

**FINAL  
ANNUAL MONITORING REPORT  
GOLDSBORO HOUSING AUTHORITY**

**STREAM RESTORATION  
WAYNE COUNTY, NORTH CAROLINA  
(EEP Project Number 145)**

Monitoring Year 2 of 5 (2010)



Submitted to:  
North Carolina Department of Environment and Natural Resources  
Ecosystem Enhancement Program  
Raleigh, North Carolina



November 2010

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November 2010

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## 1.0 EXECUTIVE SUMMARY/PROJECT ABSTRACT

The Goldsboro Housing Authority Mitigation Site (Site) is located in the northeast quadrant of the intersection of NC-581 and US-13 within the West Haven Apartments complex owned by the Goldsboro Housing Authority (GHA) in central Wayne County. As constructed the Site provides 799 stream mitigation units. The Site is located in United States Geological Survey (USGS) Hydrologic Unit 03020201200020 (North Carolina Division of Water Quality Subbasin 03-04-05) of the Neuse River Basin. The Site was identified to assist the North Carolina Ecosystem Enhancement Program in meeting mitigation goals. Primary activities at the Site included stream enhancement (levels I and II), creation of a Best Management Practice (BMP) constructed wetland, and replanting riparian areas with native vegetation. Project restoration efforts provided 799 Stream Mitigation Units and 1 Stormwater Wetland credit. This report summarizes data for year 2 (2010) monitoring.

The primary components of the restoration project included the following.

1. In keeping with the Neuse River Basinwide Management Plan developed by the North Carolina Division of Water Quality, a major goal of the project is to reduce sediment and other water quality stressors, nitrogen in particular, to the receiving watershed. This was achieved via the following measures:
  - a. Restore channel dimension throughout the Site to include bank resloping, benching and provision of reference appropriate width-depth ratios to reduce near bank stress and attendant erosion, and to move bedload towards equilibrium, thereby preventing future bank instability related to potential bed aggradation and/or degradation.
  - b. Replace the existing highly managed grass with an appropriate vegetated buffer providing root mass that will stabilize project banks, treating both overland and groundwater inputs.
  - c. Install a large stormwater wetland adjacent to Unnamed Tributary to Borden Field Ditch (UTBFD) designed to receive and provide off-line treatment to a portion of storm flows that meet or exceed the 1 inch storm, which will provide a significant sediment and biogeochemical sink for the inputs from the UTBFD watershed. The drainage area of the UTBFD is approximately 125 acres with approximately 50 acres of impervious surface. The existing Nitrogen load to the UTBFD at the location of the stormwater wetland is approximately 1229 pounds per year. It is anticipated that the stormwater wetland will receive flow during several storm events each year, as the typical 1 inch storm event and the one year design storm are expected to overtop the weir by 1.8 or 2.7 feet, respectively.
2. Attenuate storm flows and excess hydrologic energies associated with this highly urban watershed via 1 a,b,c.
3. Enhance the natural aesthetic of the project corridor
4. Increase local awareness of natural resources in an urban setting and the conditions necessary for their improvement/enhancement.

Based on interagency guidelines (USACE 2003), success criteria dictate that survival of woody species planted at mitigation sites should be at a minimum density of 320 stems per acre at the end of the third monitoring year. Subsequently, 290 stems per acre must be surviving at the end of year 4 and 260 stems per acre at the end of year 5. Based on the number of stems counted, average densities were measured at 580 planted stems per acre surviving in year 2 (2010). The dominant species identified at the Site were planted stems of river birch (*Betula nigra*) and sycamore (*Platanus occidentalis*). Supplemental planting of the Site is scheduled to occur in the winter of 2010.

Success criteria for Site streams with an assurance that project goals are being achieved will primarily be based on indicators and trends describing the stability of the channel and success of the riparian buffer. In addition, a minimum of two bankfull events must be documented within the standard 5 year monitoring period. In order for the monitoring to be considered complete, the bankfull events must occur in separate monitoring years. Year 2 (2010) monitoring measurements indicate that there have been minimal changes in the cross-sections as compared to as-built data. In addition, one bankfull event was documented in the field to occur February 5, 2010 with a second bankfull event occurring on September 26-27, 2010 after 4 inches of rain.

In summary, the Site achieved success criteria for vegetation and stream attributes in the Second Monitoring Year (2010). Summary information and data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in table and figures within this report's appendices. Narrative background and supporting information formerly found in these reports can be found in the mitigation and restoration plan documents available on EEPs website. All raw data supporting the tables and figures in the appendices is available from EEP upon request.

## 2.0 METHODOLOGY

### 2.1 Vegetation Assessment

Following Site construction, three plots (20-meters by 5-meters) were established and monumented with metal rebar at all plot corners. Plots were surveyed in June 2010 for the year 2 (2010) monitoring season. Sampling was conducted as outlined in the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee et al. 2006) (<http://cvs.bio.unc.edu/methods.htm>); results are included in Appendix C. The taxonomic standard for vegetation used for this document was *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas* (Weakley 2007). The locations of vegetation monitoring plots are depicted on Figure 2 in Appendix A.

### 2.2 Stream Assessment

Four permanent cross-sections were established after construction was completed. Measurements of each cross-section include points at all breaks in slope including top of bank, bankfull, and thalweg. Riffle cross-sections are classified using the Applied Fluvial Morphology (Rosgen 1996) stream classification system. Cross-section plots and data are included in Appendix D; the locations of cross-sections are depicted on Figure 2 in Appendix A.

## 3.0 REFERENCES

- Lee, Michael T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0. (online). Available: <http://cvs.bio.unc.edu/methods.htm>
- Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology (Publisher). Pagosa Springs, Colorado.
- 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.
- Weakley, Alan S. 2007. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas (online). Available: <http://www.herbarium.unc.edu/WeakleysFlora.pdf> [February 1, 2008]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.
- Weather Underground. 2010. Station in Goldsboro, North Carolina. (online). Available: <http://www.wunderground.com/cgi-bin/findweather/getForecast?query=35.33916855,-77.96055603> [February 9, 2010]. Weather Underground.

APPENDIX A  
FIGURES AND PLAN VIEWS

Figure 1. Site Location

Figure 2. Monitoring Plan

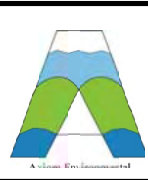
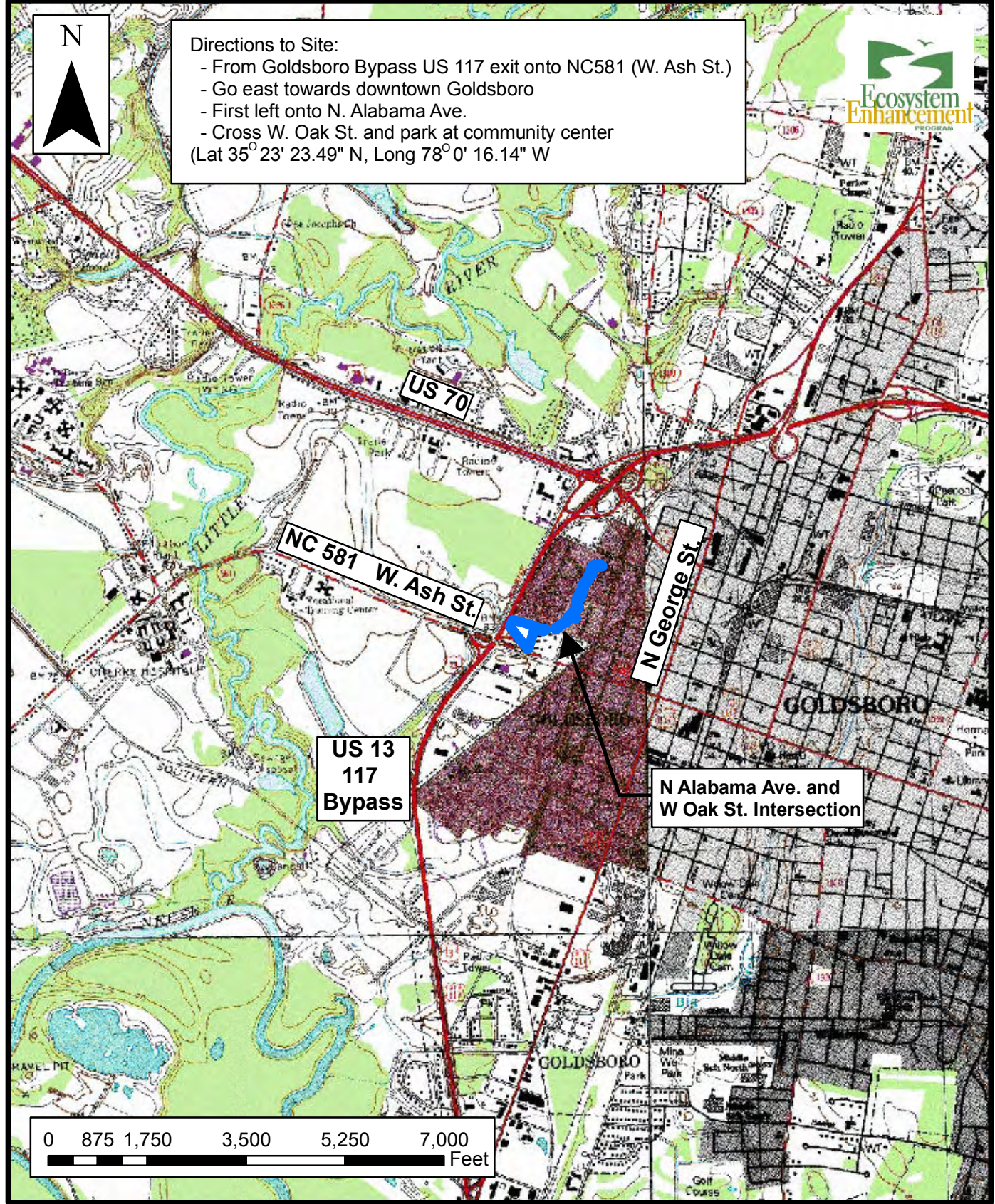




Directions to Site:

- From Goldsboro Bypass US 117 exit onto NC581 (W. Ash St.)
- Go east towards downtown Goldsboro
- First left onto N. Alabama Ave.
- Cross W. Oak St. and park at community center

(Lat 35° 23' 23.49" N, Long 78° 0' 16.14" W)



20 Enterprise St. #7  
 Raleigh, NC 27607  
 (919) 215-1693  
 (919) 341-3839 (fax)

SITE LOCATION  
 GOLDSBORO HOUSING AUTHORITY - EEP #145  
 STREAM RESTORATION PROJECT  
 Wayne County, North Carolina

Dwn. By: WGL  
 Date: June 2009  
 Project: 08-001

FIGURE  
 1



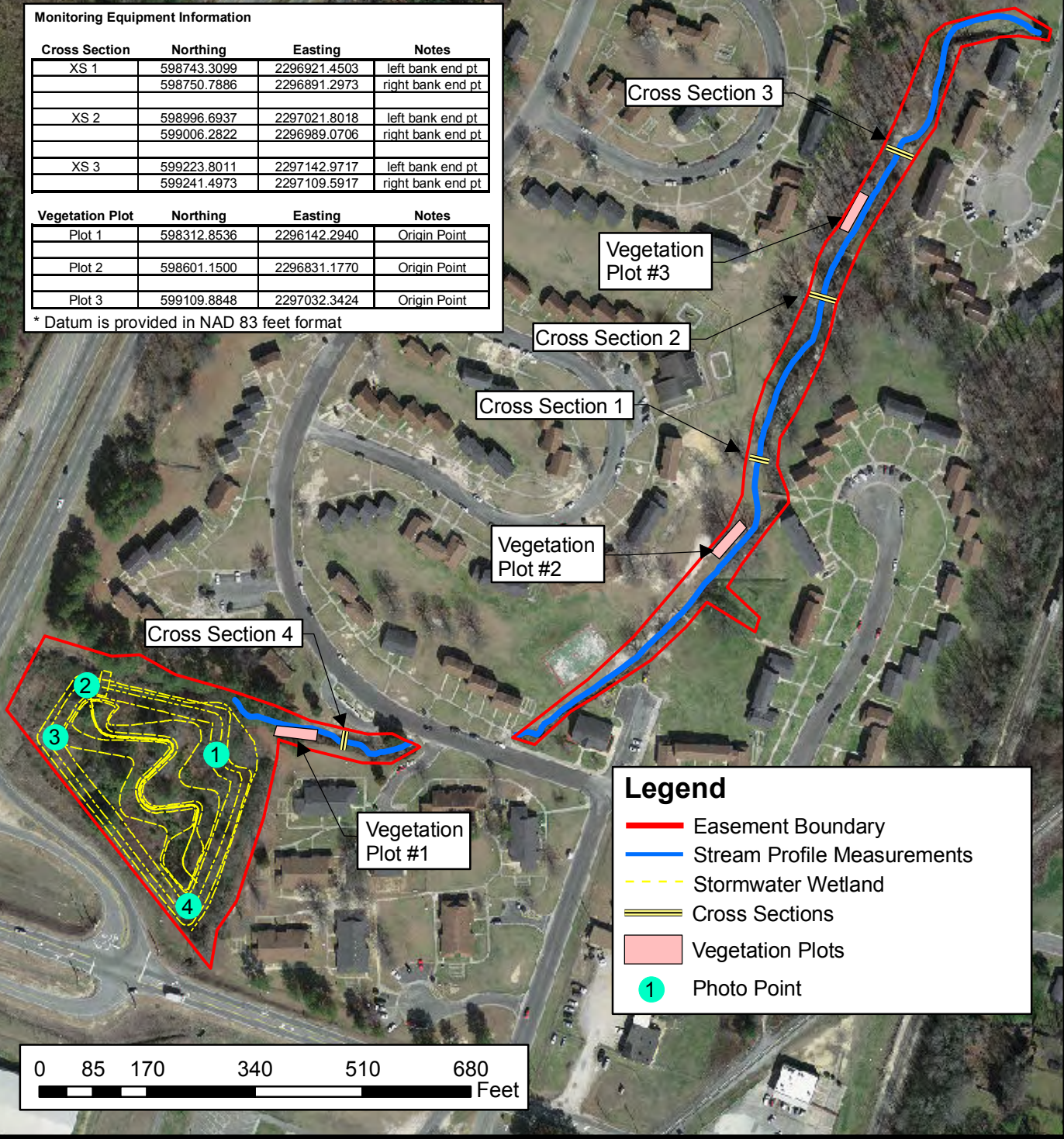


**Monitoring Equipment Information**

Cross Section	Northing	Easting	Notes
XS 1	598743.3099	2296921.4503	left bank end pt
	598750.7886	2296891.2973	right bank end pt
XS 2	598996.6937	2297021.8018	left bank end pt
	599006.2822	2296989.0706	right bank end pt
XS 3	599223.8011	2297142.9717	left bank end pt
	599241.4973	2297109.5917	right bank end pt

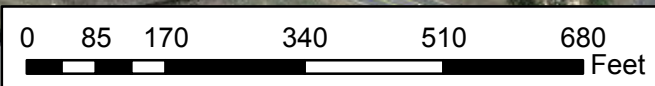
Vegetation Plot	Northing	Easting	Notes
Plot 1	598312.8536	2296142.2940	Origin Point
Plot 2	598601.1500	2296831.1770	Origin Point
Plot 3	599109.8848	2297032.3424	Origin Point

\* Datum is provided in NAD 83 feet format



**Legend**

- Easement Boundary
- Stream Profile Measurements
- Stormwater Wetland
- Cross Sections
- Vegetation Plots
- 1 Photo Point



20 Enterprise St. #7  
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**MONITORING PLAN**  
**GOLDSBORO HOUSING AUTHORITY - EEP #145**  
**STREAM RESTORATION PROJECT**  
 Wayne County, North Carolina

Dwn. By: WGL  
 Date: June 2009  
 Project: 08-001

FIGURE  
2

APPENDIX B  
GENERAL PROJECT TABLES

Table 1. Site Restoration Structures and Objectives

Table 2. Project Activity and Reporting History

Table 3. Project Contacts Table

Table 4. Project Attributes Table

**Table 1. Site Restoration Structures and Objectives  
 Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)**

Project Component or Reach ID	Restoration Level	Approach	Footage or Acreage	Stationing *	Ratio	Mitigation Units	BMP Elements **	Comment
UTBFD-Reach1	EII	P2	275	3+75 – 6+50	2.0	138		Systemic change to dimension and planted buffer
UTBFD-Reach2	-	P4	200	8+25 – 10+25	0.0	0		Primarily stabilized via hardening with rip rap above Oak Street due to need to protect adjacent housing
UTBFD-Reach3	EII	P2/P3	275	10+25 – 13+00	2.0	138		Combination of P2/P3. Systemic dimensional enhancement with planted buffer.
UTBFD-Reach4	EI	P2	200	13+00 - 15+00	1.5	133		Alignment change. Systemic enhancement to dimension, modest enhancement to pattern and profile. Obstacle avoidance and removal of pattern jeopardizing stability
UTBFD-Reach5	EII	P3	675	15+00 - 21+75	2.0	338		Systemic change to dimension and planted buffer
UTBFD-Reach6	EII	P2	133	21+75 - 23+08	2.5	53		Alignment change. Systemic enhancement to dimension, pattern and profile. Obstacle avoidance and removal of pattern jeopardizing stability. Buffer is heavily constrained
BMP	-	-	1.09 acre	At confluence			SW	Large stormwater wetland intercepting storm flow from 123 acre UT

\*Stationing is from bottom to top

\*\*SW = Stormwater Wetland

Component Summations				
Restoration Level	Stream (lf)	Ratio	Mitigation Units	BMP
Enhancement I	200	1.5	133	
Enhancement II	1225	2.0	613	
Enhancement II	133	2.5	53	
				1 SW
Totals	1558		799	1 SW

**Table 2. Project Activity and Reporting History  
Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)**

<b>Activity or Report</b>	<b>Data Collection Completion</b>	<b>Actual Completion or Delivery</b>
Restoration Plan	--	June 2006
Construction Completion	NA	October 2008
BMP Planting	NA	November 2008
Streamside/Buffer Planting	NA	November 2008
Mitigation Plan / Asbuilt (Year 0 Monitoring Baseline)	October 2008	July 2009
Year 1 Annual Monitoring	September 2009	October 2009
Year 2 Annual Monitoring	September 2010	October 2010

**Table 3. Project Contacts Table  
Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)**

<b>Designer</b>	Dewberry & Davis, Inc. 2301 Rexwoods Drive Raleigh, North Carolina 27607 Sheila Reeves (919) 8819939
<b>Construction Contractor</b>	Appalachian Environmental Services 1165 W. Main St. Sylva, North Carolina 28779 Mickey Henson (828) 5861973
<b>Planting Contractor</b>	Habitat Assessment and Restoration Program, Inc. 9305D Monroe Rd. Charlotte, North Carolina 28270 Alan Peoples (704) 9750881
<b>Year 1-2 (2009-2010) Monitoring Performer</b>	Axiom Environmental, Inc. 20 Enterprise Street, Suite 7 Raleigh, NC 27607 Grant Lewis (919) 215-1693



**Table 4. Project Attribute Table  
Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)**

Project County	Wayne County, North Carolina
Physiographic Region	Coastal Plain
Ecoregion	Southeastern Floodplains and Low Terraces
River Basin	Neuse
USGS 14digit HUC	03020201200020
NCDWQ Subbasin	030405
Within EEP Watershed Plan?	No
WRC Class	Warm
% of project easement fenced	~ 45%
Beaver activity observed during the design phase?	No
Drainage Area	UTBFD at outfall: 0.40 square miles UT at confluence with UTBFD: 0.17 square miles
Restored/Enhanced stream lengths (linear feet)	1558
Perennial or Intermittent	Perennial
Watershed type	Developed
Watershed distribution	40% Commercial 38% Residential 14% Industrial 10% Open Space
Watershed impervious cover	~ 35 percent
Stream Order	UTBFD: First and Second UT to UTBFD: First
Rosgen Classification of Asbuilt	E5/C5type
Dominant Soil Types	Norfolk, Johns, Lumbee, Wickham
Reference Site ID	UT to Little River (REF1) and unspecified stream in Moores Crossroads, NC (REF2)
NCDWQ Classification	Not classified, drains to Borden Field Ditch (275723, C,NSW)
303d listed?	No
Upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	Not Applicable
Total acreage of easement	~ 4.7 acres
Total planted acreage as part of the restoration	~ 4.7 acres
Rosgen classification of preexisting	F5/G5
Rosgen classification of asbuilt	C5/E5
Valley type	VIII
Valley slope	.26.46 %
Cowardin classification	R3UB2
Trout waters designation	No
Species of concern, endangered, etc.?	No

APPENDIX C

VEGETATION ASSESSMENT DATA

Table 5. Vegetation Plot Mitigation Success Summary

Vegetation Monitoring Plot Photos

CVS Summary Data Tables

Table 6. Vegetation Metadata Table

Table 7. Total and Planted Stems by Plot and Species

**Table 5. Vegetation Plot Mitigation Success Summary Table  
 Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)**

Vegetation Plot ID	Vegetation Survival Threshold Met?	Tract Mean
1	Yes	67%
2	No	
3	Yes	

**Goldsboro Housing Authority  
 Year 2 (2010) Annual Monitoring  
 Vegetation Plot Photos (taken June 2010)**



**Table 6. Vegetation Metadata Table  
Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)**

<b>Report Prepared By</b>	Corri Faquin
<b>Date Prepared</b>	9/28/2010 8:45
<b>database name</b>	Axiom-EEP-2010-A.mdb
<b>database location</b>	C:\Axiom\Business\CVS Database\2010
<b>computer name</b>	CORRI
<b>file size</b>	36999168
<b>DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----</b>	
<b>Metadata</b>	Description of database file, the report worksheets, and a summary of project(s) and project data.
<b>Proj, planted</b>	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
<b>Proj, total stems</b>	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
<b>Plots</b>	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
<b>Vigor</b>	Frequency distribution of vigor classes for stems for all plots.
<b>Vigor by Spp</b>	Frequency distribution of vigor classes listed by species.
<b>Damage</b>	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
<b>Damage by Spp</b>	Damage values tallied by type for each species.
<b>Damage by Plot</b>	Damage values tallied by type for each plot.
<b>ALL Stems by Plot and spp</b>	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
<b>PROJECT SUMMARY-----</b>	
<b>Project Code</b>	145
<b>project Name</b>	Goldsboro Housing Authority
<b>Description</b>	Stream Restoration
<b>River Basin</b>	Neuse
<b>length(ft)</b>	
<b>stream-to-edge width (ft)</b>	
<b>area (sq m)</b>	
<b>Required Plots (calculated)</b>	
<b>Sampled Plots</b>	3



**Table 7. Total and Planted Stems by Plot and Species**  
**Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)**

Species	CommonName	plot 1		plot 2		plot 3		Current Mean MY2 (2010)		MY1 (2009)		Asbuilt	
		Total	Planted	Total	Planted	Total	Planted	Total stems	Planted stems	Total stems	Planted stems	Total stems	Planted stems
<i>Acer Rubrum</i>	red maple	1						1					
<i>Baccharis Halimnifolia</i>	eastern baccharis					7		7		7			
<i>Betula nigra</i>	river birch	42	19	1	1	3	2	46	22	32	14	16	16
<i>Celtis laevigata</i>	sugarberry									1			
<i>Liquidambar styraciflua</i>	sweetgum	4				5		9		24		9	
<i>Morella cerifera</i>	wax myrtle	1	1	1	1	1	1	3	3	3	3	4	4
<i>Pinus taeda</i>	loblolly pine	2						2					
<i>Platanus occidentalis</i>	american sycamore			2	2	13	13	15	15	16	16	18	18
<i>Prunus serotina</i>	black cherry	6				23		29		62			
<i>Quercus sp.</i>	oak											1	
<i>Quercus phellos</i>	willow oak											3	3
<i>Salix nigra</i>	black willow			3	3			3	3	3	3	5	3
<i>Sambucus canadensis</i>	elderberry											4	4
<b>Plot area (acres)</b>		<b>0.0247</b>		<b>0.0247</b>		<b>0.0247</b>							
<b>Species Count</b>		<b>6</b>	<b>2</b>	<b>4</b>	<b>4</b>	<b>6</b>	<b>3</b>	<b>9</b>	<b>4</b>	<b>7</b>	<b>4</b>	<b>8</b>	<b>6</b>
<b>Stem Count</b>		<b>56</b>	<b>20</b>	<b>7</b>	<b>7</b>	<b>52</b>	<b>16</b>	<b>115</b>	<b>43</b>	<b>141</b>	<b>36</b>	<b>60</b>	<b>48</b>
<b>Stems per acre</b>		<b>2267</b>	<b>810</b>	<b>283</b>	<b>283</b>	<b>2105</b>	<b>648</b>	<b>4656</b>	<b>1741</b>	<b>1427</b>	<b>364</b>	<b>607</b>	<b>486</b>

APPENDIX D  
STREAM ASSESSMENT DATA  
Table 8. Verification of Bankfull Events  
Cross-section Plots

**Table 8. Verification of Bankfull Events**

**Goldsboro Housing Authority Stream/BMP Project (EEP Project Number 145)**

Date of Data Collection	Date of Occurrence	Method	Photo (if available)
July 11, 2009	Between May 5-11, 2009	Total of 4.74 inches* of rain reported to fall over 7 days	--
November 12, 2009	November 12, 2009	Overbank resulting from a total of 4.47 inches* of rain reported to fall over 3 days as the result of Tropical Storm Ida	--
February 9, 2010	February 5, 2010	Visual observations of overbank event including crest gauge, wrack lines, and wrack in saplings from a 1.95inch* rainfall event on February 5, 2009 that occurred after numerous rainfall events within the 3 weeks prior to that date that totaled 4.43 inches.	1-2
September 28, 2010	September 26-27, 2010	Rainfall data totaling 3.99 inches* over a period of two days.	--

\* Reported at the Goldsboro Airport (Weather Underground 2010)



Bankfull Event Photos 1-2 showing evidence of a previous overbank event.



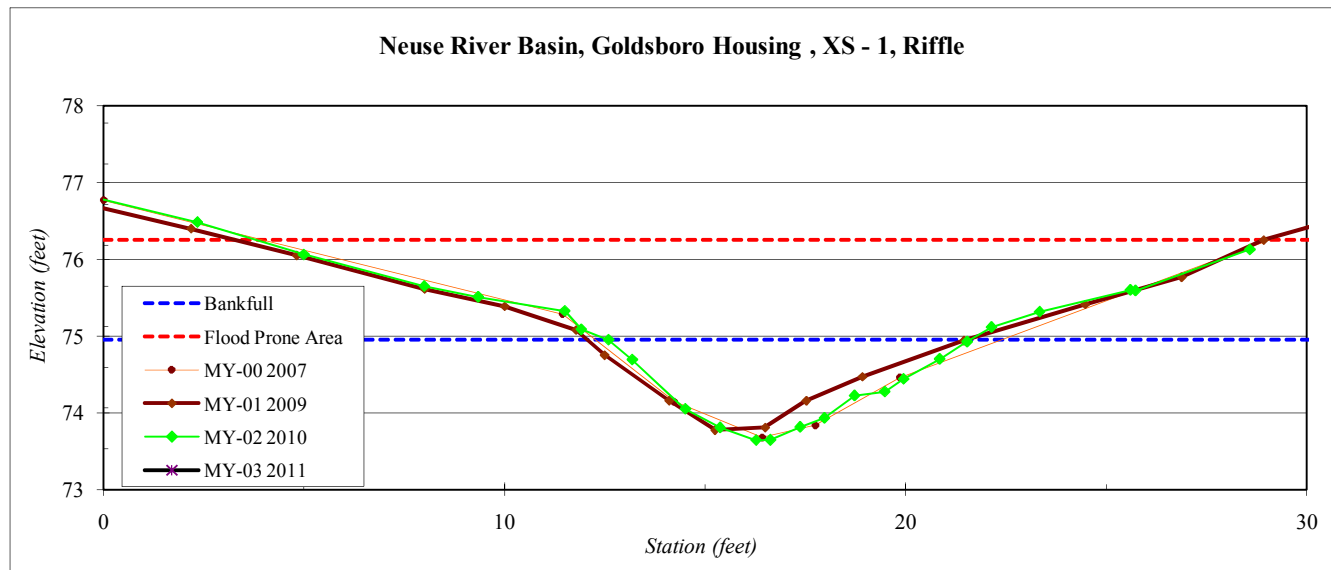
<b>River Basin:</b>	Neuse
<b>Watershed:</b>	Goldsboro Housing
<b>XS ID</b>	XS - 1, Riffle
<b>Drainage Area (sq mi):</b>	0.2
<b>Date:</b>	8/2/2010
<b>Field Crew:</b>	Dean, Perkinson

Station	Elevation
-3.4	77.2
-0.8	76.9
2.3	76.5
5.0	76.1
8.0	75.6
9.3	75.5
11.5	75.3
11.9	75.1
12.6	74.9
13.2	74.7
14.5	74.0
15.4	73.8
16.3	73.6
16.6	73.6
17.4	73.8
18.0	73.9
18.7	74.2
19.5	74.3
20.0	74.4
20.8	74.7
21.5	74.9
22.1	75.1
23.3	75.3
25.6	75.6
25.7	75.6
28.6	76.1
31.1	76.6

SUMMARY DATA	
<b>Bankfull Elevation:</b>	75.0
<b>Bankfull Cross-Sectional Area:</b>	6.8
<b>Bankfull Width:</b>	9.0
<b>Flood Prone Area Elevation:</b>	76.3
<b>Flood Prone Width:</b>	25.0
<b>Max Depth at Bankfull:</b>	1.3
<b>Mean Depth at Bankfull:</b>	0.8
<b>W / D Ratio:</b>	11.9
<b>Entrenchment Ratio:</b>	2.8
<b>Bank Height Ratio:</b>	1.0



<b>Stream Type</b>	E/C
--------------------	-----











APPENDIX D  
BMP ASSESSMENT DATA  
Fixed Photo Stations



**Goldsboro Housing Authority Stream/BMP Project  
(EEP Project Number 145)  
Fixed-Station Photographs  
taken August 2010**

