ANNUAL MONITORING REPORT
YEAR 5 (2010)
BROGDEN ROAD BUFFER RESTORATION SITE
JOHNSTON COUNTY, NORTH CAROLINA
(Contract Number D05015-3)

Prepared for:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
ECOSYSTEM ENHANCEMENT PROGRAM
RALEIGH, NORTH CAROLINA

Prepared by:

Restoration Systems, L.L.C.
1101 Haynes Street, Suite 211
Raleigh, North Carolina 27604

And

Axiom Environmental, Inc.
20 Enterprise Street, Suite 7
Raleigh, North Carolina 27607

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EXECUTIVE SUMMARY

Restoration Systems, LLC has completed riparian buffer restoration at the Brogden Road Buffer Restoration Site (hereafter referred to as the "Site") to assist the North Carolina Ecosystem Enhancement Program in fulfilling restoration goals in the region. The Site is located approximately 0.25 mile south of Smithfield in Johnston County. This portion of Johnston County is located centrally within Neuse River Basin 14-digit Targeted Local Watershed 03020201140010.

The Site encompasses approximately 15 acres immediately adjacent to unnamed tributaries to the Neuse River. A total of 15 Buffer Mitigation Units, resulting from 15 acres of buffer restoration, were completed in January 2006.

Prior to restoration, Site land use consisted of agricultural fields utilized for row crop production. Site stream banks were characterized by little or no vegetation and extensive erosion. Excessive runoff during storms from nearby Interstate 95 exacerbated stream bank erosion problems caused by previous onsite land use.

Site reforestation, consisting of a Mesic Pine Flatwoods community, was implemented within the entire 15-acre Site. The primary goals of this buffer restoration project focused on reforestation of the Site with native species to 1) improve water quality; 2) enhance flood attenuation; 3) reduce sedimentation/siltation; 4) increase channel bank stability; 5) filter and reduce pollutants prior to entering the Neuse River; 6) serve as a wildlife corridor by providing connectivity to forested areas adjacent to the Site; 7) provide increased habitat for aquatic and terrestrial wildlife; 8) increase organic matter, carbon export, and woody debris in the stream corridor; 9) restore shade to open waters; 10) increase potential for freshwater mussel recruitment; 11) enhance macroinvertebrate species populations in the channel; 12) augment the existing Mesic Pine Flatwoods Natural Community documented by the North Carolina Natural Heritage Program (NCNHP) just northeast of the Site; and 13) expand potential red-cockaded woodpecker (*Picoides borealis*) foraging habitat for populations documented by the NCNHP approximately 0.3 mile and 0.9 mile northeast of the Site.

As a whole, the densities of four vegetation plots across the Site were well-above the required 320 stems per acre with an average of 1591 tree stems per acre in the Fifth Monitoring Year (Year 2010). All individual vegetation plots met success criteria and had good species diversity with 8 to 16 Character Tree Species present within each plot.

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JOHNSTON COUNTY, NORTH CAROLINA

1.0 INTRODUCTION

Restoration Systems, LLC (Restoration Systems) has completed riparian buffer restoration at the Brogden Road Buffer Restoration Site to assist the North Carolina Ecosystem Enhancement Program (EEP) in fulfilling restoration goals in the region. The Site is located approximately 0.25 mile south of Smithfield, in Johnston County (Figure 1).

The Site conservation easement encompasses 15 acres immediately adjacent to unnamed tributaries to the Neuse River within subbasin 03-04-02 of the Neuse River Basin. The Site is part of United States Geological Survey Catalog Unit 03020201 of the South Atlantic/Gulf Region and is encompassed within a watershed targeted for restoration needs (Targeted Local Watershed 03020201140010) (NCWRP 2002).

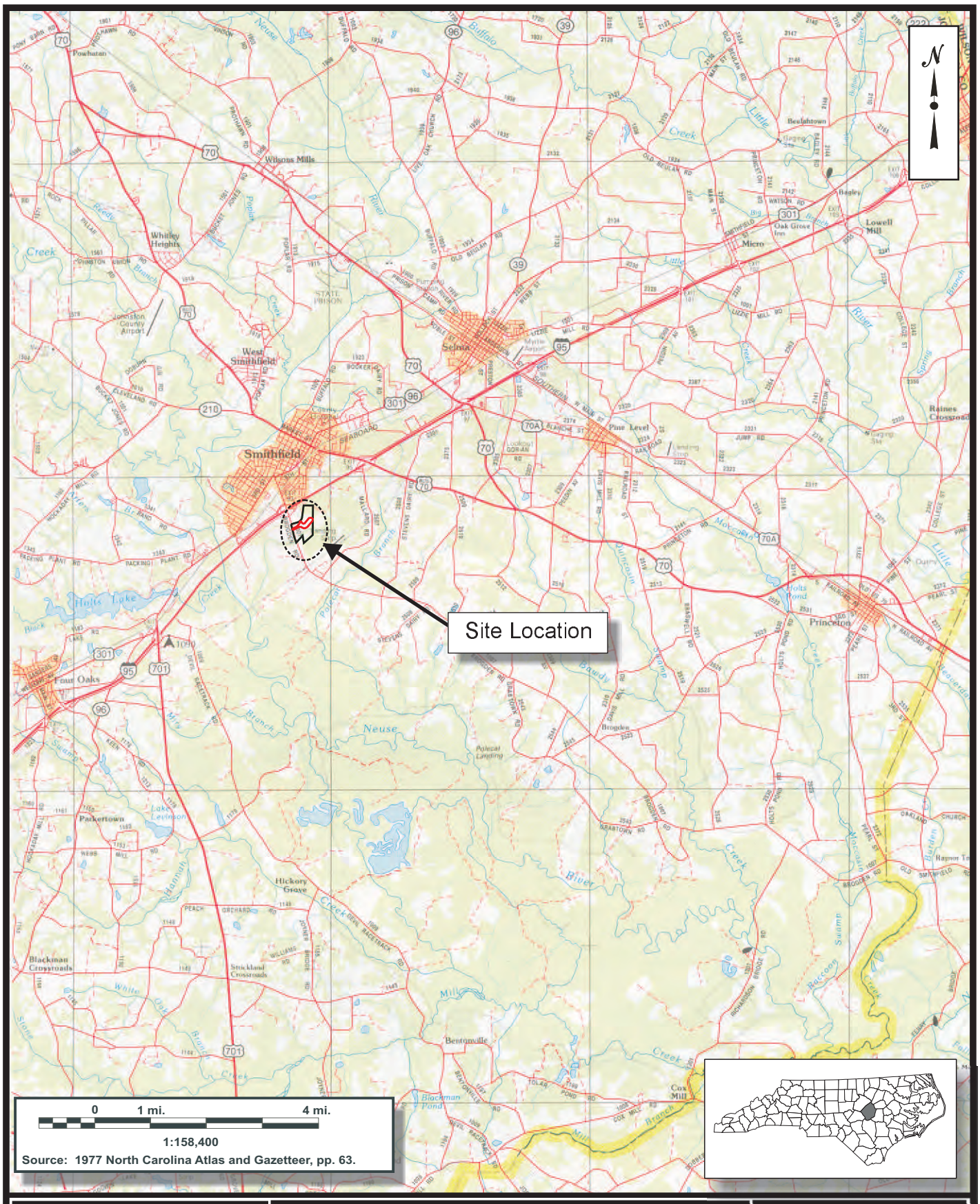
A Detailed Buffer Restoration Plan was completed for the Site in July 2005. The plan outlined methods designed to reforest the entire 15-acre Site with native species. Prior to implementation, the entire Site was composed of row-crop agriculture. The following implemented activities provide 15 Buffer Mitigation Units as requested under the EEP Request for Proposal (RFP) 16-D05015 dated October 22, 2004:

- Restoration of 15 acres of riparian buffer through planting with native forest species.
- Protection of the Site in perpetuity with a conservation easement that is held by the State of North Carolina.

The primary goals of this buffer restoration project focused on reforestation of the entire 15-acre Site with native species to 1) improve water quality; 2) enhance flood attenuation; 3) reduce sedimentation/siltation; 4) increase channel bank stability; 5) filter and reduce pollutants prior to entering the Neuse River; 6) serve as a wildlife corridor by providing connectivity to forested areas adjacent to the Site; 7) provide increased habitat for aquatic and terrestrial wildlife; 8) increase organic matter, carbon export, and woody debris in the stream corridor; 9) restore shade to Site open waters; 10) increase potential for appropriate mussel habitat; 11) enhance characteristic macroinvertebrate species populations in the channel; 12) augment the existing Mesic Pine Flatwoods Natural Community documented by the North Carolina Natural Heritage Program (NCNHP) just northeast of the Site; and 13) expand potential red-cockaded woodpecker (*Picoides borealis*) foraging habitat for populations documented by the NCNHP approximately 0.3 mile and 0.9 mile northeast of the Site.

The primary goals were accomplished by:

1. Removing nonpoint sources of pollution associated with agricultural production including a) cessation of broadcasting fertilizer, pesticides, and other agricultural materials into and adjacent to Site streams and b) providing a vegetative buffer adjacent to streams to treat surface runoff.



Axiom Environmental, Inc.
2126 Rowland Pond Dr
Willow Springs, NC 27592
(919) 215-1693
(919) 341-3839 fax

SITE LOCATION
BROGDEN ROAD
BUFFER RESTORATION SITE
Johnston County, North Carolina

Dwn. by:	CLF
Ckd by:	WGL
Date:	May 2008
Project:	08-007

FIGURE
1

2. Reducing sedimentation within onsite and downstream receiving waters by a) reducing bank erosion associated with agricultural practices, b) filtering surface runoff from adjacent land, thereby reducing particulate matter deposited into area waterways, and c) planting a forested buffer adjacent to Site streams.
3. Promoting floodwater attenuation by revegetating Site floodplains, thereby promoting increased frictional resistance on floodwaters crossing Site floodplains.
4. Providing wildlife habitat including a forested riparian corridor.

As constructed, the Site provides 15 acres of riparian buffer restoration (15 Buffer Mitigation Units).

On July 1, 2005, EEP contracted with Restoration Systems to complete restoration of the Site. A Detailed Buffer Restoration Plan was completed for the project in July 2005. Upon completion of the detailed plan, Bruton Nurseries and Landscapes planted the Site during the first week of January 2006. Axiom Environmental, Inc. completed an As-built Mitigation Report in April 2006.

Information on project managers, owners, and contractors follows:

Owner Information
Restoration Systems, L.L.C.
George Howard and John Preyer
1101 Haynes Street, Suite 211
Raleigh, North Carolina 27604
(919) 755-9490

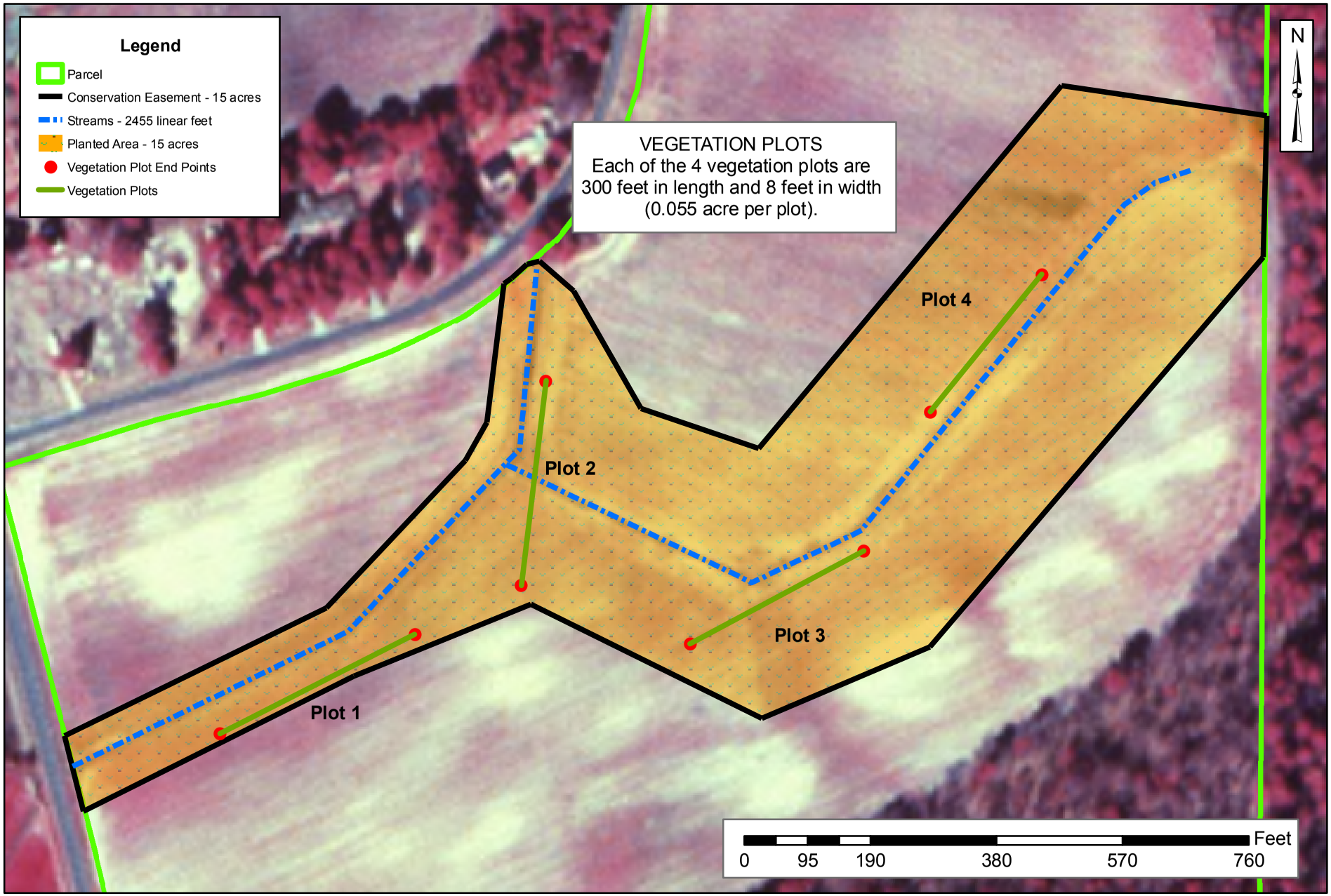
Designer and Monitoring Performer Information
Axiom Environmental, Inc.
W. Grant Lewis
20 Enterprise Street, Suite 7
Raleigh, North Carolina 27607
(919) 215-1693

Planting Contractor Information
Bruton Nurseries and Landscapes
Charlie Bruton
PO Box 1197
Fremont, North Carolina 27830

2.0 VEGETATION MONITORING PROGRAM

Monitoring procedures for vegetation were designed in accordance with *Stream Mitigation Guidelines* (USACE et al. 2003) and the *Draft Internal Guidance for Vegetation Monitoring Plans for NCWRP Riparian Buffer and Wetland Restoration Projects* (undated). A general discussion of the plant community restoration monitoring program is provided. Monitoring of restoration efforts will be performed for a minimum of 5 years or until success criteria are fulfilled. The locations of monitoring plots are depicted in Figure 2.

During the first year, vegetation received visual evaluations on a periodic basis to ascertain the degree of overtopping of planted species by nuisance species. Subsequently, quantitative sampling of vegetation was performed between June 1 and September 30 of each monitoring year for five years.



2126 Rowland Pond Drive
Willow Spring, NC 27592
(919) 215-1693
(919) 341-3839 fax
Axiom Environmental, Inc.

MONITORING PLAN
BROGDEN ROAD BUFFER RESTORATION SITE
Johnston County, North Carolina

Dwn. by: CLF
Date: May 2008
Project: 08-007

FIGURE 2

Four linear sample plots were installed within planted areas to equally represent the Site (Figure 2). Each plot is 300 feet in length and 8 feet in width (0.055 acre). Vegetation parameters monitored within each plot include species composition and species density. Visual observations of the percent cover of shrub and herbaceous species were documented in photographs included in Appendix A.

2.2.1 Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component is dependent upon density and growth of "Character Tree Species." Character Tree Species include planted species, those observed in forest stands near the Site, and those listed in the Mesic Pine Flatwood community descriptions from *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 1990). All planted canopy tree species and those identified in Schafale and Weakley (1990) will be utilized to define "Character Tree Species" as termed in the success criteria.

Table 1. Character Tree Species

Planted Species	**Examples of Mesic Pine Flatwood Species***
River Birch (*Betula nigra*)	Mockernut Hickory (*Carya alba*)
Loblolly Pine (*Pinus taeda*)	Sand Hickory (*Carya pallida*)
White Oak (*Quercus alba*)	Sweetgum (*Liquidambar styraciflua*)
Southern Red Oak (*Quercus falcata*)	Longleaf Pine (*Pinus palustris*)
Swamp Chestnut Oak (*Quercus michauxii*)	Bluejack Oak (*Quercus incana*)
Water Oak (*Quercus nigra*)	Post Oak (*Quercus stellata*)
Cherrybark Oak (*Quercus pagoda*)	Blackjack Oak (*Quercus marilandica*)
Willow Oak (*Quercus phellos*)	Black Gum (*Nyssa sylvatica*)
Northern Red Oak (*Quercus rubra*)	Flowering Dogwood (*Cornus florida*)

* Species described in Schafale and Weakley (1990) and observed in adjacent sites; this is not a comprehensive list.

Vegetation success criteria for the Site consist of an overall density of at least 320 stems per acre of Character Tree Species five years after the initial planting. Additional seedlings are expected to be recruited to the Site from adjacent forested communities. These individuals may also be counted in the overall success rate for the Site provided they are native hardwood tree species.

If vegetation success criteria are not achieved based on average density calculations from combined plots over the entire restoration area, supplemental planting may be performed with Character Tree Species. Supplemental planting will be performed as needed until achievement of vegetation success criteria.

No quantitative sampling requirements are proposed for herb assemblages as part of the vegetation success criteria. Development of floodplain forests over several decades will dictate the success in recruitment and establishment of desired understory and groundcover populations. Visual

estimates of the percent cover of herbaceous species will be documented through periodic photographs. Photographs of the vegetation plots are included in Appendix A.

2.2.2 Vegetation Sampling Results and Comparison to Success Criteria

Quantitative sampling of vegetation was conducted in June 2010. Results are provided in Table 2. Vegetation success criteria for year 5 (320 stems per acre) were exceeded for the 2010 annual monitoring year with 1591 tree stems per acre across the Site. All individual vegetation plots met success criteria and had good species diversity with 8 to 16 Character Tree Species present within each plot.

3.0 CONCLUSIONS

In summary, as a whole, the densities of four vegetation plots across the Site were above the required 320 stems per acre with an average of 1591 tree stems per acre in the Fifth Monitoring Year (Year 2010). All individual vegetation plots met success criteria and had good species diversity with 8 to 16 Character Tree Species present within each plot. Table 3 summarizes plot data over the five year monitoring period.

Table 3. Summary of Vegetation Plot Results

Plot	Stems/Acre Counting Towards Success Criteria				
	Year 1 (2006)	**Year 2 (2007)**	**Year 3 (2008)**	**Year 4 (2009)**	**Year 5 (2010)**
1	582	891	618	1182	2564
2	673	1127	945	1382	1655
3	473	636	418	836	727
4	600	1473	800	1109	1418
Average Plots 1-4	**584**	**1022**	**695**	**1127**	**1591**

The average number of tree stems per acre has increased dramatically over the five year monitoring period primarily as the result of loblolly pine natural recruits. Additional increases may be attributed to natural recruits of species other than loblolly pine and resprouting of planted seedlings grazed by deer and rabbits. The Site should be considered successful after five years of monitoring as evidenced by stem counts and species diversity observed throughout the Site.

TABLE 2
2010 VEGETATION MONITORING DATA AND RESULTS

Note: Each plot totals 0.055 acre in size.

Community	Mesic Pine Flatwoods						
Species*	Plot 1	Plot 2	Plot 3	Plot 4	Total Stems for Plots 1-4	Total Stems/ Acre	Total Stems/Acre Counting Towards Success Criteria
Character Tree Species (count toward success)							
Acer rubrum (red maple)	2				2	9	9
***Betula nigra* (river birch)**	2	4	1	4	11	50	50
Cornus amomum (silky dogwood)	1				1	5	5
Fraxinus pennsylvanica (green ash)	1				1	5	5
Liquidambar styraciflua (sweetgum)	14	1		1	16	73	73
Morella cerifera (wax myrtle)	7	1			8	36	36
Nyssa sp. (blackgum)	1				1	5	5
***Pinus taeda* (loblolly pine)**	58	32	10	11	111	505	505
Prunus serotina (black cherry)	4				4	18	18
***Quercus alba* (white oak)**	13	3	12	8	36	164	164
***Quercus falcata* (southern red oak)**		3			3	14	14
Quercus lyrata (overcup oak)	1				1	5	5
***Quercus michauxii* (swamp chestnut oak)**	5	1	2	11	19	86	86
***Quercus nigra* (water oak)**	5	7	3	5	20	91	91
***Quercus pagoda* (cherrybark oak)**	19	18	5	25	67	305	305
***Quercus phellos* (willow oak)**	3	16	3	6	28	127	127
***Quercus rubra* (northern red oak)**	5	5	4	6	20	91	91
Quercus sp. (oak)				1	1	5	5
Species that Don't Count Toward Success							
Baccharis halimifolia (eastern baccharis)	110	20	40	90	260	1182	0
Rhus copallinum (winged sumac)		1			1	5	0
TOTAL STEMS/PLOT	**251**	**112**	**80**	**168**	**611**	**2777**	**1591**
TOTAL STEMS/PLOT COUNTING TOWARDS SUCCESS CRITERIA	**141**	**91**	**40**	**78**			
TOTAL STEMS/ACRE COUNTING TOWARDS SUCCESS CRITERIA	**2564**	**1655**	**727**	**1418**			

* Planted species are in bold.

4.0 REFERENCES

North Carolina Wetlands Restoration Program (NCWRP). 2002. North Carolina Wetlands Restoration Program Neuse River Basin Watershed Restoration Plan. North Carolina Department of Environment and Natural Resources, Raleigh.

North Carolina Wetlands Restoration Program (NCWRP). Undated. Draft Internal Guidance for Vegetation Monitoring Plans for NCWRP Riparian Buffer and Wetland Restoration Projects. North Carolina Department of Environment and Natural Resources, Raleigh, North Carolina.

Schafale, M. P., A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina: Third Approximation, NC Natural Heritage Program, Division of Parks and Recreation, NC DEM, Raleigh NC.

United States Army Corps of Engineers (USACE), United States Environmental Protection Agency (USEPA), North Carolina Wildlife Resources Commission (NCWRC), Natural Resources Conservation Service (NRCS), and North Carolina Division of Water Quality (NCDWQ). 2003. Stream Mitigation Guidelines. State of North Carolina.

APPPENDIX A
VEGETATION PLOT PHOTOGRAPHS

Brogden Road Buffer Restoration Site
Year 5 (2010) Annual Monitoring
Vegetation Plot Pictures Taken June 2010