Timberlake Farm
EEP RFP #16-D06067
5,000 Feet of Stream
Baseline Monitoring Report (as-built)
Great Dismal Swamp RestorationBank, LLC

Submitted to NCDENR-EEP
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Table of Contents

List of Tables

I. Executive Summary - Baseline Monitoring

A. Stream Flow

A research team from Duke University under the direction of Dr. Emily Bernhardt have been recording flows at 15 minute intervals since February 2007. They have installed four ISCO Doppler Velocimeters, model 2680 monitors. One is at the lower reach outlet and a second 843 feet upstream of the upper reach limits, of the 5,000' RFP #16-D06067. Data from these two flow meters will be included in annual monitoring reports to show net outflow from the site.

B. Macro Benthos

Collect macroinvertebrates quarterly (Mar, Jun, Sept, Dec) using a modification of a method developed by the NC DWQ for sampling swamp biota (aptly named the "Swamp Protocol"). Determine a specimens "riverine affinity" based largely on expert opinion and habitat tables from Merritt, Cummins, & Berg's (2008) "Introduction to the Aquatic Insects of North America," which is the standard key for benthologists. These tables include genus-specific data on distributions and habitat preferences.

C. Vegetation

Riverine wetlands within the 100' wide stream corridor were planted with seedlings in February 2005 as part of the approved MBRT Restoration Plan. Areas planted must have a minimum of 450 seedlings per acre at the end of the first growing season (2005). After year two a minimum of 400 seedlings per acre must exist. Following year three of monitoring there shall be no less than 320 seedlings per acre. At the end of year four the minimum tree count shall be 290 seedlings per acre and finally in year five the minimum seedlings per acre, shall not be less than 260 seedlings per acre.

D. Pump Removal - Schedule and Rationale

The pump station near highway 64 was in place and operational during the 2005 and 2006 monitoring season. This pump remained functioning to prevent the drowning of young planted seedlings until they became established and grew to sufficient height to survive anticipated water levels. On 27 February 2007 the pump was turned off and the flap gates raised. Unfortunately, 2007 was the **driest** precipitation year since 1970 (**38 years**).

The new pump station at the south end of Timberlake canal was rarely used because of the drought conditions in 2007 and 2008. Inputs of nitrogen and phosphorus were measured by the Duke research team and will be published in per review journals.

Neither the present pump station nor the new pump site are within the EEP contract area. However, the pump and coordination with the MBRT does affect water levels of the contract area. Further information regarding the pump station and restoration of flows from Little Alligator River are in **Removal of Pump - Return of Flows** of this document.

II. Project Background

A. Location and Setting

This was fully described in the Mitigation Plan (As-Built) 8 February 2006 Section 1. C. on page 1 with Figures 1 through 6 of vicinity maps and onsite information for EEP contract **#16-D04016.** Site is approximately 5 miles east of Columbia, Tyrrell County, south of and adjacent to US highway 64. Figure 6 of that As-Built was a 11"X17" survey with vegetation sample grid locations and well installations.

B. Project Structure - Mitigation Type

Outer Coastal Plain Stream Restoration based on agency guidelines.

Table 1 - Mitigation Type			
Project Component	Type	Stream	Acres
Stream	100% Restoration	5,000 feet	11.48 ± acres

C. Project History and Background

Prior to submittal of mitigation proposal to EEP this site was an active MBRT approved wetlands mitigation bank. The site was purchased in 1997 by Great Dismal Swamp RestorationBank, LLC (GDSRB). Restoration and monitoring activities began in 1997 prior to the award of EEP RFP #16-D04016 and RFP #16-D06067 (Table 2). The GDSRB Timberlake Farm Mitigation Bank has **2,000+ possible wetland credits** (in addition to the 455 acres under contract to EEP with RFP #16-D04016).

Table 2 - Project Activity and Reporting History			
Activity (related to RFP #16-D06067)	Scheduled	Data Collection	Delivery
Restoration Plan	modified from MBRT approved plan		25 January 2005
Final Design	modified from MBRT approved plan		25 January 2005
Construction	began under MBRT plan		October 2004
Temporary S&E	n/a		
Seedlings planted	began under MBRT plan		January 2005
AS-Built			29 October 2010
Year 1 Monitoring	December 2008	December 2008	
Year 2 Monitoring	December 2009	December 2009	
Year 3 Monitoring	December 2010		
Year 4 Monitoring	December 2011		
Year 5 Monitoring	December 2012		

III. Introduction

The pump was turned off and the flap gates welded open on 27 February 2007. The tract was separated from the farm south of Mills Ridge Road in January 2007. The entire pump station will be excavated and removed within the next three years. Its continued presence is only to provide a method of lowering water levels if an unforeseen climatic event necessitated replanting. On 24 July 2006 the MBRT for the remaining portion of the tract approved an Implementation Plan that **recognizes riverine and stream credits on this site**; quantities to be determined through monitoring. The opening of the pump flap gates was specified in the MBRT Implementation Plan.

IV. Vegetation Sampling

A. Materials and Methods

Within the 100' corridor there are seven evenly spaced 10M X 10M sample plots. No plots were located within the formerly drained shrub-scrub area in the upper reach of the 5,000'. The most downstream plot, V8 was established in 2005 as part of the Mitigation Bank sampling. The MBRT had specified one-tenth acre circular plots. This plot has now been modified to a square plot for EEP sampling protocol. Surviving seedlings within the plots will be counted and converted to trees per acre for success criteria evaluation.

V. Stream Flow Monitoring

A. ISCO Velocimeters

A research team from Duke University under the direction of Dr. Emily Bernhardt have been recording flows since February 2007. They have installed four ISCO Doppler Velocimeters, model 2680 monitors. One is at the lower reach outlet and a second 843 feet upstream of the upper reach limits, of the 5,000' RFP #16-D06067. Data from these two flow meters will be included in annual monitoring reports to show net outflow.

B. Precipitation Recording

Long term precipitation data was provided by the State Climate Office from the Plymouth Research Station. The most recent 30 years monthly rainfall data was analyzed to determine the monthly 30 and 70 percentiles. Duke University provide rainfall data from the ISCO recording devices for onsite precipitation.

C. Macro Benthos

Collect macro invertebrates quarterly (Mar, Jun, Sept, Dec) using a modification of a method developed by the NC DWQ for sampling swamp biota (aptly named the "Swamp Protocol"). Method involves standing at a fixed point on the bank and sampling everything that can reach with a 4' D-frame net, mesh size 500 micron. This includes the channel sediment, bank vegetation, and water column. Netted samples are then put in a tray and field-picked until my picking rate is slower than 1 individual per minute, for a maximum of 30 person-minutes (e.g. 30 minutes for 1 person, or 15 minutes each for 2 people). This is what DWQ calls "semi-quantitative sampling," as it is fairly accurate at getting a representative sample of the site, richness, and relative abundance, but produces somewhat

ambiguous true abundance and density data. Keep the specimens in 95% ethanol, and count and ID them in the lab. Most identifications are to the genus level, with some exceptions. Determine a specimens "riverine affinity" based largely on expert opinion and habitat tables from Merritt, Cummins, & Berg's (2008) "Introduction to the Aquatic Insects of North America," which is the standard key for benthologists. These tables include genus-specific data on distributions and habitat preferences, based on published accounts.

D. Additional Scientific Research

Doctors Emily Bernhardt of Duke University and Martin Doyle of University of North Carolina have begun research on the Timberlake site. Their research exceeds any of the standard monitoring as part of a mitigation bank site. Dr. Bernhardt's research will focus on Nitrogen, Phosphorus and Carbon. Dr. Doyle will study the geomorphological and functional restoration of outer coastal plain headwater streams and riverine wetlands.

VI. Conclusions

A. Vegetation

Monitor seven 10 meter square plots and convert to seedlings per acre for success criteria.

B. Flows

Plot charts of flow data from ISCO meters at outlet and upstream locations of the 5,000' of contracted stream. Will include water levels.

C. Macro Benthos

Utilize data collected by Dr. Doyle and associates of UNC. Will be placed in tables and rated by "riverine affinity" based largely on expert opinion and habitat tables from Merritt, Cummins, & Berg's (2008) "Introduction to the Aquatic Insects of North America," which is the standard key for benthologists.