and Beaufort counties in South Carolina before emptying as a tidal river into the Intracoastal Waterway behind Daufuskie and Hilton Head Islands (Fig. 1). The floodplain of the Great Swamp proper in Jasper County is more than 2 km wide and at the time of project initiation was almost completely undeveloped. Historically, most of the adjacent upland habitat was used for silviculture and leased by hunt clubs for recreational use. Over the past decade, residential and commercial land uses have rapidly expanded in the project area and replaced much of the areas formerly managed as forests.

The Great Swamp EMS includes swamp forest that is located in a tributary east of the Great Swamp proper. The EMS area has intermittent tributary inflows from the southeast and south. Surface water in the Great Swamp EMS typically flows west to mix with water in the Great Swamp proper (Fig. 2). However, under intermittent high flow conditions and resulting high water stages in the Great Swamp proper, flow direction may reverse and back up into the Great Swamp EMS. The entire EMS area is nearly level with less than one meter of topographic relief and consists of a mature

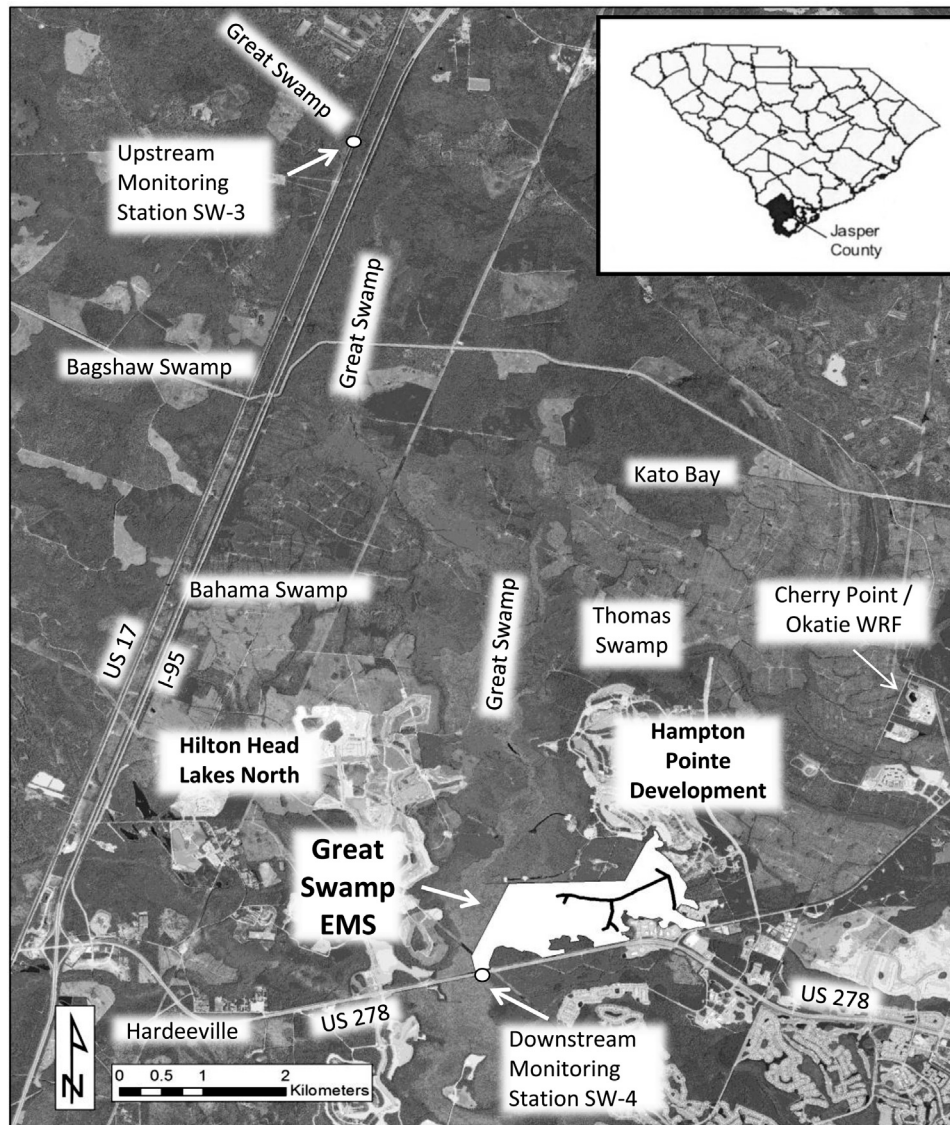


Fig. 1. Great Swamp EMS project location map.

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